DRAFT EIA GUIDANCE MANUAL –
PORTS & HARBORS

Ministry of Environment & Forests
GOVERNMENT OF INDIA, NEW DELHI

Environmental Impact Assessment Guidance Manual

Ports & Harbors

Administrative Staff College of India
Bellavista, Khairatabad, Hyderabad 500082, AP, India
www.asci.org.in

September 2009

CONTENTS

List of Tables

List of Annexures

Abbreviations

AAQ	Ambient Air Quality
ASCI	Administrative Staff college of India
BOD	Biological Oxygen Demand
BSI	Biological Survey of India
CRZ	Coastal Regulation Zones
CPCB	Central Pollution Control Board
CZM	Coastal Zone Management
CPM	Critical path method
CO	Carbon Monoxide
CFS	Container Freight Station
Cu. M	Cubic meters
CD	Chart Datum
DWT	Dimensions and tonnages
DO	Dissolved Oxygen
DMP	Disaster Management Plan
DGPS	Differential Global Position System
Db	Decibels
EIA	Environmental Impact Assessment
EC	Environmental Clearance
EMP	Environmental Management Plan
EAC	Expert Appraisal Committee
EHS	Environment, Health and Safety
GoI	Government of India
GC	General Conditions
GW	Ground water
HTL	High Tide Line
H_2S	Hydrogen Sulfide
Ha	Hectare
HW	Hazardous Waste
IMD	Indian Meteorological Department
ISPS	International Ship and Port Safety
IMDG	International Marine Dangerous Goods
IFC	International Finance Corporation
Kl	Kiloliters
LTL	Low Tide Line
LNG	Liquid Nitrogenous gas
LPG	Liquid Petroleum Gas
LLW	Lowest Low water
MoEF	Ministry of Environment and Forestry
MSIHC	Manufacture, Storage and Import of Hazardous Chemical Rules
Marpol	Marine Pollution
M & H	Management and Handling
MPN	Most Probable Number
Mg	Milligrams
Min	Minimum
Max	Maximum
µmhos	Micro (10^{-6}) mhos
MSL	Mean Sea Level
MT	Metric Tonnes

NEP	National Environment Policy
NO_X	Oxides of Nitrogen
NAAQS	National Ambient Air Quality Standards
NFPA	National Fire Protection Agency
NRSA	National Remote Sensing Agency
PERT	Program Evaluation and Review Technique
pH	Hydrogen Ion Concentration
PHC	Polycyclic Hydro Carbon
P	Phosphorous
PPE	Personal Protection Equipment
Pb	Lead
PAH	Polycyclic Aromatic Hydrocarbon
PLI	Public Liability Insurance Act
R&R	Rehabilitation and Resettlement
RSPM	Respirable Suspended Particulate Matter
SEIAA	State Level Environmental Impact Assessment Authority
SEAC	State Level Expert Appraisal Committee
SPCB	State Pollution Control Board
SBMs	Single Buoy Moorings
SO_2	Sulphur Dioxide
SPM	Suspended Particulate Matter
SO_X	Oxides of sulphur
STP	Sewage Treatment Plant
TOR	Terms of Reference
TSS	Total Suspended Solids
TKN	Total Kjeldahl Nitrogen
TPA	Tons per anum
UTPCC	Union Territory Pollution Control Committee
WII	Wildlife Institute of India
ZSI	Zoological Survey of India

Foreword

(To be given later)

Acknowledgements

(To be given later)

Core Committee

Dr.B. Sengupta Former Member Secretary, CPCB	**Chairman**
Shri. M. Parabrahmam Former Adivsor-MoEF, GoI	
Chairman Karnataka Pollution Control Board	
Dr. M S Narayan Former Chairman, Coal India	
Dr. Wate Head, EIA Division NEERI, Nagpur	
Shri Arvinder Singh Brar Member Secretary, Rajasthan Pollution Control Board	
Dr. P G Sastry Hyderabad	
Shri A K Debnath CG M, Central Mine Plan & Design Institute	
Representative Ministry of Urban Development, New Delhi	
Dr. Irulappan General Manager (Com), Airport Authority of India, New Delhi	
Mr. V K Sharma Head, Environment Division, NHAI, New Delhi	
Ms. Sarita Sawhny Confederation of Indian Industry, New Delhi	
Representative Atomic Regulatory Board, New Delhi	
Mrs. Rohini Devi Director, HTCC, Sg -'G' ASL/DRDO, Hyderabad	
Capt. Rama Rao N G O, Hyderabad	

Peer Committee

Dr.B. Sengupta Former Member Secretary, CPCB	**Chairman**
Shri B P Shukla CPCB, Regional office, Bangalore	
Representative Vishakhapatnam Port Trust	
Dr. Swarna Subba Rao Director, Survey of India, Hyderabad	
The Chief Planning Officer Hyderabad Urban Development Authority	
Shri N V Bhasakara Rao AP Pollution Control Board	
Shri G V Raghava Rao Hyderabad	
Sri P Janardhan Reddy SPEQUEL, Hyderabad	
Sri G Udaya Bhaskar GM-Env, Essar Group, Mumbai	
Head of Environment Division National Highway Authority of India, New Delhi	
Er. Nanda Kumar Energy Conservation Mission, Institute of Engineers, Hyderabad	
Representative Town and Country Planning, Hyderabad	
Representative Hyderabad International Airport Ltd	

Team

Project Management Unit

Prof. V. S. Chary	Director Centre for Energy, Environment, Urban Governance and Infrastructure Development, Administrative Staff College of India, Hyderabad
Shri. G.Bala Subramanyam	Advisor Environment Area, ASCI
Dr. Valli Manickam	Area Chair Person, Environment Area, ASCI Project Co-ordinator

Sector Resource Persons

Dr. K.S.R. Murthy	CSIR Emeritus Scientist NIO, Vishakapatnam
Shri. SVSLN Sastry	Former Chief Engineer Vishakapatnam Port Trust
Shri. G.Bala Subramanyam	Advisor Environment Area, ASCI

About the Manual

Environmental Impact Notification S.O.1533 (E), dtd.14th September 2009, issued under Environment (Protection) Act 1986, has made it mandatory to obtain prior environmental clearance (EC) for scheduled development projects. The notification has classified projects under two categories A & B. Category A projects (including expansion and modernization of existing projects) require clearance from Ministry of Environment and Forest (MoEF), Govt. of India (GoI) and for category B from State Environmental Impact Assessment Authority (SEIAA), constituted by Govt. of India

Submission of EIA report is a statutory requirement for obtaining prior environmental clearance under EIA Notification 2006, for scheduled developmental projects. While carrying out EIA studies for developmental projects, some difficulties have been encountered in implementing EIA procedures and in the appropriate shaping of projects. These problems include:

- Insufficient awareness of project proponent and stake holders
- Difficulty in accessing the latest technical information on EIA
- Lack of appropriate environmental data/ information required for EIA; and
- Inadequate awareness of the potential impacts of development project on the environment within the general public.

The format for EIA manual approved by the MoEF existing hitherto is common for all the sectors of infrastructure and industrial development projects. In order to more comprehensively cater to the needs of each of the sectors of development, it was considered necessary by the MoEF to make available technical EIA guidance manuals for each of the development sector exclusively. Accordingly, among others, the sector specific Terms of Reference (TOR) & developmental activity specific guidance manual for the port and harbor developmental activities is prepared by the Administrative Staff College of India (ASCI), Hyderabad.

This technical EIA guidance manual for Port and Harbor projects accordingly addresses the related environmental concerns duly taking into consideration the requirements of all. While the proponent and the consultant need guidelines for preparing the EIA report, public needs information on possible environmental impacts of a project, in particular the impact on their livelihood. The reviewers and sanctioning authorities make use of this report including the questionnaire to ensure that the impacts of the project on the environment are fully assessed and required mitigation measures are proposed, in the Environmental Management Plan (EMP), by the proponent in order to consider grant of prior environmental clearance for the project or otherwise.

To ensure effective utilization by all the stakeholders, this manual is divided in to twelve chapters bringing out the EIA process in chronological order.

***Chapter 1*:** This chapter contains the general information on the port sector, major sources of environmental impacts in respect of port projects and details of the environmental clearance process.

***Chapter 2*:** This chapter contains the description of the project, such as the type of project, need for the project, project location, project layout, cargo handling methods, utilities and services, and the project implementation schedule, estimated cost of development etc

***Chapter 3*:** This chapter should cover details of various alternatives both in respect of location of site and technologies to be deployed, in case the initial scoping exercise considers such a need.

***Chapter 4*:** This chapter forms the heart of the manual, since it is in this chapter that the proponent shall give the comprehensive data on the existing and additional data collected by him on the baseline environmental data in the study area as well as in the surrounding area that is likely to be affected by the proposed activity.

***Chapter 5*:** This chapter should cover the anticipated impacts on the environment and mitigation measures. The method of assessment of impacts including studies carried out, modeling techniques adopted to assess the impacts where pertinent should be elaborated in this chapter. It should give the details of the impacts on the baseline parameters, both during the construction and operational phases and the mitigation measures to be implemented by the proponent.

***Chapter 6*:** This chapter should cover on Environmental Monitoring Program. It should include the technical aspects of monitoring the effectiveness of mitigation measures (including measurement methodologies, data analysis, reporting schedules, emergency procedures, detailed budget & procurement schedules).

***Chapter 7*:** This chapter should cover the details of the additional studies required in addition to those specified in the TOR and which are necessary to cater to more specific issues applicable to the particular project. These studies may be suggested either by the proponent itself or the regulatory authority.

Chapter 8: This chapter should cover the benefits accruing to the locality, neighbourhood, region and nation as a whole. It should bring out details of benefits by way of improvements in the physical infrastructure, social infrastructure, employment potential and other tangible benefits.

***Chapter 9*:** This chapter should cover on Environmental Cost Benefit Analysis of the project.

Chapter 10: This chapter should comprehensively present the Environmental Management Plan (EMP), which includes the administrative and technical setup, summary matrix of EMP, the cost involved to implement the EMP, both during the construction and operational phases.

Chapter 11: This chapter forms the summary of the full EIA report condensed to ten A-4 size pages at the maximum. It should provide the overall justification for implementation of the project and should explain how the adverse effects are proposed to be mitigated.

Chapter 12: This chapter should include the names of the consultants engaged with their brief resume and nature of consultancy rendered.

CHAPTER 1

Introduction

1.0 Preamble

Environment plays a vital role in overall development of the country. Recognizing the importance of environmental protection and sustainable development, the Ministry of Environment and Forest, Government of India had formulated policies and procedures governing the industrial and other developmental activities to prevent indiscriminate exploitation of natural resources and to promote integration of environmental concern in developmental projects.

Environmental Impact Assessment (EIA) is a planning tool now generally accepted as an integral component of sound decision-making. The purpose of EIA is to give the environment its due place in the decision-making process by clearly evaluating the environmental consequences of the proposed activity before action is taken. Early identification and characterization of critical environmental impacts allows the public and the government to form a view about the environmental acceptability of a proposed developmental project and what conditions should apply to mitigate or reduce those risks and impacts.

The Ministry of Environment & Forest has made environmental clearance (EC) for certain developmental projects mandatory through its notification issued on 27.01.1994 under the provisions of Environment (Protection) Act, 1986. The process of conducting public consultation has also been made mandatory for certain developmental projects through its notification issued on 10.04.1997.

Keeping in view the experience gained in the environmental clearance process over the past decade and the demands from various stakeholders, the MoEF in terms of the notification dated 14.09.2006, directed that the required construction of new projects or activities or expansion or modernization of existing projects or activities listed in the schedule to this notification shall be undertaken in any part of India only after the prior environmental clearance from the Central Government/ SEIAA. The categorization of the developmental projects / activities is specified in the EIA notification 2006

1.1 General information on port and harbor sector

Ports and harbors are the gateways of maritime trade. Need to enhance the standard of living calls for continual growth in the economy and calls for rapid industrialization and commensurate development of all the associated sectors of the country as a whole. Inasmuch as maritime transport is economical and the only means to transport larger volumes of cargo across oceans, ports and harbors are therefore, called upon to handle larger volumes of cargo throughputs of both raw material as well as products. Thus demand for handling bigger size ships and deploy state of the art cargo handling systems many a time require augmentation/expansion of facilities at existing ports and development of new ports and harbors. However, port development and operational activities may create a wide range of impacts on the environment through activities like dredging, reclamation, construction work, development of utilities and services, discharges from ships and waterfront industries, cargo operations, and other port related activities. The potential adverse effects of port development encompass water pollution, contamination of bottom sediments, damage to marine ecology and fisheries, beach erosion/accretion, current pattern

changes, waste disposal, oil leakage and spillage, emission of hazardous gases, air pollution, noise pollution, flood light effect and other socio-cultural impacts. The preparation of EIA report and implementation of EMP are essential to effectively address these adverse effects.

1.1.1 Major sources of environmental impacts in respect of port and harbor projects

Major sources of the adverse effects on account of development of port and harbour projects can be categorized into the following types:

(a) Location of port;
(b) Construction
(c) Port operation, including ship traffic and discharges,
(d) Cargo handling, storage and land transport.

1.2 Environmental clearance process

In terms of the 14th September 2006 notification of the MoEF, ports and harbour projects are divided into two categories as mentioned below:

Project or activity	Category with threshold limit	
	A	B
Ports & Harbors*	≥ 5 million TPA of cargo handling capacity (excluding fishing harbors)	< 5 Million TPA pf cargo handling capacity and/or ports/ harbors ≥ 10, 000 TPA of fish handling capacity
Authority for approval of TOR & issue/reject of EC	MoEF, GOI on the recommendations of Expert Appraisal Committee (EAC)	State/Union territory Environmental Impact Assessment Authority (SEIAA) on the recommendations of State or Union territory level Expert Appraisal Committee (SEAC)
General condition shall apply* General Condition (GC): Any project or activity specified in Category 'B' will be treated as Category A, if located in whole or in part within 10 km from the boundary of: i) Protected areas notified under the Wild Life (Protection) Act, 1972, ii) Critically polluted areas as notified by the Central Pollution Control Board from time to time (Annexure-2), iii) Notified Eco-sensitive areas, iv) Inter-state boundaries and international boundaries		

The environmental clearance process for new projects will comprise of a maximum of four stages. These four stages in sequential order:

Stage (1)-Screening

In case of Category 'B' projects or activities, this stage will entail the scrutiny of an application seeking prior environmental clearance made in Form 1 by the concerned SEAC for determining whether or not the project or activity requires further environmental studies for preparation of an Environmental Impact Assessment (EIA) for its appraisal prior to the grant of environmental clearance depending upon the nature and location specificity of the project. The projects requiring an Environmental Impact Assessment report shall be termed Category 'B1' and remaining projects shall be termed Category 'B2' and will not require an Environmental Impact Assessment report.

Stage (2)- Scoping

'Scoping' refers to the process by which the EAC in the case of Category 'A' projects or activities, and SEAC in the case of Category 'B1' projects or activities, including applications for expansion and/or modernization and/or change in product mix of existing projects or activities, determine detailed and comprehensive TOR addressing all relevant environmental concerns for the preparation of an EIA report in respect of the project or activity for which prior environmental clearance is sought. The EAC or SEAC concerned shall determine the TOR on the basis of information furnished in the prescribed application Form 1 including TOR proposed by the applicant, a site visit by a sub-group of EAC or SEAC concerned only if considered necessary by the EAC or SEAC concerned and other information that may be available with the EAC or SEAC concerned.

Stage (3)- Public consultation

"Public consultation" refers to the process by which the concerns of local affected persons and others who have plausible stake in the environmental impacts of the project or activity are ascertained with a view to taking into account all the material concerns in the project or activity design as appropriate. All Category 'A' and Category 'B1' projects or activities shall undertake public consultation, except the projects or activities concerning national defense and security or involving other strategic considerations as determined by the central government and all B2 Projects and activities.

After completion of the public consultation, the applicant shall address all the material environmental concerns expressed during this process, and make appropriate changes in the draft EIA and EMP. The final EIA report, so prepared, shall be submitted by the applicant to the concerned regulatory authority for appraisal. The applicant may alternatively submit a supplementary report of draft EIA and EMP addressing all the concerns expressed during the public consultation

Stage (4)- Appraisal

Detailed scrutiny by the EAC or SEAC of the application and other document like the Final EIA report, outcome of the public consultations including public hearing proceedings, submitted by the applicant to the regulatory authority concerned for grant of EC

Flow-chart depicting these stages in obtaining the prior environmental clearance for Port and harbor projects is presented in **Figure 1.1 and 1.2**

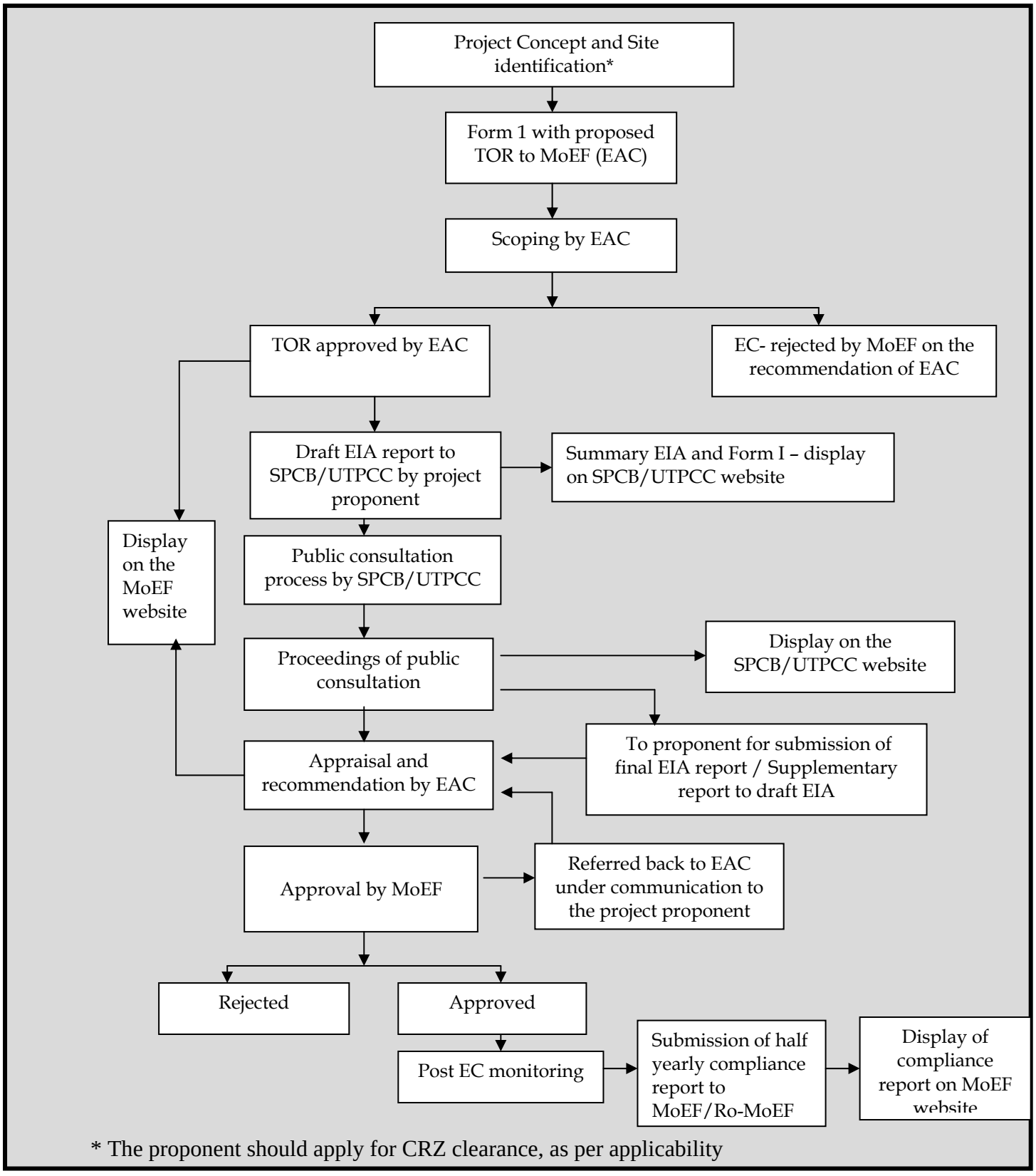
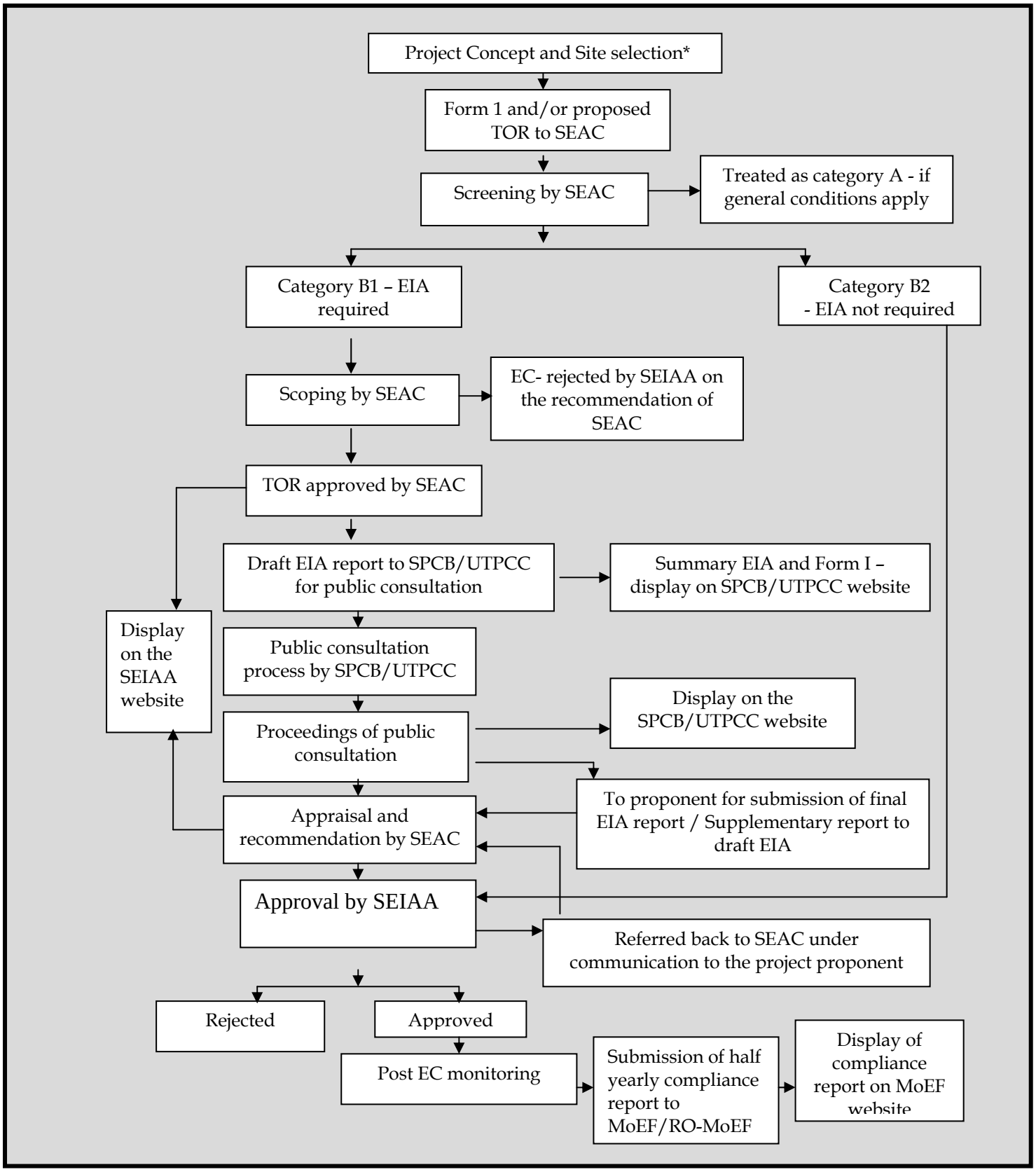


Figure 1.1: Prior Environmental Clearance Process for Category A projects



* The proponent should apply for CRZ clearance, as per applicability

Figure 1.2: Prior Environmental Clearance Process for Category B projects

1.3 Terms of Reference (TOR) for preparation of EIA report

Duly catering to the commonly expected environmental concerns, Terms of Reference (TOR) for the Port and Harbors sector is prepared and attached as "**Annexure 1"** to this document. In addition, the proponent is required to identify specific issues, if any, pertinent to the project and include those issues also in the TOR for preparation of EIA and EMP report upon approval of the TOR by the Expert Appraisal Committee.

1.4 Validity of environmental clearance

The prior environmental clearance granted for ports and harbors sector is valid for a period of five years. The regulatory authority concerned may extend this validity period by a maximum period of five years.

1.5 Post environmental clearance monitoring

The Project management shall submit half-yearly compliance reports in respect of the stipulated prior environmental clearance terms and conditions on 1st June and 1st December of each calendar year. All such reports shall be public documents.

1.6 Transferability of environmental clearance

A prior environmental clearance granted for a specific project or activity to an applicant may be transferred during its validity to another legal person entitled to undertake the project or activity on application by the transferor or the transferee with a written "no objection" by the transferor, to, and by the regulatory authority concerned, on the same terms and conditions under which the prior environmental clearance was initially granted, and for the same validity period.

1.7 Generic structure of environmental impact assessment document

In terms of the EIA notification of the MOEF dated 14th September 2006, the generic structure of the EIA document shall be as under:

- Introduction
- Project Description
- Analysis of Alternatives (Technology and Site)
- Description of the Environment
- Anticipated Environmental Impacts & Mitigation Measures
- Environmental Monitoring Program
- Additional Studies
- Project Benefits
- Environmental Cost Benefit Analysis
- Environmental Management Plan
- Summary & Conclusion
- Disclosure of Consultants engaged

1.8 Identification of project proponent

Profile of the project proponent, contact address with-mail, fax, phone numbers, implementing organization and project consultant is to be furnished.

1.9 Brief description of project

Details of the project nature, size, location and its importance to the country and the region are to be included. Project site description- survey/ village, tehsil, district, state & extent of the land, latitude & longitude of the boundaries as per the state/central govt. gazette notification should be furnished.

Description of existing environmental laws/regulations on the proposed activity is to be brought out clearly. If there are any notified restrictions/limitations from environmental angle, issued by the District administration, State or Central government, the same should be furnished. Details of litigation(s) pending against the project/ proposed site and or any direction passed by the court of law against the project, if any, should be stated.

In case of expansion/ modernization of the project, the environmental compliance status for the existing project should be furnished for the following:

- Validity of the Water Consent, Air Consent and HW authorization
- Standards and compliance of conditions
- Notices/directions issued by the regulatory agencies under section 33(A) of the water act 1974 as amended, under section 31(A) of the air act 1981 as amended, under the provisions of the E (P) Act 1986 during the last one year

Whether the proposal involves approval/clearance under the following acts should be specifically stated.

- The Forest (Conservation) Act, 1980
- The Wildlife (Protection) Act, 1972
- The CRZ Notification, 1991

Details of the scope of study in terms of Terms of Reference approved by the Expert Appraisal Committee and the details of regulatory scoping carried out should be mentioned in the introduction chapter.

CHAPTER 2

Project Description

2.0 General

This chapter on project description in the EIA study report to be prepared by the proponent should include the following aspects:

- Overall suitability of the site and the proposed activity in light of the existing environmental acts and serious deviations, if any.
- Significance of the project both at local and national level including background information and overall scenario of the proposed activity in the Indian context
- Relevance of the project in light of the existing development plans of the region, project coverage, master plan, phasing and scope,
- Estimated cost of development of the project, of environmental protection works both during construction and operational phase of the project
- Estimated water budget for the project – during the construction and operational stages
- Whether project implementation is proposed to be undertaken by the central or state government or through Public Private Participation or private entrepreneurs

It is to be noted that the location as well as layout of port structures also contribute to potential impacts on the environment. The description of the project to be given in this chapter of the EIA study report shall be reasonably adequate to understand the likely overall impact of the project construction and operational phases on various facets of environment. Keeping in view of this aspect in order to enable the proponent to accordingly present the project description in the EIA report to be submitted by him as required to obtain prior environmental clearance.

2.1 Description of the project

Description of the project shall be brief but elaborate enough to assess the impact of the project location on the environment. Therefore these brief details should include:

- Type of the project- new/expansion/modernization/container cargo handling/fisheries
- Classification of the port - minor/major port and the details of the gazette notification issued by the state/central government
- The proponent shall furnish planned capacity of the proposed port development including but not limited to the size of the port extent of the port area both land area and water area, number and size of various berths, types and sizes of ships proposed to call at the port with their dimensions and Tonnages (DWT), types, categories and volumes of cargoes proposed to be handled annually etc., including hazardous cargoes and chemicals, if any, proposed to be handled. The proponent shall also furnish details of transit shed, warehouses and open storage yards proposed for various cargoes.
- Details of geology including geological map of the proposed port project/development area, topography, transport and connectivity, demographic aspects,

- Socio cultural and economic aspects,
- Villages, settlements, need for rehabilitation and resettlement (R&R) of communities/villages along with present status of such activities
- Land acquisition requirement and status
- Historical data on climatic conditions such as, rainfall, wind pattern, history of cyclones, storm surges, visibility, earthquakes etc

Essential Maps to be provided

- A map specifying locations of the state, district and project location
- A map of project area and 10 km area from boundary of the proposed/existing project area, delineating protected areas notified under the wild life (Protection) Act, 1972 / critically polluted areas as notified by the CPCB from time to time / notified eco sensitive areas / inter state boundaries and international boundaries
- A map covering aerial distance of 15 km on the landward side from the proposed project boundary delineating environmental sensitive areas as specified in Form I of EIA notification dated 14th Sep 06
- Land use map of the study area to 1: 25,000 scale based on recent satellite imagery of the project area and 10 kms from the proposed project boundary as per **Annexure 3**
- Site lay out plan of the proposed development should be submitted to a scale of 1:5000, clearly marking the layout of breakwaters, navigation channels, harbour basin, SBMs, moorings, berths-number-dimensions-water depths, dry docks, work shops, container freight station, cargo handling systems, conveyors, pipe lines, covered and uncovered storage yards with their capacities, ware houses, transit sheds, roads, railway tracks, water supply, effluent disposal point, drainage, power, administrative and operational buildings, utilities, welfare and community centers, town ships, greenbelt, dredged material disposal, etc. Boundaries of the proposed port shall be shown therein with latitude and longitude
- Area drainage contour map of the project area and 2-5 km from the proposed project area shall be clearly indicated. In case of any proposed diversion of nallah/canal/river, same should be shown in the map
- Hydrographic charts of the offshore area giving the general morphology of the coastal stretch to a scale of 1:50,000 shall be submitted covering water depth up to 10m beyond the maximum proposed dredging depths of the project and covering a distance of 5 km along the coast from the project limits on both sides
- The CRZ maps indicating the High Tide Line (HTL), Low Tide Line (LTL), demarcated by one of the authorized agencies and the project lay out superimposed on the map should be submitted on 1:5000 scale map. The State/Union Territory CZM authority shall recommend this map

2.2 Bathymetric data

Hydrographic charts of the offshore area including the general morphology of the coastal stretch to a scale of 1:50,000 should be submitted covering water depths up to 10 m beyond the maximum proposed dredged depths of the project and covering a distance of 5 km along cost from the project limits on both sides. Site-specific details such as coral or rock out crops, places of importance from heritage point of view, sand dunes, recreational beaches etc., should be shown therein.

2.3 Description of the layout of proposed port development

All proposed port facilities should be described as per the details mentioned in the site layout plan at 2.1

2.4 Natural Resources

Requirement of natural resources for construction along with their sources, technologies involved in the design, construction, equipment and operation should be furnished in the EIA report by the proponent. Water requirement during the construction and operational phases should be covered along with the identified sources. Water balance flow chart should be prepared considering phases of construction and operation. Rainwater harvesting provisions shall be explored. Utilization of solar energy for lighting etc shall be explored. The resources requirement for the construction shall be quantified. Efforts should be made for utilization of dredged material for development of back-up space/storage yards, wherever feasible.

2.5 Cargo-handling equipments etc

Technologies to be adopted like cargo handling methods, machinery and equipments, shore handling methods, machinery and equipment like cranes, tractor trailers, container handling equipment, cargo handling systems, handling transfer and storage facilities of oil/chemicals, workshop equipments, conveyor systems and utilities shall be explained in the EIA report in sufficient detail to assess their impacts on the environment. Similarly details of harbour craft such as tugs, launches, barges, floating cranes, dredgers, SBMs, moorings and other floating craft shall be furnished. Where new untested technologies are proposed in the project the details of assessment made in respect of such new & untested technology for the risk of technological failure should also be mentioned.

2.6 Description of activities and ancillary operations

Details of various activities involved both during construction phase and operational phase along with flow charts duly indicating required resources should be described duly supported with sufficient details in appropriate tabular forms in order to enable assessment of impacts of the activities on various facets of environment.

2.7 Housing

Requirement of housing for the workers and employees both during construction phase as well as operation phase should be specified in detailed and should be catered to by the proponent. In the event the proponent proposes to develop township for housing the workers/employees involved in the port operations he should submit details of various types of buildings envisaged, layout plan of township, utilities and services along with methods of disposal and treatment of sewage. The proponent shall comply with all statutory provisions and directions, as may be, imposed by concerned local bodies in this regard. Details of utilities such as water supply, power supply, along with sources and distribution network should be mentioned in the EIA report. It should be ensured that housing projects are not situated in CRZ areas.

2.8 Use of public infrastructure

The proponent should furnish the connectives of road and rail network to the proposed port location.

Details of dedicated road/rail networks in the proposed port area and outside the proposed area should be furnished, with necessary clearances obtained for the same. In case the existing road and rail facilities are utilized for the port activity, the proponent should furnish details of extra capacities required to augment the existing connectivity such that the infrastructure is not subject to congestion. The layout of such road and rail facility should be incorporated in the project layout. Approval of appropriate authorities for the proposed layout of the connectivity should be pursued by the proponent and implemented as part of the project such that the public hitherto availing these utilities are not deprived of these road and rail facilities as a consequence of the port project implementation.

2.9 Project services and utilities

The proponent should also furnish details of proposed road network with in the port area along with types of pavements, surface drainage arrangements, truck parking areas and repair facilities. Similarly, the proponent shall furnish details of railway yard layouts proposed to be developed as the port activity. These infrastructure facilities shall be planned to cater to congestion free traffic not only within the port but also in the approaches to port and surrounding areas keeping in view the likely impact of the port on the area as a whole.

2.10 Man power requirement

The proponent should indicate the requirement of various categories of manpower such as skilled, semi-skilled, unskilled workers, technicians, engineers, managers and other professionals for both construction and operational phases. The proposed training methods for imparting and up gradation of specialized skills, where required, should be mentioned in the EIA Report.

2.11 Project implementation schedule

The proponent shall also submit the detailed project implementation schedule bar chart, CPM/PERT chart etc., duly bringing out interrelationship of major activities, including the mitigation measures that were studied for the project development and to be implemented in the year one itself to avoid adverse effects on the shoreline/environment.

CHAPTER 3

Analysis of alternatives (Technologies and Site)

3.0 General

In case, the scoping exercise results in need for consideration of alternative sites or technologies on account of predicted environmental impacts, the details of such alternatives considered should be included in this chapter.

Description of various alternatives like locations or layouts or technologies studied, including:

- Description of each alternative
- Summary of adverse impacts of each alternative and
- Selection of alternative

Proponent should also explain why the existing facilities from the nearby port couldn't be utilized.

In case the proposed port is chosen adjacent to an existing port, the proponent should furnish the environmental impacts on the existing port and the mitigative measures to reduce these adverse effects

CHAPTER 4

Description of Environment

4.0 Study area

As a primary requirement of EIA process, the proponent should collect primary baseline data in the project area as well as the area falling within 5 km from the proposed project boundary and secondary data should be collected within 15 kms aerial distance from the project boundary, as specifically mentioned at column 9(iii) of form I of EIA Notification 2006. The study areas mentioned in this document should be considered for guidance purpose but the exact study area for different environmental attributes (water, air, noise, soil etc) is to be submitted considering the proposed activities and location, along with proper reasoning, for review and approval by the expert appraisal committee.

4.1 Land Environment

4.1.1 Land

Port projects require considerable land area for development of cargo handling areas, transit corridors, citing operational and non-operational buildings, and areas for ancillaries, utilities including townships. These may result in changes in land use pattern, for ex, change from agriculture, housing, etc., to port related activity also involving changes in land terrain like cutting of high grounds and hillocks, filling of low lying areas and reclamation effecting drainage patterns as well.

In the event land acquisition from either public or private sources is involved, justification for the proposed extent of the area to be necessarily given. Availability of land for earmarking for the port activity without causing due hardship to local habitat and their socio cultural and economic aspects is very important. Availability of required land for acquisition is to be ascertained from local authorities, revenue records etc.

Land use of the proposed project site and the adjacent areas should be ascertained from the existing approved master plans, if any and from the revenue records. The environmental sensitivity areas as mentioned at column 9 (III) of form I of EIA notification 2006, covering the following with in an aerial distance of 15 kms from the project boundary should be furnished along with the aerial distance from the project boundary

- Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value
- Areas which are important or sensitive for ecological reasons – wetlands, watercourses or other water bodies, coastal zone, biospheres, mountains, forests
- Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration
- Inland, coastal, marine or underground waters
- State, national boundaries
- Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas
- Defense installations
- Densely populated or built-up area

- Areas occupied by sensitive man-made land uses *(hospitals, schools, places of worship, community facilities)*
- Areas containing important, high quality or scarce resources *(groundwater resources, surface resources, forestry, agriculture, fisheries, tourism, minerals)*
- Areas already subjected to pollution or environmental damage *(those where existing legal environmental standards are exceeded)*
- Areas susceptible to natural hazard, which could cause the project to present environmental problems *(earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions)*

The applicability of General Condition (GC) for categorization (A or B) of the proposed site should be specifically furnished.

4.1.2 Topography

Landforms, terrain, coastal and inland topography etc., may get affected due to construction of a port. It may require large scale quarrying, dredging and reclamation, which may cause changes in the topography. This in turn may affect the drainage pattern of the land/terrain. Coastline changes like erosion or accretion may be expected due to the establishment of ports inasmuch as the natural littoral process may be intercepted.

Construction works of port related structures like breakwaters and berths require large quantities of natural resources like sand, stone aggregates for concrete and stone/ rock boulders of varying sizes and weights. These may lead to undue exploitation of the natural resources in the region.

Baseline data to be given on description of existing situation of the land at the proposed project area including description of terrain viz., coastal and inland topography, coastal features (lowland, beaches, littoral areas, shoal areas), terrain features, slope and elevation. Study of land use pattern, habitation, cropping pattern, forest cover, environmentally sensitivity areas etc, by employing remote sensing techniques and also through secondary data sources. Contour map of the project area and surrounding should be furnished.

The land-use/land cover classification system as per **Annexure-3** should be followed.

Specific importance should be given to areas close proximity to the project boundary say up to one km and land use classification and presence of ecologically sensitive areas should be described in detail, as adjoining areas are more vulnerable for impacts

4.1.3 Geology

Geology of the area is very important to ascertain seismic sensitivity as well as availability of rocks required for breakwaters where such construction is involved. For port projects huge requirement of rock is envisaged for construction of breakwaters, which consume rock of various sizes as obtained from quarries and aggregate for concrete works. Proximity of good quarries yielding required grades of suitable rock would become as an advantage for selecting the location.

Baseline data should be provided on rock types, rock texture and structure, geological conditions, geophysical and morphological details, regional tectonic setting (fractures/faults, folds, warping etc.), history of volcanic activity, seismicity and associated hazards, mainly in the coastal area. Information shall also be furnished on the quarry yields, strengths of rock, distance of quarries from habitat, restrictions for quarrying, environmental controls, statutory permits etc., needed.

4.1.4 Soil

Soil data including type, classification, characteristics, soil properties etc., are important from engineering considerations for design of structures, loading capacities of cargo stockpiles etc. Changes in parameters of soil also may affect plantation and vegetative growth, which in turn may endanger the health of local habitat.

Baseline data of the soil ascertained by way of soil investigations carried out is to be provided. Field surveys usually involve a combination of hand auger boring and drilling over the site in a systematic grid pattern, with more focus on specific areas of interest. Soil surveys should consider both the physical and engineering properties of the soil

Soil data in the proposed green belt area to ascertain the suitability for development greenbelt /mangrove plantation and for rain water harvesting should be covered

In the offshore areas of the proposed port, it is also necessary to ascertain the geo technical properties of soil up to a depth of 10 m below the proposed dredged depths where dredging is involved and up to hard strata where structures are to be sited in the harbour/coastal waters.

4.1.5 Meteorological data

Meteorological data covering the following should be furnished. The data for at least a 10 year period should be presented from the nearest meteorological station, except for the history of cyclones and tidal surges for which 100 year data should be presented.

- Wind speed and direction,
- Rainfall,
- Relative humidity,
- Temperature, and
- Barometric pressures.
- History of cyclones

a) Wind speed and direction

For preliminary studies, information may be obtained from the available meteorological records of the area. Recording of velocity and direction of wind at the proposed site should be obtained by installing continuous and self-recording anemometers. The data collected should also be correlated with the data available at places nearest to site. From the data so collected, monthly and yearly wind roses should be prepared. Obtaining accurate wind and its interpretation are of importance as wind acts as an agent to convey soot, dust etc

generated both during construction and operational phases of port activity from project area to neighborhood.

b) Rainfall, humidity, temperature and visibility

Historical data on other parameters like rain fall, temperature, humidity and visibility of the proposed port area, which is also important and should be collected. Seasonal changes of climate are associated with the changing monsoons. Data on rainfall and temperature are very important to plan and design safe operating systems, equipment, methods etc. Data collected shall be correlated with data available at places nearest to project site and with recorded data available at the IMD for the region. The length of periods over which data on various meteorological variables should be compiled may vary considerably. The data on annual average, minimum and maximum temperature, rainfall, relative humidity should be provided in the report.

c) History of cyclones

Coastal areas are more subjected to damages during severe cyclones and storms. During severe cyclones the sea water levels near shore get increased due to storm surge and set up. Higher wind velocities tend to increase the incident wave heights. The low-lying coastal areas are thus prone to inundation and submergence during such cyclonic storms. Information on cyclonic storms of the region shall be compiled regarding track of cyclones, the velocity of maximum winds, duration, pressure drop at the cyclone center and speed of movement of cyclone center can be obtained from the IMD.

4.2 Water environment

Water environment includes three environmental settings, i.e. ground, surface and marine. Baseline data with regard to these three environmental settings should be generated. Central Pollution Control Board (CPCB) has stipulated criteria for raw water usages, use based classification of surface water and water quality standards for coastal waters. These are given in **Annexure 4 and 5.**

4.2.1 Ground water

Port activities during construction/operation may have impact on groundwater quality. Due to port construction existing water logging areas may be reclaimed with dredged soil. Pollutants from dredged soil are likely to enter into the ground water. The breakwater constructions lead to contain the seawater within the harbor limits. This is likely to increase concentration/sedimentation of pollutants in the harbor area, which may migrate in time to the neighboring ground water. Also surface water from cargos stacks may percolate as leachets into the ground and may contaminate the ground water.

Baseline data for ground water quality is to be established including data of pH, salinity, dissolved solids, BOD, coliform bacteria and other parameters to be decided based on the cargo to be handled. The description of water sampling locations may be given as in **Table 4.1.** In case it is proposed to tap the ground water during construction and or operation stage(s), the same should be quantified, and source of water supply should be identified.

The stress, if any on local ground water availability should be identified and comprehensive water demand should be estimated. The salinity along the stretch of the port shall be mapped.

4.2.2 Surface water

Baseline data of sources of surface water like surface streams, lakes, tidal inlets, etc., along with their description, present quality is to be provided. The description of the water sampling locations may be given as in **Table 4.2.**

In case it is proposed to tap the surface water during construction and or operation stage(s), the same should be quantified, and source of water supply should be identified.

The stress, if any on surface water availability should be identified and comprehensive water demand should be estimated.

4.3 Marine environment

4.3.1 Coastal hydrology/geomorphology

Coastal hydrology requires collection of oceanographic data during the study period covering the following parameters:

- Tides,
- Waves (wind waves and swells),
- Storm surges,
- Currents,
- Salinity,
- Sea water temperature
- Suspended load, and
- Seabed bathymetry

Tides move the water to high peaks usually twice each day and twice a month too much higher peaks. Tidal changes vary according to geographical location. To predict tidal changes data should be collected for a period of more than two weeks. It is also possible to estimate tidal parameters from tide tables published by National Hydrographic Office for many operating ports. Data of currents i.e., velocity and direction are required to obtain input data for simulation studies and model studies to estimate tidal flow and dispersion of pollutants. Wave observation is a prerequisite for reliable prediction of highest waves and littoral drift. Data on high waves is important for the design of structures and long term wave data is important for analyzing the wave energy which effects beach erosion and accretion. The period of wave observation should be long enough to include rough sea conditions. National wave atlas published by National Institute of Oceanography may be helpful to get deep-water wave data of the regions covered therein. Survey of depth of sea bottom, littoral drifts distribution of sand particle size is also necessary for the assessment of shoreline changes.

Data of these oceanographic parameters are normally collected for evaluating engineering feasibility and carry out preliminary/detailed design as per corresponding criteria/ norms.

Summary of such information shall be furnished in the EIA report in order to appreciate and assess their impacts. As the location of port along a shore and layout of major port structures may affect the wave, current and sediment transport patterns, accuracy of the data of these oceanographic parameters is of vital importance in identifying and assessing corresponding impacts. Guidance note for collection of oceanographic data are given in **Annexure-6.** While bathymetry is a one-time parameter, oceanographic data such as currents, waves, tides, etc need to be measured at least for two seasons.

Coastal hydrology cited here includes factors concerning currents, tidal flow, littoral drifts, beach erosion, water drainage, sediment deposition, groundwater flow, and other physical phenomena in the shore zone.

The location of a port, construction of breakwaters and dredging may cause changes in current patterns and littoral drifts. The change of littoral drifts may lead to erosion or accretion in shore zones. The creation of the port may cause changes in river flow and water front drainage. A study on likely changes in littoral drift and sediment transport due to the project activity should to be taken up through modeling.

Baseline date of above parameters at the project area and the neighborhood areas should to be ascertained by proper surveys, frequency distribution of surface wind, wind direction, frequency of tropical cyclones (depressions, storms, typhoons) and associated hazards, other atmospheric disturbances, rainfall and temperature, climatological normal and extremes. Base line data should extend at least to water depths of more than 10 m of proposed deepening of the harbor approach and basin as per master plan of the port proposed. Base line data should also include details of existing mangroves, marshy lands, coastal vegetation, sand dunes, coastal stability, seismic characteristics, history of any endangered species, coastal erosion, shoreline changes, if any etc.

4.3.2 Bed sediment contamination

Bottom contamination encompasses many kinds of contamination of bottom sediments by toxic or harmful substances, oils, oily mixtures and other hazardous materials. Contamination of bottom sediments are often measured by the size of sediment particles, pH, colour, smell, oil and grease, organic materials, and concentration of organic nitrogen, phosphorus, sulphide, and toxic substances such as heavy metals and pesticides including toxic components of antifouling paints.

Location of a port, construction of breakwaters and dredging may accelerate sediment deposition in stagnant water behind structures and cause contamination of the sea bottom. Sediment deposition covers bottom biota and physical habitat. Baseline date of above parameters at the project area and the neighborhood areas should to be ascertained by proper surveys.

4.3.3 Sea/harbor water quality

Port activity comprising of construction of breakwaters, berths, wharfs, jetties and operations like dredging, cargo handling, discharges from drainage rivers, rivulets, estuaries, discharges from ships are likely to effect the harbour water quality. The Breakwater constructions lead to contain the seawater within the harbour limits. This is likely to increase pollutants in the harbour water.

Baseline data on chemical parameters in the open sea and navigation channel and harbour area of the proposed port should be ascertained for understanding hydro chemical characteristics in the marine environment (such as BOD, DO, pH, TSS, salinity, heavy metals etc. The sampling is generally carried out at 0.1d, 0.5d and 0.9 d where "d" is the depth of water at the location. The sampling shall be carried both during ebb and flood conditions and during periods of high and low upstream discharges.

4.4 Biological environment

The baseline status for biological environment should be established by studying distribution pattern, community structure, population dynamics and species composition of flora and fauna. Biological environment like water encompasses both land, coastal and marine habitat and as such field surveys differ widely in the three cases.

4.4.1 Marine/coastal ecology

Marine and coastal ecology includes aquatic fauna and flora composed of a large number of species of bacteria, phytoplankton, zooplankton, benthonic organisms, coral, seaweed, shellfish, fish and other aquatic biota, terrestrial flora such as mangroves and wetlands. Loss of bottom habitat and fishery resources is also significant problems included in this category. The location of a port affects aquatic fauna and flora through changes of water quality, coastal hydrology and bottom contamination.

Baseline data of above parameters at the project area should to be ascertained by proper surveys including mangroves and marshes and other coastal vegetation, sand dunes, coastal stability, and seismic characteristics. History of any endangered species, coastal erosion, and shoreline changes, if any. Fisheries activity in the proposed area should be ascertained from the fisheries department.

Survey of aquatic biota should be carried out using different methods, depending on group of organisms. Sampling of aquatic organisms and their measurement is usually done by the methods listed in **Annexure-7**

4.4.2 Flora and fauna in the neighborhood

Details on secondary data on the existing flora and fauna in the project area as well as with in 15 kms from project boundary, carried out by an university/institution under the relevant discipline (such as BSI, ZSI, WII, etc) should be included in the list of flora and fauna along with classification as per schedule given in the Wild Life Protection Act, 1972 (for fauna) and in the Red Book Data (Flora) and a statement clearly specifying whether the study area forms a part of an ecologically sensitive area or migratory corridor of any endangered fauna.

4.5 Air environment

Baseline data for the parameters RSPM, SO_2, NO_x, CO and heavy metals (keeping in view of cargo proposed to be handled), extending an area up to 5 km from the project boundary should be generated for one season other than monsoon as per the CPCB norms. The monitoring locations and the results should be presented as per **Table 4.3** & **4.4.** Specific importance is to be attached to areas in close proximity of project say up to 1 km and areas

of habitat, recreation places and sensitive zones such as schools and hospitals in the neighborhood, if any. The values shall be compared with National Ambient Air Quality Standards **(Annexure 8)**

The number of monitoring stations can be selected based on the general criteria as mentioned in the **Annexure-9,** duly giving consideration to the sensitive environmental receptors in the study area.

4.6 Noise

Baseline data at the project area and the neighborhood habitat areas is to be monitored as per CPCB protocol. Noise pollution generated by road traffic, cargo operations, ship traffic and other port activities also cause nuisances to local people. Hourly monitoring of noise levels (Leq) should be recorded for 24 hours by using noise level meter for 15 minutes during each hour. Noise standards have been designated for different types of land use, i.e. residential, commercial, industry areas and silence zones as per the Noise Pollution (Regulation and Control) Rules, 2000 notified by the Ministry of Environment and Forests **(Annexure 10)**. The noise environment studies can be restricted up to 1km from project boundary or distance to nearest habitation whichever is more. The description of noise monitoring locations may be give as in **Table 4.5.**

4.7 Existing solid waste disposal facilities

Wastes from construction are mainly spoils generated by civil construction, dredging. Wastes generated during port operates includes oily wastes such as bilge water, ballast water, washing water, lubricant oil, sewage and garbage, hospital waste and cargo residues. These waste discharges/spills cause problems of pollution, floating garbage, unsanitary conditions, odour and other degradation of water quality.

Details of authorized municipal solid waste facilities, biomedical treatment facilities and hazardous waste disposal facilities in the area are to be ascertained by proper surveys. This will help the project proponent to ascertain the availability of common environmental infrastructure facilities or to plan separately.

Incase, common environmental infrastructures are planned for utilization, the adequacy of the same shall be ascertained.

4.8 Socio-economic and occupational health environment

Building or expanding a port often requires relocation of the local community, sometimes causing conflicts with local people and may change the cultural traditions of the local community. Oil and oily wastes discharged from ships may reach nearby beaches and spoil recreational activities, which cause serious damage to tourism. Ship traffic may disturb pleasure boat cruising and fishery boat operations. The possibility of accidents in the ship traffic becomes a worry to local people. Ship calls create many related jobs including pilotage, tug services, stevedoring, bunkering and crew services; however, they may bring considerable changes in the life style of local people.

Socio-cultural impacts include all kinds of influence on the local community and people's life style such as relocation of villages, industrialization, population growth, and the

formation of slums. It may have impact on fisheries. **Annexure 11** gives the illustrative types of socio-economic impacts due to port activity for reference.

Baseline date of above parameters at the project area and the demography, particularly on human settlements, health status of the communities, existing infrastructure facilities in the proposed area and area of impact due to the proposed activity should be collected. Information on fish production, total catch, as well as number of fisherman and their income should be collected.

Present employment and livelihood of these populations, awareness of the population about the proposed activity should be collected.

4.9 Public utilities

Transportation of construction material during the construction phase and cargoes to/from the port during the operations phase of the port may result in excessive use of existing public infrastructure like roads, railways and in-land waterways etc., resulting in congestion and early ageing etc. Similarly public utilities such as water supply, drainage, electrical power etc may also get undue demand.

Base line data of existing public utility infrastructure shall be ascertained and reported to assess the impacts of the project on these public utilities in order to incorporate desired methods in the EMP and monitor the same during the construction as well as operational phases of the port.

Incase of handling hazardous chemicals, the existing off site emergency facility system is to be explained. This will help the project to plan integration with the existing off site emergency facility.

CHAPTER 5

Anticipated Environmental Impacts and Mitigation Measures

5.0 General

The purpose of the EIA is to quantify the impact and ensure that changes to the environment fall within acceptable pre-defined limits and to give the environment its due place in the decision-making process by clearly evaluating the environmental consequences of the proposed activity before action is taken. The potential adverse effects of port development encompass land, water pollution, contamination of bottom sediments, loss of bottom habitat, damage to marine ecology and fisheries, beach erosion/accretion, current pattern changes, waste disposal, oil leakage and spillage, air pollution, noise, vibration and flood light effect.

By suitable means including modeling where necessary, the impact of all the identified environmental concerns of port activities on each facet of the environment should be assessed both during construction and operational phases and suitable mitigation measures against the potential adverse impacts should be considered such that an effective EMP can be prepared and adhered to during the project construction and operations phases. The impacts and the mitigation measures pertain to the different phases like location, construction and operation (ship traffic and cargo operations) of the port.

5.1 Land environment

5.1.1 Potential impacts due to port location

Changes in land use pattern for example, change from agriculture, housing, etc., to port related activity may necessitate rehabilitation and resettlement (R&R) of effected communities/villages.

Port projects may also involve changes in land terrain like cutting of high grounds and hillocks, filling of low lying areas for creation huge extant of port infrastructure like operational areas, storages, roads, railway lines etc. Such terrain changes are likely to affect drainage patterns as well as road rail connectivity. The impacts of such changes in the terrain shall be in order to incorporate desired methods in the EMP and monitor the same during the construction as well as operational phases of the port.

Coastline changes like erosion or accretion may be expected due to the establishment of ports inasmuch as the oceanographic and littoral process may be intercepted due to construction of breakwaters, groynes etc., and dredging and reclamation works. These are likely to have serious consequences. These impacts are to be, therefore, assessed by proper techniques some times involving mathematical/physical model studies.

Transportation of huge quantities of construction material for the breakwaters, berths, operational, administrative and welfare buildings, land filling/development, formation of storage and stacking yards etc., during the construction phase and transport of cargoes to/from the port during the operations phase of the port may result in excessive use of existing public infrastructure like roads, railways and in-land waterways etc., resulting in congestion and early ageing etc. Similarly public utilities such as water supply, drainage, electrical power etc may also get undue demand.

Mitigation measures

Careful site selection and port design should be carried out, focusing on the possibility of limiting the extent of land area requirement. Where R&R measures are necessitated, these measures are to be undertaken by the proponent to the satisfaction of effected communities and the regulatory authority.

Land acquisition where required shall be carried out by duly acceptable transparent non-restrictive methods as may be directed by the concerned authorities and duly addressing the concerns of the effected communities/villages.

Coast line changes like erosion or accretion likely to have serious consequences are to be, assessed by proper techniques some times involving mathematical/physical model studies to ascertain remedial measures such as shore protection works, sand bye passing etc., The implementation of these measures and coast line stability/changes should be monitored during implementation of the construction and operation phases of the project.

Drainages and road and rail connectivity's should to suitably designed and implemented to overcome affects of changes in land terrain. The existing network of road and rail infrastructure should be improved by suitable expansion including development of bye passes as part of project to avoid congestion of existing road rail net works and resulting inconvenience to the public. Similarly the utilities like water supply, sewage treatment/disposal, waste management/disposal, electrical power supply should be augmented or developed as the case may be as a part of the port project.

Land reclamation

Land reclamation from the sea usually brings the problem of effluent of turbid water in the landfill site. It is sometimes economical to reclaim the land by dumping landfill material without any revetment or retention bunds. This method is not applicable to land fill with silt or clay or to the sea area with high waves. In order to prevent turbid water from land reclamation retaining bunds are usually built in advance of landfill.

Settling ponds play an important role in reducing the effluent of turbid water. The use of coagulants encourages the settlement of fine materials but should be monitored at the outfall and near by points in the sea. Filtration of discharge water through sand layer is also an effective method to reduce suspended solids and thereby turbidity.

Dredging should be conducted if necessary, and based on an assessment of the need for new infrastructure components or port navigation access to create or maintain safe navigations channels, or, for environment reasons, to remove contaminated materials to reduce risk to human health and the environment.

5.1.2. Potential impacts during construction

Transportation of huge quantities of construction material for the breakwaters, berths, wharfs, jetties, operational, administrative and welfare buildings, land filling/development, formation of storage and stacking yards etc., during the construction phase and transport of cargoes to/from the port during the operations phase of the port may result in excessive use of existing public infrastructure like roads, railways and in-land waterways etc., resulting in

congestion and early ageing etc. Similarly public utilities such as water supply, drainage, electrical power etc may also get undue demand.

Mitigation measures

Where R&R measures are necessitated, these measures are to be undertaken by the proponent to the satisfaction of effected communities and the regulatory authority. Land acquisition where required should be carried out by duly acceptable transparent non-restrictive methods as may be directed by the concerned authorities and duly addressing the concerns of the effected communities/villages.

Drainages and road and rail connectivity are to suitably designed and implemented to overcome affects of changes in land terrain.

The existing network of road and rail infrastructure shall be improved by suitable expansion including development of bye passes as part of project to avoid congestion of existing road rail net works and resulting inconvenience to the public. Similarly the utilities like water supply, sewage treatment/disposal, waste management/disposal, electrical power supply shall be augmented/developed as the case may be as part of the port project.

5.1.3. Potential impacts during operations

Ship traffic and discharges may cause environmental concerns on the land where they are unloaded and stored or when they are being transported.

Mitigation measures

If port or harbor expansion or upgrading will result in more vehicular traffic, the increases and their impacts must be evaluated. Background data required, if available, should include an up-to-date delineation of the existing roadway network with indication of any expansion or improvement either underway or in the planning stage, quantification of present traffic loads and their periodicity, accident data with indication of severity (casualty losses, deaths and injuries), and any special characteristics of traffic (trucks, taxis, buses-frequency, routes etc.)
Important aspects will be the nature of the increases (workers communicating, trucks, tractor-trailers, heavy loads, hazardous cargoes, etc. general commercial traffic), the nature and patterns of congestion, and routes likely to carry the expand burden. With these projections developed, preliminary plans should be developed for improved roads and highways, new bypass routes to serve the additional traffic, and needs for traffic control. Additional problems include over-night working of trucks and drivers, trucks waiting for port access, damage by trucks to roadways, and spillage from trucks. An important factor in developing these requirements is an examination of the secondary impacts-traffic increases not directly attributable to the project but expansion of residential, market and commercial areas due to the enlarged industrial employment base.

Only cargoes permitted under statutory acts, rules, regulations and directions shall only be handled in the port duly complying with approved procedures to the extent facilities exist at the port. Ship traffic, especially international trade, shall also comply with International Ship and Port Safety (ISPS) Code.

Green-belt development along the periphery of the port boundary, around the storage yards and also along the roadside should be undertaken as per CPCB norms, subject to the suitability of the soil conditions.

5.2 Water environment

5.2.1 Potential impacts due to port location

Impacts due to associated and ancillary port activities should be assessed

Breakwaters and landfills may change current patterns and cause stagnation of water behind the structures. If municipal or industrial effluent flows into a port, stagnant port water may deteriorate through a dramatic increase of phytoplankton and a decrease of dissolved oxygen, resulting from eutrophication of water, caused by effluents containing nutrient salts (chemical compounds including N and P). Anaerobic water leads to the generation of hydrogen sulphide (H2S) and can be identified by its odour. It has serious effects on organisms. Municipal sewage also brings coliform bacteria into the port and may cause unacceptable contamination of the harbour.

Mitigation measures

The impacts due to associated and ancillary port activities should be estimated based on possible assumption of population and economic growth. Design of sewage treatment system, installation and regulation of effluent into rivers or the sea, diffusion of pollutants, etc are to be assessed by models to predict future levels of water pollution.

Careful site selection and port design should be carried out, focusing on the possibility of water stagnation. If the basic pollution level is critically high, a sewage treatment system should be planned as part of the environment management of the area. Regulations on discharges of effluents into water and provision of sanitary treatment facilities are indispensable for reducing pollutants from hinterlands. In a polluted bay or port, it could be effective to dredge or cover contaminated bottom sediment capping to reduce the flux of pollutants from the sediment to the water.

5.2.2 Potential impacts due to port construction

Pile driving, deposition of rubble, dredging, sand compaction and other construction work in water cause re-suspension of sediments and turbid water. Re-suspension of sediments in water leads to an increase in the level of suspended solids and in the concentration of organic matter, possibly to toxic or harmful levels. It also reduces sunlight penetration.

Work vessels are a possible cause of oil spills, garbage discharge, and leakage of other substances into water. Diffusion from concrete work in water and overflows from landfills may be possible sources of water pollution.

Potential impacts to be assessed also include physical properties of the water, disruption or destruction of bottom sediment organisms, wildlife habitat disruption of destruction, wildlife breeding and feeding grounds disturbed or destroyed, broken life cycles and food chains, soil erosion, regeneration potential of vegetation, loss of native forage, effects of air and water pollution on plants and animals

Mitigation measures

The adverse effects of construction work could be minimized by appropriate selection of equipment in pile driving or dredging, proper use of silt curtains, careful planning of settling ponds and overflow weirs for landfills, and suitable transport of construction materials and dredged material. Proper disposal of dredged material plays a critical part in preserving the environment. Deposition in landfills may offset problems being caused by dumping at sea.

5.2.3 Potential impacts due to port operations

Possible discharges from ships that could be sources of water pollution are bilge water, ballast water, oily wastes, sewage, garbage and other residues in a ship. Spills of oils, lubricants, fuels and other oily liquids may be other sources of water pollution. Once an oil or oily compound is

On the surface of seas in tropical or temperate zones, oils can be polymerized gradually by biodegradation and eventually form dense particles, which sink. Concentration of oily compounds in water is an important indicator of water quality, particularly in recreational water areas. Repair docks may be a possible source of toxic or harmful materials such as anti foulants, paints, or heavy metals.

Water drawl sources shall be identified and its impact shall also be predicted. Similarly, wastewater discharge into sea and impact prediction shall be carried out. Adequacy of outfall in mitigating the adverse impacts shall be ensured by suitable study.

Mitigation measures

Appropriate regulations on ship discharges and provision of reception facilities are indispensable for proper control of emissions and effluent from ships. Detection of spills is also important for regulating ship discharges. To handle the accidental spills recovery vessels, oil fences, and treatment chemicals should be prepared with a view to minimizing dispersal. Proper contingency plans and a prompt reporting system are keys to prevention of oil dispersal. Periodical clean up of floating wastes is also necessary for preservation of port water quality.

Mechanism to monitor the pollution from the ships and enforcement by the port should be discussed.

Impacts on water quality due to cargo operations

Runoff from raw material storage, spills from bulk cargo handling, and wind-blown dust are possible sources of contamination of port water. Toxic or harmful substances may be included in runoff from sulfur, bauxite, phosphates, nitrogenous manure, coal, metal ores and other cargo materials. Organic materials in runoff are decomposed to the inorganic form, spending dissolved oxygen and increasing the nutrient level in water. Accidental spills of toxic, harmful materials, oils or oily compounds, and other raw materials are also possible sources of contamination of water.

Mitigation measures

Counter measures against runoff are: (a) covering or enclosing raw material storage areas (b) sprinkling water on raw material except anti-humid materials like grains or cement (c) providing special equipment for cargo handling and transport (e.g., covered conveyor or pneumatic unloader) and (d) other methods to reduce the influence of wind and rain. A reversed slope apron is an effective means to avert rainfall from washing away from the apron and joining the seawater directly. The drains from the apron are led to a settling pond and released into the sea after settlement of suspended materials.

5.3 Marine environment (coastal hydrology/bottom contamination, sea/harbour water quality)

5.3.1 Potential impacts due to port location

The location of a port may cause changes in current patterns and littoral drifts due to alteration of wave refraction, diffraction and reflection. The change of littoral drift may lead to erosion or accretion in shore zones. Altered currents or reflected waves may endanger small ships maneuvering near structures. The creation of a port may cause changes in river flow and waterfront drainage. Tides are usually unaffected by port construction except where an enormous amount of land reclamation takes place in a closed bay. Currents are altered by marine structures and land reclamation and these can be predicted by computer simulation models

The location of a port may accelerate sediment deposition in stagnant water behind structures and cause contamination of the sea bottom. Sediment deposition covers bottom biota and physical habitat. Pile structures shade the bottom and affect habitat. Eutrophication of water induces sedimentation of dead plankton and changes chemical characteristics of bottom sediments, resulting in an increase of organic matter, hydrogen sulphide, and mobilization of harmful substances.

Mitigation measures

Careful site selection and port design should be made to minimize the impact due to changes in current patterns and other coastal hydrology. Model experiments or computer simulations of these changes are useful in developing an appropriate design. Coastline changes like erosion or accretion that are likely to have serious consequences are to be assessed by proper techniques. Remedial measures for shoreline protection, like construction of sea walls, groynes, sand bye passing or beach nourishment, etc should be planned. The implementation of these measures and coastline stability/changes should also be monitored during the construction and operation phases of the project.

5.3.2 Potential impacts due to port construction

Dredging may cause changes in current patterns and flows as well as salt wedge intrusion into a river mouth or littoral drifts in the shore zone. Changes in littoral drifts lead to beach erosion or accretion. Disposal of dredged material on land may possibly cause leakage of harmful substances into ground water or changes in waterfront drainage.

Construction work and dredging disturb bottom sediments and induce re-suspension, dispersal and settlement of such sediments. Dumping of dredged material directly alters

bottom configuration and biota and may disperse toxic or harmful chemicals around the disposal site. Dredging removes bottom habitat and may lead to a loss of fishery resources.

Mitigation measures

The impact of dredging on current flow is usually not serious and can be assessed by current flow simulation. Beach erosion could be avoided by carefully planning the steepness of the dredging slope and the deviation from the shoreline.

A survey of contamination of bottom sediments should be undertaken before dredging. Selection of disposal site, disposal methods and requirements for capping are key issues in undertaking disposal at sea. In shallow water, silt curtains, as well as careful selection of the dredging method, could be effective in minimizing dispersal of resuspended sediments.

5.3.3 Potential impacts due to port operations

Ships generate: (a) oily wastes such as bilge water, ballast water, washing water, lubricant oil and other residues in machinery space; (b) sewage and garbage; and (c) cargo residues. Discharges and spills of these wastes cause problems of oil pollution, floating garbage, unsanitary conditions, odour and other degradation of water quality.

Bottom contamination may result from runoff from quay and storage area, spills from bulk cargo operations, and wind blown dust. Discharge from waterfront industries is a major source of contamination of bottom sediments.

Mitigation measures

Ports are required to provide sufficient reception facilities to receive residues and oily mixtures generated from ship operations according to provisions of the International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL) as amended by the 1978 Protocol (MARPOL, 1973/78). Besides oily residues, reception of sewage and garbage is also required in accordance with the needs of calling ships. Connection to sanitary treatment facilities or a municipal waste treatment system may be a means for a port to receive such wastes and the details should be covered.

Provision of these facilities, promulgation of regulations on discharge of oily residues, and proper detection are keys to successful control of ship discharges. Unsanitary discharges from repair docks should also be connected to appropriate waste treatment systems.

> Regulation 9(2) of Annex V of MARPOL 73/78 states, "Every ship of 400 tons gross tonnage and above, and every ship which is certified to carry 15 persons or more, shall carry a garbage management plan which the crew shall follow. This plan shall provide written procedures for collecting, storing, processing and disposing of garbage, including the use of the equipment on board. It shall also designate the person in charge of carrying out the plan. Such a plan shall be in accordance with the guidelines developed by the organization and written in the working language of the crew".

Standard format of the advance notification form for waste delivery to port reception facilities and standard format for the waste delivery receipt following a ship's use of port reception facilities as recommended by Marine Environment Protection Committee, IMO are given at **Annexure 12 & 13**

5.4 Biological environment (coastal and marine ecology)

5.4.1 Potential impacts due to port location

The location of a port affects aquatic fauna and flora through changes of water quality, coastal hydrology and bottom contamination. Land reclamation from the sea destroys bottom habitat and displaces fishery resources. Terrestrial fauna and flora may also be altered by the location of a port.

Diminution of bottom biota is usually linked to a reduction of fishery resources, and occasionally to an increase of undesirable species. Deterioration of water quality usually gives rise to changes in aquatic biota: a decrease in the number of species, and an increase in the quantity of one or two specific species.

Diminution of plants in a shore zone within enclosed water may degrade its aeration capability and worsen water pollution. Mangroves in wetlands play an important role in providing habitat for terrestrial and aquatic biota and indirectly recovering water quality. Mangroves and coral reefs are very sensitive ecological organisms, which are intolerant to changes in the environment. Mangroves are easily affected by changes in current flow, salinity, oil film and deposit of silt. Coral reefs and their eco systems are very fragile and sensitive to changes in water transparency, water temperature, salinity, euthrophication, siltation, oil film and other similar pollution. Adverse effects on marine coastal ecology result from deterioration of water quality and contamination of bottom sediments

Mitigation measures

Adverse effects on marine and coastal ecology usually result from deterioration of water and air quality, current pattern changes, bottom contamination; physical loss of water area and changes in natural land habitat. Measures mentioned in subsections 5.1.1 and 5.1.3 for mitigating changes in aquatic and terrestrial habitat. Careful survey of the ecological characteristics of a project area is indispensable if the welfare of endangered and fragile species is to be considered and disruption of their spawning seasons and areas and migration is to be minimized. Planting of green plants around a port may be an effective means to mitigate adverse effects on terrestrial habitat.

Greenbelt proposal should be prepared as per the "Guidelines for developing greenbelt" published by the Central Pollution Control Board

5.4.2 Potential impacts due to port construction

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

particularly coral reefs, which are formed by the extra cellular product of symbiotic plants. The great number of coral polyps attached need dissolved oxygen for respiration and the plants need sunlight for photosynthesis.

Piles, concrete surfaces, rubble mounds and other similar structures in water could form new habitats, which may introduce undesirable species. If toxic substances and other contaminants are resuspended through dredging or dumping, they may lead to contamination of fishery and shellfishery resources.

Mitigation measures

Careful survey of a fragile marine and coastal ecology is essential for appropriate planning of construction work, dredging, and disposal of dredged material. Selection of port site is the key to minimizing adverse effects. Since adverse effects usually result from bottom contamination and deterioration of water quality, measures against those adverse effects noted in subsections 5.2.1 to 5.2.3 are also effective for mitigating changes in aquatic and terrestrial habitat.

5.4.3 Potential impacts due to port operations

Leakage of oils, oily wastes and mixtures may directly cause damage to fishery resources, aquatic biota and coastal habitat. Biodegradation of oil also generates polymerized oil particles and toxic aromatic fractions using dissolved oxygen in the water, which indirectly cause damages to bottom biota and habitat. Both effects may seriously damage marine and coastal ecology. Flood light effect on turtles should be assessed.

Oil and toxic substances generated by biodegradation may spoil fishery resources. Some oils contain carcinogens and their contamination is reported in fishery resources.

Potential impacts to be assessed also include:

Aquatic Habitat: Physical properties of the water, changes in aquatic species composition and number, changes in bottom dwellers, fisheries damage, fish sizes decrease, aquatic animals without suitable habitat or food supply.

Terrestrial habitat: Damage to vegetation, small animals, wildlife habitats and wildlife displacement, damage to migration routes or disruption, damage to breeding grounds, wildlife ranges division, isolation of animals with small home ranges, suitability of remaining habitats.

Illumination or Flood light Effect: Certain coastal stretches, which are ideal locations for nesting of endangered species like olive ridley turtles may have adverse impact due to the illumination or flood light effect associated with port activities.

"Edge" Habitat and Draw down Zone: Invasion of new plant species and plant communities, increased habitat diversity, invasion of new animal species, human impact on biota.

Mitigation measures

Impact of port operations on the movement and nesting process of turtles, aquatic habitat and terrestrial habitat should be studied and remedial measures to be taken up, particularly during the nesting periods.

Potential Impacts during Cargo operations

Cargoes handled at the ports and harbours can be broadly classified in to the following categories:

- Bulk cargoes:
  - (i) Dry Bulk Cargoes like metallurgical ores, coal and various types of coke, fertilizers, fertilizer raw materials, food grains etc.
  - (ii) Liquid Bulk Cargoes like Petroleum crude, finished petroleum products, natural gases like LPG & LNG etc,
  - (iii) Chemicals including hazardous cargoes etc.
- General cargoes (break bulk cargoes) bagged and unitized cargoes, machinery, project cargoes, manufactured products like iron and steel products, electrical and electronic equipments, cars and other vehicles, raw materials and finished items including consumer durables of various kinds etc.
- Container cargoes.

The impacts on various environmental parameters due to cargo handling at ports and harbours are to be assessed for each type of cargo based on its properties, volume and location of the facility as well as prevailing meteorological and climatic conditions. However, the environmental parameters likely to be affected due to handling of above mentioned types of cargoes are presented here under:

S.No	Type of Cargo likely to be handled	Major Environmental Parameters likely to be attracted by such cargo handling activities	Areas of concern
1	Dry Bulk Cargoes like metallurgical ores, coal and various types of coke, fertilizers, fertilizer raw materials, food grains etc.	Land, Air, Surface Water, Health, Public utilities	Cargo Dust & Leaching etc.
2	Liquid Bulk Cargoes like Petroleum crude, finished petroleum products, natural gases like LPG & LNG etc,	Land, Air, Surface Water, Harbour Water, Health, Public utilities	Collision, Spillages, Leakages, Explosion, fire etc.
3	Chemicals including hazardous cargoes etc	Land, Air, Surface Water, Harbour Water, Health,	Leakages, Explosion, fire etc.
4	General cargoes (break bulk cargoes) bagged and unitized cargoes, machinery, project cargoes, manufactured products like iron and steel products,	Air, Surface Water, Harbour Water, Public utilities	Handling, Transportation etc.

	electrical and electronic equipments, cars and other vehicles, raw materials and finished items including consumer durables of various kinds etc.		
5	Container cargoes	Public utilities	Container movements, CFS etc.

Mitigation measures

See subsection 5.4.1.

5.5 Air environment

5.5.1 Potential impacts due to port construction

Impact of project construction/operation on the ambient air quality on account of emissions of dust during construction and cargo handling as well as emission of gases from equipment deployed for construction and cargo handling should to be assessed by empirical methods or models and/or reference to existing similar situations. Impacts also include accidental leakage of emissions, exposures, fumes, odors, hazardous airborne emissions and water front industries. Assessment of changes in AAQ parameters shall be carried out by suitable modeling techniques or empirical methods. Anticipated impacts during the construction stage and during the operation stage in the immediate surroundings may have a greater impact. The existing surrounding features up to 1 km and impact on them shall be addressed specifically. Prediction of fugitive dust emission/air emissions during loading, un-loading, transportation and storage of cargo, prediction of point source emissions, prediction of air emissions from the ships in the port area, prediction of air emissions due to increase in traffic, prediction of impact on ambient air quality, emission inventory for critical pollutants with mitigation measures and without mitigation measures, prediction of the impact due to the existing activity on the proposed project, prediction of impacts due to sanctioned/on going projects in the surrounding area on the proposed project and the ambient environment shall be carried out.

Mitigation measures

Mitigation measures to be proposed during the construction stage should include resorting to dust suppression measures by suitable techniques. Mitigation measures to be proposed during the operation stage shall include alternative solutions such as closed conveyor system, closed silos, direct loading of dusty cargo through electronic chutes in to the vehicle, closed vehicles to transport dusty cargo etc, mitigation measures to lower the emissions during loading, un-loading, transportation and storage of cargo, mitigation measures to lower the point source emissions, mitigation measures to lower the emissions from automobile, mitigation measures to lower the emissions from the ships, green belt development as well as institutional arrangements proposed with other agencies for effective implementation of environmental measures, applicable environmental standards and compliance.

5.5.2 Potential impacts due to port operations

Traffic and discharge

Mechanism to monitor the air pollution from the ships and enforcement by the Port shall be discussed.

Cargo operations

Emissions of dust from bulk cargo handling and gasses from cargo handling equipment can be sources of air pollution. Liquid cargo handling may result in the release of vapour during the cleaning of storage tanks and by the breather system for ambient temperature changes. Accidental leakage of gasses may cause problems such as toxic material emission, explosions, fumes, odours and hazardous airborne emissions.

Mitigation measures

Mitigation measures includes such as mechanized cargo handling system, closed conveyor systems, covered dusty cargo storage yards, closed silos, closed evacuation of dusty cargo from the ship to storage silo, direct loading of dusty cargo from the silo through electronic chute in the truck, dust suppression system, closed truck or covered truck etc.

The export & import of the cargo will generally be handled by a number of exporters, importers and local transporters. Environmental specifications for these stakeholders should cover the required safeguards during the cargo handling and transportation. Institutional mechanism between port authority and port users for monitoring and enforcement of environmental specifications shall be explained.

5.6. Noise pollution

5.6.1 Potential impacts due to port construction

Construction activities may create a problem of noise and vibration generated by construction equipment, truck traffic, work vessels and other similar sources.

Mitigation measures

Transmission of noise and vibration are limited by the distance from their sources. Noise could be considerably reduced by adoption of low noise equipment or installation of sound insulation fences. Green belt of plants can be a good barrier.

5.6.2 Potential impacts due to port operations

Cargo handling equipment and road traffic are two major sources of noise and vibration, which may cause unacceptable levels of stress among local people.

Mitigation measures

See subsection 5.6.1

5.7 Solid waste management

5.7.1 Potential impacts during port construction

Wastes from construction activities are mainly spoils generated by dredging. Disposal of dredged material on land may cause destruction of plants, loss of vegetation, leakage of contaminated materials and salt, odour, an unsightly view and other nuisances to the local community. Disposal in water may cause problems identified in subsection 5.2.3.

Mitigation measures

The adverse effects of disposal of contaminated dredged material or other wastes from construction activities could be offset by including them in land reclamation. Appropriate design, according to the characteristics of the wastes, is a basic requisite for retaining walls, settling ponds, capping of landfills, and land use after completion. Dumping of dredged materials should be treated in accordance with the provisions of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972, and the Amendments Adopted in 1978 and 1980, London Dumping Convention, and relevant national regulations.

5.7.2 Potential impacts during port operations

Cargo operations produce wastes such as the remains of bulk cargo storage, rubbish from unpacking, floating garbage and other wastes from daily activities. Generation of garbage from the offices and township and requires proper disposal.

Mitigation measures

Proper collection and disposal of solid waste from office establishment and town ship on the guidelines of Municipal Solid Waste (M&H) Rules of E (P) Act, with own treatment and disposal facilities or are tie up with existing common environmental facility should be planned.

Required infrastructure for storage, treatment and disposal of Hazardous Wastes on the guidelines of Hazardous Waste (M&H) rules of the E (P) Act should be planned. Adequate facilities for reception, storage, treatment and disposal of oily waste such as bilge water, ballast water etc should be planned with proper monitoring protocol.

Institutional mechanism for monitoring of wastes from ships, penalties/enforcement mechanism by the port and reporting mechanism with responsibilities shall be described.

5.8 Socio- cultural impacts

5.8.1 Potential Impacts due to port location

Building or expanding a port often requires relocation of the local community, sometimes causing conflicts with local people. Damages to the fishing nets and navigational problems to the fishing community should be assessed. Industrialization and modernization may change the cultural traditions of the local community.

Mitigation measures

An appropriate resettlement plan could minimize the disturbance to the local community and ensure smooth transition to industrialization. Where R&R measures are necessitated, adequate measures are to be undertaken by the proponent , with specific time schedules. Land acquisition where required shall be carried out by duly acceptable transparent non-restrictive methods as may be directed by the concerned authorities and duly addressing the concerns of the effected communities/villages.

Survey of archaeological heritage sites should be undertaken well in advance and a preservation plan included in any port development plan.

5.8.2 Potential impacts during port operations

Oil and oily wastes discharged from ships may reach nearby beaches and spoil recreational activities, which cause serious damage to tourism. Ship traffic may disturb pleasure boat cruising and fishery boat operations. The possibility of accidents in the ship traffic becomes a worry to local people. Ship calls create many related jobs including pilotage, tug services, stevedoring, bunker and crew services; however, they may bring considerable changes in the life style of local people.

Movement of vessels in the approach channels and outer harbors are often encountered by the fishing nets resulting in mutual losses. It is quite common for the fishing nets getting entangled with the moving vessels, causing huge financial losses to the coastal fishing community.

Port activities may result in the hiring of local labour and procurement of various commodities from a local market. The local economy will be boosted by port-related activities and be greatly involved in urbanization and industrialization. Labour from outside may be a possible source of conflict with a local community.

Mitigation measures

Appropriate regulations on ship traffic and discharges and contingency plan for ship accidents could mitigate the problem.

Safe navigation routes should be earmarked for the passages of fishing vessels, particularly when fishing harbours are located adjacent to the proposed port.

CHAPTER 6

Environmental Monitoring Programme

6.0 General

This chapter shall include details of environmental monitoring programme to be followed. It shall also include the technical aspects of monitoring the effectiveness of mitigation measures (including measurement methodologies, data analysis, reporting schedules, emergency procedures, detailed budget & procurement schedules).

It should include:

- Summary matrix of environmental monitoring covering location of monitoring stations, frequency of sampling, method of sampling and analysis and data evaluation - during construction and operational stages
- Requirement of monitoring facilities
- Changes with reference to base line data and compliance to accepted norms
- Plantation monitoring programme

It shall also cover different statutory returns/ compliance reports to be submitted such as:

- Submission of half yearly compliance report in respect of the stipulated prior environmental clearance terms and conditions in hard and soft copies to the regulatory authority concerned, on 1st June and 1st December of each calendar year
- Submission of environmental statement for the financial year ending 31st March to the concerned state pollution control board on or before 30th September every year
- Submission of annual returns in Form 4 as per Hazardous Waste (Management, Handling and Transboundary movement) Rules, 2008 on or before 30th June
- Format for maintaining records of hazardous waste in Form 3 as per Hazardous Waste (Management, Handling and Transboundary movement) Rules, 2008
- Format for maintaining records of hazardous waste imported and exported in Form 10 as per Hazardous Waste (Management, Handling and Transboundary movement) Rules, 2008
- Safety data sheet for hazardous chemicals should be maintained as per schedule 9 of MSIHC rules
- Format for maintaining notification of major accident in schedule 6 as per MISHC rules
- Submission of Water Cess returns in Form 1 as per Rule 4 (1) of Water (Prevention & Control of Pollution) Cess Rules 1978 on or before the 5th of every calendar month

CHAPTER 7

Additional Studies

7.0 General

TOR to be adopted for Port and Harbour projects as commonly applicable is prepared and attached to this EIA as **Annexure I**. It may however, be necessary to cater to more issues as may be applicable to individual projects in particular. The proponent or the regulatory authority may either identify such issues during the scoping process or other stakeholders including the public during public consultation. The EIA report and EMP should therefore address such issues also.

7.1 Items identified by the proponent

The proponent may be able to identify issues beyond those included in the common TOR as may be specifically considered by him important from environmental point of view. In such cases the proponent shall include such issues as additional studies under TOR and pursue them in the EIA study after the regulatory authority approves TOR.

7.2 Items identified by the regulatory authority

During the scoping process, the regulatory authority may direct specific issues, beyond those is included in the TOR proposed by the proponent, as may be specifically considered important from environmental point of view. In such cases the proponent shall pursue those issues as additional studies in the EIA study after the regulatory authority approves TOR.

7.3 Items identified by the public and other stakeholders

After completion of the public consultation, the applicant shall address all the material environmental concerns expressed during the process, and make appropriate changes in the draft EIA and EMP. The final EIA report, so prepared, shall be submitted by the applicant to the concerned regulatory authority for appraisal. The applicant may alternatively submit a supplementary report to draft EIA and EMP addressing all the concerns expressed during the public consultation. A statement of the issues raised by the public and the comments of the applicant shall also be prepared in the local language and in English and annexed to the proceedings.

7.4 Risk analyses and Disaster Management Plan

7.4.1 General

The objective of the Risk Analysis Study is to identify potential credible hazards arising out of the facilities that handle, process, store and transport of hazardous substances, to mitigate severity and to aid in preparing effective emergency response plans by delineating a disaster management plan to handle on site and offsite emergencies.

The density of traffic movements, nature of cargo handled, configuration of channels, composition of channel beds etc influence risk in a port and harbor facility. The risk of collision with other navigating ships and vessels as well as risk of grounding increases as ships approach relatively shallow waters and restricted navigation channels of ports. There

is a risk of collision with moored ships, harbour craft and port installations as well in the final approach. There is risk of leakages and explosions associated with handling, transport and storage of hazardous cargoes and chemicals.

7.4.2 Risk analysis

Risk Analysis, therefore, is the process of identifying the probability of occurrence of an accident and its consequence, when ports handle hazardous cargo or involve risky operations. Risk Analysis involves identification of hazards and the associated risks, if any, involved in these operations. Hazards could possibly originate either from within the or from sources outside the port boundary i.e., the operating area. Recognition of all the possible hazards and analysis of the associated risks is an important first step to improve the safety and reliability of port operations. Risk analysis is a tool to determine the consequence of operational failures (e.g. failure of pipeline carrying hazardous liquid, oil spill, fire, etc.,) in the port activities. It enables port authorities to determine the action that needs to be taken to improve safety of operations and deal with the probable effects of an incident in the area. Such an analysis would also provide necessary inputs for preparing the disaster management plan for the port installations

7.4.3 Risk evaluation

Presently the risk acceptability criteria are not established in India. Risk levels (fatality probability) internationally accepted and presented in " Guidelines for Major Hazard Facilities" May 2002, produced by Chemical hazard and Emergency Management Unit, Government of Australia and individual risk acceptance criteria of different countries (Ecological Impact Assessment Series: EIAS/03/2002-2003of CPCB) can be referred for guidance purpose.

7.4.4 Safety measures for handling bulk liquid substances

7.4.4.1 Approval & notification of site

The applicability and compliance mechanism of proposed project site for notification of site as per Rule 7 of MSIHC rules shall be covered depending upon the cargo type and inventory proposed to handle by the port

7.4.4.2 Safety reports

The applicability and compliance mechanism of preparation of safety reports as per Rule 10 of
MSIHC rules shall be covered depending upon the cargo type and inventory handled by the port. Guidelines for assessment, relevance and reliability of analytical methods and framework used for impact prediction and risk assessment is given in **Annexure 14.**

7.5 Personal protection equipment

Personnel Protection Equipment is required to ensure safety of the effected population, members of fire fighting and rescue teams at the time of emergencies involving leakages of toxic and flammable substances. The equipment should be adequate to deal with the hazard, but as far as possible should be comfortable and convenient to wear. The type of equipment needed, depends on a number of factors, such as the degree of protection

required, the nature of substance against which protection is required, the nature of the work to be performed and the circumstances likely to be encountered in the event of an emergency. Improvements are constantly being made in the design of devices for personnel protection and the management should ensure that the best available types are being used. Need assessment on the following category of PPE should be carried out based on the proposed activities.

7.6 Disaster management plan (DMP)

Disaster Management Plan should be prepared to effectively deal with all kinds of port related hazards and also is in a state of preparedness to respond to such events and their adverse effects to the on-site as well as off-site population. DMP should cater to worst disaster scenario with reference to specific cases like fire, explosion, toxic dispersion, oil/chemical spills, including floods, cyclones, terrorist attacks etc. The plan should include early detection of emergencies (like fire explosion, toxic gas release, natural calamities like cyclones, earth quakes etc.) command and co-ordination of response organization along with trained personnel, availability of appropriate resources for handling emergencies, emergency response actions, effective notification and communication facilities and effective training for personnel. Infrastructure requirement for on-site emergency control room and mechanism for integration along with the protocols of operation with the District off-site emergency plan if applicable shall be covered

The classifications of hazardous chemicals are rated on the basis of National Fire Protection Agency (NFPA), International Marine Dangerous Goods (IMDG), Marine Pollution (MARPOL 73/78) and Manufacture, Storage and Import of Hazardous Chemical Rules & the manufacture, Use, Import, Export and storage of Hazardous Micro-organism Genetically engineered organism or Cells Rules under EP Act, including other Government of India rules in force.

Applicability and compliance mechanism for preparation of on-site emergency plan as per Rule 13 and information submission to the concerned authority for preparation of off-site emergency plan as per Rule 14 of MSIHC rules shall be covered.

Applicability and compliance mechanism for furnishing information to the persons liable to be affected by a major accident as per Rule 15 of MSHIC rules shall be covered

7.7 Oil-spill contingency plan

Oil spills endanger public health, imperil drinking water, devastate natural resources, and disrupt the economy. Oil spills occurs due to oil tankers spilling their cargo. When oil is spilled into an aquatic environment, it can harm organisms that live on or around the water surface and those that live under water. Spilled oil can also damage parts of the food chain, including human food resources. The severity of the impact of an oil spill depends on a variety of factors, including characteristics of the oil itself. Natural conditions, such as water temperature and weather, also influence the behavior of oil in aquatic environments.

Oil spill contingency plan should be prepared in case it is proposed to handle oil cargo. The requirement of containment and recovery of oil from a spill shall be assessed. Guidelines given in MARPOL and Shipping Act for oil spill management should be followed

Mechanism for integration of port oil contingency plan with the overall area contingency plan under the co-ordination of Coast Guard should be covered.

7.8 Emergency response procedure

An emergency response should be developed with the following criteria

- Available resources (including local, regional, national and international groups, and the scale of spillage at which they should be contacted). There shall be a protocol for responding to emergencies. A list of local resources for emergency response, address, telephone numbers shall be made available at strategic locations.
- Emergency services available on site and in local area
- Define special equipment and product requirements and provide for their acquisition, deployment and maintenance
- Provide for training of personnel
- Establish the authority and responsibilities of individuals in the event of a spill or other occurrence
- Individual employee actions required (especially if employee safety is threatened)
- Emergency personnel and/or management actions required
- Procedure for informing the public and emergency response agencies about the release
- Establish a policy for response, including the legal framework for damage assessment, compensation and clean-up costs

7.9 Natural resource conservation and optimization

Plan of action for conservation of natural resources such as utilization of fly ash and other suitable waste materials availability for the construction of the project should be examined and detailed in this chapter. Dredged material utilization and disposal plan should be furnished.

7.10 Rehabilitation and resettlement(R&R) action plans

In the event land acquisition from either public or private sources is evolved, justification for the proposed extent of the area to be necessarily given. Availability of required land for acquisition is to be ascertained from local authorities, revenue records etc. Detailed R&R plan with data on the existing socio-economic status of the population in the study area and broad plan for resettlement of the displaced population, site for the resettlement colony, alternative livelihood concerns/employment and rehabilitation of the displaced people, civil and housing amenities being offered, etc and the schedule of the implementation of the project specific R&R Plan. Details of provisions (capital & recurring) for the project specific R&R Plan should be furnished. The proponent has to undertake required R&R measures as a part of the project. The communities likely to be affected should be informed well in advance, in consultation with concerned authorities, such that they may express their concerns during the public consultation process.

The Corporate Social Responsibility / community development need be also prepared. It is to be arrived at after conducting the socio-economic survey of the surrounding population.

CHAPTER 8

Project Benefits

8.0 General

This chapter shall include benefits accruing to the locality, neighbourhood, region and nation as a whole. It should bring out details of benefits by way of:

- Improvements in the physical infrastructure by way addition of project infrastructure, ancillary industries that may come up on account of the project
- Improvements in the social infrastructure like roads, railways, townships, housing, water supply, electrical power, drainage, educational institutions, hospitals, effluent treatment plants improved waste disposal systems, improved environmental conditions, etc.
- Employment potential –skilled; semi-skilled and unskilled labour both during construction and operational phases of the project with specific attention to employment potential of local population as well as necessity for imparting any specialized skills to them to be eligible for such employment in the project on a long term basis i.e., during operational and maintenance stages of the project and
- Other tangible benefits like improved standards of living, health, education etc.
- Revenue by way of royalties

CHAPTER 9

Environmental Cost Benefit Analysis

9.0 General

If recommended by the Expert Appraisal Committee at the scoping stage this chapter shall include the Environmental Cost Benefit Analysis of the project.

CHAPTER 10

Environmental Management Plan (EMP)

10.0 General

In practice, mitigation is emphasized in the EIA process following impact identification and prediction, and recommended measures will be an important part of the EIA report. These measures will be incorporated into the terms and conditions of project approval and implemented during the Environmental management stage of the EIA process. The objectives of environmental management are to:

- Ensure the mitigation measures are implemented
- Establish systems and procedures for this purpose
- Monitor the effectiveness of mitigation measures and
- Take any necessary action when unforeseen impacts occur

10.1 Components of EMP

The EMP should contain the following:

- Summary of potential impacts & recommended mitigation measures. Allocation of resources and responsibilities for plan implementation
- Administrative and technical setup for management of environment
- Institutional arrangements proposed with other organizations/Govt. authorities for effective implementation of environmental measures proposed in the EIA
- Safe guards/mechanism to continue the assumptions/field conditions made in the EIA
- Environmental specifications for contractors should cover the required safeguards during the design and construction stage

Brief information on Good Practices of EMP for Ports & Harbors are given in **Annexure 15.**

10.2 Environmental cell

It is desirable for the proponent to set up a separate environmental cell to oversee implementation of the EMP and evaluate the results of monitoring. Survey and analysis to be carried out periodically

10.3 Self Assessment

Approach towards voluntary compliance (ISO 14001 & ISO 18001) should be explained.

CHAPTER 11

Summary and Conclusions

11.0 General

Summary EIA shall be a summary of the full EIA report condensed to ten A-4 size pages at the maximum. It should necessarily cover in brief the following chapters of the full EIA report.

- Introduction
- Project description
- Description of the environment
- Anticipated environmental impacts & mitigation measures
- Additional studies
- Project benefits
- Important Aspects of the Environmental Management Plan and
- Important Aspects of the Environmental Monitoring Programme
- Disclosure of consultants engaged

CHAPTER 12

Disclosure of Consultants Engaged

12.0 General

This chapter shall include the names of the consultants engaged with their brief resume and nature of consultancy rendered. Competency and experience of the consultant should be furnished.

Tables

Table 4.1 Description of ground water sampling locations

Station No.	Location	Distance & Direction from project area	Zone (Project area/ study area)	Remarks
GW				

Table 4.2 Description of surface water sampling locations

Station No.	Location	Distance & Direction from project area	Zone (Project area/ study area)	Remarks
SW				

Table 4.3 Description of ambient air quality monitoring stations

Station No.	Location	Distance & Direction from project area	Zone (Project area/ study area)	Remarks

Table 4.4 Ambient air quality-monitoring results

National AAQ Standard	SPM				RSPM				SO_2				NOx				CO				Pb in SPM			
	200				100				80				80				4000				1.0			
	500				150				120				120				10000				1.5			
	150				75				30				30				2000				0.75			
Monitoring Station Category *(R, T, S)	Min.	Max.	Mean	98 Percentile	Min.	Max.	Mean	98 Percentile	Min.	Max.	Mean	98 Percentile	Min.	Max.	Mean	98 Percentile	Min.	Max.	Mean	98 Percentile	Min.	Max.	Mean	98 Percentile

Table 4.5 Description of noise monitoring stations

S. No	Locations	Class*	Average Day noise level (dBA)	Average Night noise level (dBA)	Day time (6.00 A.M. to 10.00 P.M)	Day time (10.00 P.M. to 6.00 A.M)	Remarks
					Standard (L_{eq} in dBA)	Standard (L_{eq} in dBA)	

*Industrial area/ Commercial area /Residential area /Silence zone

Annexures

Annexure 1

Terms of Reference for Ports and Harbor

Objective

Terms of Reference (TOR) for preparation of Environmental Impact assessment (EIA) for Ports and Harbour projects as per the EIA notification, 2006 has been devised to improve the quality of the reports and facilitate the decision making transparent and easy. TOR will help the project proponents and consultants to prepare report with relevant project specific data, which are informative, compact and easy to comprehend. TOR for Ports and Harbor projects is expected to cover all environmental related features.

General Information

Development of port facilities can make a significant contribution to the economic development and the growth of maritime transport. At the same time it may also create adverse impacts on the surrounding environment. Port development may create a wide range of impacts on the environment through activities like construction work, dredging, reclamation, land fills, discharges from ships and cargo operations, and other port related activities.. Port development and operation should, therefore, be planned with careful consideration of their environmental impacts. The preparation of EIA report and implementation of EMP is essential for effectively managing these adverse effects.

EIA-EMP report should be based on maximum rated capacity of the project in terms of cargo handling, technology, equipment, manpower, resource use, etc. The report should be based on generic structure given in appendix III to the EIA notification 2006 for the project or its expansion based on proposed peak rated capacity. The report should incorporate the page numbers of various chapters, sections and sub-sections, tables, appendices, drawings and figures etc., with titles shall be clearly indicated under the heading contents.

Ports and Harbors with cargo handling capacity ≥ 5 million TPA of cargo handling capacity (excluding fishing harbors are classified as category A projects and with cargo handling capacity < 5 million TPA and/or ≥ 10000 TPA of fish handling capacity are classified as category B projects, subject to the applicability of General Conditions as stipulated in the EIA Notification, 2006

1.0 Introduction

This chapter should cover the following.

- Purpose of the project, project proponent, brief description of the project- name, nature, size, location of the project, its importance to the country and the region
- Land description- plot/ survey nos/ village, tehsil, district, state & extent of the land
- Profile of the project proponent, name and contact address with e-mail, implementing organization, organizational chart, project consultants etc
- Whether the project attracts the provisions of General Conditions of EIA Notification 2006. If so applicability should be discussed
- The proponent should confirm that the project meets the central/state/local environmental regulations and standards applicable for the project

- Any litigation pending against the proposed project and/ or any direction/ order passed by any court of law against the project, if so, details thereof
- In case of expansion/ modernization of the project, the environmental compliance status for the existing project should be explained

2.0 Project description

This chapter should cover the broader details of the basic activities, location, layout and implementation schedule of the project.

- Type of the project- new, expansion, modernization, container cargo handling facility, fishing, minor / major port etc
- Relevance of the project in the light of the existing development plans of the region
- Project coverage, master plan, phasing and scope
- Description of a project site, geology, topography, transport and connectivity, demographic aspects, socio, cultural and economic aspects, villages, settlements
- Capacity of the port, types of cargo proposed for handling, cargo handling equipments, ancillary operations, housing, truck parking details etc
- Technologies involved for design, construction, equipment and operation
- Use of existing public infrastructure – road, railway and inland waterway net works, water supply, electrical power etc
- Estimated water budget for the proposed project- during construction/ operation stages
- Estimated cost of development of the project, environmental cost, funding agencies i.e., whether governmental or on the basis of BOT etc
- Details of land acquisition, rehabilitation of communities / villages present status of such activities
- Resources, manpower and time frame etc –required for project implementation

Essential maps to be provided with application

- A map specifying locations of the state, district and project location
- A map of project area and 10 km area from boundary of the proposed/existing project area, delineating protected areas notified under the wild life (Protection) Act, 1972 / critically polluted areas as notified by the CPCB from time to time / notified eco sensitive areas / inter state boundaries and international boundaries
- A map covering aerial distance of 15 km on the landward side from the proposed project boundary delineating environmental sensitive areas as specified in column no 9(iii), Form I of EIA notification dated 14th Sep 06.
- Land use map of the study area to 1: 25,000 scale based on recent satellite imagery of the project area and 10 kms from the proposed project boundary delineating the cropping pattern, wastelands, forest area and built-up areas, water bodies, human habitation and other surface features such as railway tracks, ports, airports, roads, NH, major industries etc.
- Site lay out plan of the proposed development shall be submitted to a scale of 1:5000, clearly marking the layout of breakwaters, navigation channels, harbour basin, berths, dry docks, work shops, container freight station, cargo handling systems, conveyors, covered and uncovered storage yards, ware houses, roads, railway tracks, effluent disposal point, administrative and operational buildings, utilities, town

ships, greenbelt, dredged material disposal, etc. Boundaries of the proposed port shall be shown therein with latitude and longitude.

- Area drainage contour map of the project area and 2-5 km from the proposed project area shall be clearly indicated. In case of any proposed diversion of nallah/canal/river, same shall also be shown in the map
- Hydrographic charts of the offshore area giving general morphology of the coastal stretch to a scale of 1:50,000 shall be submitted covering water depth up to 10m beyond the maximum proposed dredging depths of the project and covering a distance of 5 km along the coast from the project limits on both sides
- The CRZ maps indicating the High Tide Line (HTL), Low Tide Line (LTL), demarcated by one of the seven authorized agencies and the project lay out superimposed on the map should be submitted on 1:5000 scale map. This map shall be recommended by the state/Union Territory CZM authority

3.0 Analysis of alternatives (Technology & Sites)

In case, the scoping exercise results in need for alternatives this chapter shall include:

- Description of various alternatives like locations or layouts or technologies studied
- Description of each alternative
- Summary of adverse impacts of each alternative
- Selection of alternative

4.0 Description of the environment

4.0 Study area

As a primary requirement of EIA process, the proponent should collect primary baseline data in the project area as well as in the area falling 5 km from the proposed project boundary and secondary data should be collected within 15 kms aerial distance from the project boundary, as specifically mentioned at column 9(iii) of Form I of EIA Notification 2006. The study areas mentioned in this document shall be considered for guidance purpose but the exact study area for different environmental attributes (water, air, noise, soil, etc) is to be submitted considering the proposed activities and location, along with proper reasoning, for review and approval by the expert appraisal committee.

4.1 Land environment

4.1.1 Land

Availability of land for earmarking for the port without causing a due hardship to local habitat and their socio cultural and economic aspects is very important. Data on the land availability is to be ascertained from local authorities, revenue records etc. Justification for the proposed quantum of the area is to be given.

4.1.2 Topography

Baseline data to be given on description of existing situation of the land at the proposed project area including description of terrain hill slopes coastal and inland topography, coastal features (lowland, beaches, littoral areas, shoal areas), terrain features, slope and

elevation. Study of land use pattern, habitation, cropping pattern, forest cover, environmentally sensitive places etc, by employing remote sensing techniques (if available) and also through secondary data sources.

4.1.3 Geology

Baseline data to be provided on rock types, regional tectonic setting (reported fractures/faulting, folding, warping), and history of any volcanic activity, seismicity and associated hazards, mainly in the coastal area. Information on quarry yields, strengths of rock, distance of quarries from habitat, restrictions for quarrying, environmental controls, statutory permissions etc., should be provided.

4.1.4 Soil

Soil data including type, classification, characteristics, soil properties etc., are important from engineering considerations for design of structures, loading capacities of cargo stockpiles, green belt development etc. Changes in parameters of soil also may affect plantation and vegetative growth, which in turn may endanger the health of local habitat. Baseline data of the soil, results of investigations carried out to be provided for the project area.

4.1.5 Meteorological data

Meteorological data covering the following should be incorporated in the EIA report. The data for at least a 10 year period should be presented from the nearest meteorological station, except for the history of cyclones and tidal surges for which 100 year data is required.

- Wind speed and direction
- Rainfall
- Relative humidity
- Temperature
- Barometric pressures
- History of cyclones

4.2 Water environment

4.2.1 Ground water

Baseline data of ground water including data of pH, dissolved solids, suspended solids, BOD, DO, coli-form bacteria, oil, heavy metals (depending upon the type of cargo) is to be collected at least for one season. Usage purpose of the ground water, if any, is to be indicated.

4.2.2 Surface water

Baseline data on location of surface water like lagoons, lakes, tidal inlets, streams, rivers, their details, present quality and their utility, if any, is to be provided. Details of water bodies in the project area shall be described specifically. Water quality is to be monitored for one season.

4.3 Marine environment

4.3.1 Coastal hydrology/geomorphology

Coastal hydrology requires collection of oceanographic data during the study period, covering the following parameters:

- Tides
- Waves (wind waves and swells)
- Storm surges
- Currents
- Salinity
- Sea water temperature
- Suspended load, and
- Seabed bathymetry

Baseline oceanographic data should extend at least to depths more than 10m of proposed deepening of the harbor approach and basin as per master plan proposed. A study on likely changes in the sediment transport and littoral drift due to the construction of port particularly the breakwater should to be taken up.

Details of mangroves, marshes and other coastal vegetation, sand dunes, coastal stability, seismic characteristics, history of any endangered species, coastal erosion, and shoreline changes should be furnished.

4.3.2 Bed sediment contamination

Baseline data on bottom sediments and the associated bottom biota and other physical habitat, at the proposed project area and the neighborhood areas has to be collected and analyzed.

4.3.3 Sea/harbor water quality

Baseline data shall be collected on chemical parameters in the open sea and in the proposed port area for understanding hydro chemical characteristics in the marine environment (such as sea water temp, BOD, DO, pH, TSS, salinity, heavy metals depending upon the cargo, etc.)

4.4 Biological environment

4.4.1 Marine/coastal ecology

Baseline data of aquatic flora and fauna at the project area, including the coastal area is to be ascertained by proper surveys including mangroves and marshes and other coastal vegetation, sand dunes. Data on coastal stability, seismic characteristics, history of any endangered species, coastal erosion, shoreline changes, if any, is also necessary.

4.4.2 Flora and fauna in the neighborhood

Details on secondary data on the existing flora and fauna in the study area as well as 15km from its boundary, carried out by an university/institution under the relevant discipline

(such as BSI, ZSI, WII, etc) shall be included in the list of flora and fauna along with classification as per Schedule given in the Wild Life Protection Act, 1972 (for fauna) and in the Red Book Data (flora) and a statement clearly specifying whether the study area forms a part of an ecologically sensitive area or migratory corridor of any endangered fauna.

4.5 Air environment

Base line data of ambient air parameters namely RSPM, nitrogen dioxide, sulphur dioxide, carbon monoxide, heavy metals and other harmful air pollutants depending upon the type of the cargo should be monitored.

This data should be collected in an area extending at least 5 km from the project boundary by observation at a number of locations. Specific importance should be attached to areas in close proximity of project say up to 1 km. One season data should be monitored other than monsoon as per the CPCB Norms. One station should be in the up-wind/ non-impact/ non-polluting area as a control station.

4.6 Noise

Baseline data on noise pollution at the project area and the neighbourhood up to 1 km or nearest residential areas is to be monitored as per the CPCB norms.

4.7 Existing solid waste disposal facilities

Details of authorized municipal solid waste facilities, biomedical treatment facilities and hazardous waste disposal facilities in the area should be inventorized, in case if it is proposed to utilize the same

4.8 Socio-economic and occupational health environments

Baseline data at the project area shall include the demography, particularly on human settlements, health status of the communities, existing infrastructure facilities in the proposed area and area of impact due to the proposed activity. Present employment and livelihood of these populations, awareness of the population about the proposed activity shall also be included.

4.9 Public utilities

Base line data of existing public utility infrastructure shall be ascertained and reported to assess the impacts of the project on these public utilities in order to incorporate desired methods in the EMP and monitor the same during the construction as well as operational phases of the port.

5.0 Anticipated environmental impacts and mitigation measures

This Chapter should describe the likely impact of the project on each of the environmental parameters, methods adopted for assessing the impact such as model studies, empirical methods, reference to existing similar situations, reference to previous studies, details of mitigation methods proposed to reduce adverse effects of the project, best environmental

practices and conservation of natural resources. The identification of specific impacts followed with mitigation measures should be done for different stages i.e., location of the port, construction including dredging, ship traffic including discharges from vessels and cargo operations.

5.1 Land environment

5.1.1 Land

Anticipated Impacts: Impact of project construction/operation on the land requirement / land use pattern should be assessed. Affect of future growth of the port facility and/or of the ancillaries should be carefully assessed by preparing master plans for the port and the ancillaries. Impact on the public utilities arising out of the utilities for the project activities and impact on the natural drainage system are equally important. Prediction of impacts should include impacts on the existing infrastructures like road network, housing, ground water/surface water etc., and loss of productive soil and impact on natural drainage pattern.

Mitigation Measures: Mitigation measures to reduce adverse effects like adopting soil improvement techniques and adopting suitable design methods to reduce land requirement. Where land acquisition and consequential R&R methods are called for, it should be implemented duly adhering to the norms and complying with pertinent statutory requirements for such land acquisition. Strengthening of road and rail network infrastructure to handle the increase in traffic and truck parking arrangements, integration of Port development with the local land use plan should be planned.

5.1.2 Topography, geology and soil

Anticipated Impacts: Impact of port construction/operation on the topography due to activities like depletion of hills due to large scale quarrying, filling of low lying area with dredged spoil and borrowed material, damage to existing vegetation/green belt and plantation, changes in land use patterns, disturbance to existing protected areas like mangroves, forests and environmentally sensitive areas/zones should be assessed

Flooding due to filling up of low-lying areas should be assessed. Impacts on the surrounding land use pattern, on infrastructure like housing, ground water, etc should be assessed.

Impact of the project construction on the geology and vice-versa should to be studied in detailed. Impact of project construction/operation on the soil parameters, probability of settlement, subsidence, slides, surface drainage, leachets etc., are to be estimated

Mitigation Measures: Mitigation measures to reduce adverse effects include study of alternative sites, improving green belt, obtaining construction materials from other sources, usage of alternative construction materials like fly ash, where possible; storm water management etc. Adopting soil improvement techniques and adopting suitable design methods, ground covering etc.

5.2 Water environment

5.2.1 Ground water

Anticipated impacts: Discharge of trade effluent and sewage and its impact. Impact of project construction/operation on the ground water on account of leachets, run off from material and cargo storages and toxic or harmful substances, percolation, sea water intrusion etc.,

Mitigation measures: Mitigation measures to reduce adverse effects like impervious paving the cargo areas, impervious roads, lined drains, routing surface drainage to settlement tanks/pits etc. Treatment of effluent, recycle/ reuse and disposal should be planned. Groundwater study on leaches should be carried out periodically and should be correlated with baseline data. Remedial measures should be taken in case of any deviation. Based on the total water budget of the project, the use of ground water should to be reviewed and alternatives to be presented.

5.2.2 Surface water

Anticipated impacts: Impact of port operations on surface water sources, contamination due to cargo operations, impact on utility of surface water resources by the neighboring colonies, impact on surface water flow (ex. flooding) due to anticipated obstructions, etc

Mitigation measures: Protection measures to surface water resources to prevent reduction in their quality due to construction and operational activities and choice of alternative resources. Proposals to treat effluents confirming to standards notified under EP Act 1996 should be submitted.

5.3 Marine environment

5.3.1 Coastal hydrology

Anticipated impacts: Impact of the project construction/operation on the coastal hydrology on account of port construction should be assessed by suitable model studies.

Mitigation measures: Careful site selection and port design should be planned to minimize impacts due to changes in current patterns and other coastal hydrology. Model experiments or computer simulations of these changes are useful in developing an appropriate design. Shore protection works like construction of sea walls, groynes, sand bye passing or beach nourishment should be studied.

5.3.2 Bed sediment contamination

Anticipated impacts: Impact of the project construction/operation on the bed sediment contamination on account of port construction/operations is to be assessed by suitable empirical/model studies.

Mitigation measures: A survey of contamination of bottom sediments should be undertaken before dredging

5.3.3 Sea/harbor water quality

Anticipated impacts: Impact of the project construction/operation on the sea/harbour water quality on account of port construction is to be assessed by suitable empirical/model studies.

Mitigation measures: Proper collection and disposal of liquid and solid waste from shore establishment and ships should be planned.

5.4 Biological environment

Anticipated impacts: Impacts of the project construction/operation on the marine/coastal ecology on account of port construction should be assessed by suitable empirical/model studies. Impacts due to floodlights on the nesting of sea turtles and other species should be studied

Mitigation measures: Mitigation measures to reduce adverse effects should be provided.

5.5 Air environment

Anticipated Impacts: Impact of project construction/operation on the ambient air quality on account of emissions of dust during construction and cargo handling as well as emission of gases from equipment deployed for construction and cargo handling should be assessed. Prediction due to emissions during cargo handling/ emissions from the ships in the port area/ emissions due to increased traffic, emission inventory for critical pollutants with and without mitigation measures, prediction of the impact due to the existing activity on the proposed project, prediction of impacts due to sanctioned/on going projects in the surrounding area on the proposed project and the ambient environment shall be carried out.

Mitigation measures: Mitigation measures proposed during the construction stage should include dust suppression measures by suitable techniques. Mitigation measures proposed during the operation stage should include alternative solutions such as closed conveyor system, closed silos, closed vehicles to transport dusty cargo etc, mitigation measures to lower the emissions from the ships and green belt development.

5.6 Noise pollution

Anticipated impacts: Impact of project construction/operation on the noise and vibration on account of construction equipment, cargo handling equipment and road traffic.

Mitigation measures: Mitigation measures to reduce adverse effects should be provided.

5.7 Solid waste management

Anticipated impacts: Impact due to non-hazardous and hazardous solid waste generated during the construction and operational stages should be assessed.

Mitigation measures: Mitigation measures to comply the norms should be planned. Options for minimization of solid waste and environmentally compactable disposal/ recycling of

waste to conserve natural resources should be planned. Management and disposal of temporary structures, made during construction phase should be planned.

5.8 Socio-economic and occupational health environment

Anticipated impacts: Predicted impact on the communities of the proposed activity. Details of public and private land in the proposed and immediate surroundings socio-economic status of the affected owners of the private land shall be properly complied. Present status of health, housing, public utilities, commercial structures and transportation should be collected. Impact of the project on socio cultural aspects should be assessed. Socio-economic impacts due to displacement of fishing settlements and population influx due to increased activities should be assessed.

Mitigation measures: Mitigation measures to reduce adverse effects including satisfactory R&R methods should be planned.

6.0 Environmental Monitoring Program

This Chapter shall include details of environmental monitoring programme. It should include the technical aspects of monitoring the effectiveness of mitigation measures (including measurement methodologies, data analysis, reporting schedules, emergency procedures, detailed budget & procurement schedules)

- Summary matrix of environmental monitoring, during construction and operation stage
- Requirement of monitoring facilities
- Frequency, location, parameters of monitoring
- Compilation and analysis of data, comparison with base line data and compliance to accepted norms and reporting system
- Plantation monitoring program

7.0 Additional studies

Specific condition	Study required
Studies identified by the proponent and the Regulating Authority	Studies directed by the Expert Appraisal Committee while deciding the TOR for the project
Studies identified by the public and other stake holders	Public hearing with the issues raised by the public and the response of the project proponent in tabular form shall be discussed
Risk Analysis and Disaster Management Plan (DMP)	• Risk analysis • Safety measures for handling bulk liquid substances • Personal protection equipment • Disaster management Plan (DMP) • Oil spill contingency plan • Emergency response procedures
Natural resource conservation and optimization	Plan of action for conservation of natural resources such as utilization of fly ash and other suitable waste materials availability for the construction of the project. Dredged material utilization and disposal

	plan should be furnished. Water Conservation measures should be addressed. Energy efficiency measures in the activity arte to be drawn up.
R & R action plans	Detailed R&R plan with data on the existing socio-economic status of the population in the study area and broad plan for resettlement of the displaced population, site for the resettlement colony, alternative livelihood concerns/employment and rehabilitation of the displaced people, civil and housing amenities being offered, etc and the schedule of the implementation of the project specific R&R Plan. Details of provisions (capital & recurring) for the project specific R&R Plan
Specific studies requirement depending on the site and activity proposed shall be discussed	

8.0 Project benefits

This chapter shall include benefits accruing to the locality, neighbourhood, region and nation as a whole. It should bring out details of benefits by way of:

- Improvements in the physical infrastructure by way addition of project infrastructure, ancillary industries that may come up on account of the project
- Improvements in the social infrastructure like roads, railways, townships, housing, water supply, electrical power, drainage, educational institutions, hospitals, effluent treatment plants improved waste disposal systems, improved environmental conditions, etc.
- Employment potential –skilled; semi-skilled and unskilled labour both during construction and operational phases of the project with specific attention to employment potential of local population as well as necessity for imparting any specialized skills to them to be eligible for such employment in the project on a long term basis i.e., during operational and maintenance stages of the project and
- Other tangible benefits like improved standards of living, health, education etc.

9.0 Environmental cost benefit analysis

If recommended by the Expert Appraisal Committee at the scoping stage, this chapter shall include the environmental cost benefit analysis of the project.

10.0 Environmental Management Plan (EMP)

- Summary of potential impacts & recommended mitigation measures.
- Allocation of resources and responsibilities for plan implementation
- Administrative and technical setup for management of environment
- Institutional arrangements proposed with other organizations/Govt. authorities for effective implementation of environmental measures proposed in the EIA
- Safe guards/mechanism to continue the assumptions/field conditions made in the EIA Environmental specifications for contractors should cover the required safeguards during the design and construction stage

11.0 Summary & Conclusion (Summary EIA)

It shall be a summary of the full EIA report condensed to ten A-4 size pages at the maximum. It should necessarily cover in brief the following chapters of the full EIA report – Introduction/ Project description/ Description of the environment//Anticipated environmental impacts & mitigation measures/Additional studies/Environmental monitoring programme/Project benefits/Environmental management plan /Disclosure of consultants engaged

12.0 Disclosure of consultants engaged

This chapter shall include the names of the consultants engaged with their brief resume and nature of consultancy rendered.

Enclosures

Feasibility report/Form I/Photos of proposed project site, impact areas

Annexure 2

List of critically polluted area as identified by CPCB

The Central Pollution Control Board in consultation with State Pollution Control Boards has identified 24 areas in the country as critically polluted areas:

1. Tarapur (Maharashtra)
2. Bhadravati (Karnataka)
3. Chembur (Maharashtra),
4. Digboi (Assam),
5. Govindgarh (Punjab),
6. Greater Cochin (Kerala),
7. Kala-Amb (Himachal Pradesh),
8. Parwanoo (Himachal Pradesh),
9. Korba (Madhya Pradesh),
10. Manali (Tamil Nadu),
11. North Arcot (Tamil Nadu),
12. Pali (Rajasthan),
13. Talcher (Orissa),
14. Vapi (Gujarat),
15. Visakhapatnam (Andhra Pradesh),
16. Dhanbad (Bihar),
17. Durgapur (West Bengal),
18. Howrah (West Bengal),
19. Jodhpur (Rajasthan),
20. Nagda- Ratlam (Madhya Pradesh),
21. Najafgarh Drain (Delhi),
22. Patancheru -Bollaram (Andhra Pradesh),
23. Singrauli (Uttar Pradesh),
24. Ankleshwar (Gujarat),

(Source: www.cpcb.nic.in)

Annexure 3

Land use / land cover classification system

S. No	Level –I	Level-II
1.	Built up land	1.1 Built up land
		1.2 Road
		1.3 Railway
2.	Agricultural Land	2.1 Cropland
		2.2 Fallow (Residual)
3.	Forest	3.1 Evergreen/Semi-evergreen forests
		3.2 Deciduous forest
		3.3 Degraded/Scrub Land
		3.4 Forest blank
		3.5 Forest plantation
		3.6 Mangrove
		3.7 Cropland in Forest
4.	Waste land	4.1 Salt effected land
		4.2 Water logged land
		4.3 Marshy/Swampy land
		4.4 Gullied/Ravinous land
		4.5 Land with or without scrub
		4.6 Barren rocky/Stony waste/ sheetrock area
5.	Water Bodies	5.1 River/Stream
		5.2 Lake/Reservoir
		5.3 Tank/Canal
6.	Others	6.1 Grass land/Grazing land
		6.2 Shifting Cultivation
		6.3 Snow Cover/Glacial area

(Source: Draft National EIA guidance manual by NEERI)

Annexure 4

Criteria for raw water used for organized community water supplies (surface and ground water) primary parameters

	Parameters	Range/Limiting Value		Note
		Use with only disinfection	Use after conventional treatment	
1.	pH	6.5 to 8.5	6.0 to 9.0	To ensure prevention of corrosion in treatment plant and distribution system and interference in coagulation and chlorinating.
2.	Colour Pt. scale Hz Units	< 10	< 50	Color may not get totally removed during treatment
3.	Suspended Solids mg/l	< 10	< 50	High SS may increase the cost of treatment.
4.	Odour, dilution factor	< 3	< 10	May not be tackled during treatment.
5.	DO, (%saturation)	90-100	80-120	May imply higher chlorine demand.
6.	BOD, mg/l	< 3	< 5	Same as above.
7.	TKN, mg/l	< 1	< 3	Same as above.
8.	Ammonia, mg/l	< 0.05	< 1	Same as above.
9.	Faecal coliform MPN/100 ml	< 200	< 2000	Not more than 20% samples show greater than limit.
10.	EC, µm/hos/cm	< 2000	< 2000	High conductivity implies dissolved high solids making water unpalatable.
11.	Chloride, mg/l	< 300	< 300	May cause physiological impact and unpalatable taste.
12.	Sulphates, mg/l	< 250	<250	May cause digestive problems
13.	Phosphates, mg/l	< 0.7	< 1.0	May interfere with coagulation
14.	Nitrate, mg/l	< 50	< 50	May cause methamoplobinemea
15.	Fluoride, mg/l	< 1.0	< 1.5	Higher value shall cause fluorosis and lower value shall carries.
16.	Surfactants, mg/l	< 0.2	< 0.2	May impair treatability and cause foaming.

Additional Parameters for Periodic Monitoring (Seasonal – Only to be done when there are known natural or anthropogenic sources in the upstream catchment region likely or apprehended to contribute or other well founded apprehensions)

Parameters	Desirable	Acceptable	Note
Dissolved Iron mg/l	< 0.3	< 0.5	Affect taste and cause stains
Copper, mg/l	--	< 1.0	May cause live damage
Zinc, mg/l	--	< 5.0	Cause bitter stringent taste
Arsenic, mg/l	< 0.01	< 0.05	Cause hyperkeratosis & skin cancer
Cadmium, mg/l	< 0.001	< 0.005	Toxic

Total Chromium, mg/l	< 0.05	< 0.05	Toxic
Lead, mg/l	< 0.05	< 0.05	Physiological abnormality
Selenium, mg/l	< 0.01	< 0.01	Toxic symptoms similar to arsenic
Mercury, mg/l	< 0.005	<0.0005	Carcinogenic and poisonous
Phenols, mg/l	< 0.001	< 0.001	Toxic and cause taste and odour problem
Cyanides, mg/l	< 0.05	< 0.05	Physiological abnormality
PAH, mg/l	< 0.0002	< 0.0002	Carcinogenic
Total Pesticides, mg/l	< 0.001	< 0.0025	Trend to bioaccumulates & carcinogenic

(Source: Ecological Impact Assessment Series: EIAS/03/2002-03 Published by CPCB)

Use based classification of surface waters in India

Designated-Best-Use	Class of water	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	1. Total Coliforms OrganismMPN/100ml shall be 50 or less 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 6mg/l or more 4. Biochemical Oxygen Demand 5 days 20oC 2mg/l or less
Outdoor bathing (Organized)	B	1. Total Coliforms Organism MPN/100ml shall be 500 or less 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 5mg/l or more 4. Biochemical Oxygen Demand 5 days 20oC 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	1. Total Coliforms Organism MPN/100ml shall be 5000 or less 2. pH between 6 to 9 3. Dissolved Oxygen 4mg/l or more 4. Biochemical Oxygen Demand 5 days 20oC 3mg/l or less
Propagation of Wild life and Fisheries	D	1. pH between 6.5 to 8.5 2. Dissolved Oxygen 4mg/l or more 3. Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	1. pH between 6.0 to 8.5 2. Electrical Conductivity at 25oC micro mhos/cm Max.2250 3. Sodium absorption Ratio Max. 26 4. Boron Max. 2mg/l

(Source: Guidelines for Water Quality Management –CPCB 2008)

Annexure 5

Water quality standards for Coastal waters

Among the various types of uses there is one use that demands highest level of water quality/purity and that termed is a "designated best use" in that stretch of the coastal segment. Based on this, primary water quality criteria have been specified for following five designated best uses

Class	Designated best use
SW-1	Salt pans, Shell fishing, Mariculture and Ecologically sensitive zones
SW-II	Bathing, Contact water sports and commercial fishing
SW-III	Industrial cooling, Recreation (non-contact) and Aesthetics
SW-IV	Harbour
SW-V	Navigation and controlled waste disposal

Primary water quality criteria for class SW-1 waters
(For Saltpans, Shell fishing, Mariculture and Ecologically sensitive zones)

SNo	Parameter	Standards	Rationale/Remarks
1	pH range	6.5-8.5	General broad range, conductive for propagation of aquatic lives is given. Value largely dependent upon soil-water interaction
2	Dissolved oxygen	5.0 mg/l or 60 % saturation value whichever is higher	Not less than 3.5 mg/l at any time of the year for protection of aquatic lives
3	Colour and odour	No noticeable colour or offensive odour	Specially caused by chemical compound like creosols, phenols, naphtha pyridine benzene, toluene etc. causing visible coloration of salt crystal and fainting fish flesh
4	Floating matters	Noting obnoxious or detrimental for use purpose	Surfactants should not exceed an upper limit of 1.0 mg/l and the concentratic not to cause any visible foam
5	Suspended solids	None from sewage or industrial waste origin	Settleable inert matters not in such concentration that would impair any usages specially assigned to this class
6	Oil and grease (including petroleum products)	0.1 mg/l	Concentration should not exceed 0.1 mg/l as because it has effect on fish eggs and larvae
7	Heavy metals: Mercury (as Hg) Lead (as Pb) Cadmium (as Cd)	 0.001 mg/l 0.001 mg/l 0.01 mg/l	Values depend on: 1. Conc. in salt, fish and shell fish 2. Average per capita consumption per day 3. Min. ingestion rate that includes symptoms of resulting diseases

Note: SW-1 is desirable to be safe and relatively free from hazardous chemicals like pesticides, heavy metals and radionuclide concentrations. Their combined (synergistic or antagonistic) effects on health and aquatic lives are not yet clearly known. These chemicals undergo bioaccumulation, magnification and transfer to human and other animals through food chain. In areas where fisheries, salt pans are the governing considerations, and presence of such chemicals apprehended/reported, bioassay test should be performed following appropriate methods for the purpose of setting case specific limits.			
Primary water quality criteria for class SW-II waters (For Bathing, Contact water sports and commercial fishing)			
SNo	**Parameter**	**Standards**	**Rationale/Remarks**
1	pH range	6.5-8.5	Range does not cause skin or eye irritation and is also conductive for propagation of aquatic lives
2	Dissolved oxygen	4.0mg/l or 50% saturation value whichever is higher	Not less than 3.5mg/l at any time for protection of aquatic lives
3	Colour and odour	No noticeable colour or offensive odour	Specially caused by chemical compound like creosols, phenols, naphtha, benzene, pyridine, toluene etc. causing visible coloration of water and tainting of and odour in fish flesh
4	Floating matters	Noting obnoxious or detrimental for use purposes	None in such concentration that would impair usages specially assigned to this class
5	Turbidity	30 NTU (Nephelo Turbidity Unit)	Measured at 9.0 depth
6	Fecal coliform	100/100ml (MPN)	The average value not exceeding 200/100 ml in 20 percent of samples in the year and in 3 consecutive samples in monsoon months
7	Biochemical oxygen demand (BOD) (3 days at 27^0C)	3 mg/l	Restricted for bathing (aesthetic quality of water). Also prescribed by 2296-1974
Primary water quality criteria for class SW-III waters (For Industrial cooling, Recreation (non-contact) and Aesthetics)			
SNo	**Parameter**	**Standards**	**Rationale/Remarks**
1	pH range	6.5-8.5	The range is conductive for propagation of aquatic species and restoring natural system
2	Dissolved oxygen	3.0mg/l or 40% saturation value whichever is higher	To protect aquatic lives
3	Colour and odour	No noticeable colour or offensive odour	None in such concentration that would impair usages specially assigned to this class
4	Floating matters	No visible obnoxious floating debris, oil slick, scum	As in (3) above
5	Fecal coliform	500/100 ml (MPN)	Not exceeding 1000/100ml in 20% of

			samples in the year and in 3 consecutive samples in monsoon months
6	Turbidity	30 NTU	Reasonably clear water for recreation aesthetic appreciation and industrial cooling purposes
7	Dissolved Iron (as Fe)	0.5mg/l or less	It is desirable to have the collective concentration dissolved Fe and Mn less or equal to 0.5mg/l to avoid scaling effect
*8	Dissolved Manganese (as Mn)	0.5mg/l or less	
** Standards included exclusively for industrial cooling purpose, other parameters same*			
Primary water quality criteria for class SW-IV waters (For Harbour waters)			
SNo	**Parameter**	**Standards**	**Rationale/Remarks**
1	pH range	6.0-9.0	To minimize corrosive and scaling effect
2	Dissolved oxygen	3.0mg/l or 40% saturation value whichever is higher	Considering the biodegradation of oil and inhibition to oxygen production through photosynthesis
3	Colour and odour	No visible colour or offensive odour	None from reactive chemicals which corrode paints/metallic surfaces
4	Floating materials, oil, grease and scum (including petroleum products)	10mg/l	Floating matter should be free from excessive living organisms which may clog or coat operative parts of marine vessels/equipment
5	Fecal coliform	500/100 ml (MPN)	Not exceeding 1000/100ml in 20% of samples in the year and in 3 consecutive samples in monsoon months
6	Biochemical oxygen demand (BOD) (3 days at 27^0C)	5mg/l	To maintain water reactively free from pollution caused by sewage and other decomposable wastes
Primary water quality criteria for class SW-V waters (For Navigation and controlled waste disposal)			
SNo	**Parameter**	**Standards**	**Rationale/Remarks**
1	pH range	6.0-9.0	As specified by New England Interstate Water Pollution Control Commission
2	Dissolved oxygen	3.0mg/l or 40% saturation value whichever is higher	To protect aquatic lives
3	Colour and odour	None in such concentrations that would impair any usages specifically assigned to this class	As in (i) above
4	Sludge deposits,	None except for such	As in (i) above

	solid refuse floating solids, oil grease and scum	small amount that may result from discharge of appropriately treated sewage and or industrial waste effluents	
5	Fecal coliform	500/100 ml (MPN)	Not exceeding 1000/100ml in 20% of samples in the year and in 3 consecutive samples in monsoon months
Source: S.O.32 (E) dated 16.2.1987 under the provision of E (P) Act			

Annexure 6

Guidance note for collection of oceanographic data

General Information

Oceanographic baseline data has to be collected in the area proposed for the construction of the port, which includes the main entrance channel, the breakwaters and other proposed infrastructure facilities. The EIA report should give analysis of this baseline data. The parameters to be collected include:

- **Physical** (waves, currents, tides, alongshore currents, beach profiles, temperature, salinity, density, etc),
- **Chemical** (pH, Dissolved Oxygen, Biological Oxygen Demand, Nutrients analysis, PHCs, Trace Metals in sediments, Total Suspended Matter, etc),
- **Biological** (Micro-biological, Phytoplankton, Zooplankton, Macro, Micro and Meio-Benthic communities, Bacterial load, Bio-fouling studies, Fishery Potential and the maximum sustainable load, etc),
- **Seabed** bathymetry, Sub-surface layer information, Sea floor scanned images, Geo-technical properties of the sediments up to the depth of the proposed channels from bore hole data
- Surface (grab) and core samples in the proposed channel should be collected to study the geo-technical properties of the subsurface sediments at suitable station interval
- **Historical** data on wind, rainfall, visibility, cyclones, depressions, storm surges, etc has to be compiled from sources like IMD
- It may be ideal to establish an automatic weather station in the vicinity of the proposed study area to collect present weather data
- In addition site specific data on endangered species like turtles, coral reefs, etc has to be collected

Dimension of the study area

In general a rectangular grid with the longer length parallel to the coast has to be selected for collection of oceanographic data. The exact dimensions of this grid depends the water depth of the proposed Entrance Channel, the alignment of the breakwaters, etc. As an example, if the proposed water depth is 20m and if the distance of the 20m contours is approximately 5 kms from the coast, then it may be ideal if a 6 x 7 kms grid is selected with the longer length parallel to the coast. Sometimes it may also be necessary to collect oceanographic data in adjacent areas like the tidal creeks, lagoons that are connected to the sea.

Equipments and Calibration

Collection of Oceanographic data necessitates utilization of a variety of equipments from simple ones like a Niskin water sampler and biological net to Current Meters, Tide Gauges, Automatic Weather Station, echo sounder, sub-bottom profiler, side scan sonar and sometimes even a magnetometer, where the structure of the shallow basement is to be ascertained. All equipments need to be calibrated before the start of the survey, following standard method given for each equipment

Position fixing at sea

All oceanographic parameters should be collected using a high-resolution navigational system, preferably a Differential Global Position System (DGPS) with an accuracy of few centimeters.

Mode of Collection

In general, underway data like bathymetry, seismic and side scan sonar need to be collected continuously at a regular profile interval. Data need to be collected along profiles both parallel and perpendicular to the coast. The line spacing has to be selected to obtain as much information as possible and at the same time avoiding too much detail.

Other oceanographic data like physical, chemical and biological has to be collected at selected stations covering the demarcated rectangular grid. The station interval has to be selected in such a way that the entire area is covered. Data like currents has to be collected along a vertical profile at each station, say at surface, 10 and 20m, by deploying a Current Meter Array.

While geological/geophysical data like bathymetry, seismic and side scan sonar can be collected only at one time, physical, chemical and biological data has to be collected in two to three seasons so as to understand their impact in different seasons like pre- and post monsoon.

Corrections to the observed data

All basic data has to be corrected for removing any erroneous values, regional gradient, etc., so as to bring out the anomalies in the ocean parameters in the study area. For example, the bathymetry data has to be reduced with reference to the Chart Datum.

Additional data collection

The same procedures have to be followed for data collection during post-monitoring stage also and in case of maintenance dredging. In case studies are to be carried out at any stage for meeting some emergency situations like unexpected disasters (cyclones, tsunamis. oil spills, etc), some additional parameters specific to the nature of the disaster have to be included in the survey. Parameters like beach profiles, littoral drift may have to be continued for longer periods to understand the post- construction impacts like, impact of breakwaters on the littoral drift, etc.

Presentation of data

It is preferable to present the results from the final analysis of all parameters on a uniform scale and including the basic features of the coastline. However, representative sections for each parameter need separate scale and presentation. CRZ Maps for example have to be submitted only in two scales 1:5000 and 1:25,000

Annexure 7

Measurement methods for sampling of aquatic organisms

Group of organisms	Sampling Method	Measurement
Bacteria	Water sampling	Aerobic viable counting
Phytoplankton	Water sampling	Number off/cells
Zooplankton	Net sampling or water Sampling	Weight of collected material and number of individuals
Seaweed	Quadrant sampling	Weight
Attached Organisms	Quadrant sampling	Weight species and number of individuals
Benthic Organisms	Bottom sediment sampling	Weight species and number of individuals
Fishery Resources	Trial catch	Weight species and number of individuals

Annexure 8

National Ambient Air Quality Standards (NAAQS)

Pollutant and time-weighted average		Concentration in ambient air ((in µg/m3)		
		Industrial area	Residential, rural and other areas	Sensitive area
Sulphur dioxide	Annual average*	80.00	60.00	15.00
	24-hour**	120.00	80.00	30.00
Oxides of nitrogen	Annual average*	80.00	60.00	15.00
	24-hour**	120.00	80.00	30.00
Suspended particulate matter	Annual average*	360.00	140.00	70.00
	24-hour**	500.00	200.00	100.00
Respirable particulate matter (size less than 10 µm)	Annual average*	120.00	60.00	50.00
	24-hour**	150.00	100.00	75.00
Lead	Annual average*	1.00	0.75	0.50
	24-hour**	1.50	1.00	0.75
Carbon monoxide	8-hour**	5.00	2.00	1.00
	1-hour	10.00	4.00	2.00

* Annual Arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval
** 24 hourly/8 hourly values shall be met 98% of the time in a year. 2% of the time, it may exceed but not on two consecutive days

Note:

1. National Ambient Air Quality Standard: The levels of air quality necessary with an adequate margin of safety, to protect the public health, vegetation and property.
2. Whenever and wherever two consecutive values exceed the limit specified above for the respective category, it shall be considered adequate, reason to institute regular/continuous monitoring and further investigations.

(Source: G.S.R 176 (E) dated 02.04.1996 under the provisions of E (P) Act1986)

Annexure 9

Air quality network requirements

Pollutant	Region population	Minimum No. Of Air quality monitoring stations
Particulate matter	Less than 100,000 100,000-1,000,000 1,000-001-5,000,000 Above 5,000,000	4 4+0.6 per 100,000 population 7.5+0.25 per 100,000 population 12+0.16 per 100,000 population
SO_2	Less than 1,00,000 1,00,001-5,00,000 5,00,001-10,00,000 Above 10,00,000	3 2.5+0.5 per 1,00,000 population 6+0.15 per 1,00,000 population 20
NO_2	Less than 1,00,000 1,00,000-5,00,000 Above 1,000,000	4 4+0.6 per 1,00,000 population 10
CO	Less than 1,00,000 1,00,000-5,00,000 Above 5,000,000	1 1+0.15 per 1,00,000 population 6+0.05 per 1,00,000 population
Region means the study area around the project boundary area decided in scoping Additional monitoring locations should be set up if sensitive sites such as places of archeological importance and biosphere reserves exist		

(Source: National Ambient Air Quality Series: NAAQMS/25/2003-04-CPCB)

Annexure 10

Ambient Air Quality Standards in respect of Noise

Area code	Category of area	Limits in db (A) Leq	
		Day time	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 shall mean from 6.00 a.m. to 10.00 p.m.
2. Night time shall mean from 10.00 p.m. to 6.00 a.m.
3. Silence zone is an area comprising not less than 100 meters around hospitals, educational institutions, courts, religious places or any other area, which is declared as such by the competent authority.
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 relatable to human hearing.

A "decibel" is a unit in which noise is measured.

"A", in dB(A) L_{eq}, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.

L_{eq}: It is an energy mean of the noise level over a specified period.

(Source: Noise pollution (Regulation and control) Rules, 2000)

Annexure 11

Illustrative types of socioeconomic impacts

Impact Area	Potential Changes
General Characteristics and trends in population of region	Increase or decrease in population
Migration trends in study area	Increase or decrease in migration trends
Population characteristics in study area, including distributions by age, sex, ethnic groups, educational level and family size	Increase or decrease in various population distributions, people relocations
Distinct settlement of ethnic groups or deprived economic/ minority groups	Disruption settlement patterns, people relocations
Economic history for the region	Changes in economic patterns
Employment pattern in study area, including occupational distribution and location and availability of work force	Increase or decrease in overall employment or unemployment levels and change in occupational distribution
Income levels and tends for study area	Increase or decrease in income levels
Land values in study area	Increase or decrease in land values
Housing characteristics in study area, including in types of housing and occupancy levels	Changes in types of hosing and occupancy levels
Health and social services in study area, including health, workforce, law enforcement, fire protection, water supply, wastewater treatment facilities, solid waste collection and disposal and utilities	Changes in demand on health and social services
Public and private educational resources in study area	Changes in demand on educational resources
Transportation systems in study area, including high way, rail, air and waterway	Changes in demand on transportation systems
Community cohesion, including organized community groups	Disruption of cohesion
Tourism and recreational opportunities in study area	Increase or decrease in tourism and recreational potential
Religious patterns and characteristics in study area	Disruption of religious patterns and characteristics
Areas of unique significance such as cemeteries of religious camps	Disruption of unique areas

(Source: Draft National EIA Guidance Manual-NEERI)

Annexure 12

Standard Format of the Advance Notification Form for waste delivery to port reception facilities

Notification of the delivery of waste to: …….. (*Enter name of the port or terminal*)

The master of a ship should forward the information below to the designated authority at least 24 hours in advance of arrival or upon departure of the previous port if the voyage is less than 24 hours
This form shall be retained on board the vessel along with the appropriate Oil RB, Cargo RB or Garbage RB

DELIVERY FROM SHIPS (ANF)

1. Ship Particulars

1.1 Name of ship:	1.5 Owner or operator:
1.2 IMO number:	1.6 Distinctive number or letters:
1.3 Gross tonnage:	1.7 Flag state:
1.4 Type of ship ☐ Oil Tanker ☐ Chemical tanker ☐ Bulk carrier ☐ Container ☐ Other cargo ship ☐ Passenger ship ☐ Ro-ro ☐ Other (specify)	

2. Port and voyage particulars

2.1 Location/Terminal name and POC:	2.6 Last Port where waste was delivered:
2.2 Arrival Date and Time:	2.7 Date of last delivery:
2.3 Departure date and time:	2.8 Next port of delivery (if known):
2.4 Last port and country:	2.9 Person submitting this form is (if other than the master):
2.5 Next port and country (if known):	

3. Type and amount of waste for discharge to facility

MARPOL Annex I-Oil	**Quantity (m^3)**
Oily bilge water	
Oily residues (sludge)	
Oily tank washings	
Dirty ballast water	
Scale and sludge from tank cleaning	
Other (please specify)	
MARPOL Annex II-NLS	**Quantity (m^3)/Name[1]**
Category X substance	
Category Y substance	
Category Z substance	
OS-other substances	
MARPOL Annex IV-Sewage	**Quantity (m^3)**

MARPOL Annex V-Garbage	**Quantity (m^3)**
Plastic	
Floating dunnage, lining or packing material	
Ground-down paper products, rags, glass, metal bottles, crockery etc	
Cargo residues[2], paper products, rags, glass, metal, bottles, crockery etc	
Food waste	
Incinerator ash	
Other wastes (specify)	
MARPOL Annex VI-Air Pollution	**Quantity (m^3)**
Ozone-depleting substances and equipment containing such substances	
Exhaust gas-cleaning residues	

Name of Ship:	IMO Number:

Please state below the approximate amount of waste and residues remaining on board and the percentage of maximum storage capacity. If delivering all waste on board at this port

please strike through this table and tick the box below. If delivering some or no waste, please complete all columns.

I confirm that I am delivering all the waste held on board this vessel (as shown on Page 1) at this port ☐

Type	Maximum dedicated storage capacity m^3	Amount of waste retained on board m^3	Port at which remaining waste will be delivered (if known)	Estimate amount of waste to be generated between notification and next port of call m^3
MARPOL Annex I-Oil				
Oily bilge water				
Oily residues (sludge)				
Oily tank washings				
Dirty ballast water				
Scale and sludge from tank cleaning				
Other (please specify)				
MARPOL Annex II-NLS				
Category X substance				
Category Y substance				
Category Z substance				
OS-other substances				
MARPOL Annex IV-Sewage				
Sewage				
MARPOL Annex V-Garbage				
Plastic				
Floating dunnage, lining or packing material				
Ground paper products, rags, glass, metal bottles, crockery				
Cargo residues[2], paper products, rags, glass, metal, bottles, crockery				
Food waste				
Incinerator ash				
Other wastes (specify)				

Date: ……. Name and Position: ……

Time: ……

Signature:…….

[1] Indicate the proper shipping name of the NLS involved

[2] Indicate the proper shipping name of the dry cargo

(Source: 4th November 2008, MEPC.1/Circ.644 of International Maritime Organization)

Annexure-13

Standard Format for the Waste Delivery Receipt

The designated representative of the reception facility provider should provide the following form to the master of a ship that has just delivered waste
This form should be retained on board the vessel along with the appropriate Oil RB, Cargo RB or Garbage RB

1. Reception facility and Port particulars

1.1 Location/Terminal name:
1.2 Reception facility provider(s):
1.3 Treatment facility provider(s) – if different from above:
1.4 Waste discharge date and time from: to:

2. Ship particulars:

2.1 Name of ship:	2.5 Owner or operator:
2.2 IMO number:	2.6 Distinctive number or letters:
2.3 Gross tonnage:	2.7 Flag state:
2.4 Type of ship ☐ Oil Tanker ☐ Chemical tanker ☐ Bulk carrier ☐ Container ☐ Other cargo ship ☐ Passenger ship ☐ Ro-ro ☐ Other (specify)	

3. Type and amount of waste received

MARPOL Annex I-Oil	**Quantity (m^3)**
Oily bilge water	
Oily residues (sludge)	
Oily tank washings	
Dirty ballast water	
Scale and sludge from tank cleaning	
Other (please specify)	
MARPOL Annex II-NLS	**Quantity (m^3)/Name[1]**
Category X substance	
Category Y substance	
Category Z substance	
OS-other substances	
MARPOL Annex IV-Sewage	**Quantity (m^3)**

MARPOL Annex V-Garbage	**Quantity (m^3)**
Plastic	
Floating dunnage, lining or packing material	
Ground paper products, rags, glass, metal bottles, crockery	
Cargo residues[2], paper products, rags, glass, metal, bottles, crockery etc	
Food waste	
Incinerator ash	
Other wastes (specify)	
MARPOL Annex VI-Air Pollution	**Quantity (m^3)**
Ozone-depleting substances and equipment containing such substances	
Exhaust gas-cleaning residues	

On behalf of the port facility I confirm the above wastes were delivered.
Signature:…… Fill Name and Company Stamp:……

(Source: 4th November 2008, MEPC.1/Circ.645 of International Maritime Organization)

Annexure-14

Guidance for assessment relevance and reliability of analytical methods and framework used for impact prediction: risk assessment

Relevance		
Name	**Application**	**Remarks**
EFFECT WHAZAN	Consequence Analysis for Visualization of accidental chemical release scenarios & its consequence Consequence Analysis for Visualization of accidental chemical release scenarios & its consequence	Heat load, pressure wave & toxic release exposure neutral gas dispersion
HEGADIS	Consequence Analysis for Visualization of accidental chemical release scenarios & its consequence	Dense gas dispersion
HAZOP and Fault Tree Assessment	For estimating top event probability	Failure frequency data is required
Pathway reliability and protective system hazard analysis	For estimating reliability of equipment and protective systems	Markov models
Vulnerability Exposure models	Estimation of population exposure	Uses probit equation for population exposure
F-X and F-N curves	Individual / Societal risks	Graphical Representation

(Source: EIA manual – 2001 of MoEF, GoI)

Annexure-15

Good Practices of EMP for Ports and Harbors

Dredge Planning Activities

- Dredging should only be conducted if necessary, and based on an assessment of the need for new infrastructure components or port navigation access to create or maintain safe navigations channels, or, for environmental reasons, to remove contaminated materials to reduce risks to human health and the environment;
- Prior to initiation of dredging activities, materials should be evaluated for their physical, chemical, biological, and engineering properties to inform the evaluation of dredge materials reuse or disposal options.

Dredging

- Excavation and dredging methods should be selected to minimize suspension of sediments, minimize destruction of benthic habitat, increase the accuracy of the operation, and maintain the density of the dredge material, especially if the dredge material includes contaminated areas. There are several dredging methods, which are commonly used depending on the depth of the sediments and environmental concerns such as the need to minimize sediment suspension and increase dredging accuracy
- Areas sensitive for marine life such as feeding, breeding, calving, and spawning areas should be identified. Where sensitive species are present, dredging (and blasting) should be conducted in a manner so as to avoid fish migration or spawning seasons, routes, and grounds;
- Use techniques (e.g. silt curtains), to minimize adverse impacts on aquatic life from the re-suspension of sediments
- Inspection and monitoring of dredging activities should be conducted to evaluate the effectiveness of impact prevention strategies, and re-adjusted where necessary.

Methods of dredging and reclamation

Dredging is a major source of water pollution causing turbid water, re-suspension of contaminated bottom sediments and other adverse effects. However, dredging is indispensable for construction of port structures, development of navigation channels and basins. Special dredgers and equipment have been developed in recent years to cope up with less environmental effects due to dredging. The borehole data of the seabed should be generated and based on the data type of dredging should be planned. Typical methods for dredging are as follows:

a) Air-pump dredger

An air-pump dredger consists of a drag head, basal tanks to suck the sludge and an air pump to discharge the dredged sludge. The drag head is firstly to be lowered into the sludge layer and the valve to release air into the basal tanks is to be opened such that water pressure pushes the sludge into the basal tank. After sucking the sludge, the air in the tank is compressed and the sludge is discharged through the pipe. This method enables high density dredging with little disturbance to the sediments and without taking much water together. In shallow waters, due to low water pressure, the performance of this type of

equipment is not so high. To cope with, a new type of equipment with vacuum pump to reduce air pressure in basal tank is evolved.

b) Piston-pump dredging

The idea of piston pump dredging is similar to air pump dredging. A piston pump system consists of a huge hydraulically operated piston and cylinder to intake sludge. Dredging procedure in this system is firstly to settle the intake in the sludge layer, secondly move up the piston to suck the sludge and then to move down the piston to discharge the sludge inside the cylinder.

The above two methods are not so effective to dredge large volumes but useful for dredging contaminated sediments without causing resuspension of sediments.

c) Low pollution pump dredging

Ordinary pump dredging usually disturbs bottom sediments by cutter blades and generates considerable volumes of suspended solids in the water. With a view to reduce suspended solids generation several types of drag heads have been developed including cutter less drag head. Low pollution pump dredging equipment consists of a special drag head equipped with a screw and a full cover on the head. The drag head only has an opening in the front and moves ahead to take the sludge. The sludge is stirred by screw and sucked in the drainpipe. The speed of rotation is changed according to the type of soil or sludge to be dredged to enable high density dredging of the order of 100 to 500 cu m/hour depending on the ability of the pump.

d) Watertight grab bucket

Grab dredging usually generates more suspended solids than other dredging methods. However, it is economical for small scale dredging and applicable to various dredging situations. For use in sludge dredging, low pollution type grab bucket has been developed, which is designed to be watertight and avoid scattering dredged sediments while pulling up in the water.

Disposal of Dredged Material

- Dredged material should be analyzed in order to select appropriate disposal options (e.g. land reclamation, open water discharge, or contained disposal). Beneficial reuse of uncontaminated, dredged material should be considered (e.g. for wetland creation or enhancements, habitat restoration, or creation of public access / recreational facilities);
- Use of submerged discharges should be considered for hydraulic disposal of dredged material
- Use of lateral containment in open water disposal should be considered. Use of borrow pits or dikes reduces the spread of sediments and effects on benthic organisms
- Use of cap containment sediments with clean materials should be considered. Level bottom capping or combinations of borrow pits / dikes with capping reduces the underwater spread of contaminated material
- Confined disposal facilities should be used, either near shore or upland, when open water disposal is not feasible or desirable. If dredge spoil is contaminated, confined disposal facilities should include liners or other hydraulic containment design options to

prevent leaching of contaminants into adjacent surface or groundwater bodies. Treatment of dewatering liquids (e.g. metals and persistent organic pollutants) may be required prior to discharge. Site-specific discharge quality standards should be established depending on the type and toxicity of the effluents and the discharge location

Air emissions

Combustion Sources

- Developing air quality management procedures applicable to ship operators, such as:
  - Maintaining emissions of NOx and SOx within the limits.
  - Using low-sulfur fuels in port, if feasible, or as required by international regulations
  - Navigation of port access areas at partial power, achieving full power only after leaving the port area
  - Avoiding or limiting the practice of blowing soot from tubes or flues on steam boilers while in port or during unfavorable atmospheric conditions
  - If the port provides onshore power for vessels to reduce shipboard power use during loading / unloading activities, requiring vessels to shut down power plants (go "cold iron") if docked above a specified time threshold

- Depending on the need to address local air quality concerns, operators should develop air quality management procedures for application to land-based activities which may include:
  - Keeping transfer equipment (e.g. cranes, forklifts, and trucks) in good working condition
  - Upgrading the land vehicle fleet with less-polluting trucks and vehicles, and using alternative fuels and fuel mixtures
  - Encouraging reduction in engine idling during on- and off-loading activities.
  - Encouraging storage planning to avoid or minimize restorage and reshuffling of cargo

- Where practicable, designing new facilities to minimize travel distance from ships off-loading and on-loading facilities to storage areas.

Dust

- Dry bulk materials storage and handling facilities should be designed to minimize or control dust emissions, including:
  - Storing pulverized coal and pet-coke in silos
  - Installing dust suppression mechanisms (e.g. water spray or covered storage areas)
  - Using telescoping chutes to eliminate the need for slingers
  - Using vacuum collectors at dust-generating activities
  - Using slurry transport, pneumatic or continuous screw conveyors, and covering other types of conveyors
  - Minimizing free fall of materials
  - Minimizing dry cargo pile heights and containing piles with perimeter walls
  - Removing materials from the bottom of piles to minimize dust re-suspension
  - Ensuring hatches are covered when material handling is not being conducted
  - Covering transport vehicles

- Regularly sweeping docks and handling areas, truck / rail storage areas, and paved roadway surfaces

Waste Management

- Avoiding installation of storm drainage catch basins that discharge directly into surface waters, using containment basins in areas with a high risk of accidental releases of oil or hazardous materials (e.g. fueling or fuel transfer locations), and oil / grit or oil / water separators in all runoff collection areas. Oil / water separators and trapping catch basins should be maintained regularly to keep them operational. Recovered contaminated solids or liquids disposed of as hazardous materials
- Installing filter mechanisms (e.g. draining swabs, filter berms, drainage inlet protection, sediment traps and sediment basins) to prevent sediment and particulates from reaching the surface water.
- Information should be available for ship captains to identify solid waste reception facilities and acceptable handling procedures at ports

Spill Control Planning

- Outlines responsibility for managing spills, releases and other pollution incidents, including reporting and alerting mechanisms to ensure any spillage is reported promptly to the port authorities and personnel are informed to take appropriate action

(Source: Refer EHS guidelines for Ports, Harbors and terminals by IFC & World Bank Group document, April 30, 2007)

Annexure16

General standards for discharge of effluents

S. No	Parameter	Standards			
		Inland surface water	Public sewers	Land for irrigation	Marine coastal areas
		(a)	(b)	(c)	(d)
1	Color & odour				
2	Suspended solids mg/l, Max	100	600	200	1. For process waste water-100 2. For cooling water effluent 10% above total suspended matter of effluent
3	Particle size of suspended solids	Shall pass 850 Micron IS sieve	--	--	1. Floatable solids max. 3 mm 2. Settleable solids max. 850 microns
4	pH Value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
5	Temperature	Shall not exceed 5^0 C above the receiving water temperature	--	--	Shall not exceed 5^0 C above the receiving water temperature
6	Oil and grease mg/l Max.	10	20	10	20
7	Total residual chlorine mg/l Max.	1.0	--	--	1.0
8	Ammonical Nitrogen (as N), mg/l Max.	50	50	--	50
9	Total Kjeldahl nitrogen (as NH_3), mg/l Max.	100	--	--	100
10	Free ammonia (as NH_3), mg/l Max.	5.0	--	--	5.0
11	Bio-chemical oxygen demand (5 days at 20^0 C), mg/l max.	30	350	100	100
12	Chemical oxygen demand, mg/l max.	250	--	--	250
13	Arsenic (as As), mg/l max.	0.2	0.2	0.2	0.2
14	Mercury (as Hg), mg/l max.	0.01	0.01	--	0.01
15	Lead (as Pb), mg/l max.	0.1	1.0	--	2.0
16	Cadmium (as Cd), mg/l max.	2.0	1.0	--	2.0
17	Hexavalent chromium (as Cr +6), mg/l max.	2.0	1.0	--	2.0
18	Total chromium (as	2.0	2.0	--	2.0

	Cr), mg/l max.				
19	Copper (as Cu), mg/l max.	3.0	3.0	--	3.0
20	Zinc (as Zn), mg/l max.	5.0	15	--	15
21	Selenium (as Se), mg/l max.	0.05	0.05	--	0.05
22	Nickel (as Ni), mg/l max.	3.0	3.0	--	5.0
23	Cyanide (as CN), mg/l max.	0.2	2.0	0.2	0.2
24	Fluoride (as F), mg/l max.	2.0	15	--	15
25	Dissolved phosphates (as P), mg/l max.	5.0	--	--	--
26	Sulphide (as S), mg/l max.	2.0	--	--	5.0
27	Phenolic compounds (as C_6H_5OH), mg/l max.	1.0	5.0	--	5.0
28	Radio active materials:				
	a. Alpha emitter micro curie/ml	10^{-7}	10^{-7}	10^{-7}	10^{-7}
	b. Beta emitter micro curie/ml	10^{-6}	10^{-6}	10^{-6}	10^{-6}
29	Bio-assay test	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent
30	Manganese (as Mn), mg/l	2	2	--	2
31	Iron (as Fe), mg/l	3	3	--	3
32	Vanadium (as V), mg/l	0.2	0.2	--	0.2
33	Nitrate nitrogen, mg/l	10	--	--	20
* These standards shall be applicable for industries, operations or processes other than those industries, operations or process for which standards have been specified of the Environment Protection Rules, 1989					
Source: G.S.R 422 (E) dated 19.05.1993 and G.S.R 801 (E) dated 31.12.1993 issued under the provisions of E (P) Act 1986					

Questionnaire

Questionnaire for environmental appraisal of ports & harbour projects

Note 1: All information to be given in the form of Annexures should be properly numbered and form part of reply to this proforma

Note 2: No abbreviation to be used – **Not available** or **not applicable** should be clearly mentioned

1. General Information

1.1 Name of the Project :

a. Name of the project proponent :

b. Mailing Address :
E-mail :
Telephone :
Fax Number :

c. Existing project/proposed project/ expansion project/modernization project :

d. If existing/expansion/modernization project :

e. Capacity (TPA) for existing and after expansion :

1.2 Location

S.No & Village	Tehsil	District	State

1.3 Classification of the project:

- Major
- Intermediate
- Minor
- Fishing
- Container cargo handling only

1.4 Geographical information

a. Latitude

b. Longitude

c. Elevation above MSL (meters)

d. Total area envisaged for setting up of project (in ha.)

e. Nature of terrain

f. Nature of soil (sandy, clayey, sandy loam etc.)

g. Seisimic zone classification

1.5 Current land use of the proposed project site Area (in ha.)

a. Agricultural

- Irrigated
- Unirrigated

b. Homestead

c. Forest

d. Notified industrial Area/ estate

e. Grazing

f. Fallow

g. Mangroves

h. Orchards

i. Sand dunes

j. No development zone

k. Marshes

l. National park/sanctuary

1.6 Environmental sensitivity details within 10 km from the boundary of the project for applicability of "**General Condition (GC)"** as per EIA notification dated 14.9.2006.

S.No	Item	Name	Aerial Disance (in Km)
1	Protected areas notified under the wild life (Protection) Act, 1972		
2	Critically polluted areas as notified by the Central Pollution Control Board from time to time		
3	Notified Eco-sensitive areas		
4	Inter-state boundaries and international boundaries		

Surrounding features with in 15 kms from the boundary of the project

S.No	Item	Name	Aerial Disance (in Km)
1	Habitation		
2	Lake/resevoirs/dams/rivers/streams		
3	Breeding site		
4	Nesting site		
5	Mangrooves		
6	Defence installations		
7	Air ports		
8	National/State highways		
9	Railway lines		
10	Archeological sites		
11	Major industries & industrial estates		
12	Sensitive zones		

1.7 CRZ Classification:

a. What is the categorization of the area (as per approved CZMP)?

CRZ-I ☐ CRZ II ☐

CRZ-III ☐ CRZ IV ☐

b. Does the proposed activity qualify under the category of permissible activity?

Yes ☐ No ☐

c. If yes, under what provision it is permitted?

S.No	Provision No.

1.8 Approach and Charts

a. Is the port connected with a river/canal system? (if yes, give details)

b. Enclose a detailed layout map for transportation system for approach to and from the harbour.

c. Location Map to 1:50,000 scale presenting recent features with the help of satellite imagery (NRSA) of

- Project area
- Surrounding area covering 10 KM radial distance from project boundary delineating protected areas notified under wild life (Protection) Act 1972/Crotically polluted areas as notified by the CPCB from time to time /notified eco-sensitive areas and Inter state boundaries and international boundaries and
- Environmental sensitive places

d. Describe any other means of transportation including railway system with marshalling yard, etc.

e. List of hydrographic charts in use for operational purpose and any other charts applicable.

f. List of industries adjoining the harbour from which discharges of pollutants may effect the ecology of the harbour.

1.9 Please indicate minimum and maximum water depth in:

- Adjoining coastal waters
- Approach channel to harbour waters
- In harbour area

2. Berthing, Docking and Handling Facilities

2.1 Berthing Facilities

- Total number and types of berths/wharfs

- Give complete details of dimensions, water depths and major handling facilities on the above berths together with the length and size of the vessels which can be accommodated. The type of cargo normally handled at these berths

2.2 Docking facilities

Nos. and principal dimensions of

- Dry docks
- Floating docks
- Slipways
- Marine workshops

2.3 Seagoing Facility

- Nos. of dredgers, floating cranes etc.
- Nos. of tugs with their bollard capacity and their capacity with regard to fire fighting, salvage stage operations and pollution combating facilities.
- Nos. of sullage / garbage disposal barges with capacities,

2.4 On Shore Handling Facilities

- Give the details of major cargo handling equipment and allied machinery

3. Warehousing and Storage Facilities

Note: Details under this section are required for projects relating to warehousing facilities, independently or as part of a major project.

a. Number of warehouses with dimensions
b. Number of temporary sheds with dimensions
c. Number of transit sheds with dimensions
d. Number of dangerous cargo sheds, if any
e. Number and area of open spaces available for storage purposes
f. Do Warehouses have railway stores/facilities?
g. Are open spaces available with sliding facilities?
h. Container storage area?

4. Amenities

4.1 Power- Electrical

- Sources of power supply and requirement for the total energy consumption in the controlled area of the port.
- Details of the energy centre/electrical substation and distribution systems.
- Projections for the energy consumption in the next ten years.

4.2 Power-Coal and oil based

- Details of power generation based on coal or oil and the source of supply of inputs.

4.3 Fresh Water (Cu.m/day)

Sea	
River	
Ground water	
Rain water harvesting	
Municipal water supply	
Others (please specify)	

Attach water balance statement in the form of a flow diagram indicating source (s), consumption (section-wise) and output

4.4 Transportation

- Brief description of Public railway Public roadways Other modes
- Truck parking arrangements

4.5 Housing

Give brief description and distance of housing colonies for

- Workers

- Supervisors
- Officers and Management

4.6 Green Belt

a. Total area of the project/township (in ha.)

b. Area already afforested (for existing projects) in ha.

c. Area proposed to be afforested (in ha.)

d. Plant species proposed

- Indigenous
- Exotic

e. Width of Green belt (minimum in m.)

- Along the project boundary
- Roads and avenues within the plant
- Along the storage areas
- Township
- Other-ornamental garden spaces etc

5. Traffic and Cargo Handling

5.1 Imports & Exports

Indicate figures for the past five years (in case of existing activity) and the projections for the next five years

Cargo Type	Imports	Exports
Edible oils		
Food stuffs		
Crude oil		
Hazardous Chemicals as per		

MISHC rules (give details)		
Fertilizers		
General engineering items		
Dusty cargo items		
Hazardous waste as per HW (M & H) Rules		
Other items		

5.2 Shipping Movement: Numbers and types of ships loading/unloading per annum

Up to 15000 tons displacement	
15000 to 40,000 tons displacement	
Above 40,000 tons displacement	
Maximum numbers in port at any time	
Secured alongside being serviced	
On waiting line alongside	
On waiting line at anchorage	

6. Bunkering Facilities, Oil Residue Facilities and pipelines

6.1 Bunkering Facilities

- Give details of the bunkering facilities at the port.
- Define and explain the fuel cargo transportation system at the port
- Give details of the oil pipeline connection, if any, and the existing oil discharge facilities.
- Procedures adopted in issuing permits for bunkering and supervision during bunkering operations.

6.2 Facilities for Reception of Oily Wastes from Ships

a. Type of facilities available in the port

- If fixed (give details)
- If mobile (give details)

For both fixed and mobile facilities give each type of oily waste which the facility can receive, and indicate

- The maximum receiving rate in cubic metres (m~) per hour,
- The maximum continuous throughput in cubic metres (m3) per hour and
- The charges (if any) applicable at the time of completion of the questionnaire

b. Dirty Ballast Water

- Maximum receiving rate (m3/hour)
- Storage facilities

c. Tank Washings (Slops)

- Maximum receiving rate (m3/hour)
- Storage facilities

d. Scale and sludge (from tank cleaning operations prior to docking)

- Any handling limitations (e.g, lifting gear, equipment, disposal etc.)
- Charges

e. Oily Mixtures contaminated by Chemical Cleaning Agents

- Maximum receiving rate (m3/hour)
- Storage facilities

f. Oil contaminated bilge water

- Maximum receiving rate (m3/hour)
- Storage facilities
- Whether fitted with IMCO Standard Discharge Connection Yes/No

g. Sludge (from purification of fuel or lubricating oil)

- Maximum receiving rate (m3/hour)
- Storage facilities
- Whether fitted with IMCO Standard Discharge connection Yes/No

6.3 Additional information

a. If the discharge of "clean ballast" (as defined in the International Convention for the Prevention of Pollution from Ships 1973) is prohibited by national legislation, please indicate the receiving capability of

- Clean ballast (m3/hour)
- Maximum receiving rate (m3/hour)
- Storage facilities

b. Are there any restrictions in the use, of the facility, e.g. restriction as to user (tied facility) an embargo on contamination by certain chemical cleaning agents, restriction on type (s) of oil accepted? If so, please specify these in detail.

6.4 Planned Facilities

- Information on enlarging existing facilities or constructing new facilities:
- Are there any plans to enlarge the existing capacity? If so, please indicate.

- Are there new facilities planned? if so, please give the same particulars as requested for existing facilities and indicate when these new facilities are expected to be operational.

7. Hazardous chemicals as defined under MSIHC rules

S.No	Hazardous Chemicals	Storage details with capacities	Handling capacity (KL or MT per annum)	Safety measures

Also provide details of Disaster Management Plan for spills or accidents involving these materials.

8. Oil Pollution

8.1 Oil spill Contingency plan

Do you have any contingency plan for major oil spillage at sea? If yes, give details.

- Number and type of vessels
- Methods/techniques adopted

8.2 Coordinating Agency

- Is there any coordinating authority for pollution abatement in the case of oil spillage while lading/unloading, leakages from machinery/tanks and ship discharge etc., If so, give its composition, and functions.

9. Waste Disposal

9.1 Solid Wastes

a. What is the nature of solid wastes present at the port premises?

- Category and quantity of hazardous waste as notified under HW(M&H) Rules
- Details of Non hazardous solid waste generated, with quantities
- Details of solid waste generated from the housing

b. What are the quantities and methods adopted for the disposal of solid waste?

- For disposal of Hazardous solid waste
- For disposal of non hazardous solid waste
- For disposal of solid waste from the housing

c. What is the amount of spillage from cargo handling operations?

- On berth
- On board

d. Can any portion of the solid wastes be recovered or re-utilised? if yes, give details.

e. Would disposal of solid wastes create pollution of air, water or soil? If yes, please explain.

9.2 Sewage Treatment

a. Provisions and state of sewage treatment plants (STP) on board ships approaching the harbour-area, annually during past 5 years.

- Fitted with STP
- Without STP

9.3 Air Pollution

a. What are the prescribed quality standards for air emissions.

9.4 Noise Pollution

a. Source
b. Level at Source (dB)
c. Level at project boundary (dB)
d. Abatement measures (give source-wise details)

10. Accidents

10.1 What different types of accidents have occurred during the past 10 years in the port or can occur in shipping and harbour operations?

(Give the exhaustive list of possible accidents like collisions, fire, sinking machine failure involving crane operations, navigation and communications, vessels carrying hazardous toxic cargo, corrosive materials, failure of power supply, sabotage, failure of harbour security and protection measures etc.)

10.2 What major accidents have occurred so far within 50 miles of the port? Classify them in the following two broad categories:

- Accidents involving shore based facilities
- Accidents on and/or involving floating vessels.

11. Fire-Fighting/Emergency

11. 1 Describe giving capability, manpower, readiness and other details of (separately for onshore and offshore)

- Clean-up facility
- Fire-fighting facility
- On site emergency control room and integration with district off site emergency facility

- Enforcement of PLI Act with hazardous cargo importers and exporters and as per Hazardous Work Management Rule, 2008
- Any other

11.2 What are your training and manpower development plans for proper utilisation of above facilities?

11.3 Describe the contingency plan in the event of natural catastrophe, enemy action/sabotage, and operational failure/ negligence or equipment failure/malfunctioning.

11.4 Are such emergency plans being periodically tested, evaluated and improved upon by performing mock drills? If so, with what frequency?

11.5 Give the details of shore-based medical facilities for the workers and other concerned staff.

12. Port/Harbour Development Activities

12.1 Elaborate the proposed plan of action for the next ten years.

12.2 List out major equipment/ machinery being procured and/ or proposed to be acquired during the next ten years

12.3 What development activities are being undertaken or approved for: - New construction -Reclamation - Extension and modernization for Berthing Breakwaters Loading Unloading Storage Midstream anchorage Widening and deepening of channel Repairs Sanitation/sewage

12.4 What is your maintenance dredging load

- Per annum
- Monthly (show variations)

12.5 What dredging equipment is used for this purpose?

- Dredging Contractors
- Your own organisation
- Any other
- Nature of dredged material
- Whether dredged spoil is proposed to be utilized for reclamation
- Toxic matter etc expected in dredged spoil
- Specify pollution control measures, if required

12.6 Please state the area of vegetative cover/agricultural land being affected by the proposed harbour/port development.

12.7 Please state the area to be reclaimed for port activities.

12.8 Do you see any inter linkages with the on-going port/harbour development activities with the following?

- Change in migration pattern of the coastal population
- Nucleation of population
- Nucleation of facilities/services and institutional development
- Social change life style, health, education, etc)
- Employment pattern
- Regional economy

(Please explain and give adequate data to support it)

13. Environmental Management Plan

13.1 Capital cost of the project (as proposed to approved by the funding agency)

Rs. Lakhs

13.2 Cost of environmental protection measures

S.No		Capital cost		Annual recurring cost	
		Existing	Proposed	Existing	Proposed
1	Pollution control (provide break-up separately)				
2	Pollution monitoring (provide break-up separately)				
3	Fire fighting & emergency handling				
4	Green Belt				
5	Training in the area of environment & safety				
6	Others (specify)				

13.3 Give details of pollution control set up presently in operation incase of existing port.
13.4 What improvement do you plan in the next five years?
13.5 What is the level of expertise of the person in charge of pollution control?
13.6 How do you monitor the different kinds of pollution at present or propose to monitor in future.
13.7 Environmental specifications for contractors during the design, construction and operation stages

14. Rehabilitation & Resettlement plan including vocational training and other avenues of employment

a. Population to be displaced

S.No	Name of village	Population		
		Land oustees only	Homestead oustees only	Land+Homestead Oustees

b. Rehabilitation Plan for oustees
c. Site where the people are proposed to be resettled
d. Compensation package
e. Agency/Authority responsible for their resettlement

15. Compliance with environmental safeguards (For existing units)

a. Status of the compliance of conditions of Environmental clearance issued by MoEF, If any, enclosed — Yes ☐ No ☐

b. Status of the compliance of 'Consent to Operate' issued by SPCB, if any, enclosed — Yes ☐ No ☐

c. Latest 'environmental statement' enclosed — Yes ☐ No ☐

16. Public Hearing

a. Date of Advertisement
b. Newspapers in which the advertisement appeared
c. Date of Hearing
d. Panel present
e. List of public present along with addresses and occupation

S.No	Summary/details of public hearing issues raised	Recommendation of panel	Response of project Proponents

Date .....

Name and Signature of the Competent Officer/authority
E-mail:
Phone and Fax nos:

Given under the seal of organization on behalf of whom the applicant is signing

Note: The project authorities are earnestly advised in their own interest to provide complete information on points, which they think are relevant to their proposal. Non-supply of required information may result in considerable delay in according environmental clearance.

Bibliography

- Ministry of Environment and Forests' EIA Notification New Delhi, the 27th January 1994 (As amended up to 14th Sep 2006), CRZ Notification (19th February 1991 as amended up to August 2000). (www.envfor.nic.in)
- Pollution control Acts, Rules and Notifications issued thereunder (Pollution Control Law Series), CPCB (www.cpcb.nic.in)
- Proceedings for the workshop on Environmental Impact Assessment studies for developmental projects, CPCB
- Environmental Guidelines for Ports and Harbour Projects', Ministry of Environment and Forests, Govt. of India
- MARPOL (International Convention for the Prevention of Pollution from ships) 73/78, 1992 Amendment, International Maritime Organisation
- A guidebook for EIA of port development, Economic and Social Commission for Asia and the Pacific, UN
- United Nations Environmental Program (UNEP) EIA Training Resource Manual, by Environment Australia (Environmental Protection Group) Canberra, Australia under the guidance and technical support of UNEP International Working Group on EIA, February 1997
- World Bank Technical Paper Number 126, Environmental considerations for port and harbor developments
- 'Environmental Assessment' A guide to procedures, London, HMSO, Dept. of Environment
- 'Environmental Impact Assessment for Developing Countries in Asia', Asian Development Bank
- Environmental Handbook, 'Documentation on monitoring and evaluating environmental impacts' Volume 1 Introduction, Cross-sectoral Planning, Infrastructure, German Federal Ministry for Economic Cooperation and Development, vieweg
- 'A Handbook of Environmental Impact Assessment Guidelines' ± 1988 Malaysian Guidelines
- Guidelines for developing greenbelts, Programme objective series, PROBES/75/1999-2000, CPCB
- IAPH, 'Guidelines for Environmental Planning and Management in Ports and Coastal Area Development' 1991, The International Association of Ports and Harbours
- IAPH, 'Guidelines for Port Planning and Design' 1993, The International Association of Ports and Harbours
- IAPH, 'Guidelines on Port Safety and Environmental Protection' May 1989, The International Association of Ports and Harbours
- 'Air Pollution – An Introduction', Jeremy Colls, E & FN SPON
- 'Chemical Reactivity worksheet' (Software package), National Oceanic & Atmospheric Administration
- 'Chemodynamics and Environmental Modeling -An introduction', Part 1, Stefan Trapp, Michael Matthies, Springer
- 'Dispersion in Estuaries and Coastal Waters', Roy Lewis, John Wiley & Sons
- 'Dredging - A Handbook for Engineers', R.N. Bray, A. D. Bates & J.M. Land, Published by Arnold
- 'Encyclopedia of Environmental Science & Engineering', III edition, Parker Corbitt, McGraw-Hill
- 'Environmental Assessment', R.K. Jain, L.V. Urban, G.S. Stacey, H.E.Balbach., McGraw-Hill, Inc

- 'Environmental Engineering - A design approach', Arcadio P. Sincero, Gregoria A. Sincero, Prentice Hall
- Zooplankton Methodology, Collection & Identification - a field Manual, National Institute of Oceanography
- 'Environmental Impact Analysis Handbook', Edited by John G. Rau and David C. Wooten, University of California at Irvine, McGraw-Hill Book Company
- 'Fuel Barge Oil Spill Plan', Shipping and Air operation Section, Australian Antarctic Div.
- 'Handbook of dredging, a dredging reference manual', Volume I and II, by Applied Dredging Consultancy, The Hague, The Netherlands 1989
- 'Handbook of environmental laws, acts, guidelines, compliances and standards, Vol 1 & 2 R.K. Trivedy
- Gudelines for Ambient Air Quality Monitoring, National Ambient Air Quality Monitoring Sereis: NAAQMS/25/2003-04, CPCB
- 'Hazardous Material Information System', Office of hazardous materials safety research and special programs administration, U.S. Department of Transportation, 1998. Publication.
- Hazop and Hazan, ' Identifying and Assessing Process Industry Hazards, Trevor Kletz, Institution of Chemical Engineers
- 'ISO 14001 EMS Implementation Handbook', Hewitt Roberts & Gary Robinson, Butterworth Heinemann
- IS: 4651-1974 Parts I-IV, Indian Standards, Code of Practice for planning and design of ports and harbours
- 'Manual for preventing spills of hazardous substances at fixed facilities, Walter Unterberg, Robert W. Melvold, Kathleen S.Roos, Patricia A. Scofield, Combustion Engineering, Environmental Monitoring and Services, Inc
- 'Manual of methods in aquatic environment research'. Part II: Biological assessment of marine pollution with particular reference to benthos. Gray J.S., McIntyre A.D. and Stirn J.FAO Fisheries Technical Paper 324, FAO Rome, 49pp
- 'Marine Pollution', J. Albaiges, Hemisphere Publishing Corporation
- 'Oil spill simulation model', Jen-Men Lo, Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 117, 3, May/June 1991.
- 'Perry's Chemical Engineers' Handbook', Robert H. Perry & Don.W. Green, Seventh Edition
- 'Port and Harbour Engineering', Volume 1 & 2, Per Brunn, Gulf Publishing Company
- 'Principles of surface water quality modelling and control', Thomann and Mueller
- 'Process safety management of highly hazardous chemicals, Occupational Safety and Health Agency (OSHA)
- 'Reference Manual of Counter measures for Hazardous Substance Releases', Walter Unterberg, Robert W. Melvold, Scott L. Davis, Frank J. Stephens, Fitzhugh G. Bush, III, Hemisphere Publishing Corporation
- 'Surface Water Quality Modelling' , CE series, Steven C. Chapra, McGraw-Hill
- The ISO 14001 Implementation Guide, 'Creating an Integrated Management System', Suzan L. Jackson, John Wiley & Sons, Inc.
- 'The measurement of diversity in different types of biological collections', J. Theor. Biol, 13:131-144.
- International Maritime Dangerous Goods Code (IMDG-code)
- International Convention for the Prevention of Pollution from ships (MARPOL)
- United Nations Convention on the Law of the Sea (UNCLOS), 1982
- Ramsar Convention on Wetlands: http://www.ramsar.org/