Annexure 13: Disaster management plan

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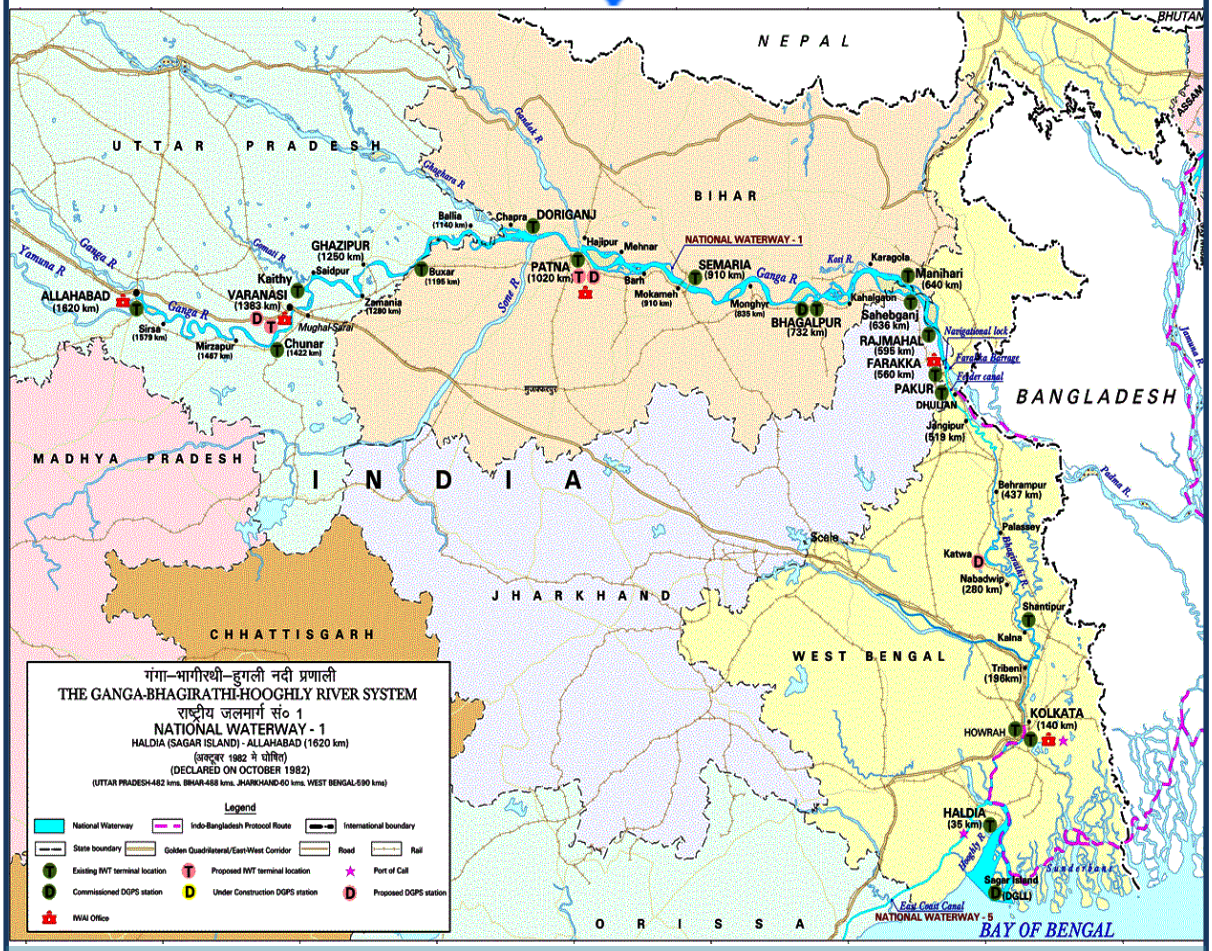
INLAND WATERWAYS AUTHORITY OF INDIA



Consulting Services for Risk Assessment and Disaster Management Plan for National Waterway-1 (River Ganga)

Final Report
Volume I – Main Report

KITCO the consultants

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF MAPS

Maps Showing Hotspots – 12 Sheets

ABBREVIATIONS

ALARP	As Low As Practically Reasonable
AIS	Automatic Identification System
BHD	Back Hoe Dredgers
BMP	Best Management Practices
BPCL	Bharat Petroleum Corporation Limited
BSDMA	Bihar State Disaster Management Authority
BOOT	Build Own Operate and Transfer
CCS	Cabinet Committee on Security
CAPF	Central Armed Police Forces
CCA	Central Coordinating Authority
CWC	Central Water Commission
CBRN	Chemical Biological Radiological and Nuclear
CIC	Chief Incident Controller
CIF	Chief Inspector of Factories and Boilers
CS	Chief Secretary
CRZ	Coastal Regulation Zone
CNG	Compressed Natural Gas
CMG	Crisis Management Group
CSA	Critical Section Analysis
CSD	Cutter Suction Dredger
DWT	Dead Weight Tonnage
DAE	Department of Atomic Energy
DGPS	Differential Global Positioning Systems
DGICG	Director General of Indian Coast Guard
DM Act	Disaster Management Act
DMA	Disaster Management Authority
DMD	Disaster Management Department
DMP	Disaster Management Plan
DRR	Disaster Risk Reduction
DC	District Collector
DDMA	District Disaster Management Authority
EDFC	Eastern Dedicated Freight Corridor
ENC	Electronic Navigational Chart
ECC	Emergency Control Centre
EOC	Emergency Operation Centre
ERV	Emergency Recovery Van
ESFs	Emergency Support Functionaries
EIA	Environmental Impact Assessment
FCP	Field Command Post
FAST	First Applied Sorbent Treatment against Chemical Threats
FGDs	Focus Group Discussions
FOCAL	Forum of Cargo Owners and Logistics Operators
FO	Furnace oil
GSI	Geological Survey of India
GST	Goods and Services Tax

GoI	Government of India
HDC	Haldia Dock Complex
HNS	Hazardous and Noxious Substances
HO	Head Office
HSD	High Speed Diesel
HTL	High Tension Line
ICR	Incident Control Room
IMT	Incident Management Team
IBP	India Bangladesh Protocol
IMD	India Meteorological Department
INCOIS	India National Centre for Oceanic Information Services
ICG	Indian Coast Guard
IRS	Indian Registry of Shipping
IV Act	Inland Vessel act
IWT	Inland Water Transport
IWAI	Inland Waterways Authority of India
IADC	International Association of Dredging Companies
IMDG	International Maritime Dangerous Goods
IMO	International Maritime Organization
IMSBC	International Maritime Solid Bulk Cargoes
ISGINTT	International Safety Guide for Inland Navigation Tank-barges and Terminals
IBRD	International Bank for Reconstruction and Development
JMVP	Jal Marg Vikas Project
JSDMA	Jharkhand State Disaster Management Authority
KAT	Key Assessment Team
KoPT	Kolkata Port Trust
LAD	Least Available Depth
LNG	Liquefied Natural Gas
LC-DMAF	London Convention- Dredged Material Assessment Framework
MSIHC	Manufacture, Storage and Import of Hazardous Chemical
MSDS	Material Safety Data Sheets
MTPA	Metric Tons Per Annum
MMT	Million Metric Tone
MoAFW	Ministry of Agriculture and Farmers Welfare
MoCA	Ministry of Civil Aviation
MoD	Ministry of Defence
MoES	Ministry of Earth Science
MoEF&CC	Ministry of Environment, Forest sand Climate Change
MoHFW	Ministry of Health and Family Welfare
MHA	Ministry of Home Affairs
MoM	Ministry of Mines
MoR	Ministry of Railways
MoRTH	Ministry of Road Transport and Highways
MoS	Ministry of Shipping
MoUD	Ministry of Urban Development

MoWR	Ministry of Water Resources
NCMC	National Crisis Management Committee
NDMA	National Disaster Management Authority
NDMP	National Disaster Management Plan
NDRF	National Disaster Response Force
NEC	National Executive Committee
NINI	National Inland Navigation Institute
NIDM	National Institute of Disaster Management
NOS-DCP	National Oil Spill Disaster Contingency Plan
NTPC	National Thermal Power Corporation
NW 1	National Waterway - 1
NWs	National Waterways
NGOs	Non-Government Organization
OMD	Operation, Maintenance and Development
OSCP	Oil Spill Contingency Plan
OSR	Oil Spill Response
O-D	Origin-Destination
ODC	Over Dimensional Cargo
PFD	Personal Flotation Devices
PPE	Personal protective equipment
PAC	Provincial Armed Constabulary
QHSE	Quality, Health, Safety & Environment
RO	Regional Office
RA	Risk Assessment
RIS	River Information System
RNA	River Navigation Atlas
Ro-Ro	Roll-on – Roll-off
SCBA	Self-Contained Breathing Apparatus
SIC	Site Incident Controller
SOC	Site Operation Centre
SASE	Snow and Avalanche Study Establishment
SOP	Standard Operating Procedure
SAP	State Armed Police
SDMA	State Disaster Management Authority
SDMP	State Disaster Management Plan
SDRF	State Disaster Response Force
SEOC	State Emergency Operation Centre
SEC	State Executive Committee
SIDM	State Institute of Disaster Management
ToR	Terms of Reference
TML	Transportable Moisture Limit
ULSD	Ultra-Low Sulphur Diesel
UPDMA	Uttar Pradesh Disaster Management Authority
UP	Uttar Pradesh
UPPCL	Uttar Pradesh Power Corporation Ltd.
VTMS	Vessel Traffic Management System

WS	Water Supply
WTMS	Water Traffic Management System
WB	West Bengal
WBDMA	West Bengal Disaster Management Authority
WODA	World Dredging Association

Executive Summary

National Waterway - 1 (NW 1) with an extend of 1620 km is the longest waterway which is essential part of Ganga - Bhageerathi - Hooghly river system falling within 4 major States of the Country i.e. Uttar Pradesh, Bihar, Jharkhand and West Bengal exiting to Bay of Bengal. Industrial developments along the project region, proximity with Eastern Dedicated Freight Corridor and connection with Port of Call, Kolkata and its Dock complex at Haldia offers great potential for intermodal and multimodal operability for NW-1. Towards developing NW 1 as an alternative mode of transport, Government of India is assisted by International Bank for Reconstruction and Development under the flagship project "Jal Marg Vikas Project" through developing fairway between Varanasi and Haldia.

*As part of JMVP, A fairway of 45 m bottom width with 3.0/2.5/2.2/1.5 m Least Available Depth (LAD) is proposed for the Varanasi to haldia strech of waterway with provision of Multimodal Terminals at Varanasi, Sahibganj and Haldia with Intermodal terminals at Ghazipur and Kalughat and Tribeni. Ro-Ro terminals at 5 locations, construction of new navigational lock at Farakka, installation of RIS and VTMS facilities etc. are already integrated in the project. As per the standard design vessels for NW 1, the maximum vessel size allowed is 110*12*4.3 with a Dead Weight Tonnage around 2000 tonne requiring draft of 2.8m with an air draught of 9 m. 22 types of cargos are identified including hazardous and non-hazardous cargoes and total traffic expected in 5, 07,44,762 Tonnes by 2020 (Source: EIA Report, IWAI)*

The present study is targeted on identifying the risk associated with IWT operation in NW 1 and preparation of proposal for integration of IWT related risk with respective District Disaster Management Plans(DDMPs) of the 30 bordering districts with provision for escalation to involve national plan stakeholders based on the criticality of the incident. The study also includes preparation of onsite and offsite emergency plan for IWT related incidents and proposing emergency response equipments including cost estimation towards implementing the same.

Towards comprehensive risk assessment study, Consultants(KITCO) carried out detailed reconnaissance visit along the entire waterway and comprehensive database on salient features has been developed for NW 1.with support of extensive literature review with an interval of 2 km to delineate critical risk elements associated with waterway. As per the terms of reference, the study was focused on hazards associated with four risk elements i.e. related to channel, cargo, vessel and dredging for both offshore and onshore operations. Historical analysis shows that, hazards, which can develop into risky scenarios with respect to the four risk elements are grounding, collision, contact, fire and explosion. The consequence may include toxic contamination, toxic cloud, spillage of flammable liquid /gas. Vulnerability of project region to natural hazards i.e., cyclone, thunderstorm, flood, earthquake, tsunami, tidal bore were also assessed. Towards deriving the credible scenarios for detailed risk assessment, channel related risk were studied through critical section analysis, cargo related risk was assessed through intrinsic and inter compatibility issues, vessel related risk were assessed with causative factors and dredging related risk based on operation pattern. The major outcomes of the study are:

- *Out of the total 1620 km stretch of waterway, there are 325 sections along in NW 1 - 105 no between Prayagraj and Munger and 220 no between Munger and Haldia) due to presence of risk elements. There are **169 hotspots** identified all along the stretch studies.*
- *Total of 105 critical stretches identified for Prayagraj -Munger section, out of that, 38 are hotspots. The critical risk factors include critical bridge locations, pontoon bridges, mass gathering areas, environmentally sensitive stretches, high traffic areas, cargo handling terminal locations, multiple ferry crossings, sagging and eroding tower lines etc.*
- *There are 220 critical sections identified for Munger - Haldia section out of which 131 are hotspots. The critical risk factors within hotspots were sharp curves less than 200 , environmentally sensitive areas, high traffic areas such cargo jetties, multiple ferry crossings, presence of cross structures having low clearance, tower lines in eroding banks, lock gates and aqueducts etc.*
- *It is proposed that cautionary approach is to be adopted for the yellow sections, which are moderately critical and standard operating procedure, compliance with regulations, regular Thalweg surveys and dredging shall be adopted for the white sections including remaining sections. Also, in case of narrow stretches with thickly populated banks disaster management mechanism to be correctly aligned.*
- *The areas falling under Vikramshila Gangetic Dolphin Sanctuary and Kashi Turtle Sanctuary requires specific attention.*
- *The analysis of the intrinsic properties of cargo shows that, hazardous cargoes include liquefied ammonia, CNG, LNG, Petrol, High Speed Diesel, Furnace Oil, Coal, Ammonium Nitrate based Fertiliser (based on ammonium nitrate content) and Iron as Ferrous Metal Borings, shavings, turnings or cuttings or Iron Oxide, Spent or Iron Sponge, Spent (obtained from coal gas purification) which are to be transported as per the IMDG guidelines.*
- *Coal, Coke, Manganese Ore, and Iron in its various forms are attracting IMBC code require to follow the specific guidelines w r to the same and non-listed cargoes such as edible oil, food grains, plastic, paper, ODC etc. has to follow the best industry practice for safe transport through NW 1.*
- *Provision of RIS, VTMS facility, routine thalweg surveys, standardisation of cargo vessels for NW 1, implementation of FOCAL etc. would contribute for avoiding risks associated with vessels and manoeuvring. However, the risk associated with vessel malfunction, mis-communications, negligence of crew etc. cannot be ruled out and hence need close monitoring on operation and maintenance of vessels including the training and capacity building for the crew.*

A detailed disaster management plan has been prepared for inegration of the IWT related disaster operation for handling disasters onshore (terminal) and offshore (along waterway). The major aspects of DM Plan for NW-1 are

- *Being a continuous medium the emergency may easily transport from one location to another. As per the administrative system of India, the emergency within a State shall be routed through State and National Disaster Management Authority whereas*

incidents affecting multiple states the entire coordination shall be done through National Crisis Management Committee.

- *The onsite emergency plan has been prepared to deal the emergency Level 1 in a terminal with detailed proposal as Emergency Control Centre, Incident Management Team, Roles, Responsibilities, Training and Capacity Building including mock drills with provision of essential emergency equipment and facilities including the block cost estimate.*
- *For Level 2 /3 operation, proposal is made with suitable scaling up of intervention of IWAI-RO /HO in line with the DM Act, 2005 with provision of Incident Management Team at RO and HO with specific roles and responsibilities. A dedicated Crisis Management Group has been proposed at HO to handle the management decisions is and to coordinate with the apex authorities of country i.e. National Disaster Management Authority and National Crisis Management Committee. The proposal formulated has given the communication and operation flow and guideline suiting with both situations.*
- *Existing DM mechanism of each State was analysed in detail to understand the present nodal departments and specific roles assigned. The vulnerable resources along the project region of each State was listed out towards delineating the line departments / agencies who need to be integrated in the respective State Disaster Management Authority. Nodal departments who shall take care of the responsibility of coordination in each state as per the present operation plan was also delineated towards integrating the DM operations in case of an emergency. It is identified/proposed that*
- *For State of UP, Boat capsizing is the only IWT related disaster considered in the SDMP with Department of Revenue as Nodal Department. It is proposed to include IWT related disasters in SDMP with incremental cargo operation with suggesting Department of Revenue as nodal department. Vulnerable resources who may directly or indirectly affected include - Turtle Sanctuary, water supply Intake, Ferry services, Tourism vessels, Country boats, passenger vessels, fishing vessels, Jetties, HT line/Overhead Tower lines, Road bridge/ Rail bridge and human settlements, agriculture activities, common use of public. Since majority of respective line departments are already part of SDMA, it is proposed that Fisheries Department and Tourism Department to be integrated in the SDMA and integrate the same department in DDMAs of bordering districts of NW 1. IWAI and Ministry of Railways will act as resource agencies.*
- *For the State of Bihar, inland water transport related disasters are not identified as disaster within the state and is to be added in the disasters list in SDMP. The Secretary, Department of Transport, who is already part of SDMA could be represent SDMA, same department shall act as nodal department in case of IWT related disasters within the State. Vulnerable resources who may directly or indirectly affected include – water supply intake, Gangetic Dolphin Sanctuary, ghats, rural/urban settlements, pilgrim centres, road cum railway bridge, Ro-Ro, Passenger Boats, Agriculture, HT Lines and fishing activities. Additionally, Department of Revenue and Land Forms and Dept. of*

Industries shall be added as additional stakeholder in SDMA and essentially in DDMAs of bordering districts.

- *In the State of Jharkhand, inland water transport related disasters are not listed in SDMP and is to be integrated. The Secretary, Department of Transport is already designated as one of the ESF in the SDMA, who could be represented for handling the IWT related disasters. The same department shall act as nodal department in case of IWT related disasters within the State. Vulnerable resources of project region who may directly or indirectly affected include fishing and agriculture activities, Ro-Ro facilities, country boat operations, municipal water supply, common property resources such as temple, burning ghats etc. It is required that Department of Environment and Department of Industries has to be added within SDMA to meet the requirement of emergency handling in IWT sector.*
- *For the State of West Bengal, inland water transport related disasters are to be added to SDMP with proposed incremental cargo operation. The Secretary, Irrigation & Waterways Department is already part of SDMA could represent for handling the IWT related disasters. The same department shall act as nodal department in case of IWT related disasters within the State. Vulnerable resources of project region who may directly or indirectly affected include floating jetty, bank protection, irrigation water supply, fishing activities, vessels –tourism, ferry, passenger vessels, fishing harbour, H/T lines, agriculture activities, Port related traffic, Defence vessels/establishments road bridge, human settlements and public uses and drinking water supplies. It is proposed that Department of Land and Land Reform and Refugee Relief and Rehabilitation, Industry, Commerce and Enterprises, Department of Forest, Department of Environment with representation from State Pollution Control Board shall be added to SDMA. Kolkata Port Trust, IWAI, NTPC and Ministry of Railways would act as resource agencies within the project region.*
- *It is required that necessary inclusion of provision for Inland oil spill incidents to be integrated in the National Oil Spill Disaster Contingency Plan, which presently deals with only marine oil spill contingencies. However, following the essential criteria and guidelines of NOS-DCP, proposal has been made for handling oil spill incidents within NW 1. It is concluded that*
- *Only Furnace Oil is the persistent oil to be transported through NW 1 requiring specific Oil Spill Response (OSR) equipments. OSR equipments have been proposed for all terminals in line with NOS-DCP guidelines and it is proposed to have arrangement with Kolkata Port Trust and Indian Coast Guard for emergency operations in case of an offshore incidents.*
- *Emergency response equipment's including OSR equipments has been proposed at each IWAI terminal along with facilities for setting up of an Emergency Control Centre in IWAI terminals, Ro and HO.*
- *The block cost estimate for implementing the facilities at each terminal works out to* ***Rs. 6.66 Cr for an oil handling terminal*** *and* ***Rs. 1.49 Cr for a non-oil handling terminal.*** *The total cost for proposed 3 terminals works out to* ***Rs 19.98 Cr and Rs 4.5 Cr*** *respectively. The cost is inclusive of all tax except GST.*

- *RO and HO of IWAI shall be having a dedicated ECC facility to coordinate the response operations. The total cost estimate for setting up the facilities works out* ***to Rs. 20 Lakhs each totalling to Rs. 60 Lakhs*** *excluding GST.*
- *For handling the offshore emergencies associated with the vessels by respective DDMAs of the project region, it is proposed that additional facilities shall be ensured such as portable firefighting facilities and adequate PPEs etc. The total cost works out to* ***Rs.19.64 lakhs*** *for each DDMA and total of Rs.5.892* ***crore*** *for 30 districts in case the facilities proposed are not available with them.*
- *Environmental Sensitive Areas of project region – Vikramshila Gangetic Dolphin Sanctuary and Kashi Turlte Sancutary is proposed with specialised onshore oil spill containment facilities with provision of River Booms with accessories. The total cost works out* ***to Rs.78.85 Lakhs*** *excluding GST.*
- *IWAI shall have a dedicated provisioning for meeting with disaster management requirements with specific budgetary provisions to meet the expenses related with training, maintenance and upkeepting of the facilities and manpower to deal with any disaster situation.*

The best management practices that could be implemented at NW 1 for ensuring safe and sustainable IWT operation is proposed based on international practices and study has integrated the essential Standard Operating Proceedure (SOPs) as per Inland Vessel act and specific protocosl on speed control, monitoring, vessel tracking, waste management, incident reporting with aquatic mammals, hazardous chemicals handling etc. as part of the study. The final report incorperates all the findings of the study is submitted for approval.

1

INTRODUCTION

India is blessed with more than 18, 240 km of navigable or potentially navigable waterways through the extensive network of rivers, canals, creeks and back waters. It is with clear understanding on the potential and advantages of the inland waterways development for the country that Inland Waterways Authority of India (IWAI) was set up in October, 1986 vide IWAI Act, 1985 under the Ministry of Shipping (MoS) towards coordinating the task of developing, monitoring and administering Indian waterways. IWAI plays a key role in the expansion and maintenance of the waterways with development of infrastructure and regulations in National Waterways (NWs), taking up feasibility studies and advising Central Government and supporting State Governments in their initiatives to develop waterways. So far, 111 waterways of the country have been declared as NWs.

Ganga - Bhageerathi - Hooghly river system of 1620 km is the longest waterway in India, declared as national waterway with effect from 27th October, 1986. It spans from Central portion of North India till North –West Boundary of India, exiting to Bay of Bengal. The historical waterway is geographically, economically and strategically important and is serving as a lifeline of the country in all respects in terms of its multifaceted dependence stretching through four states, i.e. Uttar Pradesh, Bihar, Jharkhand and West Bengal, which have been marked with industry as a thrust area. The waterway is located in close proximity with Eastern Dedicated Freight Corridor (EDFC) and connectivity to Port of Call, Kolkata and Haldia make it apt for the establishment of vast network with ample opportunity for both intermodal and multimodal systems.

Understanding the potential of NW 1 to serve as an alternative mode of transport, the Government of India (GoI) has been assisted by the International Bank for Reconstruction and Development (IBRD) to develop the same as an alternative mode of transport under the flagship project “Jal Marg Vikas Project (JMVP)”. The project envisages developing fairway between Varanasi to Haldia covering a distance of 1620 km with many infrastructure interventions in between such as development of cargo terminals, Roll-on – Roll-off (Ro-Ro)

terminals, re-development of navigational lock etc. This would enable commercial navigation of vessels of around 2000 Dead Weight Tonnage (DWT).

River Ganga being a perennial river with industrial areas developed along its banks offers potential for commercial activities. However, it is to be noted that like any activity there are inherent risks as well as that posed by the hazardous commodities. Thus, it is necessary to undertake a detailed risk assessment study on safety and sustainability aspects. IWAI recognizes the need to preserve and protect human health and natural environment from the ever-present risk of oil and chemical spills, accidents and other natural hazards. In this context, the risk assessment study for the transport of existing and prospective cargo movement is highly relevant. The risk management measures would be integrated as mutually agreeable Disaster Management Plan (DMP) for NW 1, after due consultation with all the stakeholders including Disaster Management Authority (DMA) and integration of the same to the District Disaster Management Plan (DDMP). This proactive step will ensure integration of sustainability aspects to the planning as well as operational aspects of the IWT operations and maintenance of the same.

With present national policies focusing on the improvement of NWs, with several initiatives have been taken up by the government for enhancing the essential infrastructure facilities, establishing communication and navigation aids, ensuring regular maintenance of channels etc., the present study would be a leap in the sustainable management of IWT operations of cargo transport, especially hazardous cargo transport through prestigious inland waterways of India and a bench mark project for NW 1.

Through the national competitive bidding, M/s. KITCO Limited, Kochi, India's first state level public sector technical consultancy organisation was qualified as the Consultant towards undertaking the Risk Assessment study towards integration of IWT related risk in to DDMP and awarded the above work through Contract No.IWAI/WB/NW-1/10/3(4)/2016 dated 04thApril 2018. The present report makes the Final Report of the study incorporating all scope of work as per the Terms of Reference (ToR) requirement. The report has been structured in to 2 Volumes including this introduction as below.

- Volume I –Final Report
  - Section 1 - Introduction
  - Section 2 - Salient Features of Waterway and its Operational Profile

- Section 3 - Risk Assessment
- Section 4 – Proposal on DM Plan for IWT Related Disasters for NW 1.
- Section 5 – Best Management Practices

- Volume II –Final Report – Protocols, SOPs and Annexures

2

SALIENT FEATURES OF NW 1 AND ITS OPERATIONAL PROFILE

NW 1 forms the part of the Ganga-Bhagirathi-Hooghly river system, extends between Allahabad in Uttar Pradesh to Sagar Island in West Bengal. The waterway connects four major states of the Country; Uttar Pradesh (UP), Bihar, Jharkhand and West Bengal (WB) and serves multi-stakeholder utilization pattern. It is fed by various tributaries along the entire stretch such as Tons, Gomti, Ghaghara, Sone, Gandak, Punpun and Kosi. A fairway of 45 m bottom width with 3.0/2.5/2.2/1.5 m Least Available Depth (LAD) is being provided for the entire waterway.

Most sacred river of India, the Ganges is mainstay of this system and has the status "living human entities" and first to receive the same in the country. It is the lifeline to millions of Indians who live along its course and depend on it for their daily needs. NW 1 passes through diverse cultural and socio-economic provinces having much of difference in language, geography, means and way of living for those who depend on this water body. With industrial developments picked up in the respective States, there are numerous industrial units set up along the riverbank and its hinterlands. The portion of the water body declared as NW 1 forms part of major important pilgrim centers and thus attracts tourist activities throughout the year.

NW 1 on its long course serves major cities and their industrial hinterlands like Haldia, Howrah, Kolkata, Sahibganj, Bhagalpur, Munger, Patna, Ghazipur, Varanasi and Allahabad, which are themselves the key promoters for the IWT operations in NW 1. Thus, JMVP aims at making it a full-fledged parallel transportation system to facilitate the commercial operations, with adequate connectivity with conventional transportation network including intermodal and multimodal aspects. **Figure 2.1.** presents the location map of the project region.

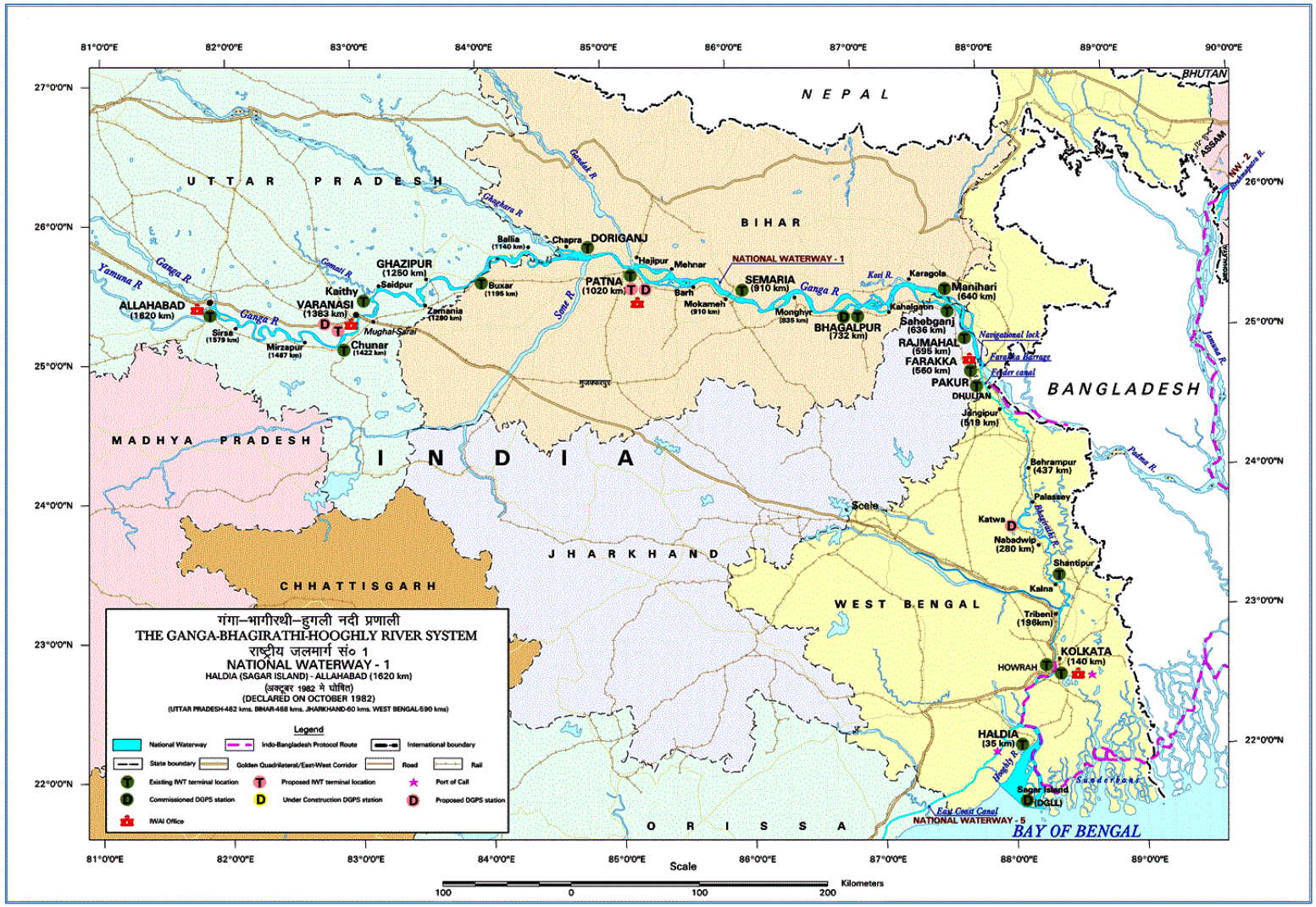


Figure 2.1. Location Map of NW 1

While considering the utilization of NW 1 as a cargo transport medium, it could be seen that the cargo includes wide variety of both solids and liquid commodities including hazardous ones. Also, at presen,t there have been extensive movement of Over Dimensional Cargo (ODC) especially related to Thermal Power projects by various power companies. Other common operators are tourism vessels, Inland Waterways Authority of India (IWAI) vessels and other traditionally operated vessels. Liquefied Natural Gas (LNG) is a prospective commodity under consideration in the near future. Operations of LNG operated vessels are also anticipated.

The present study targets on assessing the risk associated with cargo operation in NW 1 towards deriving a proposal for integration of risk into DDMPs of the project region.

2.1. Scope of the Study

The main objective of the present assignment is to prepare a detailed Disaster Management Plan for NW-1 in compliance with the existing DM structure of the country as the DM ACT 2005. The study will be conducted as two parts offshore and onshore. Offshore operations involve water activities with respect to the waterway, while onshore interventions for waterway activities which essentially requires activities/interventions with land –water interface such as Jetties, Terminals, Risk Information System(RIS)/ Differential Global Positioning Systems (DGPS) stations, ship repair facilities, lock gate, other assets etc.

Each aspect of NW-1 has been evaluated; independently based on its respective vulnerabilities to find and detail the declared "**hotspots**" along NW-1 and will make a recommendation to the IWAI to identify the more promising development of the DMP, which will include allocation and stockpile of resources at the designated hot spots.

For this project, the following activities will be done in brief:

- Review and adopt the international standards used in the DMP for inland waterways
- Analyse the IWT operational profile of NW - 1 with respect to all potential cargo movement.
- Risk Assessment
- Identify all "Hotspot" related risks under construction, operation and maintenance activities for NW-1
- Examine the vulnerability of the stakeholders affected by these risks

- Determine retained and transferable risk and quantify each risk using deterministic and probabilistic approaches for analysis as applicable.
- Identify practically possible safeguard options for integration to IWT operational procedure, ie., potential offshore & onshore emergencies during all phases of the project ie., construction, maintenance & operation phase of the waterway, river/marine accidents like grounding, collisions, capsizing etc., oil spill disaster contingency plan along NW-1, including plan for hazardous goods and vessels operating and/or carrying LNG/CNG as define by law in India.
- Develop an emergency preparedness and response strategy which shall outline the potential foreseeable emergency scenarios, classification, resources, incident command structure and a management plan encompassing prevention, control, recovery and remediation measures to deal with any emergency event that may occur within the project during construction, maintenance & operation phases.
- Preparation of Standard Operating Procedures (SOPs) in line with the Inland Vessels Acts, 1917 as amended from time to time.
    - Development and update of following protocols:
    - For speed control, monitoring, and vessel tracking
    - Waste management for barge operations and terminals
    - Biodiversity protection & accident reporting with aquatic mammals
    - Oil & Hazardous chemicals spills reporting and control and remediation as define by law in India.
    - Risk assessment procedures to assess and manage risks to personnel, vessels and the environment.
- Internal and external audit procedures and frequency.
- Delineate a methodology for integration of operational risk abetment measures to existing District Disaster Management Plan (DDMP) and coordinate with all nodal agencies on behalf of IWAI.
- Formulate capacity building and training strategy for effective implementation of comprehensive Disaster Management Plan.
- The Disaster Management Plan for NW-1 shall lay down clear guidelines for execution of mock drills of the plans.
- Validate the cost estimate for each segment of the DMP (i.e. infrastructure cost, equipment cost and training cost) based on the information collected for the NW-1. If

any relevant costs are missing in the studies, the Consultant is responsible to make the proper estimates. IWAI will facilitate the access of the Consultant to the relevant documentation;

- The DMP for NW-1 therefore will cover all phases of a disaster and therefore will have three plans - Mitigation Plan, Preparedness Plan and Response Plan and confirm that each part of the DMP substantially complies with local, state and national international safety, environmental and social requirements, and if not, what additional steps need to be taken in this regard.
- The DMP for NW -1 there for will cover all phases of a disaster and therefore will have three plans – mitigation plan, preparedness plan and response plan.
- Assistance of any statutory clearance/approvals for proposed Disaster Management Plan for NW-1.

2.2. Approach and Methodology

The present study targets on assessing the risk associated with the enhanced IWT operation with implementation of JMVP. In order to facilitate realistic view on the risk assessment study, the salient features of the waterway focusing to its key features w.r.to risk has been primarily delineated. IWT sector has 4 major components – channel, terminal, vessel and cargo. The salient features of channel, operation pattern of cargo transport and the properties of cargo are critical influential factors and multifaceted interaction between the activities/features or with operation, which will be emerged as a hazard, are analyzed in detail in the risk assessment study. Sequence of activities are presented in **Figure 2.2**.

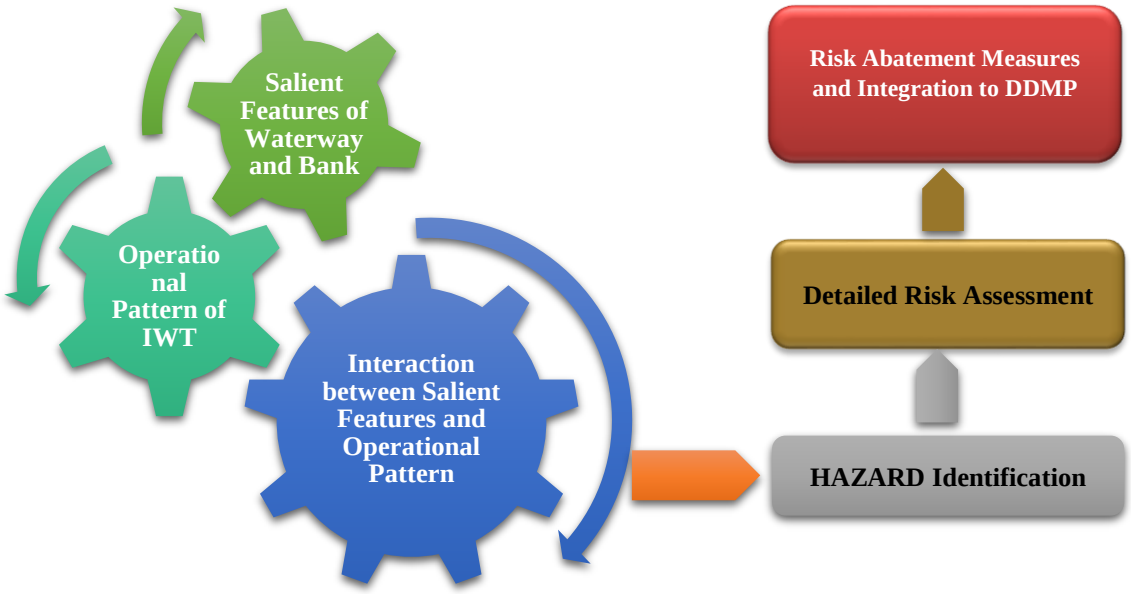


Figure 2.2. Sequence of Activities Leading to RA for NW 1

The salient features of the waterway has been studied in detail to understand its specific attributes and operational pattern, which are directly influencing the risk profile. The various components which become critical in risk include the features of the water body, the activities within the water body and the features along the bank in order to delineate the multifaceted interaction in between them which may derive as a risk element in the IWT operation.

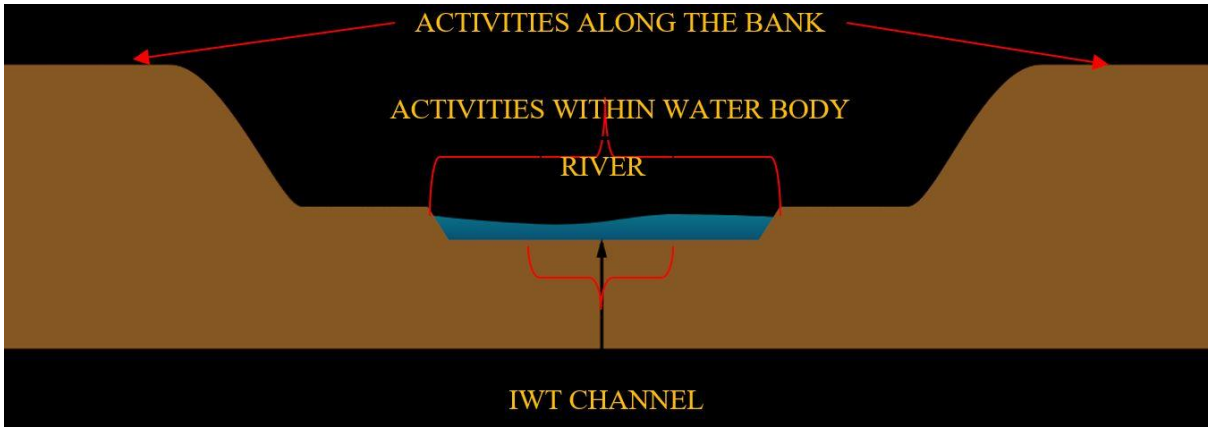


Figure 2.3. Schematic Representation of Salient Features of Waterway Influencing Risk

Thus, the salient features of the waterway could be assessed under three categories as below.

- Features of the river/fairway: Width of water body, Channel Morphology – Straight/meandering, alignment of fairway, proximity to bank, siltation areas, channel diversion areas, stream entering areas, environmental sensitivity of stretch, disaster prone areas etc.
- Activities within the water body: Transportation (ferry/cargo/passenger vessel/tourist vessels, fishing vessels), Jetty (Cargo/passenger/Ro-Ro), Recreation, Water Supply (WS) intake, agriculture Intake, navigation locks, industrial intake, country boat fishing, Net fishing, presence of vertical structures – road, railway, bridges, multiple bridges, electric line crossings, Common Public Utilities – Washing , bathing, Swimming, Cattle Rearing, cooling tower outfall etc.
- Bank Features– proximity of fairway to bank, bank characteristics – flat, gentle slope, steep slope, type of bank – clay/sand/soil, bank protection (rubble embankment/natural levees, grasy/open), sensitivity of Bank – Urban, town, rural, barren land, island, residential, agriculture, vegetated, educational institutions, industrial, historic monuments, temple/church/mosque, burning ghats, hospitals etc.

Risk due to IWT operation is a cumulative of probability of accident and the consequence on the receptors on various aspects. Through an extensive review of the features of the waterway, the critical elements, which may be a risk element, or the receptors, which could be critically impacted are delineated. A comprehensive five tier approach integrating the secondary and primary data collection through reconnaissance visits were followed as below towards establishing a well-defined project area profile towards delineating the critical aspects to be integrated in to the risk assessment study.

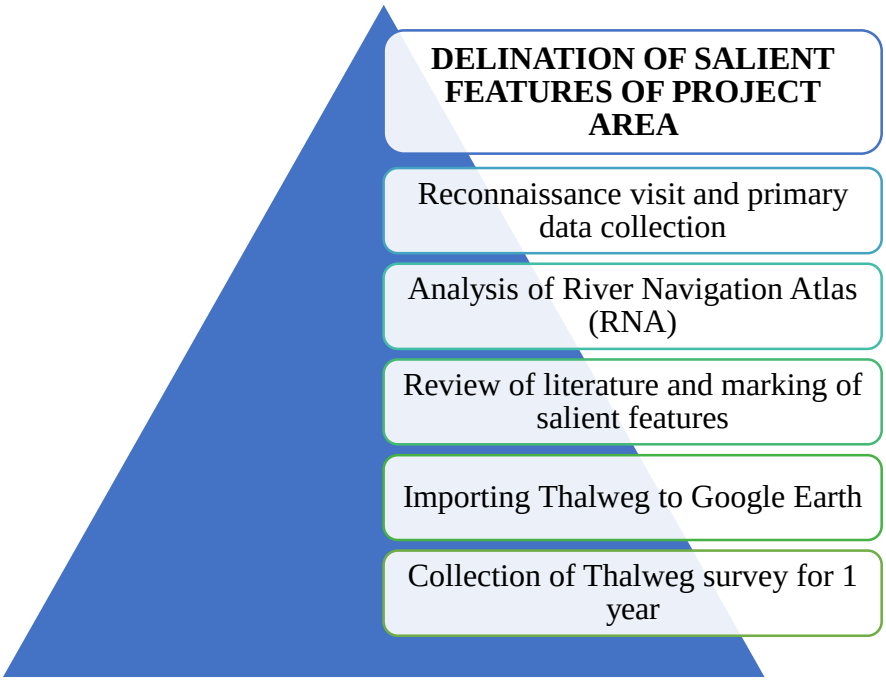


Figure 2.4. Five Tier Approach in Delineating Salient Features of Project Region

The details of Thalweg surveys conducted for the period from January 2017 to December 2017 has been analysed and it was observed that there is no major deviation in the survey route. The fairway has been demarcated at an interval of 2 km and the various sections has been further divided in to sub sections to ease the understanding and anlaysis. Consultants including the Key Professionals with Supporting Key Professionals has carried out extensive reconnaissance visit through the entire stretch of waterway towards understanding the salient features between 17 May, 2018 to 10 June 2018 (Munger – Haldia Section) and 4 August, 2018 to 12 August, 2018 (Allahabad – Munger Section) under two schedules. A detailed inventory of the project region has been prepared for an interval of 2 km. The detailed analysis of the fairway alignment and sensitivity of activities has been carried out based on the literature review and reconnaissance visits, discussion with the officials in charge and Focus Group Discussions (FGDs) along the way. Detailed RA was followed towards preparation of DMP for IWT operation in NW - 1.

2.3. Salient Features of Waterway

The 1620 km waterway, reigning between Allahabad and Haldia forms part of a round the year operational waterway without any serious seasonal implications to navigability. The waterway section falls in 4 major states of the Country as presented in **Table 2.1**.

Table 2.1. State Wise Administrative Demarcation of NW 1

State	Section	Chainage (km)		Total Length (km)
		From	To	
Uttar Pradesh	Prayagraj – Rasulpur	1454	1092	362
Uttar Pradesh & Bihar	Rasulpur - Chappara	1092	982	110
Bihar	Chappara - Munger	982	762	220
Bihar	Munger – Rampur Ogairah	762	588	174
Jharkhand	Rampur Ogairah – Gadai Maharajpur	588	572	16
Bihar	Gadai Maharajpur – Naobarar Jaigir	572	558	14
West Bengal	Naobarar Jaigir – Nityanandapur	558	516	42
Jharkhand	Nityanandapur - Dogacchi	516	512	4
West Bengal	Dogacchi – Haldia	512	0	512

The entire waterway can be divided mainly into six stretches, viz.

- Prayagraj to Varanasi Multimodal Terminal- Medium wide stretch with total length of 204 km
- Varanasi Multimodal Terminal to Chappara- Medium wide stretch with total length of 268 km
- Chappara to Munger- Wider Stretch with total length of 220 km
- Munger to Farakka lock gate- Wider stretch with total length of 262 km
- Farakka lock Gate to Kolkata- Narrow stretch with total length of 400 km
- Kolkata to Haldia- Medium and wider stretch with total length of 100 km

A brief description of the project region is presented below and a detailed description along the alignment is presented in **Annexure I**.

2.3.1. Prayagraj - Varanasi Section

Prayagraj – Varanasi section starts at Ch. 1454 km and ends at Varanasi Multimodal Terminal in Ch. 1250 km. The entire riverine stretch is sufficiently wide with an average width of 600 m with elevated banks and sand beds within the river boundaries. The average LAD along this stretch is about 1.5 m. The entire stretch runs through the State of Uttar Pradesh and Prayagraj, Mirzapur, Sant Ravidas Nagar and Varanasi are the bordering districts. The location of Triveni Sangam, where three holy rivers Ganga, Yamuna and mythical Saraswathi confluences lies in this stretch. River Tons is the other major river joining this waterway. The major settlements along this stretch are Prayagraj, Mirzapur, Chunnar and Varanasi. Cultivation is the major

activity observed along the banks. Gyanpur lift irrigation project and other medium and small scale irrigation pumps are present within the river. Among the hotspots identified, critical bridge at Mirzapur and eroded tower lines at Paranipur are within this stretch.

2.3.2. Varanasi - Chappara Section

Varanasi – Chappara section starts from Ch. 1250 km near Varanasi Multimodal terminal at Varanasi, Uttra Prasesh and ends at Chappara in Bihar where river Ghaghara joins the waterway changing the profile of the river. Bordering districts along the stretch are Varanasi, Chandauli, Ghazipur, Ballia, Buxar, Saran and Bhojpur. The entire stretch are sufficiently wide with 1.5 to 2 m LAD. Major rivers joining the waterway are Varuna, Assi, Gomti, Karamnasa, Thora, Tamsa and Ghaghara. The declared Kashi Turtle Sanctuary at Varanasi also lies in this stretch. Major settlements include the famous Varanasi Municipal Corporation, Ghazipur, Buxar, Ballia and Chappara. Varanasi temple is a world famous pilgrimage centre and is a location of mass gathering along this stretch. The critical features identified includes the critical Rajghat Bridge at Varanasi and sagging tower line at Ghazipur. Other important features includes Multimodal Terminal of Ramnager, Proposed Intermodal terminal at Ghazipur and Ramnagar Fort. State boundaries of Bihar starts at Rasulpur from Ch. 1092 km and the river runs within the jurisdiction of state of Bihar along right bank and under the jurisdiction of state of Uttar Pradesh on the left bank upto Chappara near Ch. 982 km.

2.3.3. Chappara - Munger Section

Between Chappara (Ch. 982 km) – Munger (Ch. 762 km) stretch, the river is wide with an average width of 2 km and 2 to 2.5 m LAD in the channel. The bordering districts in this stretch are Saran, Bhojpur, Patna, Vaishali, Samastipur, Lakhisarai, Begusarai and Munger. The major rivers joining this stretch are Sone, Gandak and Punpun rivers. The major settlements includes the famous capital city of Patna, Chappara, Fatuha, Barh, and Munger. NTPC Barh, Thermal Power Station at Barauni, brick kilns at Lodipur are the major industrial unit along the stretch. Confluence point of Sone River with Ganga River is a high traffic area, where barges moves with sand across the river and Kothiya, near Patna is another location of high traffic. Critical features includes eroded tower lines at Kothiya, critical bridge at Simariya and temporary pontoon bridges connecting the banks at different locations in this stretch.

2.3.4. Munger – Farakka Lock Gate Section

Munger (Ch. 762 km) – Farakka lock (Ch. 500 km) gate are wider section with an average width of 2 km and 3 m LAD is maintained throughout the stretch. This stretch of waterway traverse through three main states namely Bihar, Jharkhand and West Bengal on reaching Farakka lock gate. NW 1 borders through the districts of Munger, Bhagalpur, Khagaria, Purnia, Katihar, Sahibganj, Malda and Murshidabad in this stretch. The declared Vikram-shila Dolphin Sanctuary from Sultanganj to Kahalgaon lies along this stretch. The other predominant feature along the waterway is the Farakka barrage across River Ganga. Major River Koshi joins the waterway downstream of Kahalgaon and before reaching Manihari. Major settlements include Munger, Sultanganj, Bhagalpur, Kahalgaon, Sahibganj, Rajmahal and Farakka. The Sahibganj Multimodal Terminal in the State of Jharkand lies in this stretch. Ro-Ro ferry service connecting the opposite banks of river can be seen at Manihari and Rajmahal. Critical aspects include eroding tower lines at Bakiasukhai near Manihari and Farakka Lock gate. This section is devoid of pontoon bridges and is continuously navigable throughout the year.

2.3.5. Farakka Lock Gate – Kolkata Section

The stretch between Farakka Lock Gate and Kolkata is a narrow stretch with an average width of 300 m and lies in the State of West Bengal. Feeder canal is runned for a length of 40 km from the Farakka Barrage and is the major source of water for navigation system. The assured depth of waterway in this stretch is about 3 m and this is the Bhagirathi- Hooghly river stretch of NW - 1. The bordering districts are Murshidabad, Purba Bardhfaman, Nadia, Hooghly, North Twenty Four Parganas, Kolkata and Howrah. Major rivers joining this stretch are Bhagirathi and Ajoy. Major settlements include Farakka township area, Jangipur, Behrampore, Katwa, Nabadwip, Kalna, Kalyani, Dakshineswar, Belur and the entire Kolkata Metropolitan area lies along this stretch. Critical features identified includes Pakur Bridge, Howrah Bridge, Vivekananda Setu, and eroded tower lines at Malopara. The banks are mainly utilited for cultivation in the upstream section and on reaching Kolkata land use pattern changes to industrial/urban use. The major industries includes NTPC Farakka, Bandel Thermal Power Plant, Jute mills and Paper mills. Water intake structures for municipal and irrigation application were seen all throughout the stretch and the prominent municipal supply units includes units at Barrackpore, Kalna, Nabadwip and Kalyani.

2.3.6. Kolkata – Haldia Section

Kolkata (Ch.100 km) – Haldia (Ch.0 km) stretch is a sufficiently wide stretch with a width varying from 400 – 5000 m near Haldia terminal. Average assured depth throughout the stretch is 3 m and the shipping channel of Kolkata Port Trust (KoPT) lies in this stretch. Bordering districts in the alignment are Kolkata, Howrah, Purba Medinipur and South Twenty Four Parganas. Rupnarayan River joins the waterway near Noorpur, where the width is about 2 km. The world's second tallest power transmission towers of height 236 m is located near Haldia between Ch.30 km and Ch.32 km. Major industrial areas include Falta Special Economic Zone, Budge Budge installation , Haldia industrial area and Kolkata Port Trust area. The entire stretch experiences heavy vessel traffic whole throughout the year. This stretch is also form part of declared Indo-Bangladesh protocol route, where cargo vessels moving with fly ash and food grains are predominant. Salient features of waterway has been assessed in detail in identification of critical sections and hotspots as part of Risk Assessment.

2.4. Infrastructure Facilities

The details of existing as well as proposed terminals/jetties are presented in **Table 2.2** followed by brief description of features around the terminals.

Table 2.2. Details of Existing and Proposed IWT Terminals in NW 1

Sl. No.	Name of Terminal with Chainage (in km)	Land Area (in ha)	Size of Berth, Water front (in m)	No. of Pontoon Barge & Gangway	Cargo Handling Equipment	Storage Area	Link Approach Road	Security (in each shift)	Water/ Lighting Facility	Remarks
Existing Terminals										
1	Allahabad (Ch. 1535.00 km)	8.759	35 m berth and 300 WF	01- Pontoon Barge 01- Pontoon Gangway	Nil	To be stored on Pontoon and open space of IWAI land (0.5 ha)	Pucca Rasta (Concrete road) 500 m and metaled road 2 km connected with NH -76.	01 - armed 01 - unarmed	Drinking Water facility available.	Generator could be provided for lighting if required
2	Ramnagar (Varanasi) (Ch. 1315.00 km)	5.586 Hectare Land	35 m berth & 300 WF	01- Pontoon Barge 01 - Pontoon Gangway	Nil	To be stored on Pontoon and open space of IWAI land (0.2 ha)	Connecting with NH- 07.	01 - armed 01 - unarmed	-	Being developed under JMVP
3	Ghazipur (Ch. 1177.00 km) / Rajghat (Varanasi km)		35 m berth	01- Pontoon Barge 01- Pontoon Gangway	Nil	To be stored on Pontoon. Private land could be made available if required	Kachcha Rasta (Earthen Road) 100 m and Pucca road 100 m connected with NH 19.		Drinking Water facility available	Generator could be provided for lighting if required

Sl. No.	Name of Terminal with Chainage (in km)	Land Area (in ha)	Size of Berth, Water front (in m)	No. of Pontoon Barge & Gangway	Cargo Handling Equipment	Storage Area	Link Approach Road	Security (in each shift)	Water/ Lighting Facility	Remarks
4	Buxar (Ch. 1124 .00 km)		35 m berth	01- Pontoon Barge 01- Pontoon Gangway	Nil	To be stored on Pontoon. Private land could be made available if required	Kachcha Rasta 100 m and Pucca road 400 m connected with NH -84.		Drinking Water facility available and Street Lights available as provided by Local Administration	
5	Semaria (Ch. 850.00 km)		35 m berth	01- Pontoon Barge 01 - Pontoon Gangway	Crane on Pontoon available	To be stored on Pontoon. Private land could be made available if required.	Kachcha Rasta 200 m and Pucca road 300 m connected with NH -31.		Drinking Water facility available	
6	Munger (Ch. 793 .00 km)	1.37 ha Land	35 m berth	01- Pontoon Barge 01- Pontoon Gangway	Nil	To be stored on Pontoon and open space of IWAI land (0.1 ha)	Pucca Rasta 100 m and metaled road 5 km connected with NH- 80.	01 - armed 01 - unarmed	Drinking Water facility available and Street Lights available provided by Local Administration	Generator could be provided for lighting whenever required
7	Bhagalpur (Ch 715 .00 km)	1.56 ha Land	35 m berth	01- Pontoon Barge	Nil	To be stored on Pontoon	Pucca Rasta 300 m and metaled	01 - armed	Drinking Water Sodium Vapor	DGPS Station is operational and being

Sl. No.	Name of Terminal with Chainage (in km)	Land Area (in ha)	Size of Berth, Water front (in m)	No. of Pontoon Barge & Gangway	Cargo Handling Equipment	Storage Area	Link Approach Road	Security (in each shift)	Water/ Lighting Facility	Remarks
				01- Pontoon Gangway		and open space of IWAI land (0.1 ha)	road 2 km connected with NH- 80.	02 - unarmed	Lamps (Full Illumination)	utilized since 2010.
8	Bateshwarsthan (Ch. 683.00 km)	-	35 m berth	01- Pontoon Barge 01- Pontoon Gangway	Nil	To be stored on Pontoon.	Kachcha Rasta 200 m and Pucca road 5 km connected with NH - 80.	-	Drinking Water facility available	Generator could be provided for lighting whenever required
9	Samdaghat (Sahebganj) (Ch.617.00 km)	-	35 m berth	01- Pontoon Barge 01- Pontoon Gangway	Crane on pontoon	To be stored on Pontoon. Private land could be made available if required	Kachcha Rasta 300 m and Pucca road 1 km connected with NH -80.	-	Drinking Water facility available	Generator could be provided for lighting whenever required
10	Manglahat (Rajmahal) (Ch.588.00 km.)	-	35 m berth	01- Pontoon Barge 01- Pontoon Gangway	Nil	To be stored on Pontoon. 11Private land could be made available if required	Kachcha Rasta 100 m and connected with NH -80	-	Drinking Water facility available	Generator could be provided for lighting whenever required

Sl. No.	Name of Terminal with Chainage (in km)	Land Area (in ha)	Size of Berth, Water front (in m)	No. of Pontoon Barge & Gangway	Cargo Handling Equipment	Storage Area	Link Approach Road	Security (in each shift)	Water/ Lighting Facility	Remarks
11	U/s Farakka (Ch. 545.00 km)	0.48 ha land	35 m berth	01- Pontoon 01- Bamboo Gangway	Nil	To be stored on Pontoon & land of FBP	100 m	01- armed 03- unarmed	Drinking Water Sodium Vapour Lamps	Land belongs to FBP being used by IWAI.
12	D/s Farakka (Ch. 542.00 km)	-	35 m berth	01- Pontoon 01 Bamboo Gangway	Nil	To be stored on Pontoon.	Along the road	Nil	Street Lights provided by Local Administration	Land not available pontoon placed on water front
13	Hazardwari (Ch.439.00 km)	-	35 m berth	01- Pontoon 01- Bamboo Gangway	Nil	To be stored on Pontoon.	100 m	Nil	Street Lights provided by Local Administration	Land not available pontoon placed on water front
14	Katwa (Ch. 334.50 km)	-	35 m berth	01- Pontoon 01- Bamboo Gangway	Nil	To be stored on Pontoon.	1.5 km	Nil	Nil	Land not available pontoon placed on water front
15	Swaroopganj (Ch.280.00 km)	0.23 ha land	35 m berth	01- Pontoon 01- Bamboo Gangway	Nil	One Godown of size 4.5 x 5 m and Open space (0.029 ha)	500 m	01 - armed 03 - unarmed	Drinking Water Sodium Vapour Lamps	Land taken from KoPT on lease basis

Sl. No.	Name of Terminal with Chainage (in km)	Land Area (in ha)	Size of Berth, Water front (in m)	No. of Pontoon Barge & Gangway	Cargo Handling Equipment	Storage Area	Link Approach Road	Security (in each shift)	Water/ Lighting Facility	Remarks
16	Shantipur (Ch. 241.00 km)	0.8 ha land	35 m berth & 100 WF	01 - Pontoon 06 - Modular Pontoons Gangway	Nil	To be stored on Pontoon and open space of IWAI land (0.2 ha)	3 km	03 - unarmed	NIL	Land belongs to State Govt. of W.B. being used by IWAI.
17	Tribeni (Ch. 196.00 km)	-	35 m berth	01 - Pontoon 01 - Bamboo Gangway	Nil	To be stored on Pontoon	Along the road	01 - armed 02 - unarmed	NIL	Land not available pontoon placed on water front
18	BISN Jetty & G.R. Jetty-1 (Ch. 135.00 km)	3.04 ha land	70 m berth & 100 WF	03 – Pontoons 01 - Steel Gangway	Nil	Open Space area (0.6 ha)	1 km	01 - armed 03 - unarmed	Sodium Vapour Lamps	Land taken from KoPT on lease basis
19	Botanical Garden Jetty (Ch. 134.50 km)	0.09 ha land	35 m berth & 50 m WF	01 - Pontoon 01 -Steel Gangway	Nil	To be stored on Pontoon	150 m	03 - unarmed	Sodium Vapour Lamps (Full Illumination)	Land belongs to KoPT being used by IWAI.
20	Haldia (Ch. 35.00 km)	1.09 ha land	70 m berth & 200 m WF	04 Pontoons 01 Gangway	Nil	One Godown of size 12 x 30 m and Open	3.5 km via HDC	01 – armed 03 - unarmed	Drinking Water Sodium Vapour Lamps	Land taken from Haldia Dock Complex (HDC) on lease basis.

Sl. No.	Name of Terminal with Chainage (in km)	Land Area (in ha)	Size of Berth, Water front (in m)	No. of Pontoon Barge & Gangway	Cargo Handling Equipment	Storage Area	Link Approach Road	Security (in each shift)	Water/ Lighting Facility	Remarks
						space (0.163 ha)				
B) Fixed Terminals										
1	G.R.Jetty -2 (Ch. 134.50 km)	1,4 ha land	70 m berth	-	-	One Transit shed of size 25 x 46 m and Open space (0.4 ha)	500 m.	01 - armed 03 - unarmed	Drinking Water Sodium Vapour Lamps	Land taken from KoPT on long term lease basis. RCC Jetty completed and being operational since Nov., 2013.
2	Farakka RCC Jetty (Ch. 542 km)	-	115 m berth	-	-	-	Along the road	-	Drinking Water Sodium Vapour Lamps	Owned by FBP this can be used by the common users.
3	Pakur RCC Jetty (Ch. 522 km)	-	60 m berth	-	-	-	1 km	-	-	Owned by FBP this can be used by the common users.
Multimodal Terminals										
1	Varanasi	Multimodal								
2	Sahibganj	Multimodal								
3	Haldia	Multimodal								

Sl. No.	Name of Terminal with Chainage (in km)	Land Area (in ha)	Size of Berth, Water front (in m)	No. of Pontoon Barge & Gangway	Cargo Handling Equipment	Storage Area	Link Approach Road	Security (in each shift)	Water/ Lighting Facility	Remarks
4	Ghazipur	Intermodal								
5	Kalughat	Intermodal								
6.	Tribeni (under consideration)	Intermodal								

Source: www.iwai.nic.in

2.5. Salient Features of Multimodal and Intermodal Terminal Areas

2.5.1. Varanasi Multimodal Terminal

Varanasi is the historical city of Kashi, which has got both the religious and architectural importance. Varanasi multimodal terminal is located at Ramnagar between Ch. 1250 to 1248 km, on the right banks of river Ganga (**Figure 2.5**). The terminal was inaugurated in November, 2018. Terminal location is within Varanasi municipal corporation limit, near Ramnagar Fort with residential area of Milkipur north**.** It is connected with NH 2 through a dedicated road at around 700 m. Downstream of terminal lies the Kashi Turtle Sanctuary Ghats of Varanasi are the important physical receptors in the locality. Also, the area is densely populated.

Figure 2.5. Varanasi Terminal and Immediate Surroundings of 1 km

2.5.2. Sahibganj Multimodal Terminal

The multimodal terminal is located on the RHS of river Ganga at Ch. 582 km with location close to Sakrigali railway station around 1.45 km and is also accessible through NH 80. The area is mainly rural, with scattered settlements. At this location, the channel is having a width of around 4 km, in which there are a number of Ghats namely, Dilram Yadav Ghat, Samda Nala Ghat and Kusum Ghat. Land use is mainly for vegetation and a small school is present at around 1 km, south of the terminal location. Shoals are present and hence relatively isolated. This is a shoal forming area.

Figure 2.6. Sahibganj Terminal and Immediate Surrounding of 1 km

2.5.3. Haldia Multimodal Terminal

A multimodal terminal is under construction on RHS bank of river Hooghly at Ch. 4 km. The Haldia terminal is located in East of Medinipur District of West Bengal. The landward side of the project belongs to Coastal Regulation Zone (CRZ) - II, which are part of already developed municipal areas of Durgachawk. Here the adjoining area is the industrial area viz., with immediate neighbors are the Bharat Petroleum Corporation Limited (BPCL), United Phosphorus Limited, Consolidated Fiber and Tata Chemicals Limited. Durgachack is the nearest railway station. There is a residential colony located towards the landward side further north. The area form part of an already developed industrial belt of Haldia.

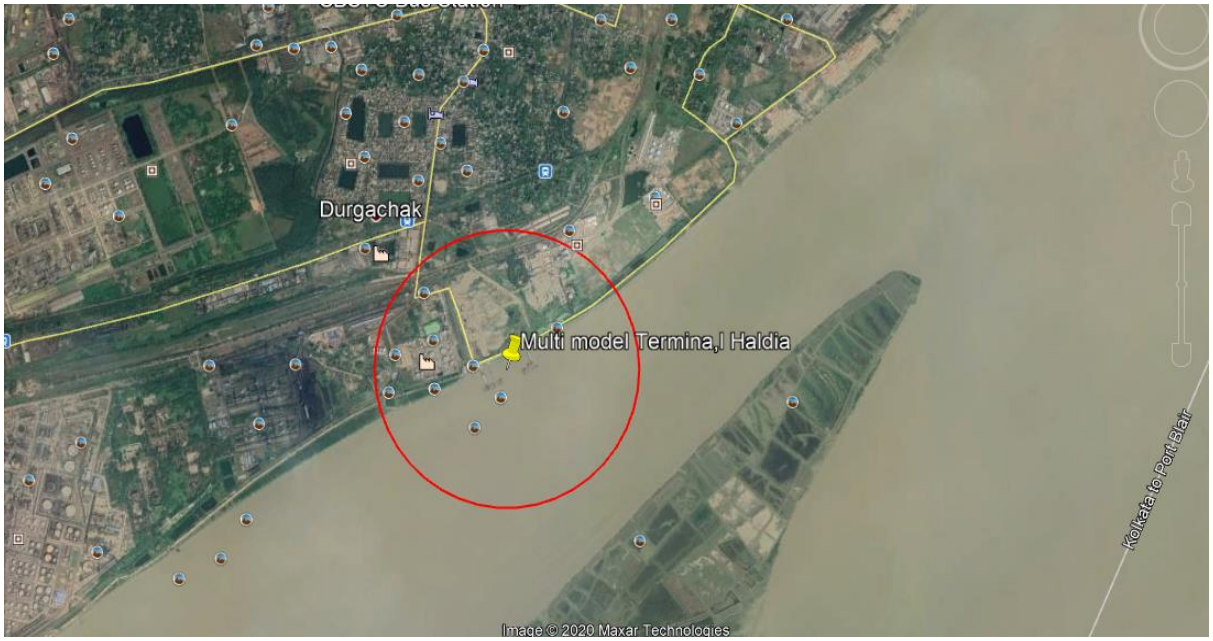


Figure 2.7. Haldia Terminal and Immediate Surrounding of 1 km

Designated capacity of terminals are is given as **Table 2.3** below.

Table 2.3. Designated Capacity of Multimodal Terminal

Sl. No.	Infrastructure Facility	Projected Cargo – 2015 (MTPA)	Projected Cargo – 2030 (MTPA)	Projected Cargo – 2045 (MTPA)
1	Varanasi Terminal	0.54	1.22	1.22
2	Sahibganj Terminal	2.24	4.39	9.00
3	Haldia Terminal	3.18	3.18	3.18

Source:IWAI
Note: MTPA- Million Tonnes Per Annum

The details of intermodal terminals proposed at Ghazipur, Kalughat and Tribeni are given below.

2.5.4. Ghazipur Intermodal Terminal

Ghazipur terminal is planned towards LHS of NW 1 i.e. the Northern bank of Ganges. It is located towards downstream of Ghazipur after Jamalpur bridge in NH 97, at around 4 km. It is located almost 3 km south of Ghazipur Ghat railway station and accessible from NH 17 through a dedicated road. The immediate premises are agricultural areas and there are rural area within 1km, further landward and north.

Figure 2.8. Ghazipur Terminal and Immediate Surrounding of 1 km

Here, the river is wide hence the 1km radial circle does not touch the opposite side of the bank.

2.5.5. Kalughat Intermodal Terminal

Kalughat is an important terminal location, which is currently proposed as an intermodal terminal, which can be used to access the land locked neighbouring country of Nepal. Here, the river stretch is narrow and also the channel beside is currently used on a seasonal basis.

Figure 2.9. Location Map of Kalughat Terminal and Immediate Surroundings

2.5.6. Tribeni Intermodal Terminal (Under consideration)

Tribeni terminal is planned towards the LHS of NW-1. The site is located on left bank of River Hooghly upstream of road bridge on SH-6 at Tribeni, West Bengal. Site is well connected with road & railways. Kalyani Samanta is nearest railway station. App. 40 ha of agricultural land is identified for development of terminal at this site. Some brick kilns also exist at the site. The opposite banks are thickly populated with a river joining the waterway just upstream to the proposed terminal. Kalyani residential area is on the same bank towards the landward side of the proposed terminal.

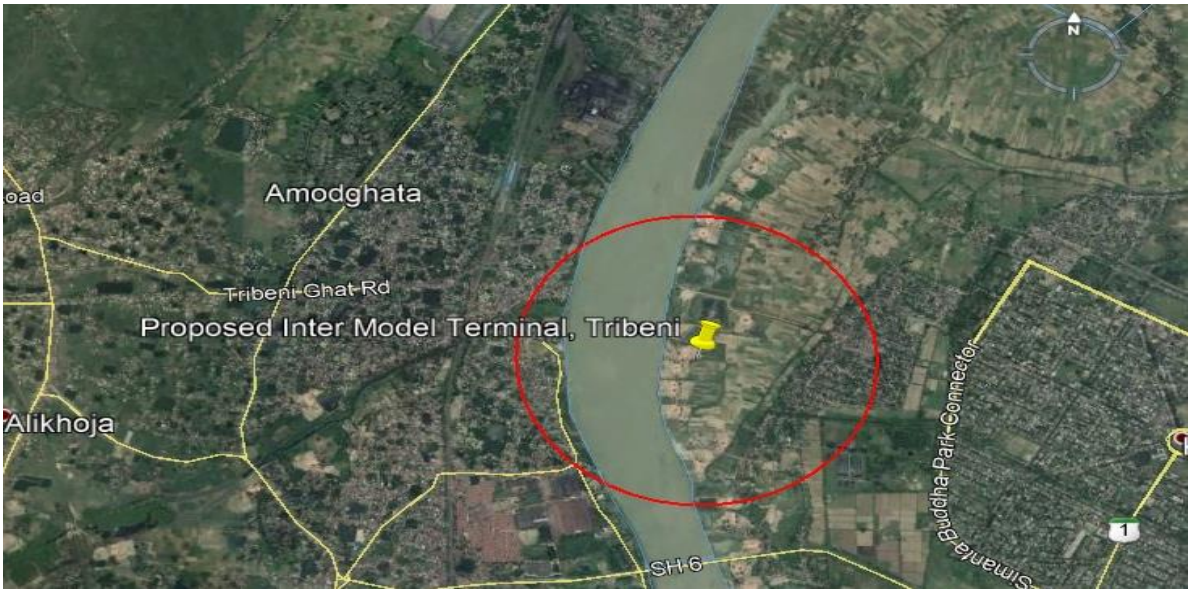


Figure 2.10. Tribeni Terminal and Immediate Surrounding of 1 km

Here, the river is narrow section and hence the 1km radial circle touch the opposite side of the bank.

2.6. Cargo Operational Pattern of NW 1

Total cargo handled and type of cargo handled are collected and analsyed towards assessing the risk elements associated with it.

2.6.1. Existing and Projected Cargo Traffic

NW 1 is having cargo operation along various segments and also the international operation along India Bangladesh Protocol (IBP) route between KoPT limit to various destinations in Bangladesh. The vessels along IBP route has to obtain prior permission from IWAI Regional

Office (RO), Kolkata to operate along the route. The cargo transportation through both NW 1 including IBP routes are presented in **Table 2.4**.

Table 2.4. Cargo Statistics through both NW 1 and IBP Routes during 2013-18

Sl.No.	Year	Quantity of Cargo (in MMT)
1	2013-14	3.35
2	2014-15	5.05
3	2015-16	6.24
4	2016-17	4.62
5	2017-18	3.06

Source: IWAI
Note: MMT- Multimedia Terminal

The total projected cargo for the year 2020 for various stretches are given as **Table 2.5.**

Table 2.5. Total Projected Cargo for NW 1 for 2020

Sl.No.	Stretch	Name of the Stretch	Forecast Medium Augmentation Case (tons)
1	Stretch-1	Haldia-Varanasi	2,42,69,096
2	Stretch-2	Patna-Varanasi	38,11,763
3	Stretch-3	Haldia-Patna	2,26,63,903
Total			5,07,44,762

Source: HPC & HOWE Engineering Projects (India) Pvt. Ltd. (Design Consultant)

2.6.2. Type of Cargo

The existing and proposed cargo were collected form IWAI. Cargo to be transported on NW-1 includes Cement, Fly Ash, Iron Ore, Iron Ore Fines, Coal, Steel Shed, Tyres, Iron Fines, Iron Ingots, Galvanized Steel Plain Sheets, Stone Chips, Furnace Oil, High Speed Diesel, Lube Oil, Boulders, Pulses, Aluminum block, Sand chips, Ship Block, Food grains, Manganese ore, Petroleum, Coke, Cooking coal, Rock Phosphate, Timber, Peas, Slag oil, and Non-cooking coal.

2.7. Vessels to be used in NW 1

The vessels proposed in NW1 includes tankers, bulk carriers, container vessels, push boats, car carriers, Ro-Ro vessels, LNG carriers and dumb barges. The details of proposed vessels for using in NW1 is presented as **Table 2.6**. It is proposed to use vessels powered by LNG along the waterway.

Table 2.6. Details of Vessels to be used in NW - 1

Vessel Type	Length (m)	Breadth (m)	Depth Main Deck (m)	Draught max.(m)	Fuel Oil Capacity (T)
Tanker T1	110,00	12,00	3,70	2,80	30
Tanker T2	110,00	12,00	3,70	2,80	30
Bulk Carrier B1	110.00	12.00	3.70	2.80	30
Bulk Carrier B2	110,00	12,00	4,30	2,80	30
Bulk Carrier B3	92,00	12,00	3,70	2,80	
Bulk Carrier B LNG	110,00	12,00	3,70	2,80	LNG fuel - 17 T, Diesel Oil - 10 T
Container Vessel CO1	110,00	12,00	3,70	2,50	30
Container Vessel CO2	110,00	12,00	4,30	2,60	30
Push Boat PB	26,00	12,00	2,40	1,60	30
Car Carrier CC	90,00	14,50	3,10	1,80	24
Ro - Ro Vessel	70.00	14.50	2.80	1.70	30
LNG Carrier LNG1	90,00	14,50	4,20	2,30	30
LNG Carrier LNG2	92,00	12,00	3,70	2,10	30
Dumb Barge DB	42,00	8,00	2,80	2,50	--

Source: IWAI

3

RISK ASSESMENT

Risk Assessment is a systematic process of evaluating the potential risks that may be involved in an activity and assessing the negative consequences. Risk, by definition is a situation involving exposure to danger and the risk is determined as the probability of one entity to be exposed to a hazard and quantum of its negative consequence. During risk assessment, the level of risk involved in an operation is determined as low/medium/high through risk analysis with respect to a given situation and appropriate risk abatement measures are proposed to reduce the risk level to As Low As Practically Reasonable (ALARP).

Like any other activity, IWT is not an exception for hazards. They may turn out into disaster, if it occur in extreme intensity in a very vulnerable locality; due to natural or human induced factors. It is extremely important to have a detailed risk analysis covering the planning, design, implementation and operational phases. This helps in the preparation of an executable plan, with a road map for ensuring better preparedness as well as response in the case of a hazard scenario. This section presents the details of the RA conducted for NW 1 for the stretch from Allahabad to Haldia.

3.1. Risk Assessment (RA) Methodology

RA methodology adopted is a hybrid method that involves both qualitative and quantitative components. Different parameters involved in the risk assessment was initially identified and shortlisted in qualitative terms and wherever possible, their extent and impacts were expressed quantitatively. In addition, towards arriving at final risk posed by credible scenarios, a combination of probabilistic method as well as deterministic method was adopted. The probabilistic method was utilized to list out all possible credible scenario and to narrow down into the most probable and worst case scenarios while, deterministic method was used to establish their extent. The basic framework of RA process is summarized in the **Figure 3.1**.

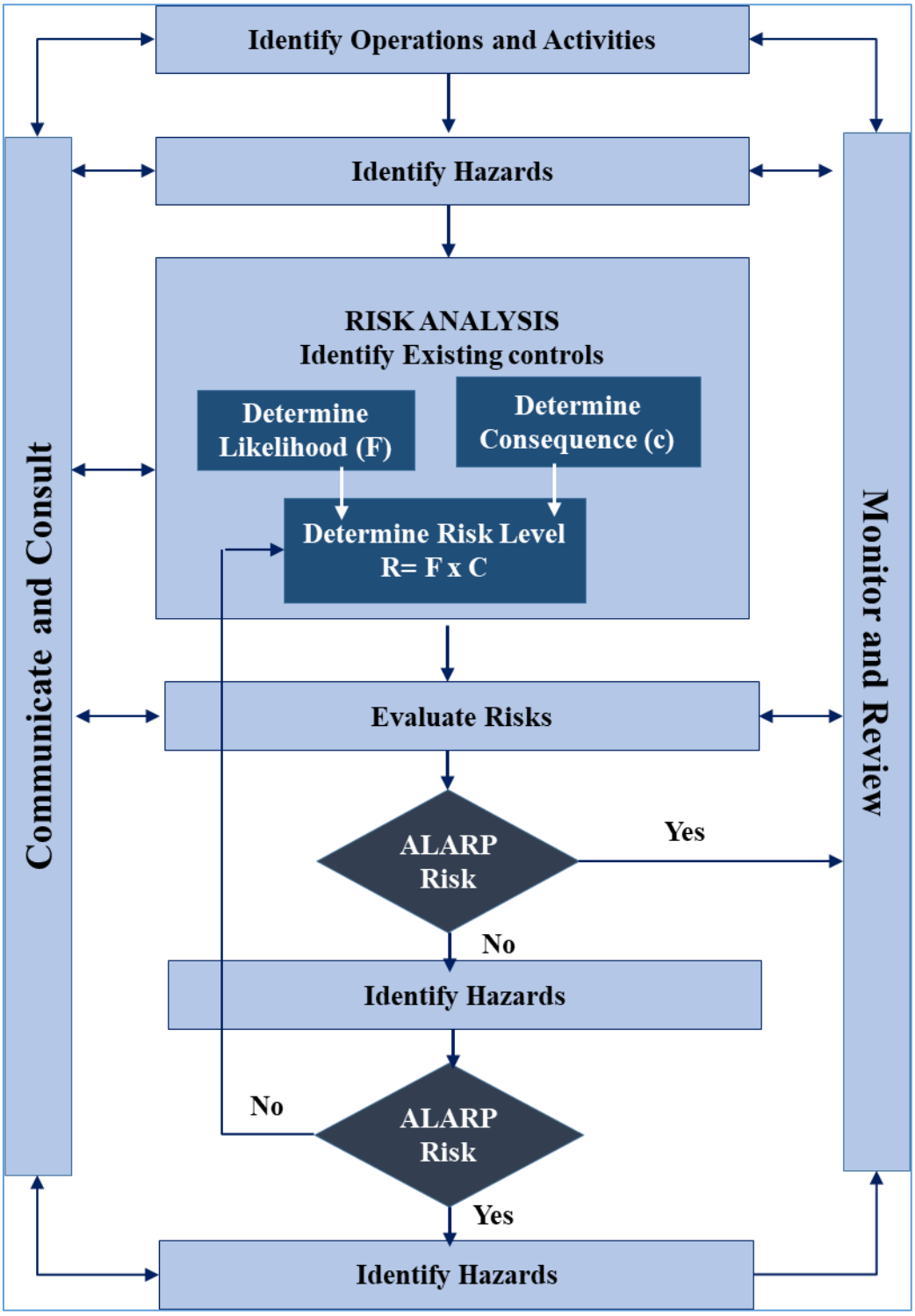


Figure 3.1. Risk Assessment Procedure

Important steps involved in the RA are:

- Identification of IWT operation and activities in NW 1.

- Hazard identification through detailed reconnaissance visit, literature review and stakeholder interaction. The exiting waterway was analysed and the risk elements were identified. Critical Section Analysis (CSA) was carried out to delineate the stretches through multi criteria decision making.
- Analysis of existing/proposed control /precautions in development and maintenance of NW 1 which will reduce the risk of operation of waterway.
- Probabilistic risk analysis using historical frequency analysis, probability assessment, expert judgement to arrive at credible scenarios.
- Deterministic risk analysis for damage estimation for representative worst-case scenarios.
- Prioritization of areas and resources based on the risk level and proposing risk control or mitigation measures.
- Mitigation or re-prioritization of exposure category based on risk levels to ALARP principle.
- Reassess high-risk events by preparing and for monitoring and control plans.
- Monitoring and Improvement at the stage of operation, maintenance and shutdown phases.

As per the methodology outlined in the Terms of Reference (ToR), the cumulative risk is having the following components, four individual risks, i.e., with respect to channel, cargo, vessel and dredging. The cumulative risk levels were determined for credible scenarios including most probable and worst case ones. Risk abatement measures were also proposed. The studies executed in this regard is followed.

3.2. Review of IWT Operational Activities

IWT Operation activities proposed under JMVP were reviewed critically as a preliminary step towards initiating the RA study. The IWT operation in NW 1 include loading of cargo at terminals, transport of cargo through waterway, unloading and storage at terminal as presented in **Figure 3.2** below.

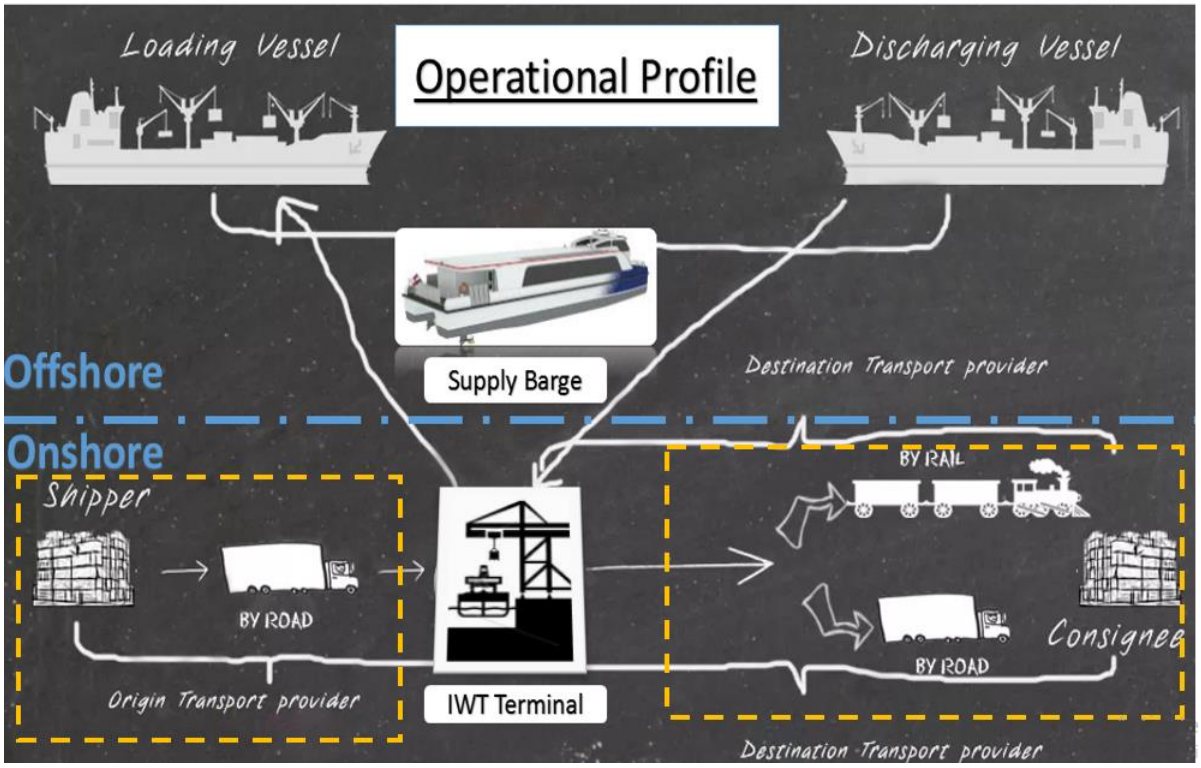


Figure 3.2. Mode Sharing in the Operational Profile of IWT through NW 1

In line with the ToR requirements, the risk assessment has been done under two broad categorization – **Off shore** and **Onshore** and the activities considered under each head is presented in **Figure 3.3**. For the present study, the scope of the risk assessment is restricted to the offshore operations through NW 1 and also, the onshore operations with NW 1 interface i.e., within the IWT Terminal.

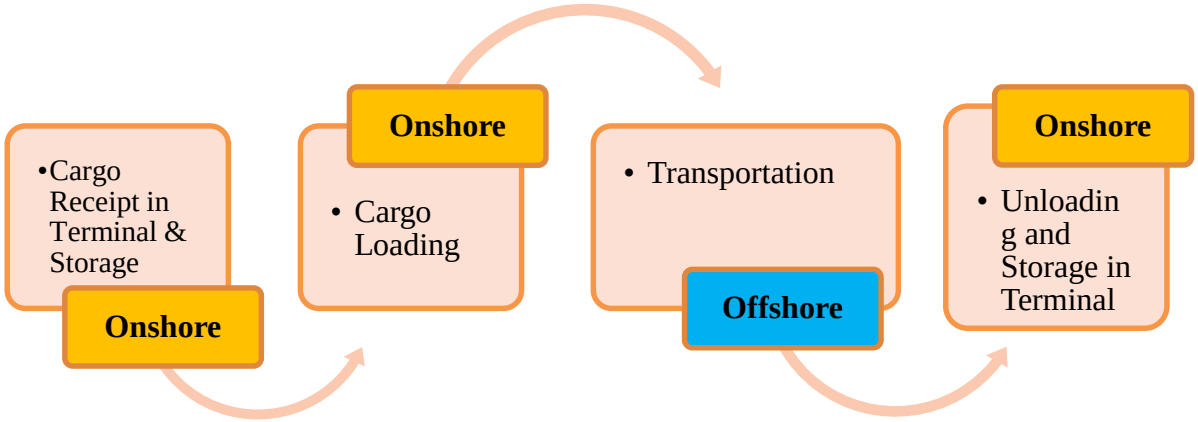


Figure 3.3. Offshore and Onshore Activities in IWT Operational Profile

Offshore and onshore risk locations are identified and summarized in **Table 3.1**.

Table 3.1. Offshore and Onshore Risks w r to Operations or Activities under JMVP

Risk Type	Risk Location	Operational/Activities related with IWT leading to risk.	Remarks
On shore	Along waterway	Cargo transport / /maintenance dredging	--
	Lock Gate	Cargo transport	--
	Other assets – All cross structures along channel	Cargo transport	Public and Private Assets and properties could be affected due to an incident while transport propagating to land masses.
Offshore	Jetties	Approaching of vessel/loading/unloading	--
	Terminals	Loading/Unloading/Storage	--
	RIS/DGPS Stations	NA	No risk expected due to IWT operation under development plan of JMVP
	Ship Repair Facilities	NA	

3.3. Identify Hazards & Analysis of Existing Control Measures

A hazard is defined as an agent, which has the potential to cause harm or damage to a vulnerable target i.e. people, property or environment. Historical anlaysis has been carried out based on the literature review to understand the hazards associated with IWT operation. The accident data were analysed to delineate the major hazard as well as the causes of hazard and further the same was analysed w. r. to their applicability for IWT operation in NW 1.

In the Indian context, there have been no reported major cargo accidents in inland waterways. In the recorded history of IWT operations through NW 1, no accidents associated with transportation of cargo occurred so far and few averted incidents such as hitting tower line near Ghazipur, collision of vessels especially within port limit etc. This may be mainly attributed to the fact that, there are very low cargo traffic in the inland waterways in the Indian context.

However, there have been accidents in connection with the movement of other vessels through the inland waterways of Ganga and immediate region w.r.to passenger vessels. They are mainly related to passenger vessels and are boat capsizes. The available statistics on analysis shows

that, total number of casualties reported during 2000-2013 were 9808 and the accident cases were 8903 for 28 States and Union Territories. i.e., more than 600 accidents on an average per year (T Kalyani et al, 2015). Bihar has reported the highest no. of accidents (836 no) in this regard. Accidents reported so far are mainly due to poor condition of the vessels, shoddy maintenance, absence of navigational aids & improper demarcation of channel, overloading, over speed, abnormalities in the design of the vessel, negligent conduct of crew and absence of life saving appliances. These aspects have been taken care while arriving at hazard scenarios for NW 1. However, there has been some incidents connected with the marine vessels in Hooghly river connected with KoPT operations as below:

- Nurpur (Diamond Harbour), March 22, 2008, a ship from Colombo got stuck in the Hooghly riverbed at Nurpur near Diamond Harbour after its steering jammed and it crashed through a jetty, while negotiating a sharp bend.
- Haldia Dock Complex, September, 2009, Collision of MV City carrying iron ore and a Dredger, while negotiating low draft areas in a zig zag course.
- 22 nautical miles south of Sagar Island, October 13, 2013 Chinese-owned Panama-flag freighter MV Bing, wrecked during Cyclone Philine which was loaded with Iron Ore from Haldia and Sagar.
- Near Sand heads, June 14, 2018, MV SSL Kolkata, a domestic merchant container vessel reported a fire on-board due to rough seas and strong winds, the fire spread rapidly and engulfed 70 per cent of the ship.

Ship stuck on the Bank Crashing the Jetty near Noorpur, 2008

Fire on-board MV SSL Kolkata, a Domestic Merchant Container Vessel, Sandheads, 2018

Figure 3.4. Vessel Accidents within Kolkata Port Limit

International accident profile for IWT operation was reviewed to delineate the probable hazards as well as risk factors which have critical influence in leading to hazardous events. While International Maritime Organization (IMO) remains as the apex authority in marine vessel related incidents and have a unified operational guidelines, data assimilation and reporting and investigation aspects, IWT sector do not have a common platform of operation. While the IWT sector follows the guidelines on cargo issued by IMO, the accident data available are diverse by its nature – a few targeting to the type of incidents while others on the causes of incidents. IWT related accident analysis was carried out for US, Germany, Myanmar, Bangladesh and Rhine (for Europe as a whole) and the findings are followed. The accidents types are commonly represented as

- Grounding- striking underwater or banks.
- Fire and Explosion – if fire and explosion is the first event reported or fire / explosion results from hull/machinery damage.
- Collision - striking or being stricken by other vessels.
- Contact - striking an external object.

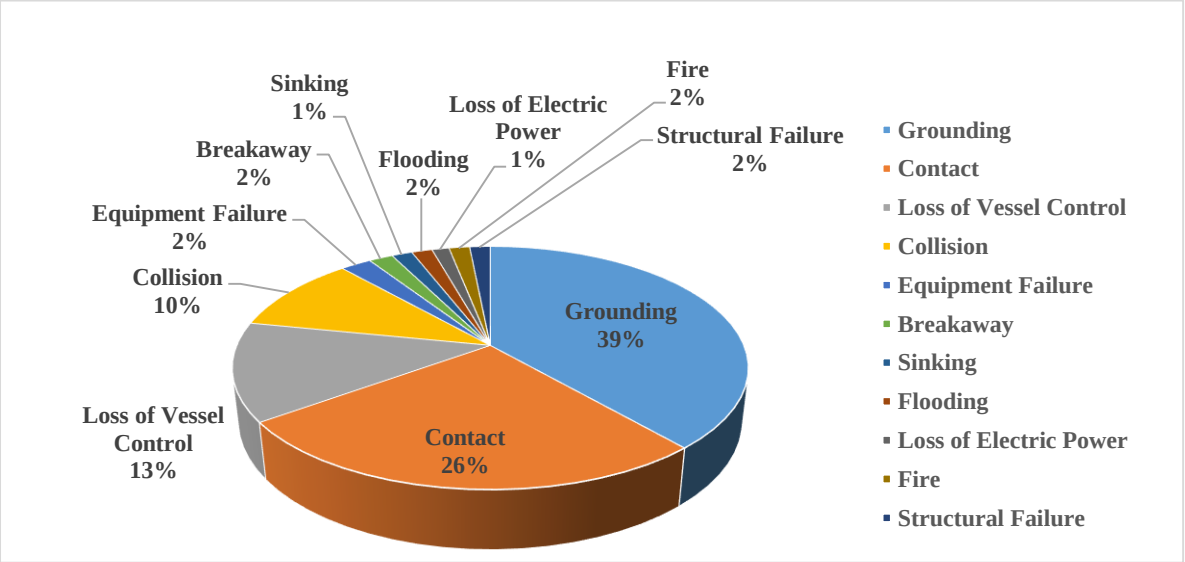


Figure 3.5. IWT Hazards and Causes of Hazards in U.S

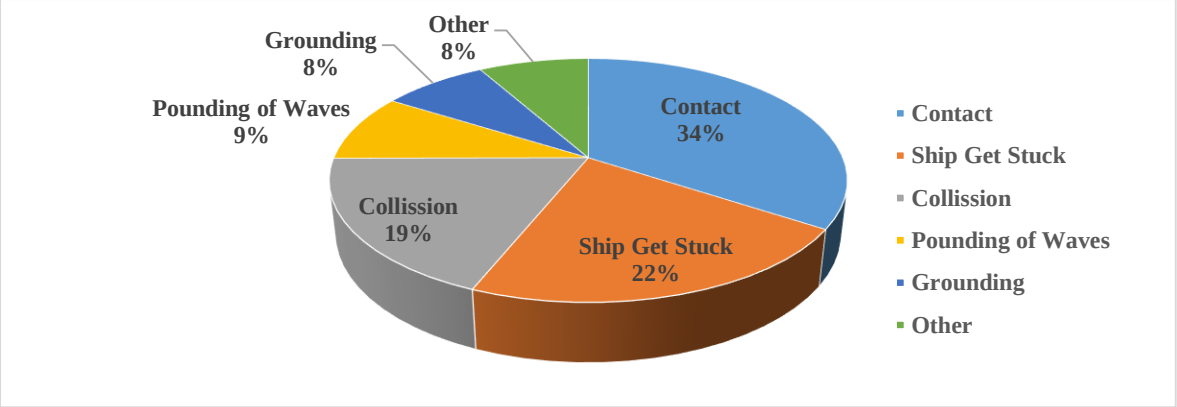


Figure 3.6. IWT Hazards and Causes for Germany

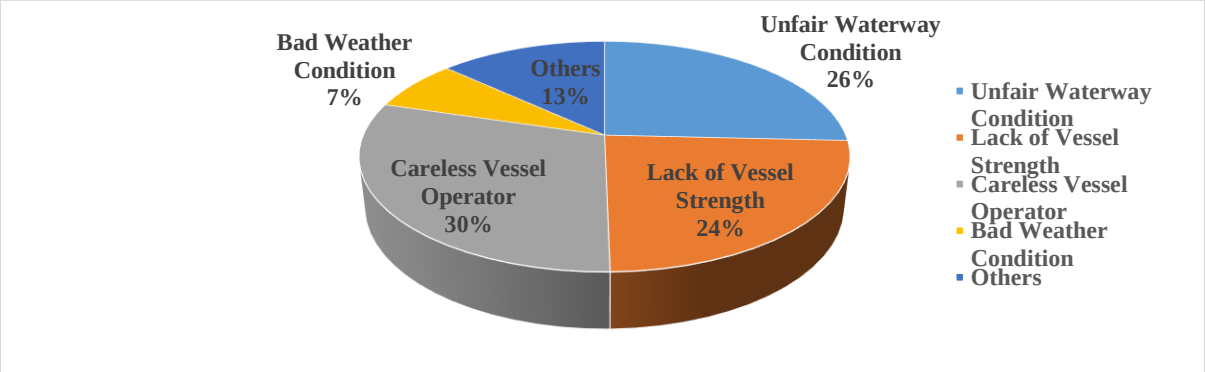


Figure 3.7. Causes of IWT Hazards in Myanmar

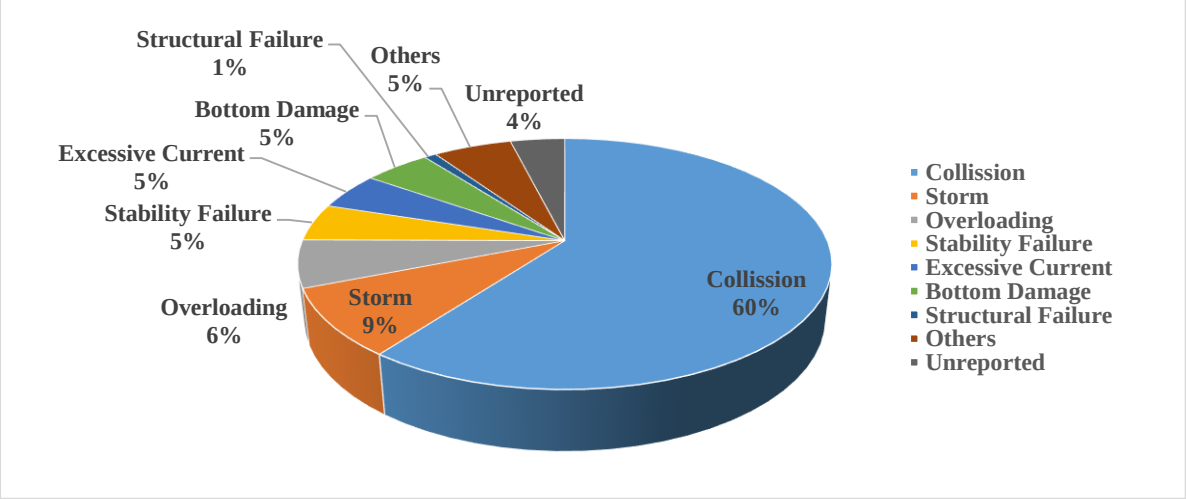


Figure 3.8. IWT Hazards and Causes of Hazards in Bangladesh

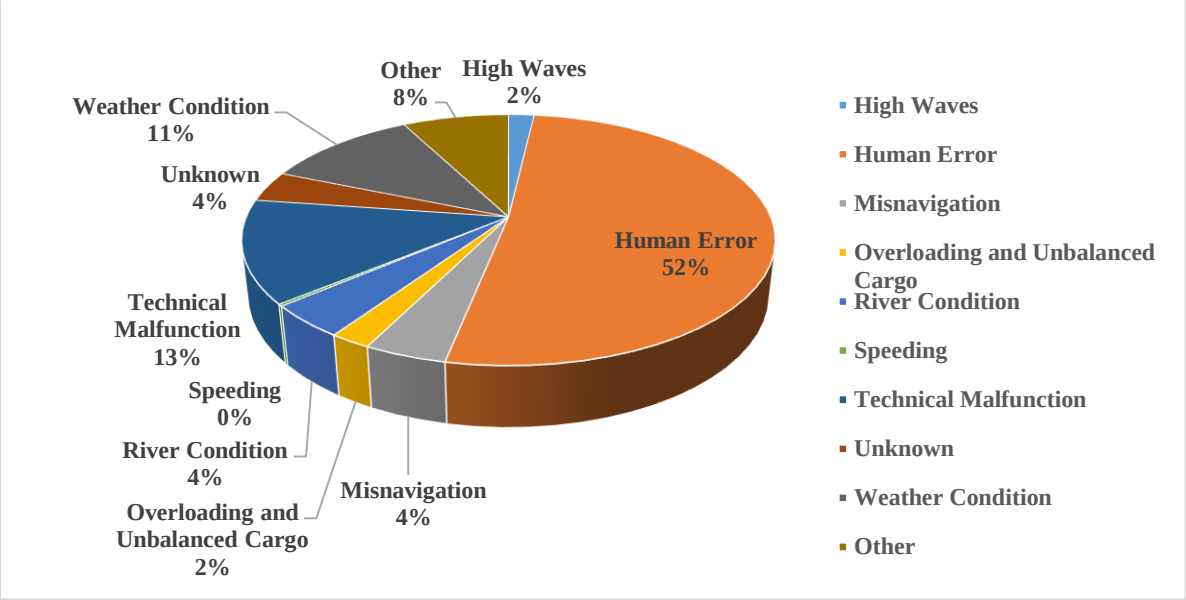


Figure 3.9. IWT Accidents and Causes in Rhine (Europe)

From the analysis it could be concluded that the major primary hazards include collision, contact, grounding, ship get stuck and fire. Considering the specific IWT operation for NW 1, involving transport of hazardous cargos explosion and spillage of cargo were also included as hazards since being very common in maritime industry. Sinking of ship is considered as a secondary hazard followed by a primary hazard.

Apart from listing the major hazards, the analysis reveals various factors which have critical role in IWT operation leading to hazard scenarios. Site specific factors of river Ganga as identified in detailed reconnaissance survey, which may have critical influence in risk profile of project region was also comparatively analysed towards further narrow down to credible scenarios.

Considering the existing control measures such as implementation of design vessel specifications, classification of vessels carrying cargo, availability of River Information System (RIS), LAD notices, dedicated portal - Forum of Cargo Owners and Logistics Operators (FOCAL) - to facilitate responses from the logistics operators against the requirement raised by cargo owners and vice-versa, information on regular thalweg survey and resultant regular maintenance dredging, implementation of Indian Vessel (IV) Act, the influence of risk factors w.r.to IWT operation in NW 1 was anlaysed towards factorizing into risk assessment. The factors and their influence w.r.to IWT operation in NW 1 is summarized in **Table 3.2**.

Table 3.2. Analysis of Causes of Hazards, Existing Control Measures and Resultant Influence of Risk factors on IWT Operation in NW 1

Sl. No	Risk Factor	Applicability w.r.to NW 1 Operation	Primary Hazard – Secondary Hazard	Primary Risk Element Involved
1	Careless Vessel Operation	Yes - The same factor is a critical factor in IWT related incidents.[1]	Collision/contact/grounding/vessel get stuck	Vessel/Channel related
2	Bad Weather Condition /Natural Hazard			
	Storm	Yes. Along influencing areas all along waterway especially during monsoon.	Collision, contact, grounding Vessel get stuck. The secondary hazard may include spillage/sinking	
	Flood			
	Earth Quake	The project region is falling in Zone III and IV.		
	Pounding of wave, excessive current, high waves, cyclone, Tsunami, Tidal bore	Yes. Occur in the coastal stretches of NW 1 between Haldia and Tribeni.	Spillage of Cargo – Sinking	
3	Overloading/Un balanced cargo	Yes. For Coal transport, trimming is reported as an accident factor due to unbalanced cargo loading.	Spillage of Cargo- Sinking of vessel	Cargo related
4	River Piracy / Sabotage	Yes. Along the disturbed areas of project region.		
5	Vessel system malfunction, communication system failure etc. leading to mis navigation	Yes. Anywhere through waterway.	Collision, contact, grounding	Vessel/Channel related
6	Loss of Vessel Control	Yes. Anywhere through waterway especially curving areas, low depth areas, channel diversion areas, navigation lock, limiting bridges	Collision, contact, grounding	Vessel/Channel related

[1] *1] A considerable % of the accidents can be attributed to causes such as rough weather, structural failure due to contingencies, age of the vessels, overloading, human error etc. Also, it is important to note that more than 60 % of all accidents are caused by human error, which takes the lion share of all events (Source: ESMA, 2015).*

Sl. No	Risk Factor	Applicability w.r.to NW 1 Operation	Primary Hazard – Secondary Hazard	Primary Risk Element Involved
7	Equipment failure	Yes. Anywhere through waterway.	Collision, contact, grounding	Vessel/Channel related
8	Loss of electric power	No. Not specific to NW 1 stretch. Additional source is available in vessel.	Collision, contact, grounding	Vessel/Channel related
9	Structural failure	No. Not specific to NW 1 and only as per the standard design issued by IWAI the vessels would be constructed and in compliance with the classification for inland vessels by Indian Registry of Shipping (IRS)	Spillage of Cargo	Vessel /Cargo related
10	Lack of Vessel Strength		Spillage of Cargo	Vessel related
11	Stability Failure		Spillage of Cargo	Vessel/Cargo related

3.4. Risk Assessment

Considering the operational pattern of IWT, as per the ToR, the various risk elements associated with the operation could be broadly classified as follows:

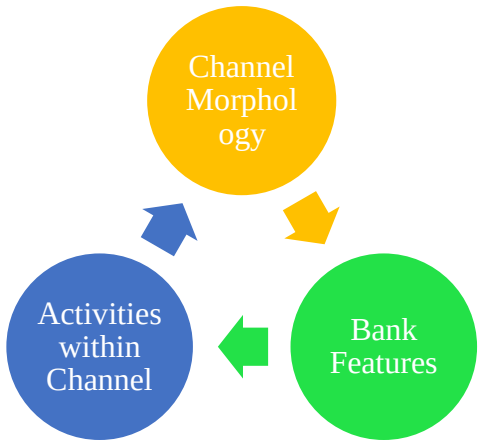
- Channel related risk.
- Cargo related risk.
- Vessel related risk.
- Dredging related risk.

The various risk elements are analysed in detail followed by cumulative interaction of risk elements.

3.4.1. Channel Related Risk Elements

The riverine feature and the channel running within it and the activities or interaction with the bank features pose critical importance in channel related risk. Part of the longest river system of NW 1 has diverse geographical features along its way. Towards delineating the areas having risk elements presence/features, critical stretches were identified through a Critical Section Analysis (CSA) as presented below.

CSA has been carried out to identify the stretches, which are critical by nature due to its inherent features, activities or interactions in between, which can be either a hazard causing or contributing factor and in due consideration of vulnerability and the resultant impact to the receptor. A detailed reconnaissance survey and data collection was carried out for 2 km interval along the entire reach of NW 1 and the river system was analyzed in detail for the presence of following elements:



- Channel Features: Channel morphology i.e., straight, meandering or curves, siltation areas, channel diversion areas, other stream entering areas, environmental sensitivity.

- Activities within Water Course: Jetty, recreation, drain inlets, water supply intake, agriculture intake, industrial intake, country boat fishing, net fishing, vessel traffic, vessel type- ferry, cargo, passenger, tourism and overlapping of activities.
- Bank Features – population density, public places, industrial clusters, accessibility, ecological and socio-economic resources, availability of response equipment.
- Cross Structures – Road, Railway bridges including multiple bridges, Lock Gates, High Tension Line Crossing and Syphon Aqueducts.

Detailed analysis of the data collected was carried out to identify Critical sections through conditional analysis of multi criteria decision-making based on Boolean. The important attributes which contributes to the channel related risk include limiting curving radius, siltation areas, environmentally sensitive stretches within the water body, limited width and close to bank alignment in densely populated areas, critical activities in water such as cargo jetties, high traffic areas, ferry crossings, bridges, aqueducts, lock gates and tower line crossings. The sections with presence of the above were identified as critical sections.

It was identified that there are 325 critical stretches along in NW 1 - (105 numbers between Prayagraj and Munger and 220 numbers between Munger and Haldia). Details of critical sections and attributes of criticality are presented in Annexure II.

While there are critical elements along the various sections above, it is possible that with implementation of control or precautionary measures, the risk level of such locations could be reduced or nullified. As presented before, the control measures and cautionary measures, which are in place or could be implemented were also identified for NW 1. Considering the same, critical sections were sub divided in to three categories – low, medium and high.

- Low (White) - Stretches which are safe enough to transport goods at favourable conditions. But important due to presence of one of the risk elements or the peculiarity of the locality.
- Medium (Yellow) - Precautions are to be taken prior to the transport. Certain hazard elements exists which may be turn out as high if left uncontrolled.
- High (Red) - designated as "**hotspots**" – Navigation limiting area for the transportation of goods in the present condition. Specific preventive measures are to be taken before

proceeding with cargo transport, which were evaluated in detail for arriving at credible hazard scenarios.

The categorization is made based on due consideration of the risk elements influencing the risk profile of IWT operation in NW 1 as presented in **Table 3.3**.

Table 3.3. Categorization of Critical Sections towards Determining the Hot Spots

Sl. No.	Risk Element	Categorization Criteria	Categorization of Stretch
Due to Presence of Risk Elements			
1.	Curve	Locations with curves <200 m – High	
		200 - 400 m – Medium	
		>400 m - Low	
2.	Siltation Areas	Medium	
3.	Environmental Sensitivity	Protected Areas and Wild Life Sanctuaries - High	
4.	Sensitive Bank	Narrow Stretch (<250 m) – Alignment Close to the bank (<100 m)	
5.	Cargo Handling Jetties (Existing & Proposed)	High	
6.	High Traffic Areas	High	
7.	Ferry Crossing Locations	Multiple Ferry	
		Ferry	
8.	Cross Structures		
	Bridges	Critical bridges (i.e., having limitation on horizontal and vertical clearances) – High	
		Multiple bridges with sufficient clearance – Medium	
		Single bridge with sufficient clearance - Low	
	Tower lines in Eroding Banks	High	
	Tower Line	Medium	
	Aqueduct	Medium	
	Pontoon Bridges (Seasonal)	High	
	Lock Gate	High	
Due to Channel Interaction with Activities of Channel and Bank Features			
9.	Narrow water body/water body with fairway	Medium	

	alignment close to bank.		
10.	Thickly populated area Close to the Bank	Medium	
11.	Highly eroding banks	Medium	

It is identified that there are 169 hotspots within NW 1 as presented in Table 3.4 and Map enclosed.

Table 3.4. Hotspot in NW 1

Sl. No.	Ch. Start	Ch. End	Start Location Name	End Location Name	Criteria for Hot Spot
1	0	2	Haldia	Nayachar Island	High traffic area, Cargo Jetty
2	2	4	Haldia	Nayachar Island	High traffic area, Cargo Jetty
3	4	6	DurgaChak	Balari Char	High traffic area
4	6	8	DurgaChak	Durga Nagar	High traffic area
5	8	10	DurgaChak	Durga Nagar	High traffic area
6	10	12	Banerwar Chak	Kulpi	High traffic area
7	12	14	Begunbere	Kulpi	High traffic area
8	14	16	Begunbere	Chakrupelsakar	High traffic area
9	16	18	Begunbere	Harinarayanpur	High traffic area
10	18	20	Begunbere	Bhishnurampur	High traffic area
11	20	22	Begunbere	Rabindra Nagar	High traffic area
12	22	24	Erakhali	Diamond Harbour	High traffic area, Passenger ferry
13	24	26	Erakhali	Diamond Harbour	High traffic area
14	26	28	Erakhali	Harinarayanpur	High traffic area
15	28	30	Kukrahati	Singal ganja Abad	High traffic area, Passenger ferry
16	30	32	Kukrahati	Roychak	High traffic area, Tower line crossing
17	32	34	Latpatia	Roychak	High traffic area
18	34	36	Thenul Bariya	Sukdebpur	High traffic area
19	36	38	Suklalpur	Sukdebpur	High traffic area, Passenger ferry
20	38	40	Gadiwara	Sukdebpur	High traffic area
21	40	42	Gurepol	Sriphalbaria	High traffic area
22	42	44	Kurchi Beria	Noorpur	High traffic area
23	44	46	Sibganga	Ramnagar	High traffic area
24	46	48	Dinga-Khola	Akalmegh	High traffic area
25	48	50	Alipur	Falta	High traffic area, Passenger ferry

Sl. No.	Ch. Start	Ch. End	Start Location Name	End Location Name	Criteria for Hot Spot
26	50	52	Barkalia	Shyamsunderpur	High traffic area
27	52	54	Kasipur	Ahmadpur	High traffic area
28	54	56	Chandipur	Padmapur	High traffic area, Passenger ferry
29	56	58	Belari	Burul	High traffic area
30	58	60	Baganda	Bahirkunji	High traffic area
31	60	62	Dakshin Ramachandrapur	Godakhali	High traffic area
32	62	64	Hirapur	Godakhali	High traffic area
33	64	66	Hiraganja	Dakshin Raypur	High traffic area
34	66	68	Kajiakhali	Birlapur	High traffic area
35	68	70	Kalinagar	Jagatballavpur	High traffic area
36	70	72	Uluberia	Achipur	High traffic area, Passenger ferry
37	72	74	Fuleswar	Pujali	High traffic area, Cargo Jetty
38	74	76	Sijberia	Pujali	High traffic area, Passenger ferry
39	76	78	Chakashi	Pujali M	High traffic area
40	78	80	Hat Bauria	Joychandipur	High traffic area, Passenger ferry, Cargo Jetty
41	80	82	Radhanagar	Shyampur	High traffic area
42	82	84	Raghudebatti	Chakchandul	High traffic area, Passenger ferry
43	84	86	Sarenga	Palpara	High traffic area
44	86	88	Manikpur	Uludanga	High traffic area
45	88	90	Osmanpur	Dakshini Housing Estate	High traffic area
46	90	92	Sankralijala	Badartala	High traffic area
47	92	94	Hatgacha	Badartala	High traffic area
48	94	96	Chunavati	Siraj Basti	High traffic area, Cargo Jetty
49	96	98	Gaubari	Bichali Ghat	High traffic area, Cargo Jetty
50	98	100	Botanical Garden	NSDock (KoPT)	High traffic area, Cargo Jetty, Narrow/dense settlement
51	100	102	Kazipara	Kidderpore (KoPT)	High traffic area, Cargo Jetty, Road Bridge
52	102	104	Naora	Fort William	High traffic area, Passenger ferry
53	104	106	Howra railway station	Fairley Palace	High traffic area, Passenger ferry, Critical Bridge
54	106	108	Mali Panchghara	Ahiritola	High traffic area, Passenger ferry

Sl. No.	Ch. Start	Ch. End	Start Location Name	End Location Name	Criteria for Hot Spot
55	108	110	Ghusur	Chitpur	High traffic area, Passenger ferry, Tower line crossing
56	110	112	Belur Math	Ratan Babu Ghat	High traffic area, Passenger ferry
57	112	114	Bally	Barahanagar	High traffic area, Passenger ferry, Critical Bridge
58	114	116	Kotrung	Jayasreenagar	High traffic area, Passenger ferry
59	116	118	Debaipukur	Nehabootnagar	High traffic area
60	118	120	Arabinda Pally	Angus Nagar Colony	High traffic area, Passenger ferry
61	120	122	Dharmadanga	Kulinpara	High traffic area, Passenger ferry
62	156	158	Tribeni	Kalyani	Passenger ferry, Cargo Jetty
63	168	170	Baneswarpur	Malopara	Passenger ferry, Eroding banks, Eroding tower line, Critical curve
64	202	204	Sultanpur	Char Sultanpur	Passenger ferry, Ro-Ro ferry
65	206	208	Kuledaha	Beltala	Passenger ferry, High traffic area, Ro-Ro ferry
66	208	210	Kalna	Nrisinghapur	Passenger ferry, High traffic area, Narrow/dense settlement
67	242	244	Nabadwip	Char Brahmanagar	Passenger ferry, High traffic area
68	252	254	Chupi	Kuturia	Highly critical curve
69	254	256	Sajiara	Kuturia	Highly critical curve
70	306	308	Mondalhat	Ballavpara	Passenger ferry, Ro-Ro ferry, Channel Siltation Area
71	308	310	Katwa	Ballavpara	Passenger ferry, High traffic area
72	318	320	Kalyanpur	Raghupur	Passenger ferry, Highly critical curve
73	330	332	Kadkhali	Char Palasi	Passenger ferry, Ro-Ro ferry
74	380	382	Ranibagan	Gora Bazar	Passenger ferry, High traffic area, Road bridge
75	382	384	Khagraghat	Khaghra	Passenger ferry, High traffic area
76	396	398	Mahinagar Diar	Azadhindbagh	Passenger ferry, High traffic area
77	398	400	Azimganj	Jiaganj	Passenger ferry, High traffic area
78	416	418	Singechwari	Bhatpara	Highly critical curve
79	418	420	Arijpur	Bhatpara	Highly critical curve

Sl. No.	Ch. Start	Ch. End	Start Location Name	End Location Name	Criteria for Hot Spot
80	442	444	Elaspur	Bahara	Highly critical curve
81	454	456	Basudebpur	Tantipara	High traffic area, Road bridge, Narrow/dense settlement
82	458	460	Khidirpur	Char Sekandara	Highly critical curve
83	480	482	Bhasaipaikar	Ghoramara	Critical Bridge, Tower line crossing
84	496	498	Chandipur	Chauki	Cargo Jetty, Narrow/dense settlement, Tower line crossing, Multiple bridge
85	498	500	Srimantapur	Farakka	Passenger ferry, Cargo Jetty
86	500	502	Bewa	Farakka	Lock gate, Critical curve, Cargo Jetty
87	502	504	Gobindarampur	Gobindarampur	Passenger ferry, Narrow/dense settlement, Highly critical curve
88	536	538	Raniganj	Narayanpur	High traffic area, Ro-Ro ferry,
89	538	540	Rajmahal	Paschim Narayanpur	High traffic area, Ro-Ro ferry
90	540	542	Rajmahal	Paschim Narayanpur	Passenger ferry, High traffic area
91	578	580	Sahibganj	Bhagwanpur	Passenger ferry, Ro-Ro ferry, Cargo Jetty
92	590	592	Lal Bathani Millk	Rampur Ogairah	High traffic area, Ro- Ro ferry
93	592	594	Lal Bathani Millk	Manihari	High traffic area
94	610	612	Hirdenagar Kant Nagar	Modi chak	Eroding tower line
95	644	646	Kahalgon	Tintanga	Passenger ferry, Vikramshila Gangetic Dolphin Sanctuary, High traffic area, Ro-Ro ferry
96	646	648	Kahalgon	Tintanga	Vikramshila Gangetic Dolphin Sanctuary, High traffic area
97	648	650	Kahalgon	Tintanga	Vikramshila Gangetic Dolphin Sanctuary
98	650	652	Kahalgon	Tintanga	Vikramshila Gangetic Dolphin Sanctuary
99	652	654	Rampur Gandharp Milik	Dimha	Vikramshila Gangetic Dolphin Sanctuary
100	654	656	Rampur Gandharp Milik	Dimha	Vikramshila Gangetic Dolphin Sanctuary
101	656	658	Rampur Gandharp Milik	Dimha	Vikramshila Gangetic Dolphin Sanctuary

Sl. No.	Ch. Start	Ch. End	Start Location Name	End Location Name	Criteria for Hot Spot
102	658	660	Rampur Gandharp Milik	Ismail pur	Vikramshila Gangetic Dolphin Sanctuary, Eroding banks
103	660	662	Kamlakund	Ismail pur	Vikramshila Gangetic Dolphin Sanctuary, Eroding banks
104	662	664	Budhuchak	Ismail pur	Vikramshila Gangetic Dolphin Sanctuary, Eroding banks
105	664	666	Budhuchak	Emadpur	Vikramshila Gangetic Dolphin Sanctuary, Eroding banks
106	666	668	Salarpur	Emadpur	Vikramshila Gangetic Dolphin Sanctuary
107	668	670	Pharka	Emadpur	Vikramshila Gangetic Dolphin Sanctuary
108	670	672	Pharka	Raziuddinpur	Vikramshila Gangetic Dolphin Sanctuary
109	672	674	Bhagalpur	Mahadeopur	Vikramshila Gangetic Dolphin Sanctuary
110	674	676	Bhagalpur	Mahadeopur	Vikramshila Gangetic Dolphin Sanctuary
111	676	678	Bhagalpur	Mahadeopur	Vikramshila Gangetic Dolphin Sanctuary, Road Bridge
112	678	680	Jalalpur	Raghopur	Vikramshila Gangetic Dolphin Sanctuary
113	680	682	Jalalpur	Raghopur	Vikramshila Gangetic Dolphin Sanctuary
114	682	684	Jalalpur	Raghopur	Vikramshila Gangetic Dolphin Sanctuary
115	684	686	Jhau	Kazi Koraia	Vikramshila Gangetic Dolphin Sanctuary
116	686	688	Jhau	Kazi Koraia	Vikramshila Gangetic Dolphin Sanctuary
117	688	690	Mohanpur	Faridpur	Vikramshila Gangetic Dolphin Sanctuary
118	690	692	Mohanpur	Faridpur	Vikramshila Gangetic Dolphin Sanctuary
119	692	694	Ajmeripur	Tekwazpur	Vikramshila Gangetic Dolphin Sanctuary
120	694	696	Mirzapur	Tekwazpur	Vikramshila Gangetic Dolphin Sanctuary
121	696	698	Mirzapur	Saiduddinpur	Vikramshila Gangetic Dolphin Sanctuary
122	698	700	Mirzapur	Saiduddinpur	Vikramshila Gangetic Dolphin Sanctuary

Sl. No.	Ch. Start	Ch. End	Start Location Name	End Location Name	Criteria for Hot Spot
123	700	702	Gangapur	Dudhaila	Vikramshila Gangetic Dolphin Sanctuary
124	702	704	Gangapur	Dudhaila	Vikramshila Gangetic Dolphin Sanctuary
125	704	706	Gangapur	Gaura	Vikramshila Gangetic Dolphin Sanctuary
126	706	708	Shahabad	Gaura	Vikramshila Gangetic Dolphin Sanctuary
127	708	710	Shahabad	Shahabad	Vikramshila Gangetic Dolphin Sanctuary
128	710	712	Shahabad	Shahabad	Vikramshila Gangetic Dolphin Sanctuary
129	712	714	Sultanganj	Madhopurpatpar	Vikramshila Gangetic Dolphin Sanctuary
130	714	716	Sultanganj	Madhopurpatpar	Passenger ferry, Vikramshila Gangetic Dolphin Sanctuary, Ro- Ro ferry, Road Bridge
131	716	718	Sultanganj	Madhopurpatpar	Vikramshila Gangetic Dolphin Sanctuary, High traffic area
132	820	822	Simariya	Hathida	High traffic area, Tower line crossing, Critical Bridge
133	892	894	Ghansurpur Diara	Ghanspur	Pontoon Bridge
134	910	912	Saidabad	Tilllak Nagar	High traffic area, Tower line crossing, Passenger ferry, Pontoon Bridge
135	914	916	Bidupur	Sabalpur	Eroding tower line, Road Bridge
136	922	924	Hajipur	Patna	High traffic area, Channel siltation area, Cargo Jetty, Pontoon Bridge, Road bridge, Narrow/dense settlement
137	936	938	Nakta Diyara	Mithila	Cargo Jetty
138	938	940	Panapur	Takiapur	Pontoon Bridge
139	958	960	Diara Singahi	Haldi Chhapra	High traffic area,
140	960	962	Diara Singahi	Haldi Chhapra	High traffic area, Channel siltation area, Passenger ferry
141	962	964	Jatia Bajidpur	Todarpur	High traffic area,
142	990	992	Kondarha Uparwar	Parasrampur	Pontoon Bridge
143	1016	1018	Shri Nagar	Gangawali	Pontoon Bridge
144	1028	1030	Dagarabad	Dangrabad	Tower line crossing, Pontoon Bridge

Sl. No.	Ch. Start	Ch. End	Start Location Name	End Location Name	Criteria for Hot Spot
145	1046	1048	Paikawali	Shivpur Diyar Saraju Khd	Passenger ferry, Pontoon Bridge, Road Bridge
146	1078	1080	Sarya	Ghola Ghat	High traffic area, Passenger ferry
147	1110	1112	Narainpur Urf Hariharpur	Andhi Tilwa	Pontoon Bridge
148	1120	1122	Nagwa Urf Nawapura	Gangbarar juvrajpur	Cargo Jetty
149	1126	1128	Foolpur	Gangbarar Mednipur	High traffic area, Channel siltation area, Tower line crossing, Multiple bridge
150	1128	1130	Barbarahana	Gangbarar Tari	High traffic area, Channel siltation area
151	1150	1152	Dharamarpur	Karbala	Channel siltation area, Eroding banks, Pontoon Bridge
152	1172	1174	Sarauli	Gangwara Nakanwa Medhw	Tower line crossing, Passenger ferry, Pontoon Bridge
153	1238	1240	Ganga Nagar	Suzabad	Channel siltation area, Critical Bridge
154	1240	1242	Ghasi Tola	Ratanpur	High traffic area, Kashi Turtle Sanctuary, Narrow/dense settlement
155	1242	1244	Gauriganj	Katesar	High traffic area, Kashi Turtle Sanctuary, Narrow/dense settlement
156	1244	1246	Nagwa Lanka	Ramnagar	High traffic area, Channel siltation area, Kashi Turtle Sanctuary
157	1246	1248	Rajghat	Susabad	High traffic area, Tower line crossing, Kashi Turtle Sanctuary, Road Bridge
158	1248	1250	Varanasi	Ramnagar	High traffic area, Eroding banks, Tower line crossing, Cargo Jetty, Road Bridge
159	1322	1324	Puranebada	Mirzapur	Passenger ferry, Critical Bridge
160	1340	1342	Pureraji	Babhani Mu. Parawa	Pontoon Bridge
161	1382	1384	Bhurra Tari	Mahewa Khurd	Eroding banks, Pontoon Bridge
162	1398	1400	Tela Khas	Chak Vishun Dutt	Tower line crossing, Pontoon Bridge
163	1404	1406	Kandala Mavaia	Paranipur Uparhar	Eroding tower line, Passenger ferry
164	1410	1412	Garhawa	Dubeypur	Tower line crossing, Passenger ferry

Sl. No.	Ch. Start	Ch. End	Start Location Name	End Location Name	Criteria for Hot Spot
165	1414	1416	Teliyatara	Sisra	Eroding banks, Passenger ferry, Pontoon Bridge
166	1446	1448	Dewrakh Ka Char	Mawaiya Ta. Javthan Ka Char	Tower line crossing, Pontoon Bridge
167	1448	1450	Jhusi	Chak Beniram, Naini	Channel siltation area, Tower line crossing, Pontoon Bridge, Mass Gathering location
168	1450	1452	Daraganj & Jhusi	Chak Hiranand, Naini	High traffic area, Channel siltation area, Mass Gathering location, Passenger ferry
169	1452	1454	Allahabad	Maheshwa Patti Purba Uparhar, Naini.	High traffic area, Tower line crossing, Mass gathering location, Narrow/dense settlement, Road bridge, Passenger ferry

Source: Analysis

These hotspots which are represented as red sections among the critical sections were taken for detailed risk analysis towards proposing risk management measures. Cautionary approach is to be adopted for the yellow sections, which are moderately critical and standard operating procedure, compliance with regulations, regular Thalweg surveys and dredging shall be adopted for the white sections including remaining sections. Also, in case of narrow stretches with thickly populated banks disaster management mechanism to be correctly aligned.

It is concluded that

- There are 220 critical sections identified for Haldia – Munger section out of which 131 are hotspots. The critical risk factors within hotspots were sharp curves less than 200 m, environmentally sensitive area, high traffic areas such cargo jetties, multiple ferry crossings, presence of cross structures having low clearance, tower lines in eroding banks, lock gates and aqueducts.
- There are 105 critical stretches identified for Munger - Prayagraj section out of which 38 are hotspots. The critical risk factors include critical bridge locations, pontoon bridges, mass gathering areas, environmentally sensitive stretches, high traffic areas, terminal locations, multiple ferry crossings, sagging and eroding tower lines etc.

- Out of the total 169 hotspots identified, 87 are falling within the state of West Bengal alone and rest 82 hotspot segments are falling under Jharkhand, Bihar and Uttar Pradesh.

3.4.2. Cargo Related Risk Elements

Cargo related risk in IWT operation are due to

- Intrinsic properties
- Inter-compatibility of various chemicals/ interaction with the medium – air/water
- Interaction with other activates – terminal operation/ vessel operation such as loading or unloading.

Towards delineating the cargo related risk, the listed cargos were anlyased in detail to understand the properties above which may turn in to a disaster. International Maritime Dangerous Goods Code (IMDG) and International Maritime Solid Bulk Cargo (IMSBC) are the accepted international guideline for safe transportation or shipment which is followed for the IWT sector too. IMDG Code list out the Hazardous cargoes - those substance when mishandled will pose damage to people, property and environment because of their intrinsic properties such as flammability, corrosivity, reactivity and toxicity which are defined as below.

- Flammability - It is the ease with which a material ignites either naturally or through the presence of an ignition source. Flammable liquids are characterized by low boiling and flash point. Other flammable materials may catch fire spontaneously in contact with air or due to friction. In the fire event, a hazardous substance causes release of heat, solid particles and toxic gases.
- Corrosivity - It is the property of the chemical by which it destroy or irreversibly damage another surface or substance with which they come into contact including both living tissues skin, eyes, lungs and such as response equipment other cargos or packaging.
- Toxicity - Toxic chemicals are those chemicals that cause death or injury to the living organisms if inhaled, ingested or absorbed through the skin at low levels. It is often represented by the risk of a particular concentration to human health or the environment.

- Environmental Pollutant - Chemicals pose an immediate or delayed danger to one or more components of the environment and for which particular care should be exercised over their disposal.

IMSBC specifies the requirement for bulk solid cargos while handling and transport by classifying as follows.

- Group A – Cargos which may liquefy if shipped at a moisture content exceeding their Transportable Moisture Limit (TML).
- Group B – Cargos which possess a chemical hazard which could give rise to a dangerous situation on ship
- Group C – Cargos which are neither liable to liquefy (Group A) nor possess chemical hazard (Group B). Cargoes in this group can still be hazardous.

It is to be noted that classified cargoes under IMDG or IMSBC Group A/B has inherent hazards associated with it while carrying which are analyzed in detailed in the detailed risk assessment. For cargoes listed in Group C of IMSBC, the guidelines of the IMSBC shall be followed for avoiding risk and whereas for non-listed cargos, the best industrial practice shall be followed for safe handling of cargo.

The detailed analysis of cargo for their applicability to IMDG and IMSBC are presented in **Annexure III**. The cargo classified in IMDG or IMSBC are presented in **Table 3.5**. For detailed features of hazardous cargo, Material Safety Data Sheets (MSDS) of the cargoes listed in IMDG are presented in **Annexure IX.**

Table 3.5. Cargo Classified in IMDG Code and or IMSCB

Sl.No	Cargo	Applicability		UN No	Physical State of Transport
		IMSBC	IMDG Code		
1	Liquid ammonia gas	NA	2.3	1005	Liquid
2	CNG	NA	2.1	1971	Gas
3	LNG	NA	2.1	1972	Gas
4	Petrol	NA	3	1203	Liquid
5	High Speed Diesel (HSD)	NA	3	1202	Liquid
6	Furnace oil	NA	9	1223	Liquid
7	Lube oil	NA			Liquid

Sl.No	Cargo	Applicability		UN No	Physical State of Transport
		IMSBC	IMDG Code		
8	Coal	Group A/B	4.1 - MHB	NA	Solid
9	Coke	Group C-Coke Breeze: Group A	NA		Solid
10	Manganese ore fines	Group a	NA		Solid
11	Ammonium based fertiliser				
	Ammonium nitrate based fertiliser	Group B	5.1	2067	Solid
	Ammonium nitrate based fertiliser	Group B	9	2071	Solid
12	Iron				
	Direct reduced iron (a) - briquettes, hot-moulded	Group B	MHB		Solid
	Direct reduced iron (b) - lumps, pellets, cold-moulded briquettes	Group B	MHB		Solid
	Direct reduced iron (c) - by-product fines	Group B	MHB		Solid
	Ferrous metal borings, shavings, turnings or cuttings	Group B	4.2	2793	Solid
	Iron and steel slag and its mixture	Group A	NA		Solid
	Iron ore fines	Group A	NA		Solid
	Iron oxide, spent or iron sponge, spent (obtained from coal gas purification)	Group B	4.2		Solid
	Iron oxide (technical)	Group A	NA		Solid
13	Concrete				
	Iron and steel slag and its mixture	Group A	NA		Solid
14	Wood		NA		
	Wood chips	Group B	MHB		Solid
	Wood products - logs, timber, saw logs, pulp wood, round wood	Group B	MHB		Solid
NA	Not applicable				
MHB	Materials hazardous only in bulk				

Hazardous cargoes attracting IMDG Code and IMSBC under Group A and B are considered in detailed risk assessment with specific inclusion of Group C cargo types having critical impact on aquatic organisms.

The inter compatibility of cargo was analysed towards understanding the probable scenarios onboard or at storage locations and the same is summarized in **Table 3.6**.

A cargo related incident can trigger various hazard scenarios such as spillage of cargo, fire or explosion. The primary release of cargo may trigger toxic cloud in air and on interaction with water lead to toxic contamination. Hence, cargo properties and immediate consequence were analysed and summarized in **Table 3.7** and the same were duly considered in identifying credible scenarios. The response of individual chemicals on release is presented in **Annexure VI**.

Table 3.6. Compatibility Matrix for Cargo to be Transported through NW1

Sl. No.	Cargo Transported/Medium of Interaction	Air (Medium)	Water (Medium)	Ammonia	LNG	Petrol	Diesel	Furnace Oil	Lube Oil	Edible Oil	Phosphoric Acid	Sulphur	Coal	Sponge Iron	Coke	Cement	Fly Ash	Rock Phosphate	Limestone	Manganese Ore	Ammo.Fertiliser	Food & Food	Plastic Granules	Textile	Paper	ODC and	Vehicles	General Cargo (non break bulk)
1.	Air (Medium)																											
2.	Water (Medium)																											
3.	Ammonia																											
4.	LNG																											
5.	Petrol																											
6.	High Speed Diesel																											
7.	Furnace Oil																											
8.	Lube Oil																											
9.	Edible Oil																											
10.	Phosphoric Acid																											
11.	Sulphur																											
12.	Coal																											
13.	Sponge Iron																											
14.	Coke																											
15.	Cement																											
16.	Fly Ash																											
17.	Rock Phosphate																											
18.	Limestone																											
19.	Manganese Ore																											
20.	Ammonium based Fertiliser																											
21.	Food & Food Stuff																											
22.	Plastic Granules																											
23.	Textile																											
24.	Paper																											
25.	ODC and similar (Iron, Steel, Concrete or Wood)																											
26.	Vehicles																											
27.	General Cargo (non break bulk)																											

Legend :-			
Compatible			Remarks
Dilution with evolution of heat		If water is entering into acid, in situ heat evolution may result in explosion.	Non-Critical
Dilution with evolution of heat		Increase in temperature, Physical Deformation by heat.	Non-Critical
Hydration with evolution of heat		Reactive hydration with evolution of heat, medium becomes alkaline, formation of solid but a slow process.	Non-Critical
Neutralization with evolution of heat		Accelerated corrosion of acid-reactive metal parts, physical deformation by heat, melting of flammable solids with low melting point such as Sulphur, which can trigger corrosion of metal parts, and loss of integrity of the container.	Non-Critical
Reaction with evolution of hydrogen		This is associated with metal and result in the formation of metal phosphate and hydrogen gas, and deposition of insoluble metal phosphate will subsequently cut off the reaction.	Critical
Reaction with evolution of carbon dioxide		Development of pressure, possible explosion on long course and loss of integrity of the container.	Critical

Table 3.7. Properties of Cargo on Release

Sl.No	Cargo	Applicability		Risk of					Consequences
		IMSBC	IMDG Code	Toxic Contamination	Toxic Cloud	Emission of Flammable Liquid	Emission of Flammable Solid	Release of Flammable Gas	
1	Liquid Ammonia Gas	NA	2.3	√	√	×	×		Gas escapes - Heat evolution - changes to alkaline pH - threat to aquatic organism
2	Compressed Natural Gas (CNG)	NA	2.1	√	×		×	√	Gas escapes - Fire can spread on to banks
3	Liquefied Natural Gas (LNG)	NA	2.1	√	×		×	√	
4	Petrol	NA	3	√	×	√	×		Liquid Spill - Fire on surface can affect aquatic - can spread on to banks
5	High Speed Diesel (HSD)	NA	3	√	×	√	×		
6	Furnace Oil	NA	9	√	×	×	×		
7	Lube Oil	NA		√	×	×	×		
8	Coal	Group A/B	4.1 - MHB	√	×	×			Dust explosion in confined space, self-heating and fire at storage. Volatile release leads to health issues for public.
9	Coke	IMO Class :NA IMSBC :Group C - Coke Breeze: Group A	NA	√	×	×	√		Liquefaction
10	Cement	IMO Class :NA IMSBC :Group C	NA	√	×	×	×		Heat evolution with increase in pH. Toxic to aquatic organisms.
11	Fly Ash	IMO Class :NA IMSBC :Group C	NA	√	√	×	×		Fly ash dust is injurious to health
12	MANGANESE Ore fines	IMO Class :NA IMSBC :Group A	NA	×	×	×	√		Liquefaction
13	Ammonium based Fertiliser								
	Ammonium Nitrate based fertiliser	IMO Class: 5.1, IMSBC Group B	5.1	√	×	×	√		Ammonium Nitrate is flammable. Enhances eutrophication
	Ammonium Nitrate based fertiliser	IMO Class: 9, IMSBC Group B	9	√	×	×	√		
	Ammonium Nitrate based fertiliser (NON-HAZARDOUS)	IMO Class: NA, IMSBC Group C	NA	√	×	×	√		
	Urea	IMO Class: NA, IMSBC Group C	NA	√	×	×	×		Aid eutrophication
14	Iron								
	Direct Reduced Iron (A) - Briquettes, hot-moulded	IMO Class: MHB, IMSBC Group B	MHB	×	×	×	√		Liquefaction

Sl.No	Cargo	Applicability		Risk of					Consequences
		IMSBC	IMDG Code	Toxic Contamination	Toxic Cloud	Emission of Flammable Liquid	Emission of Flammable Solid	Release of Flammable Gas	
	Direct Reduced Iron (B) - Lumps, pellets, cold-moulded briquettes	IMO Class: MHB, IMSBC Group B	MHB	×	×	×	√		Self-heating
	Direct Reduced Iron (C) - By-product fines	IMO Class: MHB, IMSBC Group B	MHB	×	×	×	√		Self-heating
	Ferrous Metal Borings, shavigns, turnings or cuttings	IMO Class :4.2, Group B	4.2	×	×	×	√		Self-heating
	Iron and Steel Slag and its mixture	IMO Class: NA, IMSBC Group A	NA	×	×	×	√		Self-heating
	Iron Ore Fines	IMO Class: NA, IMSBC Group A	NA	×	×	×	√		Liquefaction
	Iron Oxide, Spent or Iron Sponge, Spent (obtained from coal gas purification)	IMO Class: 4.2, IMSBC Group B	4.2	×	×	×	√		Self-heating
	Iron Oxide (Technical)	IMO Class: NA, IMSBC Group A	NA	×	×	×	√		Liquefaction
15	Concrete								
	Iron and Steel Slag and its mixture	IMO Class: NA, IMSBC Group A	NA	×	×	×	√		Self-heating
16	Wood								
	Wood Chips	IMO Class: MHB, IMSBC Group B	MHB	×	×	×	√		Self-heating
	Wood Products - Logs, Timber, Saw Logs, Pulp Wood, Round Wood	IMO Class: MHB, IMSBC Group B	MHB	×	×	×	√		Self-heating

Flammable Solid	
Flammable liquid	
Flammable Gas	
Toxic contamination	
Toxic cloud	

3.4.2.1. Oil Spill Related Risks

Oil Spill associated risk was analysed as part of the proposed increased cargo movement along NW 1 towards ensuring oil spill emergency preparedness for NW 1 in line with the requirements set out as per National Oil Spill Disaster Contingency Plan (NOS-DCP) for responding to marine oil spill emergencies in Indian Waters.

The NOS-DCP stipulates the organizational and operational details to effectively combat a national oil spill contingency. NOS - DCP envisages the Director General of Indian Coast Guard (DGICG) as the Central Coordinating Authority (CCA) for enforcing the provisions of the NOS - DCP in the maritime zones of India and delineates the duties and responsibilities of each participating agency. Keeping the operational flexibility for effective response activities, escalation of activities are planned from facility level operation to regional level stakeholder operation through mutual aid activities and then further escalating to avail assistance from national plan or international plan stakeholders. The responsibility of combating with oil spills among the various stakeholders has been assigned as presented in **Figure 3.10** below.

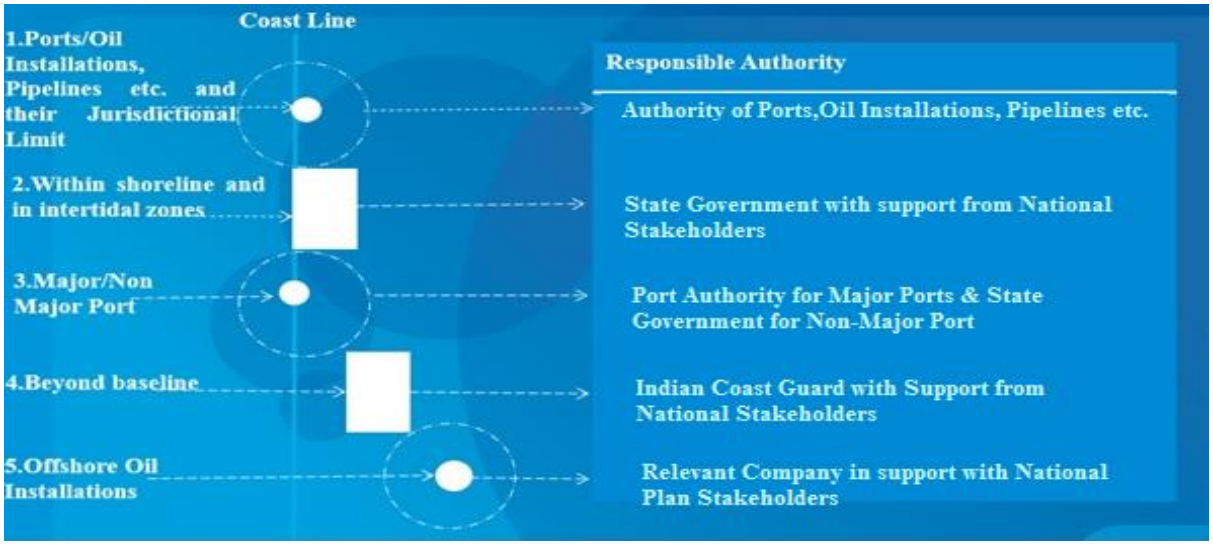


Figure 3.10. Responsibility for Combating to Oil Spill within Indian Waters

It is to be noted that the IWT Terminals/operation has not exclusively mentioned in NOS-DCP; however, in line with Port requirements and cargo operational profile, a proposal on oil spill contingency plan for cargo operation through NW 1 is formulated.

NOS-DCP guidelines defines oils and Hazardous and Noxious Substances (HNS) as below for which the Contingency Plan shall be prepared as per the ICG guidelines.

- "Oil" means petroleum in any form including crude oil, fuel oil, sludge, oil refuse and refined products, other than petrochemicals subject to the provisions of Annex II of MARPOL 73/78 and includes the substances listed in Appendix I to Annex I of MARPOL 73/78 as amended.
- "Hazardous and Noxious Substance" as defined in the IMO OPRC-HNS Protocol means any substance other than oil which, if introduced into the marine environment is likely to create hazards to human health, harm living resources and marine life, damage amenities or interfere with other legitimate uses of the sea.

When oil is spilled, it undergoes a number of physical and chemical changes, some of which lead to its removal from the sea surface, while others cause it to persist. Higher molecular fraction of oil products are persistent since considerable portion of heavy fractions of high boiling material which remain after spillage. While non-persistent oils are generally of a volatile nature and are composed of lighter hydrocarbon factions which tend to dissipate rapidly through evaporation.

Considering the fate of spilled oil, distinction is frequently made between non persistent oils which tend to disappear rapidly from water surface and persistent oils which in contrast dissipate more slowly and usually require a clean-up response.

The detailed list of cargo proposed to be handled through NW 1 was reviewed for their applicability w.r.to the provision of MARPOL 73/78 and IMO OPRC-HNS towards its applicability with NOS-DCP guidelines. For the oil classified, persistency of the oil was analysed as it is critical in planning the response operation requirement and also for ensuring that appropriate equipments and facilities are procured for handling the oil or chemical emergencies expected. **Table 3.8** presents the analysis of oil types w r to persistency towards selecting the oil spill response system to be in place.

Table 3.8. Oil Classification for Cargo through NW 1

Sl.No	Commodity	Classification as per MARPOL	Persistency
1	Motor spirit	Oil	Non-persistent
2	High speed diesel / gas oil (HSD)	Oil	Non-persistent
3	Furnace oil (FO)	Oil	Persistent
4	Lube Oil	Oil	Non-persistent

Source: Analysis

The vessel to be moved include Tankers, Bulk Carriers, Container Vessel, Push boats, Car Carrier, Ro-Ro Vessel, LNG Carrier and Dumb barge along with the present operational vessels such as barges, dredgers, survey vessels, passenger ferries, fishing vessels, sand-carrying vessels etc. All the above vessels would be fueled either by High Speed Diesel (HSD) or by LNG /CNG as the case may be. So, it is to be concluded that the only persistent oil having probability for spill in NW 1 is Furnace Oil. As per the standard design specification for vessel proposed in IWAI, the maximum fuel stored in vessel would be HSD of 30 T and Furnace oil would be carried in tanker would be 1500 T. The same is duly considered in developing credible scenarios.

NOS-DCP has classified ports as Category A, B, C and D depending on the oil spill risk in due consideration of the oil spill probability based on vessel and cargo handled as presented in **Table 3.9**. The minimum Oil Spill Response (OSR) equipments to be in place for the facilities are also detailed out in NOS-DCP.

Table 3.9. Risk Categorization of Ports as per NOS-DCP

Risk Category	Description
A	Ports handling crude oil cargo Tankers (alongside/SBM/STS)
B	Ports handling Ships with other Cargos than crude oil cargo
	Ports handling Tankers with products only
C	Other than Cat 'A' and Cat 'B'
D	Ports handling ships using HSD only as bunker fuel and nil HFO onboard.

Source: EP/0720/Circular No 03/2018 dated 19.12.2018, Indian Coast Guard.

Considering the above, the minimum preparedness equivalent to Category C has been proposed for all terminals along NW 1 with specific requirements for protecting the environmental sensitive areas of Vikramshila Gangetic Dolphin Sanctuary and Kashi Turtle Sanctuary.

3.4.3. Vessel Related Risk

Vessel related risks are equally important as cargo related and channel related risk at the same time highly dependent on them. In the case of NW 1, the vessel to be moved include Tankers, Bulk Carriers, Container Vessel, Push boats, Car Carrier, Ro-Ro Vessel, LNG Carrier and Dumb barge along with the present operational vessels such as barges, dredgers, survey vessels, passenger ferries, fishing vessels, sand-carrying vessels etc. In the port areas of Haldia and Kolkata, there are marine going vessel operations ongoing and the areas are represented with highest traffic. Pure vessel related risks and consequences, other than those covered under

channel related and cargo related risk elements are given in **Table 3.10** below. These aspects were duly considered in development of credible scenarios.

Table 3.10. Vessel Related Risks and Consequences

Sl. No.	Activity	Scenarios	Consequences	
			Primary	Secondary
1	Mechanical	Main engine failure	Lube oil / fuel oil leaks & malfunctioning, overheating or breakdown of main engines.	Stranding/drifting of vessel, Collision with banks, Grounding, collision, fire and pollution of the surrounding environment
		Generators failure	Stranding of vessels	Collision with banks or grounding
2	Structural	Hull failure	Collision or grounding	Breakage of the hull
		Ballast tanks and or other tank structure failure	Damages to tanks and leakage of cargo	Pollution and contamination of cargo and ballast water
3	Electrical Equipment	Navigational equipment and or communication equipment failure	Cannot maintain safe navigation	Endangering crew, vessel, cargo and the environment and lead to possible navigation accidents
		Electrical installations and cables failure	Create sparks , fires or explosions	Personal Injury and damage to property
		Electrical equipment failure		
4	Crew	Lack of awareness and or training	Incorrect handling of dangerous goods, mistakes in the safe operation	Pollution, personal injury or fatalities, property damage, collision, grounding, fire and explosion.
		Lack of skills, experience and competence		
		Crewmembers not following proper rules/regulations/procedures.		
		Improper Communication and signage		
5	Lifesaving appliances & Fire fighting Equipment	Absence / Failure of Fire fighting equipment.	Consequences for safety, property and the environment as crewmembers will not be able to respond effectively in an emergency.	Pollution, personal injury or fatalities, property damage, collision, grounding, fire and explosion.
		Absence / Failure of Fire detection and alarm system		
		Absence / Failure of Emergency fire pump		
		Improper communication and signage		
		Absence of fire control plan		

Sl. No.	Activity	Scenarios	Consequences	
			Primary	Secondary
		Absence / failure of personal protective equipment		
		Absence / failure of lifesaving appliances		
	Other	Corrosion of storage tanks	Leakage of cargo	Pollution, lowering of water quality & damage to aquatic organism
		Failure of flexible pipe connecting bank and vessel	Leakage of flammable materials and vapours	Fire and explosion from ignition of flammable materials and vapours.
		Valves/flanges failure		
		Corrosion of storage tanks	Leakage of cargo	Pollution, lowering of water quality & damage to aquatic organism
		Welding defects	Leakage of cargo	Pollution, lowering of water quality & damage to aquatic organism
		Failure of tank-measurement devices	Tank overflow and leakage of cargo	Pollution incidents, lowering of water quality & damage to aquatic organism and, depending on the kind of dangerous goods being loaded or discharged, the release of flammable liquids or vapors which can lead to fire or explosion.
		Damage to Propeller, Entangling of Water hyacinth, wooden pieces, plastics, Hitting Fishing Nets	Navigational Failure	Grounding or Beaching

Source: Data Analysis

3.4.4. Dredging Related Risk

Dredging related risks are present in the form of channel related risks and is applicable during both construction and operation phases associated with capital and maintenance dredging respectively. It involves risk associated with dredging and allied activities. It is essential that minimum depth of the water is maintained in the river all the time of navigation, as per the notified LAD for each stretches. It cannot be stated that, this particular stretch has more dredging related risk since, LAD varies from each stretch.

Capital dredging location of proposed terminals i.e., Haldia (Operation of terminal would require dredging of 1,57,60,596 cum and also maintenance 8.5 lakh cum/year.), Sahibganj (1.5 lakh cum and also 30,000 cum for maintenance in lean season). Maintenance dredging within Navigation Channel - 14,850,000 cum/year is the tentative quantity, from Haldia to Varanasi (at present dredging is done only up to this point). Dredging activities are most prominent during the lean season between the November to May. All the terminals are important dredging locations in this regard.

Dredging as a fairway development or fairway conservation method in National Waterway No.1 is estimated to be a modest physical intervention. Modest because firstly it's required only in few and far places where the natural depth falls below minimum requirement for navigation. Secondly, required only during the lean season which ordinarily extends for maximum seven months from November to May. The dredging activity is confined only to the navigational channel which is 50-70 m. wide in comparison to the width of the river which is hundreds of meters or even kilometres.

Cutter suction dredging being the principal method of dredging NW.1, the dredged material can be disposed either by side casting away from the channel or to a farther distance through pipe lines. Transporting the dredged material out of the river to higher banks would involve huge technical challenges and unjustified costs. Further, it would amount to mining and permanently altering the bed profile of river. Hence, this option is ruled out.

It's recommended to dispose the dredged material within the river only away from the fairway in such a way that the disposed material do not cause substantial changes to the natural river characteristics. This is appropriate because dredging in a dynamic river environment is a temporary measure to conserve the fairway. The disposal areas which are appurtenant to the main navigational channel also shall be surveyed and mapped prior to commencement of

dredging and disposal. Deposition of dredged material at the disposal areas shall be continuously monitored with equal importance as assigned to the dredging area itself. Disposal shall be planned in such a way not to cause development of mounds on the river bed. It shall be uniform spread of dredged material over an area duly marked on the disposal area that has been initially mapped. The disposal areas shall be monitored continuously and ensured that at no place the disposal exceed a certain thickness which shall be decided specific to each shoal location.

Proper record of the disposal carried out according to above guidelines, ensuring least visible changes to the river bed profile outside of the fairway shall also form part of the dredging records at each shoal. Such records for individual shoals in successive lean seasons would also lead to a data base that will offer new insights into possible improvements in coming years to the methods of dredging and disposal in order to make the activity neutral in its environmental impacts.

The risk related with dredging activities includes disturbances in water column and bottom sediments which may affect aquatic organisms due to increased turbidity. The impact of the activity may be extended up to around 300m downstream depending on localized river hydraulics. Most common area where siltation is always a serious issue includes stretches downstream Ghazipur to Patna and at the feeder canal mouth. Highest no. of shoals being reported in the Farakka – Barh (60 no), followed by Barh – Ghazipur (43 no), Ghazipur - Allahabad (30 no) and Haldia (Sagar) – Farakka (15 no).

Type of dredgers used are Cutter Suction Dredger (CSD), Agitation dredgers/plough dredgers and Back Hoe Dredgers (BHD). Disposal of dredged material through CSDs will be done through pipeline into the free stream of the river in a way to avoid material working its way back to dredged channel. This can be achieved by disposing in faster flowing water, downstream and to the side of the working dredgers and disposal of material into secondary channels or redundant channels. Material dredged by BHD will need to be placed in a barge and disposed of away from the channel, as the reach of the BHD is unlikely to be sufficient to reach the faster flow for dispersion of the material.

Dredge disposal is done preferably offshore, onshore only if sediments are found to be contaminated. In general, dredging causes only temporary damage for the water quality i.e., 3 - 4 minutes as the plume passes. As per baseline study, riverbed sediments are non-toxic except

in Allahabad to Buxar stretch where Cadmium level is found marginally higher compared to US standard for offshore sediment disposal. However, this higher level is unlikely to have toxic effect on aquatic life considering the sensitivity level to cadmium exposure (short terms at Lethal Concentration (LC)-50 level) to aquatic life as per Canadian Guidelines (Source: Consolidated Environmental Impact Assessment Report of National Waterways-1: Volume – 3). Hence, the important hazardous events related to dredging are as follows:-

- Collisions with other vessels or structures while in operation.
- Failed cranes, which can cause the structure or its load to fall and injure/kill workers.
- Other individual risks related to pipeline breakages, high-pressure system failures, dropping objects injuring or killing a worker, falls into the water, where one can drown if they are not wearing a personal floatation device and long working hours, fatigue, and difficult working conditions.

It is empirical to note that due to interactions of various risk elements, the resultant risk and its impacts would be cumulative by nature on actual scenarios in a particular location, resulting in the escalation of incident. e.g. a section of channel with limiting radius can lead to vessel related risk of losing the vessel control and leading to an accident, where if the vulnerability is more, the area could be a high risk area or vice versa. Towards assessing the cumulative risk involved in the above hazards, their mutual implications are concluded as matrix and are presented in **Table 3.11**.

Table 3.11. Matrix on Cumulative Interaction of Risk Elements

	Risk Elements	**Channel***	**Vessel**	**Cargo**
Risk Elements	**Channel ***	Escalation of emergency scenarios, i.e., a) lean season and low depth areas, b) natural disaster in an environmentally sensitive stretch.	Contact, Grounding, Collision.	Release of cargo effecting the sensitive waterway and bank features, activities in channel such as fishing.
	Vessel	Contact, Grounding.	Collision	Fire, Explosion.
	Cargo	Release of cargo effecting the sensitive bank features, activities in channel such as fishing, incompatibility of the cargo and the environment	Fire, Explosion. Trimming.	Incompatibility of Cargo resulting in Fire, Explosion and evolution of poisonous gases.

Source: Data Analysis

Note: Dredging related risk elements are confined to dredging areas which may interact with channel / vessel related risk elements.

From the above it can be concluded that, cumulative risks can emerge from the pair-to-pair combinations of all the three individual risk elements and the effects are accumulating and not nullifying. Also, the above matrix is indicative that, in addition to the above, the cumulative risk from the combination of all the three risk elements i.e., channel, cargo and vessel is also important and lead to worst case scenarios.

Other than human factor, the most important element causing or contributing or aggravating the incident are the natural disasters. The vulnerability of the project region for the natural disasters identified are summarized in **Table 3.12.**

Table 3.12. Vulnerability to Natural Disasters for NW 1

Sl. No.	Natural Disaster	Characteristics	Intensity and waterway stretch Effected.	Impacts Areas	Remarks
1	Cyclone	Cyclones emerging from Bay of Bengal which is characterized by fast winds, heavy rains and which results in flooding.	Velocity of the wind is the characteristic: Very High Damage Risk Zone, Vb = 50 m/s.	Terminal Infrastructure & vessels.	It can be a root cause and also many a times contribute or aggravate the effects of collision and contact.
			West Bengal- South 24- Parganas ,Medinipur, Howrah, Hooghly, Nadia, North 24 Pharanga.		
			High Damage Risk Zone, Vb= 47 m/s.		
			Bihar – Khagaria, Beggusarai, Samastipur, Vaishali, Buxar, Saran, Bhojpur, Patna, Nalanda, Lakhisarai, Sheikhpura, Munger, Bhagalpur,Kathihar.		
			Uttarpradesh - Gazhipur, Sant Ravidas Nagar		
			West Bengal- Murshidabad, Malda		
2	Thunderstorm	Similar to Cyclone.	Similar to Cyclone of lesser intensity.		

Sl. No.	Natural Disaster	Characteristics	Intensity and waterway stretch Effected.	Impacts Areas	Remarks
3	Flood	Mainly during monsoon rain or cyclones, it can also occur from flash flood or dam collapse.	The entire waterway is prone to flooding. However, the river entering locations along the NW1 will be seriously affected due to the cumulative discharge from the upstream. District wise vulnerability to flood is given below: Uttar Pradesh- Ballia, Ghazipur, Chanduali, Mirzapur, Varanasi, Sant Ravidas nagar, Allahabad. Bihar- Most Vulnerable- Khagaria, Beggusarai, Samastipur, Vaishali. Vulnerable – Buxar, Saran, Bhojpur, Patna, Nalanda, Lakhisarai, Sheikhpura, Bhagalpur Less Vulnerable - Munger West Bengal – All districts along NW1 (Highly Vulnerable) Jharkhand- Most Vulnerable- Sahibganj	Scouring of foundation of terminals, bridges and other infrastructure facilities, destruction of banks and formation of shoals thereby increasing chances as well as consequences of collision, contact, falling of structures etc.	It can be a root cause and also contribute or aggravate the effects of collision and contact.
4	Earthquake	Geological reason or	High Damage Risk Zone : Zone IV (MSK VIII)	Directly destructive to jetties,	It mainly emerge

Sl. No.	Natural Disaster	Characteristics	Intensity and waterway stretch Effected.	Impacts Areas	Remarks
		triggered by Dam Break	Bihar- Munger, Sheikpura, Lakhisarai, Khagaria, Begusarai, Samastipur, Vaishali, Patna, Saran, Bojpur, Bhagalpur and Buxar.	terminals and other supporting infrastructure facilities.	as a root cause.
			West Bengal – South 24- Phargana		
			Moderate Damage Risk Zone –III (MSK VII)		
			West Bengal- Medinipur, Howrah, Hooghly, Nadia, Murshidabad. North 24 Pharanga		
			Jharkhand- Sahibganj		
			Uttarpradesh- Ballia, Ghazipur, Chanduali, Mirzapur, Varanasi, St. Ravidas Nagar, Allahabad		
5	Tsunami	Origin is mainly associated with earthquake, it can also arise from Volcano or under water explosion.	Expected wave height - Around 1.5 to 2 m with a probability of 0.99 % per year. Tidal area of West Bengal.	It may damage/collapse the terminal infrastructure facilities and also cause a collision or contact hazard, beaching of vessels.	
6	Tidal Bore	Mainly associated with a cyclone or thunderstorm	Occur in the coastal stretches of NW 1 between Haldia and Tribeni. It occur around 100 days per year.	Will lead to siltation and shoaling in the area. It may damage/collapse the terminal infrastructure facilities and cause a	

Sl. No.	Natural Disaster	Characteristics	Intensity and waterway stretch Effected.	Impacts Areas	Remarks
				collision or contact hazard.	
7	Man Made Disasters		Bihar- Vaisali, Samastipur, Patna, Khagaria, Bhagalpur, Begusari West Bengal -South Pharanga, Nadia, Malda Jharkand - Sahibganj	The common manmade disasters found are: chemical hazards fire communal riot	

Source: IMD, State Disaster Management Plan, Cumulative Impact Assessment Reports, CWC

3.5. Delineation of Credible Scenarios

A cumulative analysis was carried out based on all above studies - historical accident analysis in due comparison with the existing features of waterway with specific emphasis on the various risk elements associated with channel, vessel, cargo and dredging. Credible scenarios have been shortlisted for assessing the risk levels. Risk level for various shortlisted credible scenarios were determined based on the frequency of their occurrence i.e., likelihood that the event will occur and extent of threat to vulnerable features, i.e., consequences they could cause. Basis of probability and consequence and representative risk matrix considered in the study are as below.

Table 3.13. Basis of Probability and Consequences

Probability – Definitions	Assigned Value
Frequency - Likely to occur often in the life of an item.	5.
Probable - Will occur several times in the life of an item.	4.
Occasional - Likely to occur sometime in the life of an item.	3.
Remote - Unlikely but possible to occur in the life of an item.	2.
Improbable - So unlikely, it can be assumed occurrence may not be experienced	1
Consequences – Definitions	
Catastrophic - Operating conditions are such that human error, environment, design deficiencies, element, subsystem or component failure, or procedural deficiencies may commonly cause death or major system loss, thereby requiring immediate cessation of the unsafe activity or operation	4
Critical - Operating conditions are such that human error, environment, design deficiencies, element, subsystem or component failure or procedural deficiencies may commonly cause severe injury	3

or illness or major system damage thereby requiring immediate corrective action.	
Marginal - Operating conditions may commonly cause minor injury or illness or minor systems damage such that human error, environment, design deficiencies, subsystem or component failure or procedural deficiencies can be counteracted or controlled without severe injury, illness or major system damage	2
Negligible - Operating conditions are such that personnel error, environment, design deficiencies, subsystem or component failure or procedural deficiencies will result in no, or less than minor illness, injury or system damage	1

Table 3.14. Representative Risk Matrix

Basic Frequency Classes and Assigned Values	**Consequences and Assigned Values**			
	Catastrophic (5)	**Critical (3)**	**Marginal (2)**	**Negligible (1)**
Frequent (5)	High - 20	High - 15	High - 10	Medium - 5
Probable (4)	High - 16	High - 12	Serious - 8	Medium - 4
Occasional (3)	High - 12	Serious - 9	Medium - 6	Low - 3
Remote (2)	Serious - 8	Medium - 6	Medium - 4	Low - 2
Improbable (1)	Medium - 4	Low - 3	Low - 2	Low - 1

The risk levels assessed for the credible scenarios are as presented in **Table 3.15** below.

Table 3.15. Risk Levels for Credible Scenarios for NW 1

Sl. No	Hazard	Credible Scenario	Risk Type	Probability	Consequence	Risk Value	Risk Level	Response Operation
1	Grounding	Navigation failure near Sultanganj upstream of Vikramshila Gangetic Dolphin Sanctuary leading to grounding of vessel and spillage of Furance oil in water - Oil Spill contamination of watercourse	Offshore	1	4	4	Medium	IWAI and Vessel owners shall work on control of spillage /containment and also to deploy the protective boom and in case if required get assistance from Indian Coast Guard DDMA shall take action for restricting use of the contaminated water through respective nodal departments.
		Navigation failure near Khidderpur reach at Jangipur area leading to grounding of vessel and spillage of Urea in water - Toxic contamination of watercourse	Offshore	4	2	8	Serious	IWAI and Vessel owners shall work on control of spillage /containment and State Pollution Control Board in coordination with Drinking Supply intake downstream shall confirm the usability of water and should restrict use of water.
		Navigation failure in Kashi Turtle Sanctuary at Varanasi leading to grounding of vessel and spillage of Cement in water - Toxic contamination of watercourse	Offshore	1	4	4	Medium	IWAI and Vessel owners shall work on control of spillage /containment and State Pollution Control Board in coordination with Drinking Supply intake downstream shall confirm the usability of water and should restrict use of water.
2	Contact	Rupture of pipe lines during loading/unloading of liquid ammonia due to the contact between vessels and offshore structures resulting	Onshore	3	4	12	High	IWAI and Vessel owners shall work on control of spillage /containment with specific response facilities. Incident Management Team of Terminal shall be immediately activated for response

Sl. No	Hazard	Credible Scenario	Risk Type	Probability	Consequence	Risk Value	Risk Level	Response Operation
		in the release of liquid ammonia into waterway at Haldia terminal -Toxic cloud dispersion						operation with immediate evacuation of the area up to 100 m radius along prevailing wind direction. Depending on the intensity of release, evacuation up to 1 km depending on the weather condition or level 2 operation with support of DDMA would be warranted.
		Contact between vessel carrying petrol with tower lines near Ghazipur bridge resulting in electric arc and fire	Offshore	1	3	3	Medium	Response operation shall be initiated with in house facility of vessel supported by offsite emergency operation by DDMA.
3	Collision	Collission with passenger ferry at Dakshineshwar resulting in spillage of fertilizer/urea into water causing impact to the aquatic life- Toxic contamination of watercourse	Offshore	2	2	4	Medium	IWAI and Vessel owners shall work on control of spillage /containment and State Pollution Control Board in coordination with Drinking Supply intake downstream shall confirm the usability of water and should restrict use of water if warranted.
		Collission with passenger ferry at Behrampore resulting in release of liquid ammonia into water- Toxic cloud dispersion	Offshore	1	3	3	Medium	Vessel owners shall work on control of spillage /containment and immediately request for offsite emergency operation through DDMA with emergency evacuation of 100m of aerial distance of project region in the prevailing wind direction. Depending on the intensity of release, evacuation upto 1 km

Sl. No	Hazard	Credible Scenario	Risk Type	Probability	Consequence	Risk Value	Risk Level	Response Operation
								depending on the weather condition would be warranted.
4	Explosion	Contact between vessel carrying CNG on the bridge piers at Mirzapur resulting to explosion with the release of CNG to atmosphere-	Offshore	1	4	4	Medium	DDMA has to take immediate response action with deployment of resource agencies.
5	Fire	Fire on storage location of Petrol/Diesel at Sahibganj terminal resulting in spreading of fire to the neighbourhoods	Onshore	2	4	8	Serious	Incident Management Team of terminal shall be put in to action at the earliest with support of site DDMA if required.
6	Piracy/ Sabotage	River piracy leading to theft of Petrol/HSD at Barh	Offshore	1	2	2	Low	IWAI/DDMA shall act with help of first responders.
7	Spillage	Loss of control of vessel near Katwa at the confluence location of Ajoy river and NW1 leading to spillage of coal into water- Toxic Contamination of water course	Offshore	2	2	4	Medium	IWAI and Vessel owners shall work on control of spillage /containment and State Pollution Control Board in coordination with Drinking Supply intake downstream shall confirm the usability of water and should restrict use of water .

3.6. Risk Abatement Measures

Historical analysis of accidents in IWT shows that the major primary hazards include collision, contact, grounding, ship get stuck and fire, spillage followed by explosion as an extremely negligible case. The probable areas for hazards above are identified under channel related risk and fire and explosion could be resulted as a consequence of primary hazards or due to cargo related or vessel related risk. Specific risk abatement measures has been proposed for handling channel related risk, vessel related risk, cargo related risk and dredging related risk. Considering that, 60% of the IWT related risks are caused by human error, risk abatement measures have been proposed for individual risk and crew. The following section presents the important risk abatement measures first followed by specific measures to handle channel, cargo and vessel related risk including risk abatement measures for avoiding human errors in IWT operations.

- Emergency Numbers to be displayed in vessel and at terminals where rescue facilities are available.
- 'Do's and 'Don'ts details of hazardous cargo handling, transport emergency card, MSDS etc. should be available at vessel or jetty.
- If possible, develop a software and mobile app for hazardous cargo transportation.
- Modern first aid fix fighting facility should be made available in cargo vessels.
- Training on certified first aid, fire fighting, chemical spill handling etc. to be given to crew
- Minimum 4 fire drill shall be done an year for all members (in vessel and jetty)
- Equipments like Automated External Defibrillator (AED), first aid kit, Self - Contained Breathing Equipment (SCBA) etc. should be available in vessels.
- Hotline facility shall be developed for getting expert advice in case of emergency.
- Emergency Recovery Van (ERV) facility should be made available at major terminals handling hazardous cargos.

3.6.1. Channel Related Risk

- Channel shall be marked with navigational aids all along the way, which will be operational meeting the requirement of 24-hour navigation.
- Strictly monitor for the compliance of minimum LAD assured under JMVP to ensure smooth flow of traffic to avoid the grounding and related risks in areas identified as **Annexure IV** High siltation areas. The areas shall be marked with appropriate warning

signage and the routine Thalweg survey and dredging aspects to be kept on close monitoring while IWT traffic is allowed.

- Where the critical radius is <200 m as presented in Table 3.3 navigation shall be with extreme caution with regulated speed, prohibiting parallel navigation during the initial period with a long term plan to realign the curve as per the design standard. Vessel movement through this areas shall be closely tracked in VTMS and shall be provided with appropriate warning from the nearest terminal/RO. For areas where the curving radius between 200-400 m, navigation shall be with extreme caution prohibiting parallal navigation of large sized vessels. For areas where the curving radius >400 m, proper cautionary approach shall be followed.
- There are many channel diversion areas in NW 1 and Electronic Navigation Chart (ENC) shall have essential provision to guide the channel to be followed during the various seasons. Even during flood, since water level fluctuations of 8-10 m is experienced, rerouting the vessels in bridge locations would be warranted. Under JMVP, it shall be mandated to have seasonal navigation chart in place prior to accelerating IWT operation in NW 1.
- There are 44 bridges crossing the fairway including multiple bridges up to 3 no in single locations near Farakka, at Chauki (Ch. 496 to 498 km). All bridges shall be installed with fenders to avoid any collision impacts. As per RNA, 1 bridge location, at Bally, with a vertical clearance 8.8 m only (Ch. 112 to 114 km) is a limiting bridge. Also, Howrah bridge at Ch.104 to 106 is having a vertical clearance 9 m just meeting the requisite air draft for the design vessel. Specific cautionary approach has to be installed especially on these crossings while operating in monsoon seasons.
- Along all bridge locations, conscious approach shall be made to avoid contact. Along critical bridges (i.e., having limitation on horizontal and vertical clearances) speed regulation shall be followed with confirmation on vertical clearance according to the tidal/seasonal fluctuation in water level. Extreme caution shall be applied in case of multiple bridge crossings.
- Navigation of cargo vessel should be with caution along lock gate, tower line crossings, aqueduct crossing, narrow channels, water body with fairway alignment close to bank especially thickly populated banks.
- Sharp depth transition is observed in Kahalgaon area. The ENC shall include the location for precautionary approach for loaded vessels.

- Mass gathering occurs at Prayagraj (Allahabad) during Kumbh mela (February to May once in 9 years), at Ghats in Varanasi during Ganga Arati, Ganga Puja during the month of Shrawan (July- August), Ghats of Bihar during Chat Puja and Ghats of West Bengal during Durga Puja. Ajgaivinath Dham in Sultangaj and Batheshwer Dham in Kahalgaon area are important mass gathering location during the pilgrim season and is also characterised by large number of ferry crossings in this regard. This areas shall have specific traffic management with pass by permissions for IWT traffic avoid hitting the ferry crossings. Along the mass gathering areas, IWAI shall intimate the local self-governments on the NW1 about the Cargo movement, timings etc. to derive adequate traffic management mechanisms during the festive season.
- Dense settlements along the waterway have multiple ferry crossings as listed in **Annexure V**. Standard vessel operation guidelines for inland water transport shall be strictly mandated in those areas to avoid any mishap.
- Electric tower lines are crossing the fairway at 51 locations. The reported incidents where tower line has fallen to water body are at Srikrishnapur (Ch. 168 to 170 km), Bakiya Bishanpur (Ch. 610 to 612 km), Himatpur Diara (Ch. 914 to 916 km) and Kandala Mavaia (Ch.1404 to1406 km). Sagging tower lines were observed at Ghazipur (Ch. 1126 to1128 km). As per the mandate, the respective electricity boards are in charge of the safety of the tower lines. While all the tower lines crossing the waterway has been observed to have sufficient clearances w. r. to the vessels. As a precautionary approach, the routine fortnight Thalweg survey shall be mandated with a close observation of tower lines, especially following the floods and reporting the sagging if any and also IWAI shall have a formal arrangement with respective electricity board for confirmation based on the residual life studies executed by them.
- Speed regulation shall be mandated along the Farakka feeder canal stretch due to limited waterway width as well as concentration of human activities especially fishing using country boats at regular and multiple ferry crossing locations.
- Entry location of environmental sensitive areas such as Vikramshila Gangetic Dolphin Sanctuary and Kashi Turtle Sanctuary shall be provided with appropriate caution boards to enhance the consciousness of the vessel operator to avoid any mishap which will lead to huge ecological damages. Cautionary boards shall be installed stating important regulatory frameworks mandated for such areas including implications of violations if any.

- As per the various accident statistics, 60 % of the IWT related disasters have been happened due to human errors. IWAI as a proactive measure may foster the safety culture to the crew operating in NW 1 utilising the facilities at National Inland Navigation Institute (NINI), Patna and further scaling up the skill enhancement programme as per the requirements.
- IWAI shall implement the disaster management plan proposed for the terminal and at IWAI RO and HQ and ensure regular mock drills and updation of plan as per the operation pattern. This will include Incident management team, trained response personals and all facilities in an Emergency Control Room for responding in case of emergency with provision for escalating to the essential disaster management facilities of the respective districts.
- For the enhanced IWT operations, the vessel berthing points shall be allocated in designated areas along the waterway.
- Along aqueduct area at Ch.484-486 km, cautionary signs shall be installed to guide the Master of the vessel.
- IWAI need to have close coordination with Kolkata Port Trust and major industrial establishments to have direct support on Disaster Management. Major include NTPC Farakka, various other Thermal Power plants, Industrial Units of Haldia and Kolkata including BPCL, Hindustan Unilever, Indian Oil Corporation etc. A mutual aid association shall be in place towards emergency preparedness and response.
- Risk Assessment study for IWT sector whole over the world faces challenges due to reliable records on incidents w r to incident type, frequency of occurrence etc. Under JMVP, IWAI shall mandate to have a systematic accident record with investigation details compiled for futuristic planning.
- IWT related disasters shall be included in the respective DDMPs and regular mock drills shall be conducted in coordination with the DDMA. The frequency of the mock drill shall be 2 nos. per year. The same shall be schedule in during day and the other during night.
- Being a continuous medium, horizontal integration of DDMPs would be critical towards better response.

3.6.2. Cargo Related Risk

- It is to be noted that classified cargoes under IMDG or IMSBC Group A/B has inherent hazards associated with it while carrying which are analyzed in detailed in the detailed

risk assessment. The above goods shall be transported as per the IMDG or IMSBC and shall bear the tag and MSDS shall be made available on board.

- For cargoes listed in Group C of IMSBC, the transport and storage guidelines of the code shall be followed for avoiding risk and whereas for non-listed cargoes, the best industrial practice shall be followed for safe handling of cargo.
- All transfer or storage facilities of hazardous cargo shall have essential prior approval or permissions under the Manufacture, Storage and Import of Hazardous Chemical (MSIHC) (Amendment) Rules, 2016.
- The inter compatibility of cargoes (Table 3.6) shall be taken with due care while general cargo transport planning and also while assigning storage locations at terminals.
- Crew as well as the workers shall be trained with specific training requirements as per the cargo type handled.
- No source of ignition should be allowed into or near to a place where dangerous goods containers are stowed. Flame proof equipment shall be installed at all requisite locations.
- The deck and even the cargo holds should be free of oil or greasy material. If the deck is found in such a condition, it must be cleaned up immediately.
- Safety of the cargo involves the correct lashings & securing of the cargo.
- While handling the ongoing cargo operation, be careful not to come in the way or stand under any heavy load.
- On-board refrigerated cargo such as Liquefied Natural Gas (LNG) to be monitored and should be maintained at their required temperatures. Cargo holds containing dangerous cargo or fumigated containers should be well ventilated. Entry into such a hold with inadequate ventilation must not be allowed. Any kind of oil spill or leak must be prevented so as to avoid pollution of the water.
- Emergency response operations shall be done specific to the cargo and depending upon their inter compatibility.
- Emergency response measures related to individual cargo has been detailed in the section on DMP and the same has to be maintained at each terminal and the training shall be conducted as per the proposal.

3.6.3. Terminals & Jetties Related Risk

- Introduce specific infrastructure facilities for loading /unloading, shifting/storing of cargo at terminals as the situation demands.
- Regular maintenance of terminals and associated facilities.
- Appropriate safety measures to be installed at terminals and jetties.
- Implement the disaster management plan for Terminals and conduct regular mock drills once in 3 months.

3.6.4. Vessel Related Risk

- Vessels are to be constructed as per the design approved for IWAI complying with IRS Classification for inland vessels.
- Push Barges, which requires low draft can be adopted for certain areas. This will increase the cargo carrying capacity and at the same time reduce the risk of inland operations through narrow channel section to a great extent.
- In the case of vessels with external mounting for cargo special provisions for proper securement shall be provided.
- Safe manoeuvring for the vessels shall be ensured throughout the waterway.
- Fenders are to be provided to the vessels to ensure sufficient protection due to damages from hitting.
- Qualification of crew members and timely training are to be assured.
- All crew should be aware of the vessel contingency plan, which is kept in the deck office.
- First aid kit must always be present in the deck office.
- Unification and modernisation of Vessels Act and ensuring best practices.

3.6.5. Crew Related Risk

- Personal protective equipment must be worn during cargo operation, which includes the safety shoes, safety helmet, overall, gloves, etc.
- Correct lashing procedure have to be followed to avoid back injuries and sprains. One must never stand or walk under a working spreader.
- Safety signs should be posted at appropriate places e.g. ‘No Smoking’ signs.

With the implementation of various recommendation as above, risk for transportation of goods through NW 1 shall be greatlyallineated.

4

DISASTER MANAGEMENT PLAN FOR NW 1

In the Indian context, National Disaster Management Act, 2005 (DM Act, 2005) is the basic legislation in the purview of Disaster Management (DM). DM Act defines disaster as "a catastrophe, mishap, calamity or grave occurrence in an area, arising from natural or manmade causes, by incidence or negligence which results in substantial loss of life or human suffering or damage to and destruction of property or damage to, or degradation of environment of such a nature or magnitude as to be beyond the coping capacity of the affected area". They can be natural, manmade or hybrid based on the cause of their occurrence.

Disasters are result of a hazard's impact on society. Disasters result in loss of life, livelihoods, infrastructure and property, thus pose serious disruptions to the normal functioning of the community resulting in widespread loss, pose immense hardships to them and results in the disruption of economic activity. Detailed risk assessment studies have showed the disaster vulnerability of the project region and the risk elements associated with the cargo transport through NW 1.

Towards developing a low risk cum risk resilient system for its developmental in NW 1, it was decided to take proactive measure under JMVP with deriving a detailed proposal for integration of IWT related disasters in to the District Disaster Management Plans (DDMPs). The present section details out the review of the existing disaster management system of the Country as per DM Act, 2005 and further leading to the development of proposal for integration of IWT related disasters in to existing DDMPs.

4.1. Approach towards Preparation of DMP for NW 1

The detailed risk assessment study w.r.to the IWT operations has revealed the critical hazards associated with the IWT operation include grounding, collision, contact, fire, explosion and spillage (flammable liquid, solid, chemicals leading to toxic contamination and or toxic cloud). The causes and contributing/aggravating factors include natural hazards, human error (while maneuvering, cargo handling – loading, unloading, storage) and technical issues associated with the vessels and intrinsic and inter compatibility issues of cargoes.

DM Act defines disaster management as a "continuous and integrated process of planning, organizing, coordinating and implementing measure which are necessary or expedient". It can be divided into the following steps:

- Prevention: Preventing threat of any disaster which is possible to a great extent in the case of a manmade disaster.
- Preparedness: Contingency planning, stockpiling of equipments and supplies, arrangements for inter-agency coordination, preparation of evacuation plans and public awareness, capacity building and associated training and mock drills.
- Response: Prompt response to any threatening disaster situation or disaster including evacuation, rescue and immediate relief.
- Recovery & Mitigation: Assessing the severity or magnitude of effects of any disaster. Rehabilitation and Reconstruction and implementing measures for reduction of severity or consequences of a disaster

So, in case of disaster management, the phase wise activities required could be summarized as in **Figure 4.1** below.

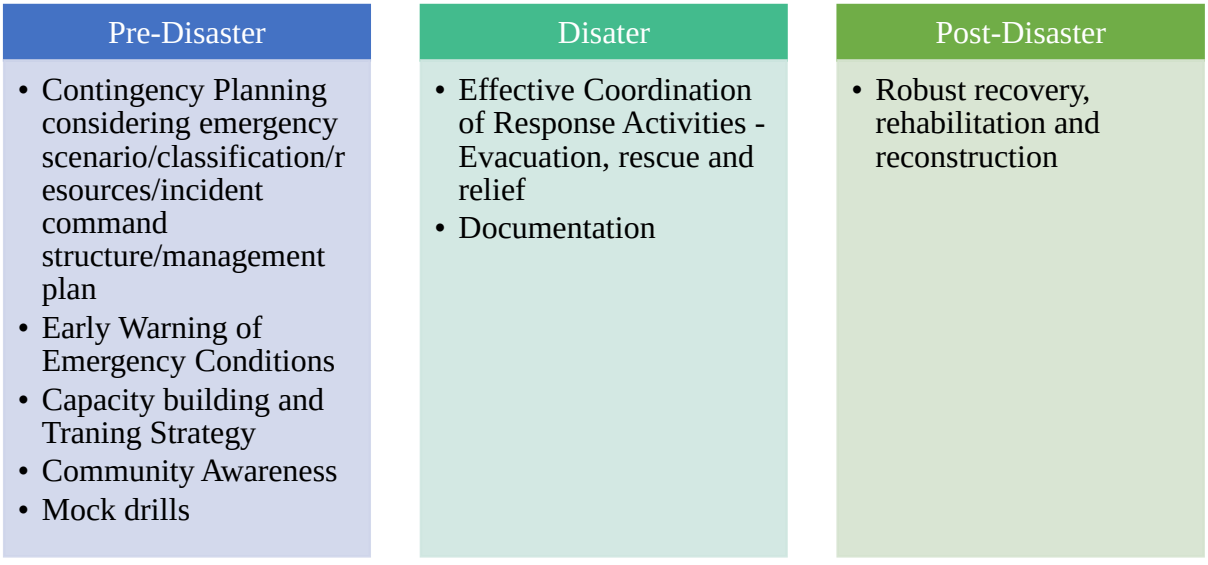


Figure 4.1. Various Phase of Disasters and Activities Involved – On a Broader Profile

The DM mechanism functional at national level and the 4 States – UP, Bihar, Jharkhand and West Bengal through which NW 1 is passing through was anlasyed in detail to understand the hazards identified in the project region and the legal, institutional and resource facilities

established for handling such emergency. Simultaneously, the vulnerability of project region w.r.to IWT related disasters, stakeholder involvement and resource requirement for handling the IWT related disaster in NW 1 was delineated and compared with the existing DM mechanism. A proposal on integration of IWT related disasters in to existing DDMPs was formulated with inclusion of additional stakeholders to handle the emergency with a route map for training and capacity building for handling such emergencies.

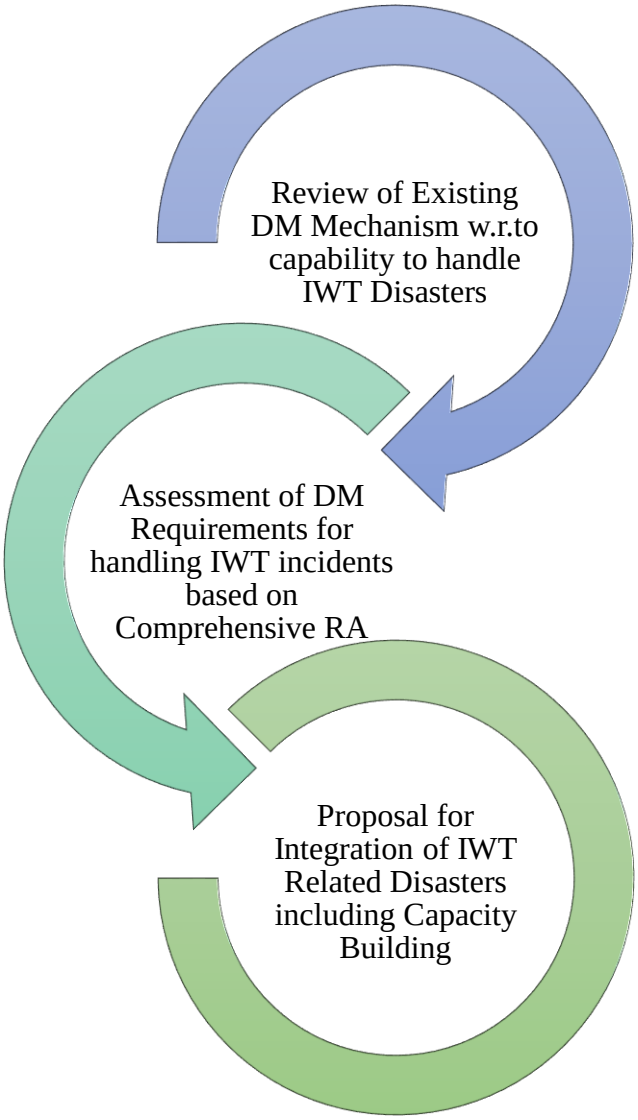


Figure 4.2. Steps Involved in Formulation of Proposal for Handling IWT Related Disasters in NW 1

4.2. Review of Institutional Mechanism for Disaster Management

DM Act, 2005 provides the legal and institutional framework for disaster management in India at the national, state and district and local levels. Before the enactment of DM Act, 2005, National level Cabinet Committee on Security (CCS) was dealing with the matters relating to nuclear, biological and chemical emergencies and National Crisis Management Committee (NCMC) under the Cabinet Secretary overseed the command, control and coordination of the disaster response. The DM Act promulgate establishment of National Disaster Management Authority (NDMA), State Disaster Management Authority (SDMA) and District Disaster Management Authority (DDMA) to combat with any disaster within the country.

DM Act mandates developing disaster management policies at the Central and State level along with preparation of Disaster Management Plan (DMP) delegating various nodal ministries/departments to effectively combat any disaster towards integrating the various manpower and infrastructure provisions available within the Country to combat with any disaster. The Central Government lays down policies and guidelines at the apex level and provides technical, financial and logistic support while the State and district administration through developing disaster management policies and plans make institutional and capacity building as per the vulnerability of the area to various disasters. Disaster management plans are integrated with various stakeholders specifying nodal agencies for early warning, coordination and mitigation or response of any operation. As an integrated approach the disaster response system of country will integrate involvement of various stakeholders i.e., academic institutions, scientific organizations, professional bodies, corporate sectors, Non-Government Organization (NGOs). National Institute of Disaster Management (NIDM) is involved in research and advisory support for the authorities in relevant policy interventions and for effective response operations and dedicated response forces have been established at Central and State levels including National Disaster Response Force (NDRF), Armed Forces and Central Armed Police Forces (CAPF). DM Act also mandates that the disaster management plans prepared at various levels shall be approved by the respective central and state authorities so as to ensure that the mechanism would function seamlessly in case of an event and also mandates for updation and revisions as per the schedules proposed.

National Disaster Management Plan (NDMP), 2016 classifies the disasters primarily as Natural Hazards or human induced hazard or result from a combination of both. Natural hazards are categorized as below.

- Geophysical – Earthquake, mass movement of earth material, volcano, Tsunami
- Hydrological – Flood, landslide, Wave action
- Meteorological – Cyclone, storm sure, Tornado, Convective storm, extra tropical storm, wind, cold wave, derecho2, extreme temperature , fog, frost , freeze, hail, heat wave, lightning, heavy rain, sand storm, dust storm, snow , ice, winter storm, blizzard
- Climatological – drought, extreme hot/cold conditions, forest/wildlife fires, glacial lake outburst, subsidence
- Biological – epidemic: viral, bacterial, parasitic, fungal, or prion infections, insect infections, animal stampedes

Human induced hazards include accidents (industrial, road air, rail on river or sea, building collapse, fires mine flooding, oil spills), Chemical Biological radiological and Nuclear (CBRN) terrorists activities etc.

NDMP has identified the area of NW 1 under the section, 'the Riverine Areas' that spread over one or more states and also are the part of regions or areas involving multiple states requiring special attention i.e., 'Ganga region' drained by River Ganga of "Rivers of the Himalayan Region" (National Disaster Management Policy, 2016).

It is to be noted that RA study has identified that the causes and contributing factors of IWT related disasters, which include a few of the natural and human induced hazards listed above.

The basic institutional framework at national level to deal with the disaster is presented in. **Figure 4.3**

[2] *A derecho is a widespread, long-lived,straight-line wind storm that is associated with a fast-moving group of severe thunderstorms known as a mesoscale convective system, which can cause hurricane-force winds, tornadoes, heavy rains, and flash floods.*

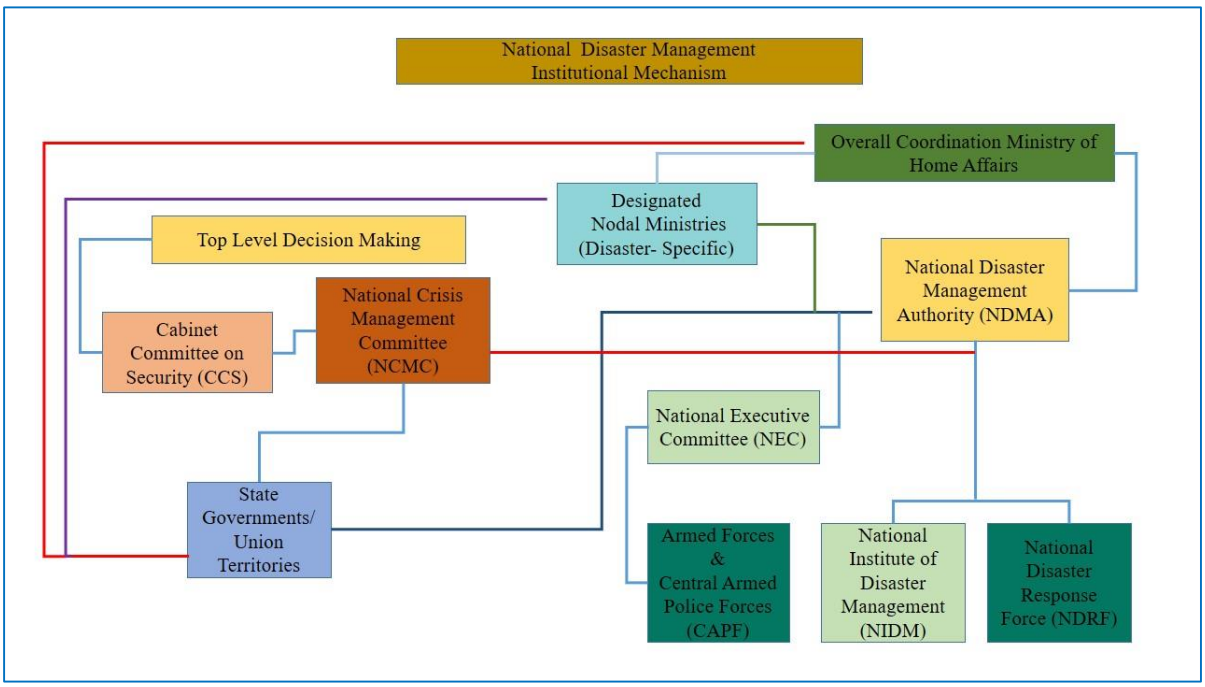


Figure 4.3. Basic Institutional Framework for Disaster Management in India

Note: This represents merely the institutional pathways for coordination, decision making and communication for disaster management and does not imply any chain of command.

Cabinet Committee on Security (CCS) and National Crisis Management Committee (NCMC) are the top level decision making authorities in the disaster management framework of the country. NDMA has the mandate to deal with all types of disasters – natural or human-induced. However, other emergencies such as terrorism (counter –insurgency), law and order situations hijacking, air accidents, CBRN weapon systems, which require the close involvement of the security forces and or intelligence agencies and other incidents such as mine disasters, ports and harbor emergencies, forest fires, oil field fires and oil spills will be handled by NCMC.

At times, the impact of disasters occurring in one State may spread over to the areas of other States. Similarly, preventive measures in respect of certain disasters, such as floods, etc. may be required to be taken in one State, as the impact of their occurrence may affect another. The administrative hierarchy of the Country is organized in to National, State and District level Administrations. This presents challenges in respect of disasters impacting more than one State. Management of such situations calls for a coordinated approach, which can respond to a range

of issues quite different from those that normally present themselves – before, during and after the event. The NCMC will play a major role in handing such multi-state disasters.

The disaster related with NW 1 extending through 4 major states of the country may require coordinated effort from two or more States where the present proposal need to have provision for involvement of NCMC to handle such disasters.

National Disaster Management Authority (NDMA) was established through the Disaster Management Act enacted by the Government of India in 30th May 2005. The agency is responsible for framing policies, laying down guidelines and best-practices and coordinating with the State Disaster Management Authorities (SDMAs) to ensure a holistic and distributed approach to disaster management.

NDMA has Prime Minister as Chairman with 3 members nominated by the Chairperson with Secretary, joint secretary (admin) and Additional secretary and Project Director (NCRMP) with operationally organized into 4 divisions - Policy & Plan, Mitigation, Operations & Communications and Finance headed by the Advisors of respective field. NDMA has the power to approve the National Plans and the Plans of the respective Ministries and Departments of Government of India. Ministry of Home Affairs (MHA) in the Central Government has the overall responsibility for disaster management in the country. NDMA is supported with National Executive Committee (NEC) consisting of the secretaries of nodal ministries or departments having responsibilities under DM Act, 2005. NEC is mandated to assist the NDMA in the discharge of its functions and further ensure compliance of the directions issued by the Central Government. NEC is responsible to prepare the National Plan and coordinate and monitor the implementation of the National Policy and the guidelines issued by NDMA. Responsibility allocation for the nodal ministries and departments are presented in **Table 4.1**.

Table 4.1. Institutional Arrangement for Management/Mitigation and Coordination of Disaster at National Level

Sl. No	Disaster	Nodal Ministry/Department/Agency for Operation at National Level	
		Management / Mitigation of Different Disasters	**Coordination of Response**
1	Biological Disasters	Min. of Health and Family Welfare (MoHFW)	
2	**Chemical Disasters and Industrial Accidents**	**Min. of Environment, Forest sand Climate Change (MoEF&CC)**	

Sl. No	Disaster	Nodal Ministry/Department/Agency for Operation at National Level	
		Management / Mitigation of Different Disasters	**Coordination of Response**
9	Forest Fire	Min. of Environment, Forests, and Climate Change (MoEF&CC)	
4	Cyclone, Tornado & Tsunami	**Min. of Earth Sciences (MoES)**	**Min. of Home Affairs (MHA)**
7	Earthquake		
8	Flood	**Min. of Water Resources (MoWR)**	**Min. of Home Affairs (MHA)**
3	Civil Aviation Accidents	Min. of Civil Aviation (MoCA)	
5	Disasters in Mines	Not listed	Min. of Coal; Min. of Mines
6	Drought, Hailstorm, Cold Wave & Frost, Pest Attack	Min. of Agriculture and Farmers Welfare (MoAFW)	
10	Landslides	Min. of Mines (MoM)	Min. of Home Affairs (MHA)
11	Avalanche	Min. of Defense (MoD)	Min. of Home Affairs (MHA)
12	Nuclear and Radiological Emergencies	Dept. of Atomic Energy (DAE)	Dept. of Atomic Energy, Min. of Home Affairs (DAE,MHA)
13	**Oil Spills**	**Not listed**	**Min. of Defence/Indian Coast Guard**
14	Rail Accidents	Min. of Railways (MoR)	Min. of Railways (MoR)
15	Road Accidents	Min. of Road Transport and Highways (MoRTH)	
16	Urban Floods	Min. of Urban Development (MoUD)	

Source: NDMP, 2016.

It is to be concluded that by the nature of risk associated with cargo operation in NW 1, support from the highlighted nodal ministries would be required depending on the response requirements.

NDMP has identified nodal agencies for early warning system for better preparedness in case of a disaster and the same is presented in **Table 4.2**.

Table 4.2. Central Agencies Designated for Natural Hazard-Specific Early Warnings

Sl.No	Hazard	Agencies
1	Avalanches	Snow and Avalanche Study Establishment (SASE)
2	**Cyclone**	**India Meteorological Department (IMD)**
3	Drought	Ministry of Agriculture and Farmers Welfare (MoAFW)
4	**Earthquake**	**India Meteorological Department (IMD)**
5	Epidemics	Ministry of Health and Family Welfare (MoHFW)
6	**Floods**	**Central Water Commission (CWC)**
7	Landslides	Geological Survey of India (GSI)
8	**Tsunami**	**India National Centre for Oceanic Information Services (INCOIS)**

National Disaster Response Force (NDRF) and National Institute for Disaster Management (NIDM) exclusively support and implements NDMA directions. NDRF headquartered at New Delhi has 3 units stationed close to the waterway, one at Kolkata (West Bengal), another at Patna (Bihar) and the third one at Varanasi (UP). Centre will be also, supporting the state by deploying Armed Forces (Army, Navy, Air Force and Coast Guard) and Central Armed Police Forces (CAPF).

NDMP identifies disaster management and its planning at various tiers must take into account the vulnerability of the disaster affected areas and the capacity of the authorities to deal with the situation as presented in **Table 4.3**.

Table 4.3. Disaster Planning at Various Levels and Responsibilities

Sl.No.	Level of Emergency	Definitions
1	Level 0	Normal working condition. Will be covered by operation and maintenance.
2	Level 1	The level of disaster that can be managed within the capabilities and resources at the District level. However, the state authorities will remain in readiness to provide assistance if needed.
3	Level 2	This signifies the disaster situations that require assistance and active mobilization of resources at the state level and deployment of state level agencies for disaster management. The central agencies must remain vigilant for immediate deployment if required by the state.
4	Level 3	This corresponds to a nearly catastrophic situation or a very large-scale disaster that overwhelms the State and District authorities.

For the project region falling along NW 1, State Disaster Management Authority (SDMA) of Uttar Pradesh, Bihar, Jharkhand and West Bengal shall be the state nodal agencies for coordinating any disaster in the region. Under SDMA, the DDMAs of the bordering districts shall be the first responders in case of a disaster, while IWAI being the owner of NW 1 shall take a key role in preparedness for avoiding any disaster and also to take up responsibility of coordination with NCMC, NEC, SDMAs, DDMAs and all stakeholders in case of a disaster.

The national and state level integrated institutional profile of Disaster Management applicable for NW 1 is presented in **Figure 4.4**. The state level mechanism operational in UP, Bihar, Jharkhand and West Bengal is described in detail in subsequent sections.

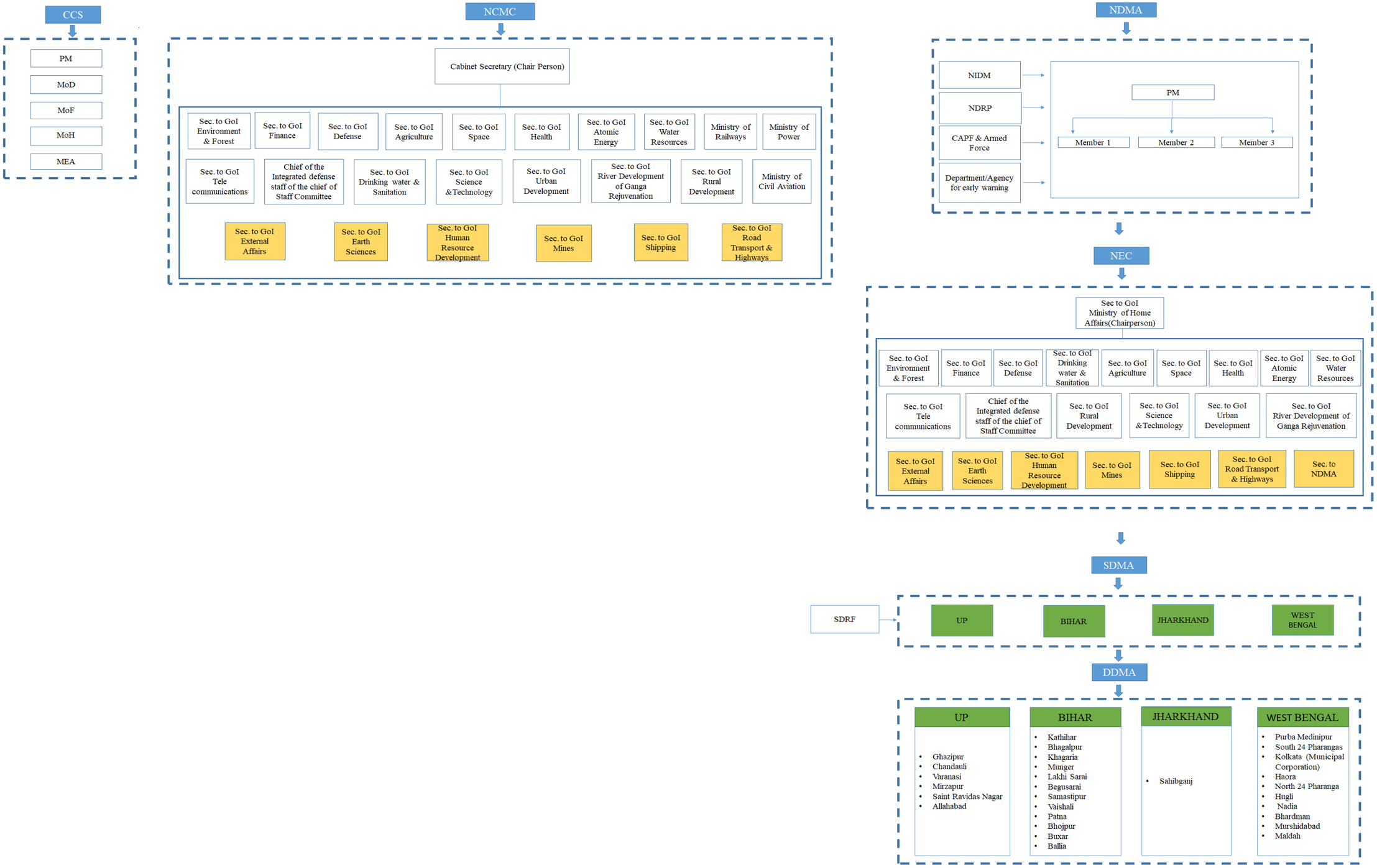


Figure 4.4. DM Institutional Framework in NW 1 Project Region

From the review of existing DM profile, it is to be concluded that

- IWT related disaster w.r.to the cargo movement has not been listed as a major hazard under NDMP. However, the port and harbor related disasters has been listed having responsibility for NCMC. With accelerated IWT related developments, the same need to be added in the NDMP.
- Secretary to Ministry of Shipping (MoS) is a special invitee to the NEC and also member of NCMC and shall be the nodal contact point with NCMC/NDMA in case of IWT related disasters.
- Disaster management Plan for NW 1 shall be prepared in line with DM Act, 2005 integrating to existing DDMPs of respective districts, while key coordination activities shall be handled by the owner – IWAI. Capacity building requirements for existing DDMAs and IWAI shall be delineated.
- The DM proposal has to have the provision to handle Level 1 emergency with a provision for escalation to Level 2 and Level 3. In case of Level 2 incidents, DDMAs would play a key role on response and for Level 3 incidents, the various national plan stakeholders such as resources from other states, national level shall be mobilized.
- It is required that the DMP proposal will involve essential provision to avail early warning from IMD (Cyclone and Earthquake), INCOISE (Tsunami) and CWC (Flood) for avoiding disasters which may be causative or contributive by nature in IWT.
- Since NW 1 is extending through 4 major states of India where the off shore hazard has high probability for getting transported to the neighboring state, the incident reporting requirements will be of two types considering the administrative system of the Country.
- DDMAs of the State shall take lead on response operation with support from the respective SDMA for inter district operations if hazard is not transferable to neighboring districts.
- In case the hazards are transferable to the districts outside the State Limit, it is required that the matter need to be taken up at a higher level under NCMC to take a key role in coordination.

Incident reporting requirement for IWT related disasters in NW 1 is presented in **Figure 4.5.**

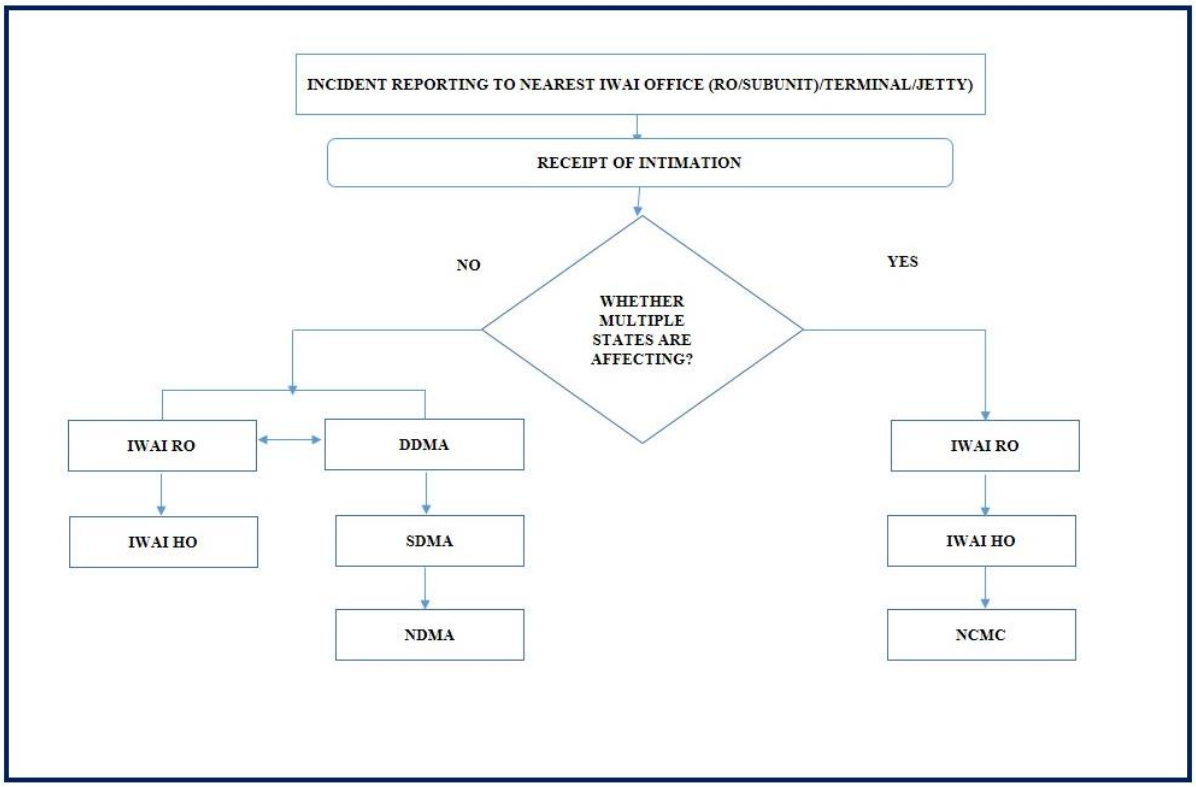


Figure 4.5. Incident Reporting for IWT Disasters in NW 1

Note: RO- Regional Office, HO – Head Office

4.3. Emergency Management Planning for NW 1

Comprehensive risk assessment study has revealed that an IWT related disaster could be resulted at off shore and onshore as presented in **Table 4.4**.

Table 4.4. Offshore and Onshore Activities and Related Hazards

Risk Location	Activities related with IWT leading to risk.	Emergency Operation Required
On shore - Along waterway , Lock gate	Cargo transport / /Capital /maintenance dredging	Grounding / Collision/Contact/ Fire/Explosion/Spillage
Offshore - Terminals/Jetties	Approaching of Vessel/Loading/Unloading /Storage	Fire/Explosion/Spillage

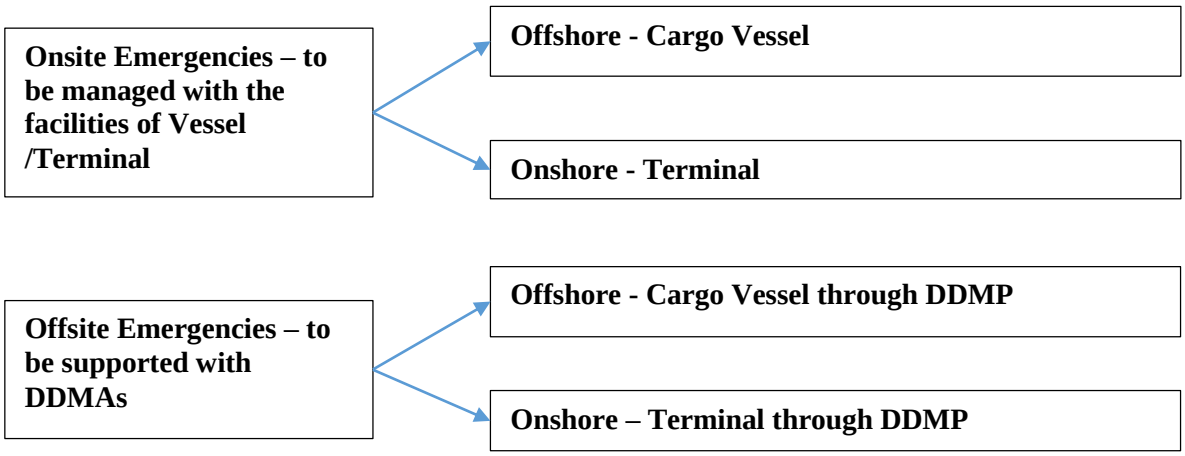
An emergency may be onsite or offsite which requires contingency planning at facility level as well as administerial level which are defined as follows.

- "Onsite emergency" means an emergency that takes place in an installation and the effects are confined to the Installation premise's involving only the people working inside the plants and to deal with such eventualities is the responsibility of the occupier

and is mandatory. It may also require help of outside resources. Thus "onsite emergency plan" means a response plan to contain and minimize the effects due to emergencies within the installations which have a potential to cause damage to people and facilities within the installation premises;

- offsite emergency" means an emergency that takes place in an installation and the effects of emergency extends beyond the premises or the emergency created due to an incident , catastrophic incidents, natural calamities, etc. It no longer remains the concern of the installation management alone but also becomes a concern for the general public living outside and to deal with such eventualities shall be the responsibilities of district administration;

Thus offsite and onsite emergencies with respect to cargo operation in NW 1 is as follows.



Operating cargo vessels will be having the integrated plan for handling onsite emergencies whereas each IWAI Terminal shall have an onsite emergency plan with an Incident Management Team (IMT) to handle the emergencies within its capability. For both onshore and offshore operations, offsite emergency plan shall be prepared with provision for involvement of DDMAs for combat operations in case of any disaster.

4.4. Onsite Emergency Management Plan for IWAI Terminals

IWAI Terminals and Jetties (only where cargo is handled) would need to be equipped for handling the hazards related with spillage of cargo/fire/explosion within its premises with trained manpower and dedicated resources. An Incident Management Team (IMT) shall be formulated for each terminal with a Chief Incident Controller (CIC) and Site Incident Controller (SIC) with supporting staff as deemed necessary.

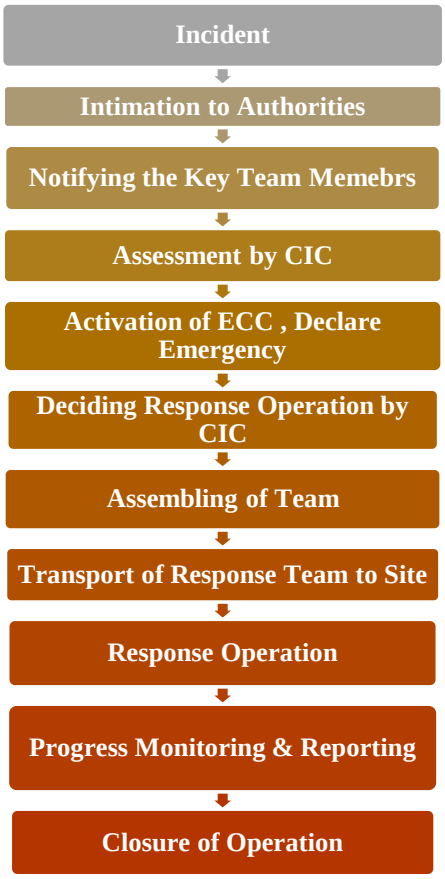
Considering that, IWAI terminals would be operational on Operation, Maintenance and Development (OMD) basis. The incident reporting shall be integrated with the IWAI operation hierarchy for higher level administerial involvement if deemed necessary.

During the onsite emergency requirements, the IMT of the terminal under the operator shall be put for combat operations. Head of Terminal shall be the Chief Incident Controller (CIC) supported by the Site Incident Controller (In Charge – Safety) and the supporting team for combat operations. The resident officer of IWAI at terminal shall be available for overall guidance and support for the terminal operator.

In case the situation warrants an operation of the offsite emergency plan supported by the District administration, the resident officer of the IWAI shall seek support from the Head (RO-IWAI) who shall be taking over the responsibility of CIC and coordinate with the DDMA of SDMA of the respective state for immediate response operation. Head (RO) shall be supported with the incident management team of RO for executing the responsibilities of coordination with various nodal departments of the respective state under direction of DDMA/SDMA as deemed necessary.

Emergency operation in a terminal would require a coordinated effort of various operational teams working in field supported by management, communication, logistic, technical and administerial support. In order to plan the Incident Management Team for each IWAI terminal, the emergency operational sequence was analysed in detail for delineating the requirement at each step in terms of the people, equipment and command and control mechanism to be in place to make the operation successful.

This detailed analysis has been followed with delineation of Emergency Control Centre (ECC) requirements delineating infrastructure facilities, manpower, resources and infrastructure facility requirement leading to the proposal on Incident Management Team (IMT) for IWAI Terminals specifying the roles and responsibilities of the IMT team members and command and control to be in place. The above analysis has been sequentially presented below.



4.4.1. Emergency Control Centre/ Incident Control Room and Facilities

In case of an emergency operation requirement, the planning and response operation need to be coordinated from a single point called Incident Control Room (ICR) alternatively called as Emergency Control Centre (ECC) whereas response action may require to be directly over seed at a site close to the incident known as Field Command Post (FCP); response operation would require to be initiated simultaneously in Jetty and associated water course as well as the shoreline areas under risk. For each IWAI Terminal, ECC shall be established at Terminal Administrative Building. ECC shall be operated on 24*7 basis and would be activated on incident reporting.

ICR shall mandatorily have the various equipments for coordination with the activities of various operational units of Port as well as field operational team at the same remaining connected with the RO, HO, District Disaster Management Authority (DDMA) and stakeholders associated with terminal operation or stakeholders at risk, due to operational activities close to Terminal. ECC should mandatorily have the copy of the approved contingency plan, maps, charts, data formats to be used for operation. The facilities planned at ECC are followed.

4.4.2. Equipment

ECC shall be equipped with all equipments, communication and coordination facilities to act on emergency.

- Maps and display charts and diagrams showing buildings, roads, underground fire mains, important hazardous material and process lines, drainage trenches, and utilities such as steam, water, natural gas and electricity.
- A copy of the relevant disaster management plan.
- Situation boards (continuously updated to present a summary of the current situation and response actions being taken).
- Aerial photographs, if possible, and maps showing the site, adjacent industries, the surrounding community, highways, etc., to help determine how the disaster may affect the community so that the proper people can be notified, adequate roadblocks established, and the civil authorities advised.
- Sufficient telephone lines to enable full liaison with outside bodies.
- Names, addresses, and telephone numbers of employees, off-site groups and organizations that might have to be contacted; all telephone lists being reviewed for accuracy on a scheduled basis and updated, as necessary.
- Dedicated and reliable communication equipment; enough telephones and at least one fax line to serve the organization for calls both on and off-the-site.
- Fixed and portable two-way radio equipment to keep in contact with activities on-scene and to maintain continuity of communications when other means fail.
- Plan board, logbook, voice recorder, television, DVD and Video facilities for playing back records from aircraft and helicopters, as well as monitoring media coverage of the incident with a person assigned to record pertinent information and to assist in investigating cases, evaluating performance, and preparing reports.
- Emergency lights so that operations can continue in the event of power failure.
- Photocopy, fax and e-mail facilities.
- Dedicated computers with LAN/ internet facility to access the installation data and the latest and updated soft copies of all standard operating procedure (SOP) etc.
- Wireless Internet Facility.
- Video Conferencing Facility to have face to face communication/meetings between the stake holders.

4.4.3. Documents, Contact Details, Lists / Maps

ECC has to maintain documents on Terminal Level Disaster Management Plan, emergency contact details, maps, charts incident logs etc. The following details shall be available at ECC.

Contact Details

- ECC Key Personals, Trained Response Personals
- Emergency Contacts – Hospitals, Ambulance, Fire, Police, DDMA, Indian Coast Guard
- Stakeholders in and around terminal
- Contact List of Resource Agencies – IMD, CWC, INCOIS etc.
- Mutual Aid Partners
- Emergency Contact Details of Sub offices, RO and HQ, IWAI.
- Response Equipment Suppliers
- Specialists available on Call

4.4.4. Lists/Maps

- Emergency Response Equipment List
- Master Plan of Terminal showing ICR, equipment storage areas, FCPs, waste storage locations based on available terminal layout

4.4.5. Field Command Post (FCP) and Communications

Field Command Post is the point from where the response persons will be operating. FCP would be identified based on the location of incident in due consideration of the safety of the people to be deployed for emergency by SIC during an incident. FCP may be on land or in a vessel depending on the incident location and type of incident to be handled.

4.4.5.1 Field Communication Equipment's

SIC shall be directly overseeing the response operation and team would be deployed within terminal or shoreline adjacent to the terminal. The team should have seamless connectivity with dedicated field communication equipment for communicating in between during the operation. ECC shall have dedicated communication facilities in place to receipt, record and respond to the team under operation and also with the statutory authorities continuously.

The emergency response operation sequence and the facility requirements to handle emergency is compiled in **Figure 4.6** based on which, the Incident Management Team proposed for IWAI Terminal is presented in **Figure 4.7.**

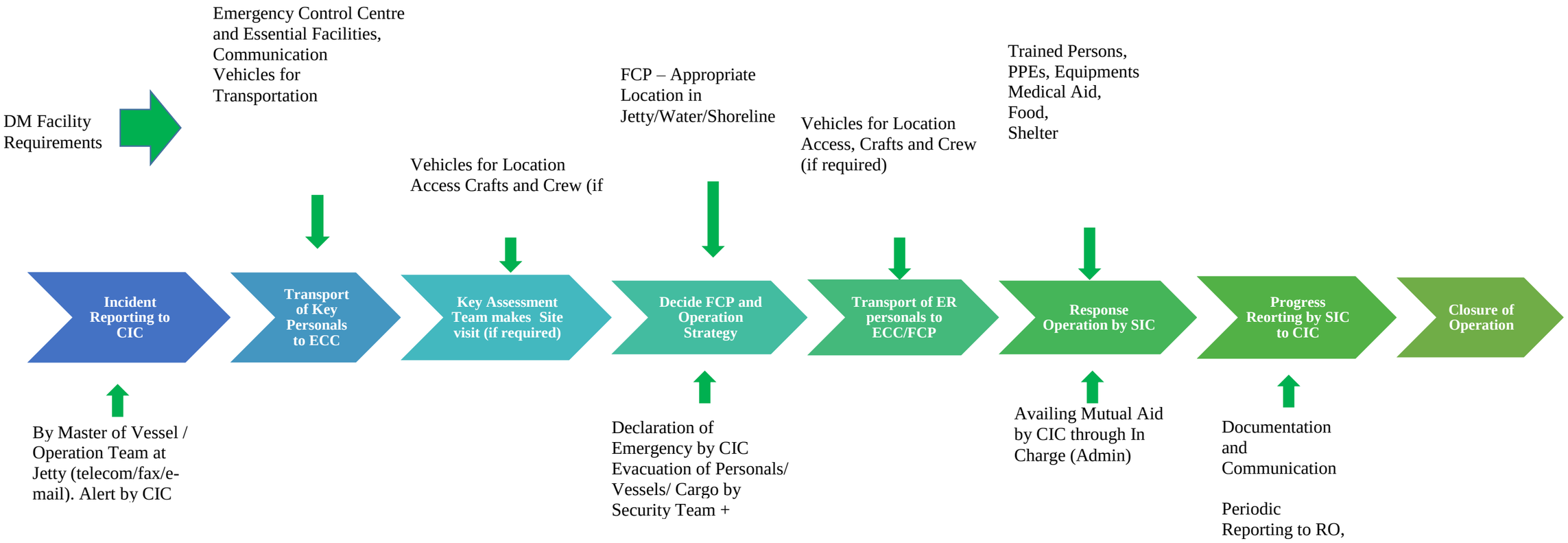


Figure 4.6. Emergency Operation Sequence and Infrastructure Provisions Required

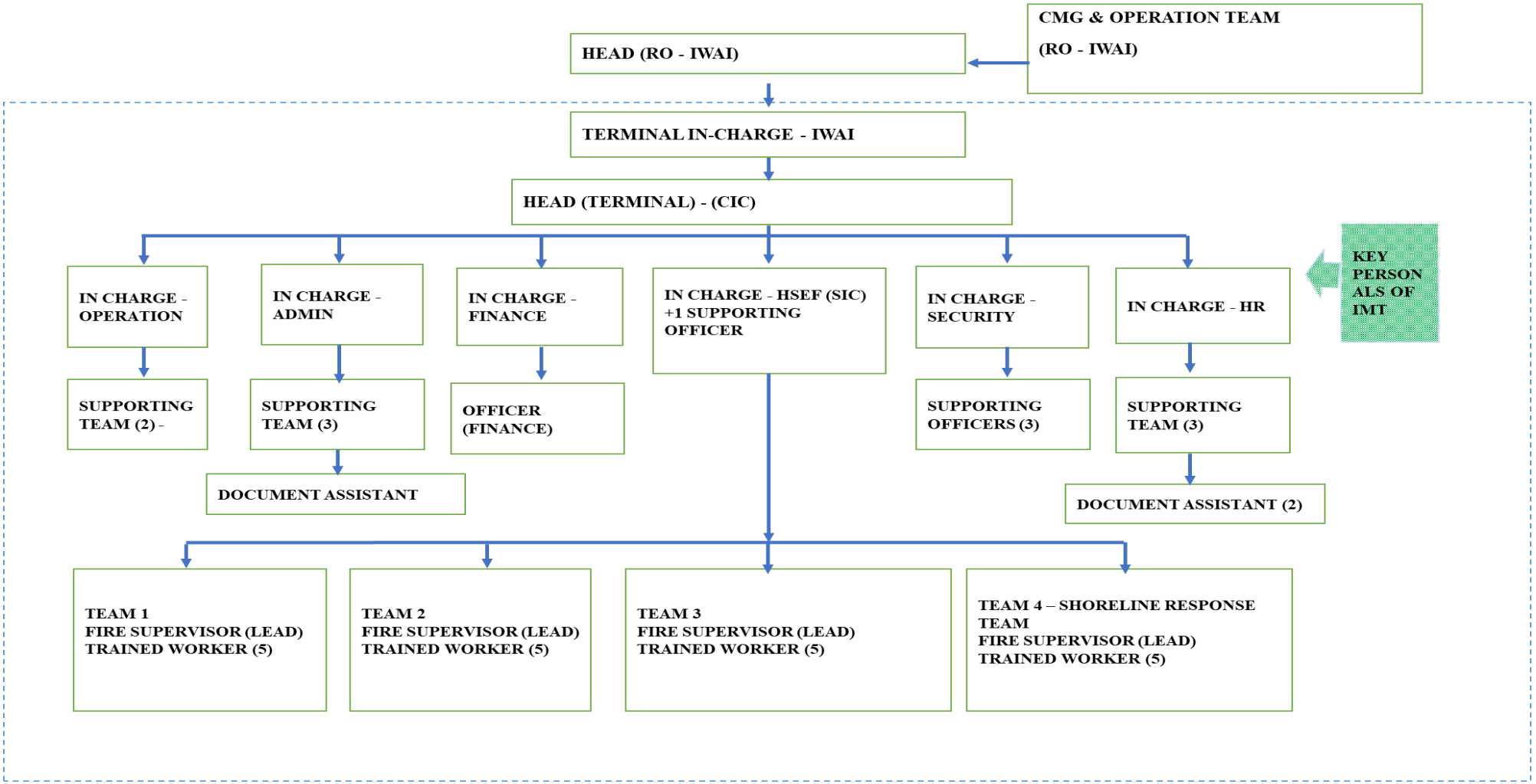


Figure 4.7. Incident Management Team for IWAI Terminal

Note: In case the water based operations are required, the Tug Operation team shall be joined with the operation team

4.4.6. Emergency Response Operation at Terminal

Head (Terminal) will act as the Chief Incident Controller and shall notify the key team members (all key officials of IMT) towards meeting up at ECC towards assessing the size and magnitude of incident. The members designated for making the preliminary assessment of the incident shall be the Key Assessment Team (KAT) whereas the other key team members shall remain available for supporting the assessment team and planning the immediate actions to be followed for response operation. The following are the key team members of the Incident Management Team.

- Head (Terminal) – Chief Incident Controller (CIC)
- In Charge - HSEF (SIC)
- In Charge – Operation
- In Charge - Security
- In charge - Admin
- In Charge - Finance
- In Charge - HR

Key Assessment Team

Key Assessment Team will assess the magnitude of incident by connecting with the incident site / vessel and initiate the initial response operation. In case the connectivity couldn't be established, the Key Assessment Team shall be proceeding to the site seeking backup support from the neighboring health care facilities and assess the situation accordingly. On reporting the preliminary assessment by SIC to CIC, the CIC shall be declaring emergency and direct for safe transition from normal operation to emergency operation and systematic shut down as per the requirements.

On declaration of emergency, the operation team shall analyse the ongoing port operation pattern, ongoing cargo transfer operation, vessel positioning/ movements and which may interfere with the incident and will be controlling/re-planning or rescheduling the operations and would be intimating the various stakeholders associated with the operation. The Key personals of the ECC shall be taking the actions for initiating the response activities as per the direction of CIC towards mobilizing the response team within the least time frame.

4.4.7. Responsibility Allocation for Incident Management Team

The following section presents the roles and responsibilities of the emergency response personals and reporting requirements.

4.4.7.1. Chief Incident Controller (CIC) – Head (Terminal)

Head (Terminal) has been designated as the Chief Incident Controller for emergencies associated with the terminal Operations. CIC is responsible for the management and coordination of response operations at the scene of incident to achieve the most cost effective and least environmentally damaging resolution to the problem. During a major incident requiring operation of DDMA through offsite emergency plan, Head – RO (IWAI) shall take over the responsibility of the CIC where the Head (Terminal) shall be acting as SIC to execute the operational aspects of the response.

The Chief Incident Controller shall have overall responsibility to protect personnel, site facilities and the public before, during, and after an emergency or disaster. The CIC shall be present at the ECC for counsel and overall guidance. Responsibilities of the Chief Incident Controller shall include the following:-

- Preparation, review and updation of the Facility Level Disaster Contingency Plan for Terminal;
- Receive incident report; declaration of initial alert, preliminary reporting to RO.
- Mobilization of Key Personals to ECC, assessment of situation, declaration of emergency.
- Activation of ECC; intimation of various stakeholders on the emergency.
- Taking decision on seeking assistance from mutual aid members and external agencies;
- Arrange for medical aid for saving life; mobilize emergency response team for operation.
- Take decision and provide alternative arrangements coordinate with stakeholders on aspects related with changes in vessel operation plans, cargo handling plans, cargo /vessel shifting requirements etc.
- Support SIC through external assistance – technical, resources/equipment/medical support as deemed necessary.

- Coordinate with Head – RO, ensure that appropriate local and national government authorities are notified and various stakeholders are informed with regular and updated reports/information/guidance.
- Ensure round the clock operation; with shift personal being prepared to take charge of the emergency control function, emergency shutdown of system if needed.
- Taking stock of casualties and ensuring timely medical attention;
- Ensuring correct accounting and position of personnel after the emergency;
- Ordering evacuation of personnel as and when necessary;
- Support RO for taking decision of escalation of response operation with involvement of NDMA and NCMC.
- Remain for counselling at ECC for various stakeholders, releasing media and public statements.
- Planning and conducting mock drills and ensure the contingency plan is ready to execute.

4.4.7.2. Site Incident Controller (SIC) – In Charge (HSFE)

In Charge (HSFE) shall be the Site Incident Controller (SIC) who has overall responsibility for managing the response and will report directly to CIC. During lesser incidents, the SIC shall act as CIC and will have In Charge (Operation)/ In Charge (Security) as the resources who will assume the responsibility of SIC in absence of In Charge (HSFE). Three member team of - SIC, In Charge (Operation) and In Charge (Security) shall be the Key Assessment Team (KAT) on receipt of any incident reporting. The key personals shall be directly involved in response strategy formulation and revisions all throughout the emergency period.

Responsibilities of the Site Incident Controller shall include the following:-

- To maintain a workable emergency control plan, establish emergency control center, organize and equip the organization with trained personnel;
- On receipt of the intimation from CIC immediately proceed to ECC and play key role in assessing the situation by contacting vessel /In charge of incident area or proceeding to site.
- Assess the situation by contacting vessel or by leading the team to the incident assessment; report to CIC for emergency declaration, lifesaving requirements,

operation and response strategy. Support CIC in decision on availing support from mutual aid members and or DDMA.

- Ensure that essential HSE/Communication equipments are availed for the Key Assessment Team.
- Take quick decisions on priority of operation – life saving requirements/ response requirements, ideal location for field command post, response strategy to be adopted and take full charge of operational activities; coordinate all activities within Incident Management Team members.
- Plan both off shore and onshore operational strategy, revisit the strategy
- Ensure that medical aid has been made available as early as possible.
- Assess mutual aid requirements, intimate to CIC. Lead the response operation in case of smaller incidents assuming the power of CIC.
- Coordinate mutual aid activities if situation warrants. Support DDMA as Coordinator on behalf of Terminal with availing equipment, manpower and supporting facilities for response operation.
- Plan and deploy the available resources – equipment, firefighting facilities assess additional requirements with support from Key Assessment Team and avail with support of ECC.
- Lead response team to Field Command Post, brief the situation, lead operational activities; ensure that the response operations are least environmental damaging and best suited to the situation.
- Guide operational activities with appropriate response strategy, provide technical inputs (meteorological conditions, physical and chemical properties, environmental significance etc.) continuously monitor and report, revise the strategy as and when required.
- Ensure the maintenance requirements of the equipments and manpower (medical, transportation, food, shelter, change of shift etc.) is met with during the course of operation.
- Assess the additional requirements for response operation –equipments/ trained resources/ crafts/ crew/ communication devices / supply of food/ transportation, specialist support, weather forecasting requirements etc., ensure timely availing the support as desired.

- Ensure that the response operations are appropriately monitored, evidences are taken as per the guidelines and passed on to In Charge HR – Documentation in charge of ECC.
- Assess the immediate financial requirements, avail the same through CIC.
- Regularly report to CIC; support with in situ information on progress, terminal /vessel operational control requirements which need to be imposed.
- Provide technical support to CIC on coordinating with stakeholders, protecting the interest of the affected parties and ensuring factual information dissemination with the statutory/media/public.

4.4.7.3. In Charge – Operation

- On receipt of the intimation from CIC immediately proceed to ECC and play key role in assessing the situation by contacting vessel or proceeding to site.
- Support the response operation throughout the period with continued availability of Crafts (tug/pilot boats/survey launches etc.) and Crew & in case vessel operation is required, guide assessment team to the boarding point ensure the assessment team reaching the site of incident.
- Provide the Key assessment team with input on the vessel met with accident and the details available on the consignment, quantity etc.
- Support for the securing the wrecked vessel and or cargo arranged by the Ship Owner/Agent/Charterer.
- In absence of SIC, take over the complete responsibility of SIC as per the advice of CIC.
- Take decision on stopping the cargo handling activities/ evacuation of other vessels /operations if the incident site is close to the berth / anchorage. Coordinate and ensure immediate evacuation from the scene of incident.
- Take adequate action in consultation with the cargo handling team for securing the unloading cargo as well as the cargo received for dispatch.
- Take adequate action for informing the various stakeholders – with the change in vessel entry/exit to terminal areas, resultant cargo handling changes; ensure that the interest of the Terminal Owner as well as the Stakeholders are protected to the maximum. Ensure constant communications from ECC and remain available for the clarifications/decisions thereto.

- Supporting team under In Charge – Operation shall execute the changes required in vessel operation and cargo handling aspects as above.
- Immediately release the emergency operational people both for the response operation and ECC management requirements. Assess the additional manpower requirement for the ongoing operation pattern in Consultation with SIC and pass on emergency call people list to In Charge (Admin).
- Support with availing suitable cranes, vehicles and supporting crews for the transfer of spilled cargo collected to land and safe transfer to temporary disposal site.
- On behalf of Terminal, as per the advice of CIC, communicate with Vessel Owner/Agent/Charterer for the salvage operation requirements. Support for the salvage operation arranged by the Vessel Owner/Agent/Charterer with allotting operational accessibilities.
- Act as Specific In Charge for Jetty/Terminal based response operations.

4.4.7.4. In Charge – Security

- On receipt of the intimation from CIC immediately proceed to ECC; alert terminal users as per the direction of CIC.
- Assess the security requirements for immediately proceeding to the site of incidence; avail utility vehicles;
- Responsible for disbursing security directions for controlling entry/exit to Terminal premises.
- Assist the operation team for evacuation of personals/cargo if warranted. Operate public warning systems in emergency situations.
- Ensure the utility vehicles in place for accessing the site of incidence. Immediately plan and make available pathways for operation for medical team/fire team/response team etc. without compromising the security.
- In case of Level 2/3 operation, control on the entry /exit of vehicles, equipments and personals for the emergency operation; ensure ease of operation within the security regime.
- Quickly assess the security areas, requirement of additional resources if any from State Police/DDMA, report to CIC and coordinate with the additional resources.

- Support SIC in limiting the access of unauthorized persons/vehicle to the scene of incidence or response operation areas including the shore line response areas. Ensure tight security of the operational areas until normalcy is restored.
- Oversee the shoreline response operations, regularly report the progress to SIC, ensure that the response operations are appropriately monitored, evidences are taken as per the guidelines.
- In absence of SIC, take over the complete responsibility of SIC as per the advice of CIC.
- Act as specific in charge for shoreline response operations.

4.4.7.5. In Charge - HR

- Core responsibility dealing with identifying manpower support for operations, handling communication with various agencies and central point of communication in ECC.
- On receipt of the intimation from CIC immediately proceed to ECC; alert terminal users per the direction of CIC.
- After primary assessment / as per the direction of SIC, immediately identify the primary responders and release intimation to In charge – Admin for necessary intimation and transport of personal to ECC.
- Support SIC in identifying additional manpower and requirement for the ongoing operation and pass on emergency call persons list to In Charge -Admin.
- Remain as the communication head of ECC, ensure that the communication from Site Incident Control is maintained uninterrupted. Support SIC in all communication aspects. Ensure that the information at ECC is continuously updated from the site.
- Responsible for all communication with all other agencies – DDMA,ICG, Government, mutual aid partners, various stakeholder – prepare the communication, get approval from CIC and release on behalf of CIC.
- Prepare response to all media/public queries, prepare press statements release responses/statements after approval from CIC.
- In case of additional support requirement, as per direction of CIC, contact mutual aid partners, collect information on the resources committed to be availed pass the information to SIC.
- Take full charge of the documentation of response operation. Direct /request the team in operation for documentary evidences, take full control on progress reports are

maintained, evidences are taken as per the DM guidelines. Get guidance from In charge (Finance) on the documentation aspects and support In charge (Finance) for financial closure of operation with providing various claims/reimbursements/disbursements etc. towards realization.

4.4.7.6. In Charge – Admin

- Responsible for core administration and logistic support for ECC and its operation.
- Responsible for the operation and maintenance for ECC. Over all coordination with the various operational unit for maintaining the ECC functional.
- After primary assessment / as per the direction of SIC, immediately coordinate with the primary responders and avail utility vehicle support for reaching ECC and further proceeding to FCP.
- Make necessary arrangements for the mutual aid partners for travel to project site, lead them to ECC and connect with the response team under SIC. Avail compliance with the security procedures of Terminal for the resources on call (internal as well as external) with a dedicated security personal for ease of operation.
- Maintain document on the resources deployment – details of the people/equipment on operation, period of deployment, comply with the financial requirements for arranging facilities for response personals through CIC.
- Avail transport and logistic arrangements for the personal on duty for emergency operation – ensure supply of food, shelter and travel requirement. Coordinate with the external facilities of terminal areas for making temporary arrangements.

4.4.7.7. In Charge – Finance

- Support CIC for preliminary estimate of the finance requirement for operations. Approve and avail the fund throughout operational period.
- Allot Officer (finance) round the clock in ECC for supporting the various team with guidance on collecting and recording the relevant supporting documents toward effecting payment directly/reimbursements.
- Support SIC on aspects of financial control of operations, after closure of operation, assume the charge of financial closure of operation with proceeding for the various claims/reimbursements/disbursements etc. until it is realized.

4.4.7.8. Technical Resource Person

- Lead coordinator for site specific support to ECC on cargo properties, weather forecasting and environmental and bathymetric aspects
- Provide technical guidance for the operation team on the chemical characteristics and fate of the cargo by analysing the incident report.
- Maintain updated contacts with the various resources agencies identified in Disaster Management Plan and avail ready to contact list in case of emergency. Identify resource persons to be utilised in case of emergency and maintain appropriate arrangements for availing services.
- Support In Charge - HR in communication with statutory agencies.
- Support response operation by connecting to the agencies such as INCOIS, CWC, IMD etc., early warning

4.4.7.9. Responsibilities of Supporting Teams of IMT

The most relevant roles of the key supporting members are listed below and being part of ECC additional responsibilities would be allotted to all members as per the requirement by CIC.

4.4.7.9.1. Supportive Team – under In Charge (Operations) – 2 Members

- Support In Charge - Operation for planning and execution of functional activities assigned to him.
- Analyse and re-plan ongoing and planned cargo operation, secure cargo unloaded or accepted for loading to vessels, securing of the vessels /facilities in incident proximity.
- Execution of the re plans as per the direction In Charge (Operation) which may include upto systematic shutting down.

4.4.7.9.2. Supportive Team – under In Charge (Admin) – 2 Members

- Support In charge – Admin to execute the role in managing ECC
- Support In charge – Admin for transportation of ECC Key members as per direction of CIC.
- Support In charge – Admin for providing logistic arrangements, catering facilities etc., for the incident response team.
- Support In charge – Admin for arranging any transfer facilities - arrangement of emergency vehicles, people etc.,

- Liaison with external facilities - hotels/resorts etc. for arranging accommodation for response personals.

4.4.7.9.3. Document Assistant– under In Charge - Admin

- Support In charge Admin to act as Centre point of communication at ECC.
- Take charge of preparation and custody of all documents w r to manpower and equipment requirements, logistic supports etc., for response operations.

4.4.7.9.4. Officer - Finance

- Complete the procedure for financial disbursement as per the direction of In Charge - Finance and ensure the disbursements.
- Keep on updating the reserve funds and additional requirements if any to In Charge - Finance.

4.4.7.9.5. Support Officer 1 – under In Charge- HR

- Support In Charge - HR for emergency call of response personals to ECC.
- Support In Charge - HR to ensure seamless communication to SIC and update to CIC.
- Support In Charge - HR for acting as the communication point at ECC, receiving and replying for the communication for all stakeholders.

4.4.7.9.6. Support Officer 2 – under In Charge- HR

- Analyse Media and PR queries, prepare replies and support In Charge - HR to get approved by CIC.

4.4.7.9.7. Supporting Officer 3 – under In Charge -HR

- Act as documentation in charge - take charge of preparation and custody of all documents - requests/orders/bills/claims etc.
- Support In Charge - HR for all documentation related aspects.
- Safe custody of progress reports of operation, ensure that essential supporting evidences are captured and documented towards claim on later stage.

4.4.7.9.8. Document Assistant for ECC – under In charge HR

- Meet the requirement of ECC on drafting, communications, printing, publishing, recording etc. throughout the operational period.

4.4.7.9.10. Supporting Officer – Under In Charge HSFE at FCP

- Support SIC executing his duties – managing FCP and coordinating the supporting units.

- Coordinate the various working units for response operation and supporting team such as medical units, equipment maintenance, communications, documentation etc. waste handling.
- Ensure that the response operations are supported with the requirements on timely basis.

4.4.8. Manpower Allocation for IMT - Training and Capacity Building Requirements

A total of 42 persons has been identified for IMT with responsibility allocation specific to the skill related with the present operation. The persons identified in IMT shall be given basic as well as specific training to handle the emergency situation. The training requirement identified in the Contingency planning phase is presented in **Table 4.5** below.

Table 4.5. Training and Capacity Building Requirements for IMT Personals

Sl.No	Training Modules	Type of Training	Duration and Frequency	Targeted Audience	Total Number of Persons
A.	Emergency Handling for IWT Terminal Operations				
1	IWT related risks in Terminals, Cargo Properties, Dos and Don'ts, Response Operation - Personal Safety, Equipment Usage, Incident Reporting, Incident Management Team, Responsibility allocation	Class room training followed by Table top exercise	3 hr	All members of IMT	42
B.	Specific Skill Development Training for Response Operations				
1	Management Training				
	Emergency Assessment, determination of level of response and development of strategy. Effective coordination of emergency. Legal aspects of handling emergency, documentation and communication requirement.	Class room Session	1.5 hr - Annually	Key Members of ECC	7
2	Supporting Team				

Sl.No	Training Modules	Type of Training	Duration and Frequency	Targeted Audience	Total Number of Persons
	Module I - Operation under emergency Requirement – Chemical properties of cargo and response planning, Planning and Execution of massive evacuation, cargo and vessel securing, cargo transfer and salvage operations	Classroom Interactive Session	1.5 hr - Annually	Technical resource person, Supporting Team - Operation, Admin, Finance, Security, HR	10
	Module II - Management of Emergency Control Centre, coordinating and arranging travel, logistics for mutual aid partners or external agencies, essential facility support for operational team. Statutory reporting, media handling and stakeholder communication during emergency.	Classroom Interactive Session	1.5 hr - Annually		10
C.	Emergency Response Personals				
	Emergency Response Operation at Terminal	Classroom followed by practical training in operation of response in riverine conditions	1.5 hr - every 3 months	All members of Response Team	24
	Shoreline Response Operation		1.5 hr - every 3 months		24

4.4.9. Conducting Mock drill

Mock drills shall be conducted at least once in every three months and a record shall be maintained of its conduct including the personnel participated, resources mobilized, etc. based on the experienced earned during mock drill, the disaster management plan shall be suitably updated.

4.4.10. Emergency Response Equipments to be availed at IWAI Terminal

Each terminal shall be provided with essential emergency response equipments along with oil spill response equipments equivalent to Category C of NOS-DCP in case of Furnace Oil handling or equivalent to Category D in case of non-oil cargo handling. The emergency

response equipments proposed at each terminal for both cases are presented in **Table 4.6** and **Table 4.7.**

Table 4.6. Emergency Response Equipments Proposed for Oil Handling Terminal

Sl No.	Description		Quantity
1	River Booms with accessories (Material: Neoprene / rubber / Neoprene rubber)		600 with 2 Power Pack
2	Fence boom (Material : Neoprene/rubber/Neoprene rubber/ PU/ PV)		200
3	Skimmer (20TPH 50% weir type, 50% Brush type)		2
4	OSD Applicant or with Spray arms type along with 02 Nozzles system and 02 hand lancers (No.)		1
5	Oil Spill Dispersant (Chemical Dispersant) (litres)		1000
6	Bio-remediation (litres)		1000
7	Flex Barge 10 Tons (no.)		2
8	River Boom 100 metres with power pack and accessories (nos) or Integrated containment cum recovery system with power pack and accessories (nos)		2 1
9	Sorbent boom size min. 5 inch Dia, min. length 5 feet (no.)		100
10	Sorbent Pads min. 20 inch x 20 inch (no.)		500
11	Shoreline cleanup Equipment	Mini Vacuum pumps capacity 25m3	1
12		Portable Oil temporary storage facility capacity 10 m3	2
13	VOC Portable Monitor		2
	200 metres Shoreline sealing boom with power pack and accessories (material: Neoprene/rubber/Neoprene rubber) (nos.)		1
14	Level A protection:		1
	Positive pressure full face-piece self-contained breathing apparatus (SCBA) or positive pressure supplied air respirator with escape SCBA; Totally encapsulated chemical and vapor protective suit; Inner and outer chemical resistant gloves; and Disposable protective suit, gloves, and boots.		
15	Level B protection:		3
	Positive pressure full face-piece self-contained breathing apparatus (SCBA) or positive pressure supplied air respirator with escape SCBA; Inner and outer chemical-resistant gloves; Face shield; Hooded chemical resistant clothing; Coveralls; and Outer chemical-resistant boots.		
16	Level C protection:		5
	Full-face air purifying respirators; Inner and outer chemical-resistant gloves; Hard hat; Escape mask; and Disposable chemical-resistant outer boots.		
17	Level D protection :		10
	Gloves; coveralls; safety glasses; Face shield; and Chemical resistant, steel-toe boots or shoes.		

Sl No.	Description	Quantity
18	FAST ACT (First Applied Sorbent Treatment against Chemical Threats) Neutralization agent- 4kg Cylinder	5.00
19	Portable Inflatable Emergency Lighting System	5.00
20	High Pressure Water Mist &CAFS(10L)	1.00

Table 4.7. Emergency Response Equipments Proposed for No- Oil Handling Terminal

Sl.No.	Description	Quantity
1	Fence boom (Material : Neoprene/rubber/Neoprene rubber/ PU/ PV)	200
2	Bio-remediation (litres)	1000
3	Sorbent boom size min. 5 inch Dia, min. length 5 feet (no.)	500
4	Sorbent Pads min. 20 inch x 20 inch (no.)	2000
5	VOC Portable Monitor	2
6	Full-face air purifying respirators; Inner and outer chemical-resistant gloves; Hard hat; Escape mask; and Disposable chemical-resistant outer boots.	20
7	Gloves; coveralls; safety glasses; Face shield; and Chemical resistant, steel-toe boots or shoes.	30
8	FAST ACT (First Applied Sorbent Treatment against Chemical Threats) Neutralization agent- 4kg Cylinder	5.00
9	Portable Inflatable Emergency Lighting System	5.00
10	High Pressure Water Mist &CAFS(10L)	1.00

4.5. Offsite Emergency Plan for IWT Operation in NW 1

Incidents beyond the capacity of manpower and equipment at terminal/vessel requires operation of an offsite emergency plan with support from respective DDMA and further depending on the severity of incident, the additional support would be warranted with involvement of SDMAs, NDMA or NCMC as the case may be. Thus a proposal for managing offsite emergency requirement has been formulated with an incident management team for IWAI RO and IWAI HQ with provision for escalation of involvement according to the level of emergency. Emergency Control Centre would be set up at IWAI RO and IWAI HQ, which will be activated on incident reporting as per the response level requirement.

In the case of an incident requiring offsite emergency operation with involvement of DDMA, respective Head (RO) shall take over the responsibilities of CIC from the IWAI side and coordinate with administrative authority for executing the emergency operation. Emergency Coordination Centre (ECC) shall be activated within the respective RO with a team supporting the coordination of response activities. Being the owner of the NW 1 and having the core

technical expertise in administering waterways, IWAI shall extend all technical assistance / advice to DDMAs for responding to the incident.

The key responsibilities of IWAI in handling offsite emergencies of an IWT related disaster would be

- Assist DDMAs by providing technical assistance on river hydrography, inland vessel operation, cargo type and its chemical characteristics, response requirements and supervising cargo transfer operations (if any).
- Execute a Mutual aid with the stakeholders along the region (under each RO) including major industrial units who may be able to assist to manage the incident with qualified persons and resources.
- Based on the Risk assessment study, provide inputs on stakeholders affected due to the incident actively involved in prioritising protection measures of the vulnerable resources.
- Be part of the DDMA to assess the situation, identifying additional resources for combat operations and help DDMA to take decision on escalation of emergency.
- RO – IWAI shall be the nodal officer from IWAI for coordinating with the disaster management system till Level 2 operation (confined within a state) with involvement of the respective SDMAs.
- On escalation of an emergency to Level 3/ in case of any emergency which may be affecting more than one state requiring involvement of NCMC, Chairman IWAI shall be the CIC from the IWAI side for effective coordination with the respective disaster management mechanism. ECC shall be activated at IWAI – HQ and the ECC would be directly coordinating with the NDMA or NCMC for availing all possible support for the response operation and will act as a facility hub for extensive maximum support from the central institutions including armed forces, NDRF etc.
- IWAI shall play an active role in emergency response with specific intervention to avail support from central authorities in the least time frame through Secretary of Shipping, (MoS)
- IWAI shall take responsibility of coordinating with the respective Inland Vessel owner/Charterer/Agent and suitably support in securing cargo or vessel and supporting salvage operations, if any, initiated by the owner of vessel.

It is to be noted that, for major incidents or incidents involving multiple States, response operation would warrant critical management decisions at the top level to coordinate with NDMA/NCMC. Hence a Crisis Management Group (CMG) has been proposed at IWAI HO. Direction of the CMG shall be implemented by the IMT of HO where senior officials shall be involved in supporting CMG for coordinating with NDMA/NCMC through relevant information from field through the IMT of RO. CMG proposed for IWAI shall be normally involved in major incidents as above and shall be available for any specific incidents which require the involvement of top level management of IWAI. Thus the Incident Organogram proposed for IWAI for handling offshore emergencies are presented in **Figure 4.8**.

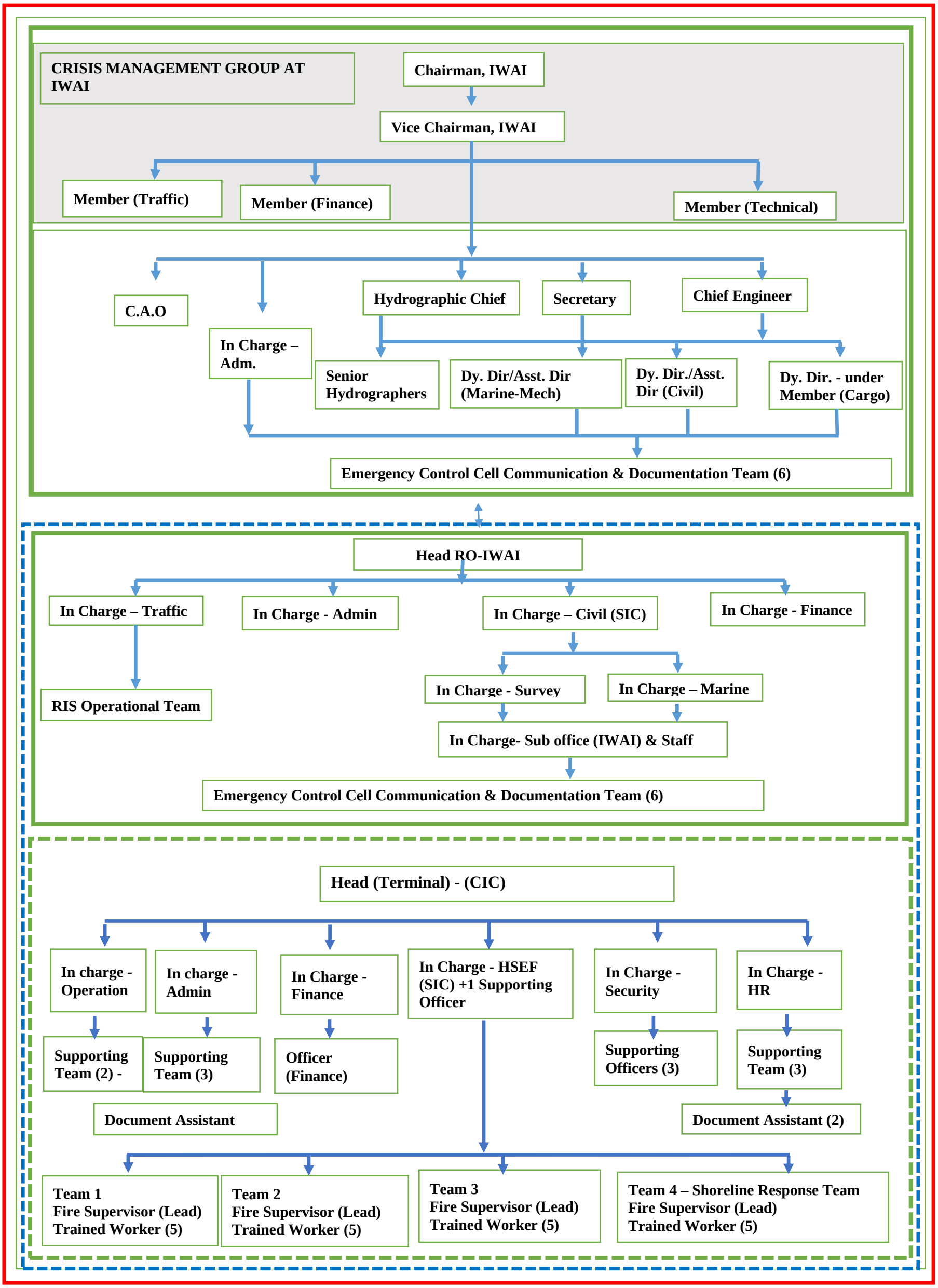


Figure 4.8. Incident Organization Chart for IWAI for Handling Operational Emergencies in NW 1

IMT for Onsite emergency Operation at Terminal

IMT for Offsite emergency operation involving only one state

IMT for Offsite emergency operation involving MULTIPLE state emergency Operation

4.5.1. Responsibility of Emergency Response Personals at IWAI - RO

Responsibility allocation of IWAI officials at RO for handling emergencies confined within a State.

4.5.1.1. Head – RO

- Receive incident report from terminals, alert RO, activate ECC at RO and send an intimation to IWAI –HQ.
- Continuously receive update from terminal on response operation and additional support requirements if any and keep IWAI – HQ updated on the incident.
- Allot a member or entire team under In Charge (Civil) to scene of incident if situation demands.
- If escalation of emergency to Level 2 is required, take over the overall coordination responsibility with respective DDMA and avail technical support to DDMAs on river hydrography, inland vessel operation, cargo type and its chemical characteristics, response requirements and supervising cargo transfer operations (if any).
- Extend support to DDMA with available vessels, tugs and crew for combat operation.
- In case of an emergency of Level 3 or multiple State involvement, act as the site representative of IWAI for coordinating the involvement of various agencies / authorities/departments.
- Act as nodal contact point with IWAI –HQ for availing timely additional guidance or assistance from HQ/ NDMA/NCMC.
- Ensure that the ECC is functional throughout the response operation period and guide various team under to execute the specific responsibilities assigned and allot additional manpower or responsibilities for better management of the situation.
- Call for mutual aid as per the demand.
- Ensure that ECC members are provided with adequate training and all essential facilities are available at ECC at working conditions to handle any incident reported.
- Actively coordinate with DDMAs/SDMA in response operations.
- Avail counselling at RO for various stakeholders and decide on escalation of emergency and avail additional support through ECC at HQ.

4.5.1.2. In Charge (Civil) – SIC

- Core responsibility to act as a representative of IWAI at the scene / allot appropriate officer under him to coordinate with the response operation initiated by DDMA.
- Give input to DDMA on hydrographic aspects and vessel operational feasibilities through In-Charge (Survey)
- Give input to DDMA on vessel related risk, cargo related risk and support response operation through In-Charge (Marine)
- Avail report from field, analyse and update to CIC on additional support requirements for the ongoing field operations and make available the same to field team. e.g, support of Mutual aid members, additional vessels, experts, travel or accommodation arrangements for IWAI team in the field etc.
- As per the requirement, assess the emergency escalation requirement, support DDMA for escalation of emergency and also intimate RO on additional support requirement and intimation of IWAI HQ involvement.
- Be available at the site of incident in case of a critical situation and act as nodal person for coordination with authorities on behalf of IWAI when SDMA/NDMA/NCMC operation is initiated.
- Closely monitor the operation of the vessel owner in securing the vessel /cargo and ensure appropriate coordination between the vessels related operation and response operation of DDMAs.
- Ensure that minimum essential HSE/Communication equipment's are available at ECC and also at field offices to immediately act on emergency.
- Coordinate mutual aid activities if situation warrants. Support DDMA as Coordinator on behalf of IWAI with making available equipment, manpower and supporting facilities for response operation.
- Guide operational activities with appropriate response strategy, provide technical inputs continuously monitor and report revise the strategy as and when required.
- Ensure the maintenance requirements of the equipment and manpower (medical, transportation, food, shelter, change of shift etc.) is met with during the course of operation.
- Assess the additional requirements for response operation – equipment/ trained resources/ crafts/ crew/ communication devices / supply of food/ transportation,

specialist support, weather forecasting requirements etc.,. Assist DDMA for ensuring timely availability the support as desired.

- Ensure that the response operations are appropriately monitored, evidences are taken as per the guidelines and passed on to In-Charge Admin – Documentation in- charge of ECC.
- Assess the immediate financial requirements, avail the same through CIC.
- Regularly report to CIC; support with on site information on progress, terminal /vessel operational control requirements which need to be imposed.
- Provide technical support to CIC while coordinating with DDMA to handle the issues and interests of various stakeholders, affected parties and ensure factual information dissemination with statutory agencies media/public in all level of emergency operation.

4.5.1.3. In-Charge Traffic

- Core responsibility to support DDMA for technical matters related with cargo and traffic.
- On receipt of the intimation from Head RO, immediately proceed to ECC and play key role in assessing the situation and actively follow up /advice/direct w r to the vessel and cargo related aspects and get updated of the situation in case of a Level 1 Incident.
- In case of Level 2 Incident, support CIC with essential traffic re scheduling and advising on securing other vessels or cargos nearby the scene of incident.
- Appraise the ECC team members on meteorological conditions, type of consignment, physical and chemical properties, environmental significance etc. and the response operation methods towards appraisal of DDMA.
- Act as the nodal officer to deal with the vessel and cargo related matters and provide technical input to DDMA if deemed necessary.
- Execute the vessel rescheduling due to the incident along the scene of incident.
- If situation warrants, be available or allot additional resources for assistance at site for vessel or cargo related matters.
- Support for the securing the wrecked vessel and/or cargo arranged by the Ship Owner/Agent/Charterer.
- Support CIC in executing his/her responsibilities throughout the operational period of ECC.

- In the absence of SIC, take over the complete responsibility of SIC as per the advice of CIC.

4.5.1.4. In-Charge – Admin

- Core responsibility for administration and logistic support for ECC and its operation. Identifying additional manpower support for operations, handling communication with various agencies, complete documentation of operation of ECC and act as central point of communication in ECC.
- On receipt of the intimation from CIC immediately proceed to ECC; alert RO per the direction of CIC.
- After primary assessment / as per the direction of SIC, arrange for transport of IMT officials of RO to scene of incident
- Support SIC in identifying additional manpower and requirement for the ongoing operation and pass on emergency call to persons identified.
- Remain as the communication head of ECC, ensure that the communication from Site Incident Control is maintained uninterrupted. Support SIC in all communication aspects. Ensure that the information at ECC is continuously updated from the site.
- Responsible for all internal communication (within RO and with HQ) and with all other agencies – DDMA, ICG, Vessel owners, mutual aid partners and various stakeholders – prepare the communication, get approval from CIC and release on behalf of CIC.
- Prepare response to all media/public queries, prepare press statements and release responses/statements after approval from CIC.
- In case of additional support requirement, as per direction of CIC, contact mutual aid partners, support transport and logistic arrangements for mutual aid partners.
- Take full charge of the documentation of response operation. Direct /request the team in operation for documentary evidences, ensure that progress reports are maintained and evidences are taken as per the DM guidelines. Get guidance from In Charge (Finance) on the documentation aspects and support In Charge (Finance) for financial closure of operation by providing various claims/reimbursements/disbursements etc. towards realization in case of Level 2 incidents.
- In case of Level 3/ any multi state incidents, support CIC to communicate with ECC with site specific updates.

4.5.1.5. In Charge – Finance

- Support CIC to prepare preliminary estimate of the finance requirement for operations. Approve and avail the fund throughout operational period.
- Allot Officer (finance) round the clock in ECC for supporting the various team with guidance on collecting and recording the relevant supporting documents toward effecting payment directly/reimbursements.
- Support SIC on aspects of financial control of operations, after Closure of operation, assume the charge of financial closure of operation with proceeding for the various claims/reimbursements/disbursements etc. until it is realized in case of Level 2 operation. In case of Level 3 on multiple state exigencies support finance team of IWAI HQ with appropriate supporting documents as above towards financial closure of activities.

4.5.1.6. RIS Operational Team

- Receive the incident report within the area.
- Pass on the message to IWAI – RO&DDMAs in the region.
- Connect with other vessels on voyage and restrict sailing to scene of incidence.
- Sharing and retrieving details on vessels involved and movement in analysing the accident scenarios.

4.5.2. Manpower Allocation for IMT - Training and Capacity Building Requirements

A total of 38 persons has been identified for IMT with responsibility allocation specific to the skill related with the present operation. The persons identified in IMT shall be given basic as well as specific training to handle the emergency situation. The training requirement identified in the Contingency planning phase is presented in **Table 4.8** below.

Table 4.8. Training and Capacity Building Activities for IMT Personals

Sl. No	Training Module	Type of Training	Duration & Frequency	Targeted Audience	No. of Persons
A.	**Basic Training**				
1	IWT related risks in Terminals, Cargo Properties, Dos and Don'ts, Response Operation - Personal Safety, Equipment Usage, Incident Reporting,	Class room training followed by Table top exercise	3 hr - Annually	All members of IMT	38

Sl. No	Training Module	Type of Training	Duration & Frequency	Targeted Audience	No. of Persons
	Incident Management Team, Responsibility allocation				
B.	**Specific Skill Development Training for OSR Operations**				
1.	Module I - Emergency Coordination, Managing ECC, Documentation and Statutory reporting - Equivalent to IMO Level 2 Course.	Class room Session	3 hr - Annually	Head - RO (CIC), In Charge - Civil (SIC), In Charge (Traffic)	3
2.	Module II - Management of ECC, Coordination and Communication in Emergency Situations, Travel, Logistic Arrangements, DM Documentation - Progress reports, evidences, claims, reimbursements/disbursements/financial closure.	Class room Session	3 hr - Annually	In Charge - Fin and In Charge Admin	2
3.	Module III - Emergency Operation Coordination and Communication. DM Documentation - Progress reports, evidences, claims, reimbursements/disbursements/financial closure.	Class room Session	3 hr - Annually	In Charge - Survey and In Charge Marine & In Charge of IWAI Sub offices and supporting Staff	33

4.5.3. Conducting Mock drill

Mock drills shall be conducted at least once in every six months internally and a record shall be maintained of its conduct including the personnel participated, resources mobilized, etc. based on the experiences earned during mock drill, the disaster management plan shall be suitably updated. RO - IWAI and all sub offices shall take part actively in the mock drills arranged by DDMA and Indian Coast Guard (ICG) on oil spill preparedness.

4.5.4. Facilities to be availed at ECC of IWAI – RO

Facilities to be made available at ECC of IWAI - RO is presented below.

- Maps and display charts and diagrams showing buildings, roads, underground fire mains, important hazardous material and process lines, drainage trenches, and utilities such as steam, water, natural gas and electricity.
- Electronic Navigational Chart (ENC) along with map of hotspots preferably superimposed on ENC and a copy of risk assessment and DMP report.
- A copy of the relevant Disaster Management Plan.
- Situation boards (continuously updated to present a summary of the current situation and response actions being taken).
- Aerial photographs, if possible, and maps showing the site, adjacent industries, the surrounding community, high-ways, etc., to help determine how the disaster may affect the community so that the proper people can be notified, adequate roadblocks established, and the civil authorities advised.
- Sufficient telephone lines to enable full liaison with outside bodies.
- Names, addresses, and telephone numbers of employees, off-site groups and organizations that might have to be contacted; all telephone lists being reviewed for accuracy on a scheduled basis and updated, as necessary.
- Dedicated and reliable communication equipment; enough telephones and at least one fax line to serve the organization for calls both on and off-the-site.
- Fixed and portable two-way radio equipment to keep in contact with activities on-scene and to maintain continuity of communications when other means fail.
- Plan board, logbook, voice recorder, television, DVD and Video facilities for playing back records from aircraft and helicopters, as well as monitoring media coverage of the incident with a person assigned to record pertinent information and to assist in investigating cases, evaluating performance, and preparing reports.
- Emergency lights so that operations can continue in the event of power failure.
- Photocopy, fax and e-mail facilities.
- Dedicated computers with LAN/ internet facility to access the installation data and the latest and updated soft copies of all standard operating procedure (SOP) etc.
- Wireless Internet Facility.
- Video Conferencing Facility to have face to face communication/meetings between the stake holders.

4.5.5. Responsibility of Emergency Response Personals at IWAI - HO

Responsibility allocation of IWAI officials at HO for handling Level 3 (through NDMA) /incidents involving more than one State (through NCMC).

4.4.5.1. Chairman – IWAI – CIC

- Receive report on any incident within terminal or waterway upto Level 2 stage (coordinated by IWAI RO) and regularly get updated from the CIC at RO and update to Secretary (MoS) as deemed necessary.
- With support of members of CMG and IMT, analyse additional support requirement for RO. Coordinate with NDMA or NCMC through MoS and extend support as far as possible.
- On Level 3 / multiple state emergency, act as CIC on behalf of IWAI and take over the overall coordination responsibility with NDMA/NCMC
- In Level 3 / multiple state emergency, on receipt of incident report from RO, activate ECC at HO and send an intimation to MoS for passing to NDMA/NCMC (if warranted).
- Deploy senior IMT members at site for coordinating the higher level response operation extend technical support on river hydrography, inland vessel operation, cargo type and its chemical characteristics, response requirements, supervising cargo transfer operations (if any).
- Update MoS on the progress, avail advice and execute at site.
- Allot additional staff for operational support for the field team as requested by CIC – RO.
- Coordinate with any specific institution at Central level for specific involvement on request of CIC-RO.
- Act as nodal contact point with IWAI –HQ for availing timely additional guidance or assistance from HQ/ NDMA/NCMC.
- Execute a mutual aid agreement with the various resource agencies who may be able to support response operations.
- Ensure that ECC members are provided with adequate training and all essential facilities are available at ECC at working conditions to handle any incident reported.

4.4.5.2. Vice Chairman, IWAI – SIC

- Support CIC to execute his / her responsibility.

- Specific responsibility to coordinate with the IMT of headquarters and actively following up or supporting the response operations and issuing essential management decision on approval of CIC.
- Support CIC for submission of regular updates to statutory authorities; MoS, NDMA or NCMC as deemed necessary.
- Over all control over operation of ECC. Ensure that minimum essential HSE/Communication equipment's are available at ECC and also at field offices to immediately act on emergency.
- Ensure that the response coordination team under Hydrographic Chief and Chief Engineer is extending technical support to the operations on hydrographic aspects and inland vessel operational feasibilities.
- Avail report from field, analyse and update CIC on additional support requirements for the ongoing field operations and avail the same to field team including intensifying the response operation with wider participation.

4.4.5.3. Member Technical /Finance/Traffic

- Key role in top level management decisions.
- Assist CIC in discharging his duties.
- Continuously analyse the progress reports from site and design strategy for efficient coordination of response operation from IWAI.
- Assist CIC for connecting with the Nodal Department of agencies and negotiate for availing specialised support if any.
- Member (Technical) and Member (Traffic) shall make key analysis on operational support requirement and coordination with resource agencies.
- Member (Finance) shall understand and analyse budgetary requirements and immediately make the same available for the field teams.

4.4.5.4. Chief Engineer, Secretary & Hydrographic Chief

- Overall responsibility for ensuring top level coordination of response operations with all resource agencies on behalf of IWAI supported with the resources at HQ an RO.
- As per the requirement assess the emergency escalation requirement support RO/HQ for escalation of emergency and extend additional support through SIC.

- Be available at site of incident in case of criticality of situation and act as nodal person for coordination with authorities on behalf of IWAI when SDMA/NDMA/NCMC operation is initiated.
- Closely monitor the operation of the vessel owner in securing the vessel /cargo and ensure appropriate coordination between the vessels related operation and response operation of DM system.
- Coordinate mutual aid activities if situation warrants. Support DDMA as Coordinator on behalf of IWAI with making available the equipment, manpower and supporting facilities for response operation.
- Guide operational activities with appropriate response strategy, provide technical inputs continuously monitor and report, revise the strategy as and when required.
- Ensure the maintenance requirements of the equipment and manpower (medical, transportation, food, shelter, change of shift etc.) is met with during the course of operation.
- Assess the additional requirements for response operation–equipments/ trained resources/ crafts/ crew/ communication devices / supply of food/ transportation, specialist support, weather forecasting requirements etc.,. Ensure appropriate support from NDMA/NCMC through SIC.
- Direct for appropriate monitoring of response operations, evidences are taken as per the guidelines and passed on to In Charge Establishment and Admin.
- Assess the immediate financial requirements, avail the same through SIC.
- Regularly report to SIC; support with in situ information on progress, terminal /vessel operational control requirements which need to be imposed.
- Provide technical support to SIC while coordinating with top level decision making authorities and also guide/ advice Head – RO to handle the issues and interest of various stakeholders, affected parties and ensuring factual information dissemination with the statutory/media/public in all level of emergency operation.

4.4.5.5. In Charge – Admin

- Core responsibility for administration and logistic support for ECC and its operation, handling communication with various agencies, complete documentation of operation of ECC and central point of communication in ECC.

- On receipt of the intimation from CIC immediately proceed to ECC; alert HO as per the direction of CIC.
- After primary assessment / as per the direction of SIC, arrange for transport of IMT officials of HO to scene of incident
- Support SIC in identifying additional manpower and requirement for the ongoing operation and pass on emergency call to persons identified.
- Remain as the communication head of ECC, ensure that the communication from site of incident/RO is maintained uninterrupted. Support SIC in all communication aspects. Ensure that the information at ECC is continuously updated from the site.
- Responsible for all internal communication (within RO and with HQ) and with all other statutory or resource agencies.
- Prepare response to all media/public queries, prepare press statements release responses/statements after approval from CIC.
- Take full charge of the documentation of response operation. Direct /request the team in operation for documentary evidences, take full control on progress reports are maintained, evidences are taken as per the DM guidelines. Get guidance from In Charge (Finance) on the documentation aspects and support In Charge (Finance) for financial closure of operation with providing various claims/reimbursements/disbursements etc. towards realization in case of Level 3 incidents or incidents involving multiple States.

4.4.5.6. Chief Accounts Officer

- Support CIC for preliminary estimate of the finance requirement for operations. Approve and avail the fund throughout operational period.
- Remain available at ECC for the emergency financial approvals and disbursements throughout the operational period collecting and recording the relevant supporting documents toward effecting payment directly/reimbursements.
- Support SIC on aspects of financial control of operations, after Closure of operation, Assume the charge of financial closure of operation with proceeding for the various claims/reimbursements/disbursements etc. until it is realized in Level 3 or multiple state exigencies.

4.4.5.7. Dy Dir. /Asst. Dir (Marine – Mech) / Civil/Traffic/ Senior Hydrographers

- Extend technical assistance on vessel related, channel related and cargo related aspects by the area of expertise and support Chief Engineer / Hydrographic chief to take decision / advice the operational team of RO.
- Support Chief Engineer / Hydrographic Chief with specific input on vessel related aspects, active coordination with CIC of RO, visit the site of incident if warranted and support the respective heads in communication, advocacy etc.
- Act as representative of HQ at site, as per the direction of Chief Engineer / Hydrographic Chief and assist CIC of RO to connect to IMT of HQ and support response operation coordination between the RO and HQ.

4.5.6. Manpower Allocation for IMT - Training and Capacity Building Requirements

A total of 17 persons has been identified for IMT with responsibility allocation specific to the skill related with the present operation. The persons identified in IMT shall be given basic as well as specific training to handle the emergency situation. The training requirement identified in the Contingency planning phase is presented in **Table 4.9**.

Table 4.9. Training and Capacity Building Activities for IMT Personals

Sl. No	Training Module	Type of Training	Duration & Frequency	Targeted Audience	No of Persons
A.	Basic Training				
1.	IWT related risks in Terminals and Channels, Cargo Properties, Response Operation , Personal Safety, Incident Reporting, Incident Management Team, Responsibility allocation	Class room training followed by Table top exercise	Two 3 hr session- Annually	All members of IMT	16
B.	Specific Skill Development Training				
1.	Strategic Decision Making in IWT Emergencies - Equivalent to IMO Level 3 Course.	Chairman, Vice Chairman, Member (Cargo), Member (Technical), Member (Finance)	3 hr - Annually		5

Sl. No	Training Module	Type of Training	Duration & Frequency	Targeted Audience	No of Persons
2.	Module I - Emergency Coordination, Managing ECC, Documentation and Statutory reporting - Equivalent to IMO Level 2 Course.	Classroom Interactive Session	3 hr - Annually	CAO, Hydro. Chief and Chief Engineer	3
3.	Module II - Management of ECC, Coordination and Communication in Emergency Situations, Travel, Logistic Arrangements, DM Documentation - Progress reports, evidences, claims, reimbursements/disbursements/financial closure.	Classroom Interactive Session	3 hr - Annually	In Charge - Admin & Est.	1
4.	Module III - Emergency Operation Coordination and Communication. DM Documentation - Progress reports, evidences, claims, reimbursements/disbursements/financial closure.			Director (Marine – Mech), Civil and Cargo. Documentation Team - Middle Level Officers of IWAI	7

4.5.7. Conducting Mock drill

Mock drills shall be conducted at least once in every six months internally and a record shall be maintained of its conduct including the personnel participated, resources mobilized, etc. based on the experienced earned during mock drill, the disaster management plan shall be suitably updated. IMT of IWAI – HQ shall actively participate in the mock drills organized by NDMA / NCMC.

4.5.8. Emergency Response Facilities to be availed at ECC of IWAI - HO

ECC shall be equipped with all equipment, communication and coordination facilities to act on emergency.

- Maps and display charts and diagrams showing buildings, roads, underground fire mains, important hazardous material and process lines, drainage trenches, and utilities such as steam, water, natural gas and electricity.
- Electronic Navigational Chart (ENC) along with map of hotspots preferably superimposed on ENC and a copy of risk assessment and DMP report.
- A copy of the relevant Disaster Management Plan.
- Situation boards (continuously updated to present a summary of the current situation and response actions being taken).
- Sufficient telephone lines to enable full liaison with outside bodies.
- Names, addresses, and telephone numbers of employees, off-site groups and organizations that might have to be contacted; all telephone lists being reviewed for accuracy on a scheduled basis and updated, as necessary.
- Dedicated and reliable communication equipment; enough telephones and at least one fax line to serve the organization for calls both on and off-the-site.
- Fixed and portable two-way radio equipment to keep in contact with activities on-scene and to maintain continuity of communications when other means fail.
- Plan board, logbook, voice recorder, television, DVD and Video facilities for playing back records from aircraft and helicopters, as well as monitoring media coverage of the incident with a person assigned to record pertinent information and to assist in investigating cases, evaluating performance and preparing reports.
- Emergency lights so that operations can continue in the event of power failure.
- Photocopy, fax and e-mail facilities.
- Dedicated computers with LAN/ internet facility to access the installation data and the latest and updated soft copies of all standard operating procedure (SOP) etc.
- Wireless Internet Facility.
- Video Conferencing Facility to have face to face communication/meetings between the stake holders.

4.6. Block Cost Estimate for Developing Facilities within IWAI

4.6.1. Cargo Handling Terminals of IWAI

Block cost estimate for setting up of facilities for IWAI terminal in case of oil handling (Furnace Oil handling) i.e. equivalent to category B of NOS-DCP and no oil handling i.e. equivalent to Category D has been worked out. The cost towards setting up of ECC with

provision for video conferencing facility, WIFI, LAN and Computers, Telephone Line, Printer, FAX Machine, Copier and Miscellaneous has also been arrived at. The total cost works out to **Rs 6.66 Cr for an oil handling terminal** and **Rs. 1.49 Cr for non-oil handling terminal** as presented in **Table 4.10** and **Table 4.11.**

Table 4.10. Block Cost Estimate for Emergency Facilities at Oil Handling Terminals

Sl No.	Description		Quantity	Amount (Rs.)
1	Fence boom (Material : Neoprene/rubber/Neoprene rubber/ PU/ PV) - (m)		500	99,54,250.00
2	Skimmer (20TPH 50% weir type, 50% Brush type) - (No)		4	1,10,32,666.00
3	OSD Applicant or with Spray arms type along with 02 Nozzles system and 02 hand lancers (No)		3	49,54,500.00
4	Oil Spill Dispersant (Chemical Dispersant) (litres)		2000	1,80,000.00
5	Bio-remediation (litres)		1000	49,98,250.00
6	Flex Barge 10 Tons (no.)		3	1,10,24,625.00
7	River Boom 100 metres with power pack and accessories (no) or		3	39,42,550.00
	Integrated containment cum recovery system with power pack and accessories (no)		1	
8	Sorbent boom size min. 5 inch Dia, min. length 5 feet (no)		200	1,94,600.00
9	Sorbent Pads min. 20 inch x 20 inch (no.)		1000	69,750.00
10	Shoreline cleanup Equipment	Mini Vacuum pumps capacity 25m^3	2	36,89,400.00
11		Portable Oil temporary storage facility capacity 10 m^3	3	9,99,,600.00
12	VOC Portable Monitor		3	12,90,375.00
13	200 metres Shoreline sealing boom with power pack and accessories (material: Neoprene/rubber/Neoprene rubber) (no)		2	88,18,333.33
14	Level A protection: Positive pressure full face-piece self-contained breathing apparatus (SCBA) or positive pressure supplied air respirator with escape SCBA; Totally encapsulated chemical and vapor protective suit; Inner and outer chemical resistant gloves; and Disposable protective suit, gloves, and boots.		3	4,54,224.00
15	Level B protection: Positive pressure full face-piece self-contained breathing apparatus (SCBA) or positive pressure supplied air respirator with escape SCBA; Inner and outer chemical-resistant gloves; Face shield;		6	9,09,960.00

Sl No.	Description	Quantity	Amount (Rs.)
	Hooded chemical resistant clothing; Coveralls; and Outer chemical-resistant boots.		
16	Level C protection: Full-face air purifying respirators; Inner and outer chemical-resistant gloves; Hard hat; Escape mask; and Disposable chemical-resistant outer boots.	10	3,30,400.00
17	Level D protection : Gloves; coveralls; safety glasses; Face shield; and Chemical resistant, steel-toe boots or shoes.	20	1,72,400.00
18	FAST ACT (First Applied Sorbent Treatment against Chemical Threats) Neutralization agent-4kg Cylinder	5	4,87,215.00
19	Portable Inflatable Emergency Lighting System	5	8,31,600.00
20	High Pressure Water Mist &CAFS(10L)	1	2,79,530.00
21	Facilities for ECC - ECC with provision for video conferencing facility, WIFI, LAN and Computers, Telephone Line, Printer, FAX Machine, Copier and Miscellaneous	LS	20,00,000.00
Block Cost for Each Oil Handling Terminal			**6,66,14,228.33**
Total Cost for 3 Multi Modal Terminal			**19,98,42,685.00**
Rounded as Rs 20 Cr			
Note: Cost is Inclusive of all taxes and Duties Except GST			

Table 4.11. Block Cost Estimate for Emergency Facilities at Non-Oil Handling Terminals

Sl.No.	Description	Quantity	Amount (Rs.)
1	Fence boom (Material : Neoprene/rubber/Neoprene rubber/ PU/ PV) - (m)	200	39,81,700.00
2	Bio-remediation (litres)	1000	49,98,250.00
3	Sorbent boom size min. 5 inch Dia, min. length 5 feet (no.)	500	4,86,500.00
4	Sorbent Pads min. 20 inch x 20 inch (no.)	2000	1,39,500.00
5	VOC Portable Monitor	2	8,60,250.00
6	Full-face air purifying respirators; Inner and outer chemical-resistant gloves; Hard hat; Escape mask; and Disposable chemical-resistant outer boots.	20	6,60,800.00
7	Gloves; coveralls; safety glasses; Face shield; and Chemical resistant, steel-toe boots or shoes.	30	2,58,600.00
8	FAST ACT (First Applied Sorbent Treatment against Chemical Threats) Neutralization agent-4kg Cylinder	5	4,87,215.00
9	Portable Inflatable Emergency Lighting System	5	8,31,600.00
10	High Pressure Water Mist &CAFS(10L)	1	2,79,530.00

Sl.No.	Description	Quantity	Amount (Rs.)
11	Facilities for ECC - ECC with provision for video conferencing facility, WIFI, LAN and Computers, Telephone Line, Printer, FAX Machine, Copier and Miscellaneous	LS	20,00,000.00
Block Cost for Each Non-Oil Handling Terminal			1,49,83,945.00
Total Cost for 3 Multi Modal Terminal			4,49,51,835.00
Rounded as Rs 4.5 Cr			
Note: Cost is inclusive of all taxes and duties except GST			

4.6.2. Regional Offices and Head Office of IWAI

RO and HO of IWAI shall be having a dedicated ECC facility to coordinate the response operations. The total cost estimate for setting up the facilities works out **to Rs.20 Lakhs each totaling to Rs. 60 Lakhs** as presented in **Table 4.12**.

Table 4.12. Block Cost Estimate for ECC Facilities at IWAI RO and IWAI HO

Sl.No	Facilities for ECC -	Amount (Rs.)
1.	Provision for video conferencing facility, WIFI, LAN and Computers, Telephone Line, Printer, FAX Machine, Copier and Miscellaneous	20,00,000.00
	Block Cost Estimate for IWAI - 2 Regional Offices, Head Office	60,00,000.00
Rupees Sixty Lakhs only		
Note: Cost is inclusive of all taxes and duties except GST		

4.4.9. Emergency Decision Making Process at IWAI

In case of facility level incidents, Head RO (IWAI) shall immediately convene a meeting at ECC – RO, assess the situation and Coordinator of Emergency Response Operation at RO through the supporting team of nearest sub unit of IWAI shall keep on availing the progress report from incident site and periodically update Head (RO).

In Level 1 or Level 2 operations, ECC shall be activated at RO – IWAI where the emergency coordination activities shall be initiated with respective DDMAs /SDMAs. In Charge – Civil (SIC) with team at RO with support of the nearest sub unit of IWAI shall remain available at site of incident for coordination with the DDMA/SDMA as required. In Charge (Traffic) at RO shall connect with the In Charge – Civil for regular progress reporting and which shall periodically send to IWAI (HQ) by Head (RO) - CIC.

In case of Level 3 response operations or when the emergency requires interstate coordinated activities, ECC shall be activated at both RO and HQ and Chairman (IWAI) shall take over the responsibility of CIC with active coordination with the NDMA, NCMC as deemed necessary. All personals at the IMT shall be immediately taking over the responsibilities of active coordination and support CIC for executing his responsibility of coordination with NDMA or NCMC as deemed necessary. The team members of IMT at HQ, RO and Sub unit shall be operational under the overall guidance of CIC. CIC shall connect with NDMA /NCMC through Secretary (MoS) and the requirements from the site of incidents shall be submitted for essential top level intervention and support for effective response operation.

4.7. Deriving of Proposal for Integration of IWT Related Disasters in to DDMPs

The existing disaster management mechanism functional at each state was anlaysed in detail to understand its capability to handle the IWT related disasters within its jurisdictional limit. Proposal has been formulated for inclusion of IWT related disaster in to respective DDMPs of bordering districts in line with the SDMP of the respective State. The process involved in deriving proposal for integration of IWT related disaster is presented in **Figure 4.9**.

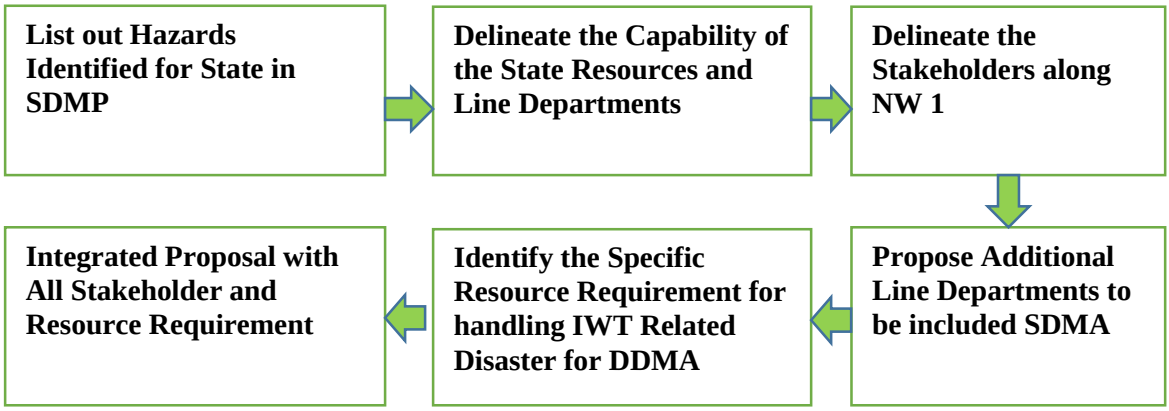


Figure 4.9. Process Involved in Integration of IWT Related Disasters to DDMPs

Considering that there are functional differences in DM structure operational in the States and the vulnerable resources of the project region are also diverse by nature, proposal has been formulated for individual States as presented below.

Considering the hazardous cargoes, response resource requirements and impact of disasters it is proposed that the following departments shall be included in the SDMAs for appropriate response.

- Department of Industries and Commerce – To support with technical resources on chemical characteristics and emergency handling persons, equipment and facilities.
- Chief Inspector of Factories and Boilers (CIF) – Regulatory authority in hazardous cargo handling.
- Department of Environment including specific representation from State/Central Pollution Control Board - CRZ authorities – Regulatory authority under Air and Water act, waste handling etc.
- Forest and Wildlife Department – Regulatory Authority in Protected Areas
- Fire and Emergency Services – Fire and Emergency support for IWT incidents
- Health and Family Welfare Department – Emergency medical support.
- Registered Vessel Owners – for handling water based emergency operations

The above departments shall be integrated in DM structure of all States to handle the requirements on IWT related incidents.

4.7.1. Integration of IWT Related Disasters in DDMAs of Uttar Pradesh

State of Uttar Pradesh is a disaster prone State. The geo-climatic conditions and critical structures along the waterway of make it vulnerable to many hazards. As seen in **Section 2.3.1** and **2.3.2** of the salient features of NW1, the Prayagraj to Ballai strech of NW 1 is falling in Uttar Pradesh for a total length of 472 km. NW 1 is boardering through 7 districts of the State – Prayagraj, Sant Ravidas Nagar, Mirzapur, Varanasi, Chandauli, Ghazipur and Ballai where DDMAs are present.

State Disaster Management Authority (SDMA) has been constituted in Uttar Pradesh vide Notification in exercise of the powers conferred by sub section (1) of section 14 of DM Act, 2005. SDMA, headed by the Chief Minister as the Chairperson with 5 members from nodal departments, one member secretary and the Chief Secretary as the Chief Executive Officer.

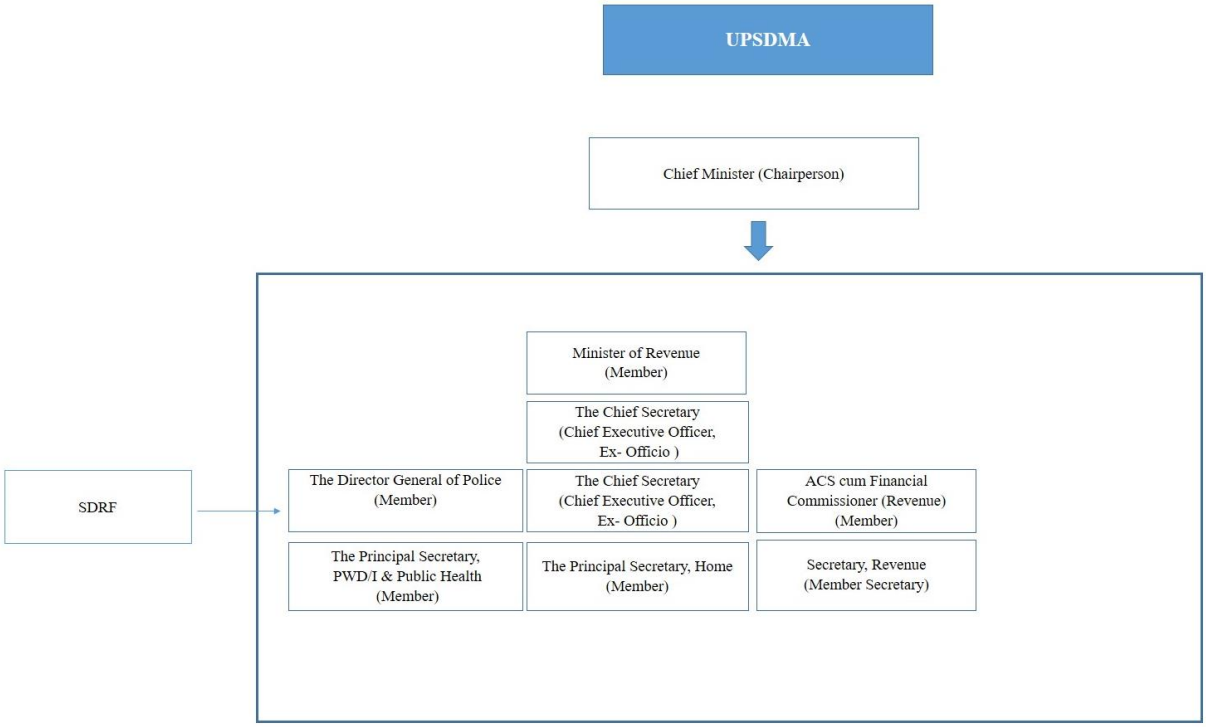


Figure 4.10. Uttar Pradesh State Disaster Management Authority

Powers and functions of State Authority are

- Promoting an integrated and coordinated system of disaster management including prevention or mitigation of disaster by the State, local authorities, stakeholders and communities.
- Collect/cause to be collected data on all aspects of disaster management and analyze it and further cause and conduct research and study relating to the potential effects of events that may result in disasters.
- Act as a repository of information concerning disaster management in the State. Lay down the policies and plans for disaster management in the State.
- Promote or cause to be promoted awareness and preparedness and advice and train the community, and stakeholders with a view to increasing capacity of the community and stakeholders to deal with potential disasters.

- On the expiry of a disaster declaration, the Authority shall, where necessary, act as an agency for facilitating and coordinating rehabilitation and reconstruction activities by departments of the Government

The SDMA and DDMA functional at State is presented in **Table 4.13**.

Table 4.13. SDMA and DDMA for Bordering Districts in Uttar Pradesh

Uttar Pradesh Disaster Management Authority (UPDMA)									
Chief Minister (Chairman)	Minister of Revenue (Member)	The Chief Secretary (Chief Executive Officer, Ex-Officio)	The Director general of Police (Member)	ACS cum Financial Commissioner (revenue) (Member)	Secretary, Revenue (member Secretary)	The Principal Secretary. Home (Member)	The principal secretary, PWD/I & Public Health (Member)		
State Executive Committee (SEC)									
Not Defined	Not Defined	Not Defined	Not Defined	Not Defined					
State Nodal Department									
Nodal State Departments for Disaster Coordination									
Department of Home	Dept. of Urban Development	Dept. of Irrigation	Dept. of Fire	Dept. of Agriculture	Department of Revenue	Dept. of Animal husbandry	Department of Industry	Dept. of Finance	Department of Science and Technology
Department of, District Administration	Dept. of Environment and Forest	Jal Nigam	Irrigation and water sources	Dept. of Planning	Dept. of Rural Development	Dept. of Information and public relations	Department of Information technology	Dept. of Ground Water	Department of Medical health and Family Welfare
Department of Education	Department of Housing	Dept. of Horticulture	Panchayati Raj	Local Bodies	UP Pollution control Board				
District Disaster Management Authority (DDMA)									
Allahabad	Chandauli	Sant.Ravidas Nagar	Mirzapur	Ghazipur	Varanasi	Ballia			

The Relief Commissioner Organisation/ UPSDMA of the state is the nodal department for controlling, monitoring and directing measures for organizing rescue, relief and rehabilitation. All other concerned line departments should extend full cooperation in all matters pertaining to the response management of the disaster whenever it occurs. The State EOC and other control rooms at the state level as well as district control rooms should be activated with full strength. The existing arrangements therefore will be strengthened by the Relief Commissioner through Emergency Operations Centers (EOC), both at State Level and at the district levels. The DM Act 2005 empowers Relief Commissioner to be the Incident Commander in the State and District Collector in the respective districts.

State Emergency Operations Centre will be the hub of activity in a disaster situation. The EOC, the key organizational structure, is flexible to expand when demands increase, and contract when the situation slows down. The primary function of an EOC is to implement the Disaster Management Action Plan which includes the following:

- Coordination
- Policy-making
- Operations management
- Information gathering and record keeping.
- Public information
- Resource management.

DDMA has been formed in all the districts of the state. Chairperson of this authority is the district magistrate and it is co- chaired by the Zila Panchayant Chairman. DDMA acts as the planning, coordinating and implementing body for DM at District level and take all necessary measures for the purposes of DM in accordance with the Guidelines laid down by the NDMA and SDMA Plan. The DDMA will also ensure that the Guidelines for prevention, mitigation, preparedness and response measures laid down by NDMA and SDMA are followed by all Departments of the State Government, at the District level and the Local Authorities in the District.

District Emergency Operation Centre located in the office of deputy commissioner shall discharge the following functions:

- On receipt of information from SEOC/SEC or from any field office or Panchayat or from any other reliable source, DEOC will bring this in the notice of DDMA.
- DEOC shall issue necessary alerts to all authorities in the district or at state level depending on the situation.
- DEOC will send regular status and appraisal reports to SEOC.
- DEOC shall maintain all records.
- DEOC shall collate and synthesise information for consideration of DDMA.

The disaster management structure of the state is presented in the flow chart below.

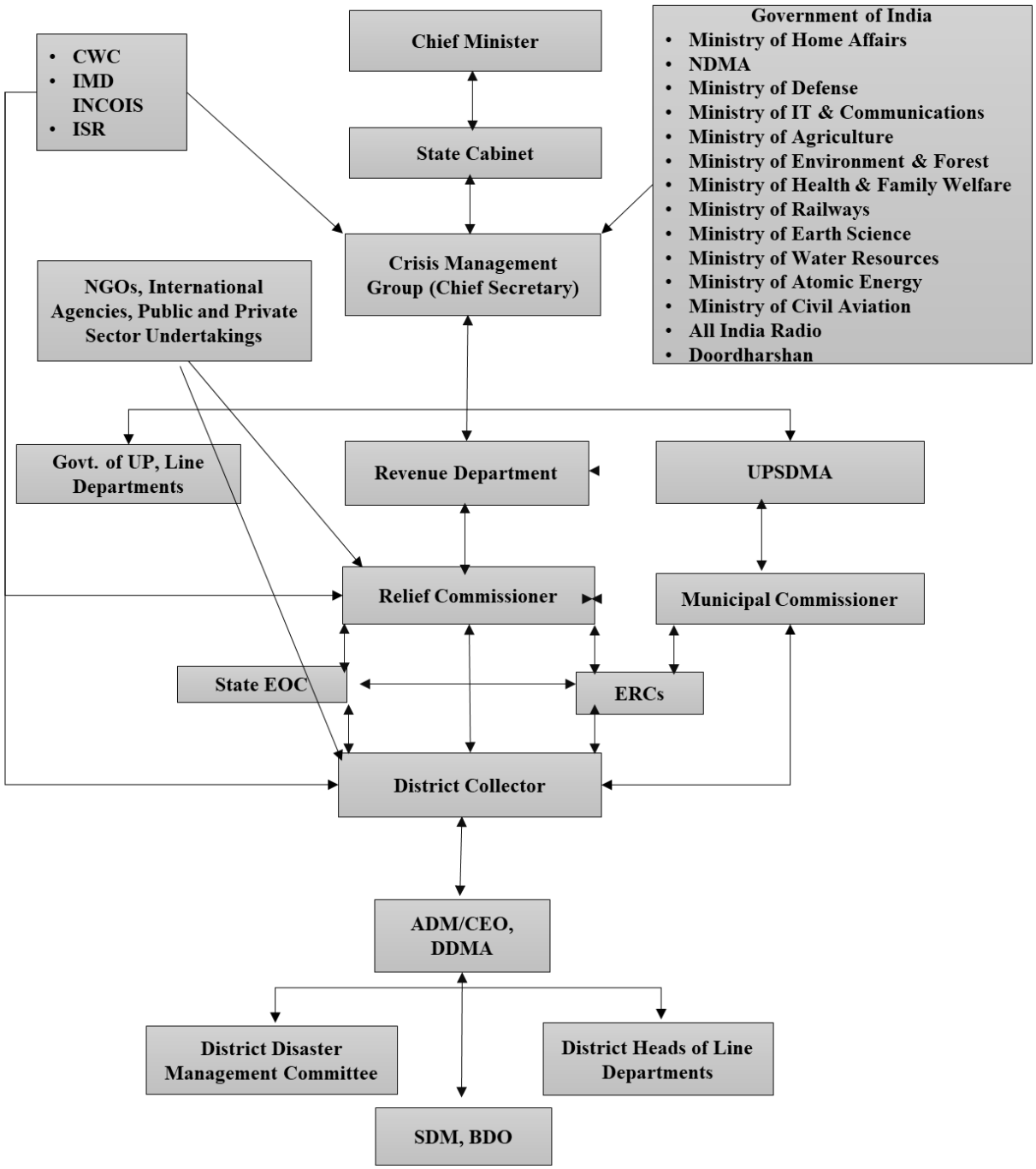


Figure 4.11. Uttar Pradesh Disaster Management Structure

Natural disasters that are of significance in Uttar Pradesh are – Floods, Droughts, Fires and Earthquakes. Loss of life and property from these disasters, especially the former three, are in terms of hundreds of Crores of rupees annually. UP is vulnerable from the aspect of man-made hazards too i.e. stampede, chemical, radiological and other hazards. The hazard threats in UP is classified and presented in **Table 4.14**.

Table 4.14. Vulnerability of State of Uttar Pradesh to Various Disasters

Classification Criteria	Disasters
Geological Disasters	Earthquakes
	Dam Bursts
	Dam Failures
Water & Climate Related Disasters	Floods
	Droughts
	Cloud burst
	Flash Floods
	Heat & Cold Waves
	Hailstorms
Chemical, Industrial & Nuclear Related Disasters	Chemical & Industrial Disasters,
	Forest Fires,
	Nuclear Disasters (Narora Power Plant)
Accident Related Disasters	Road
	Rail & Air Accidents
	Boat Capsizing,
	Major Building Collapse
	Bomb Blast
	Stampedes
	Rural & Urban Fires
Biological disasters	Biological Disasters
	Epidemics
	Cattle Epidemics
Other disasters	Other threatening events

Source:SDMP, 2016-2017

For the disasters identified, the DMP has designated nodal departments in the state with support agencies and departments for early warning systems. The same is presented in **Table 4.15**.

Table 4.15. Nodal Departments under State Disaster Management Authority

Sl No	Hazards specific	Nodal Departments	Supporting Agencies / Departments For Early Warning Systems
1	Earthquake	Dept. of Urban Development	IMD, Ministry of Earth sciences/Geological Survey of India, Remote Sensing Application Center, Dept. of Housing, Awas Bandhu, Health (Medical Care)
2	Floods/Flash Floods/Cloud Burst	Dept. of Irrigation	IMD,CWC, UP SDMA, Health (Medical Care & Epidemic Control)
3	Fire	Fire Department	IPH, Dept. of Health(Medical Care), Dept. of Home, UP SDMA,

Sl No	Hazards specific	Nodal Departments	Supporting Agencies / Departments For Early Warning Systems
4	Drought	Agriculture	IMD, Revenue, RD, DRDA, Horticulture, Ground water, Health (Medical Care& Epidemic Control)
5	Big/ Large Accidents	Department of Home	Transport, PWD, Health (Medical Care), District Administration
6	Boat capsizing	Department of Revenue	District DMA, Home, Health (Medical Care), Local Bodies
7	Stampede	Department of Home	Health (Medical Care)
8	Terrorism & Crisis events	Department of Home	Health (Medical Care), Fire
9	Industrial	Department of Industry	Labour, Home, Pollution Control Board, Health (Medical Care)
10	Chemical	Dept. of Environment	Industry/ Department Labour, Home, NDRF, Health (Medical Care)
11	Biological	Health (Medical Care)	Home, NDRF, Health (Medical Care)
12	Radiation	Environment and Science	Home, Health (Medical Care), Dept. of Science & Technology, NDRF,
13	Nuclear	Dept. of Environment, and Science & Tech.	Home, NDRF, Central Ministry of Atomic Energy and Defense, Health (Medical Care).
14	Wind Storms	Revenue	IMD, Agriculture and Horticulture, home, Health (Medical Care)
15	Extreme Cold	Department of Revenue, District Administration	IMD, Forest, Electricity, Health (Medical Care), Home
16	Dam / Reservoir Burst	Irrigation	PWD, Environment, Science and Technology, CWC and Administration, Health (Medical Care)
17	Communal Riots	Dept of Home	District Administration, Health (Medical Care), Fire
18	Epidemics	Dept. of Health & Family Welfare (In case of Human)/ Dept. o animal Husbandry (in case of Animals)	SDMA, DDMA, Local Bodies, panchayati Raj, Health (Medical Care)

The following agencies / departments have been identified as members for the emergency support functionaries to support various activities at the state level. They are as follows:-

- Communication -Department of IT
- Public Health and Sanitation - Department of health & family welfare
- Power-Department of power through UP State Electricity Board
- Transport-Department of Transport through UPSRTC
- Search and Rescue-Department of home through Police, Home Guard & Fire Brigade
- Donations, Relief supplies, Shelter- Department of Revenue
- Public works and Engineering-Department of public works, Irrigation & other engineering departments
- Information and Planning- Department of Information & Public relation
- Food-Department of Food & Civil Supplies
- Drinking water-Jal Nigam
- Media- Department of Information & public relations

State Disaster Response Force (SDRF) is operating under the Police Department under the Uttar Pradesh Provincial Armed Constabulary (PAC). There are 17 battalions earmarked as flood battalions. Three dedicated battalions of SDRF are being constituted under the home department.

From the review of existing DMP in the State of UP, it is concluded that:

- Boat capsizing is the only IWT related disaster considered in the DMP. Other IWT related disasters related with incremental cargo operation is to be added to the disasters list in the DMP.
- Department of Revenue is the Nodal department to handle boat capsizing. The same department shall act as nodal department in case of IWT related disasters within the State.

The activities along the NW 1 was studied and analysed for identifying the stakeholders and for each stakeholder, respective line departments were identified and the same is listed as **Table 4.16**.

Table 4.16. Vulnerable Users along NW 1 in Uttar Pradesh

Sl.No.	Vulnerable Users	Line Department/Agency
1	Ferry Jetties /any other non- commercial jetty	Local Bodies
2	Bank protection	Department of Irrigation
3	Water supply Intake	Jal Nigam
4	Fishing activities	Department of Fisheries
5	Rail Bridge	Ministry of Railway
6	Ferry services/Country Boats/Passenger vessels	Department of Transport
7	HT line/Overhead Tower lines	Uttar Pradesh Power Corporation Ltd. (UPPCL)
8	Agriculture activities/Transportation of agricultural goods/ Plantations	Department of Agriculture
9	Turtle Sanctuary	Department of Forest & Wild Life
10	Facilities at Tourism Jetty	Department Tourism
11	Survey Vessels, Cargo operations and IWT Operations, Maintenance of IWT jetties and terminals.	IWAI
12	Fishing vessels including fishing harbor	Fisheries Department
13	Road Bridge/ Pontoon Bridge	Public Works Department
14	Hospital	Department of Family and Healthcare
15	Human settlement & day to day activities – Bathing, Washing Cleaning, Burning Ghats, Crematorium	Department of Revenue and Relief.
16	Buffalo rearing	Department of Animal Husbandry
17	Sand mining	Department of Geology and Mining.

Considering the existing line departments which are already included in the DM Mechanism, it is understood that in order to protect the stake of the vulnerable resources of NW 1 the additional departments identified above shall be included as presented in **Figure 4.12**.

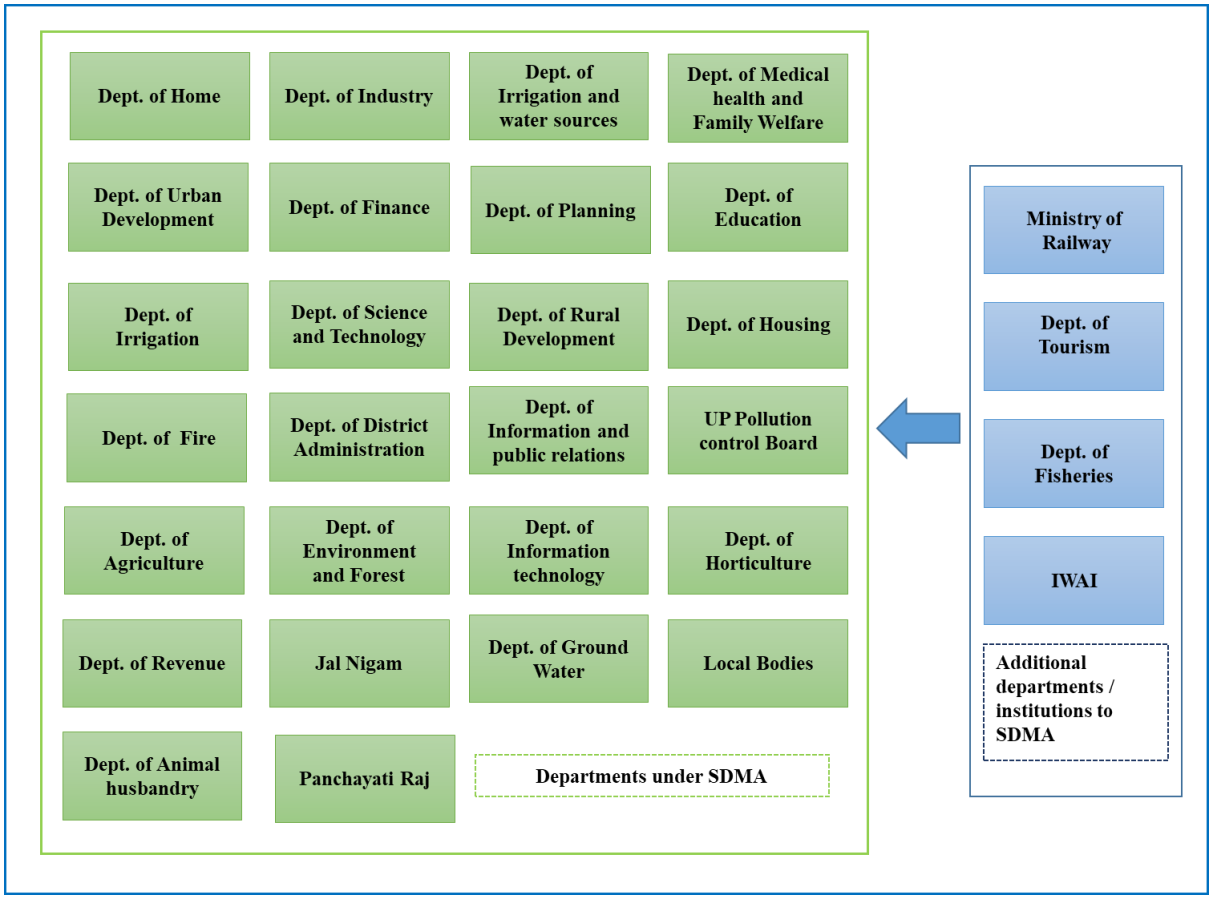


Figure 4.12. Existing and Proposed Departments and Agencies in SDMA

Note: Ministry of Railway and IWAI shall be acting as resource agencies and would not be part of DDMAs.

4.7.2. Integration of IWT Related Disasters in DDMAs of Bihar

The State of Bihar is a multi-disaster prone State. The geo-climatic conditions of Bihar make it vulnerable to many hazards. As seen in **Section 2.3.2, 2.3.3 and 2.3.4 of Salient features of NW1, the Buxar to Manihari strech of NW 1 is falling in Bihar for a total length of 532 km**. NW 1 is boardering through 13 districts of the State - Kathihar, Purnea, Bhagalpur, Khagaria, Munger, Lakhi Sarai, Begusarai, Samastipur, Vaishali, Patna, Saran (Chappara), Bhojpur and Buxar.

Bihar State Disaster Management Authority (BSDMA) was set up vide notification No. 3449 on 6th November, 2007 under Section 14 (1) of the Disaster Management Act, 2005 passed by the Parliament. Government of Bihar, in compliance with the provisions of the Disaster Management Act 2005, has developed its State Disaster Management Plan (SDMP) through

Disaster Management Department, which has been approved by the State Cabinet in the year 2014.

BSDMA, the apex body in the disaster management system, is headed by Hon'ble Chief Minister of Bihar, a full time Vice Chairman (with Cabinet Minister Rank) and few experts as its Members (with Minister of State rank). BSDMA is undertaking a number of measures focused on Disaster Risk Reduction (DRR) and mitigation. Major divisions of BSDMA are;

- Natural Disaster
- Human Induced Disaster
- Human Resource Division , Capacity Building & Training
- Environment & Climate Change Adaptation
- Administration and Finance

Role and responsibilities of BSDMA are:-

- Lay down policies on disaster management.
- Approve the State Disaster Management Plan.
- Approve plans prepared by the Departments of the State Government in accordance with the State Disaster Management Plan.
- Lay down guidelines to be followed by the District Authorities in drawing up the District Disaster Management Plan.
- Lay down guidelines to be followed by the different State Departments for the Purpose of integrating the measures for prevention of disaster or the mitigation of it's effects in their development plans and projects.
- Coordinate the enforcement and implementation of the policy and plan for disaster management
- Recommend provision of funds for the purpose of mitigation.
- Take such other measures for the prevention of disaster, or the mitigation, or preparedness and capacity building for dealing with the threatening disaster situation or disaster as it may consider necessary.
- Lay down broad policies and guidelines for the functioning of the State Institute of Disaster Management.

The prime executive body for disaster management at the state level is State Executive Committee (SEC) headed by the Chief Secretary. The State Executive Committee shall function through Disaster Management Department (DMD) and other line departments. The organizational structure of BSDMA is presented in **Figure 4.13.**

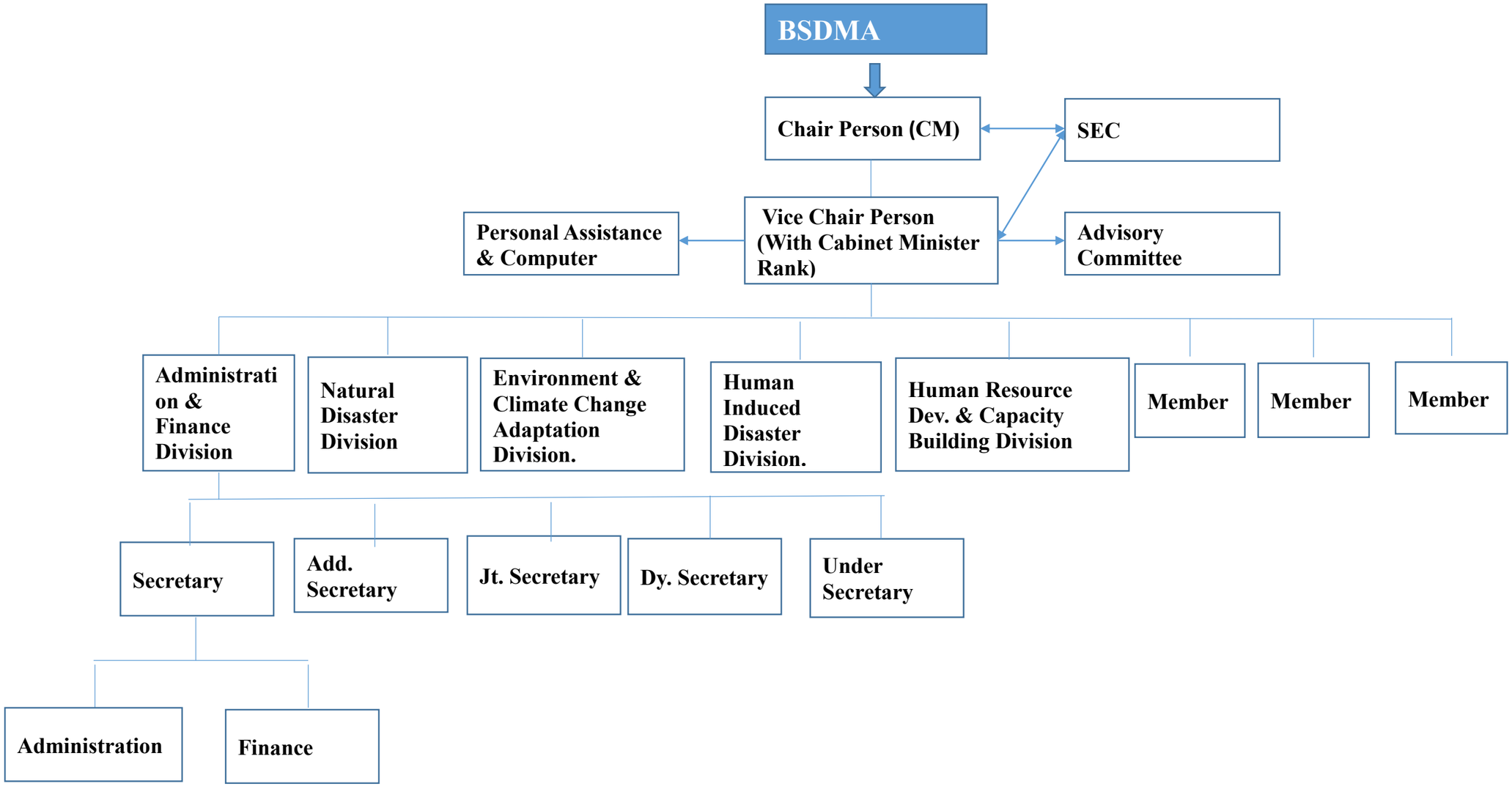


Figure 4.13. Organization Structure of Bihar State Disaster Management Authority

Out of 44 Govt. Depts. in the State, 26 departments play major role in the disaster management and have been included in the Plan. These departments are:

- Dept. of Disaster Management
- Dept. of Home
- Dept. of Water Resource
- Dept. of Minor Water Resources
- Dept. of Agriculture
- Dept. of Food & Consumer Protection
- Dept. of Panchayati Raj
- Dept. of Health
- Dept. of Education
- Dept. of Labour Resources
- Dept. of Public Health Engineering
- Dept. of Transport
- Dept. of Social Welfare/Backward Classes Welfare/SC & ST Welfare
- Dept. of Building Construction
- Dept. of Energy
- Dept. of Environment & Forest
- Dept. of Industries
- Dept. of Animal Husbandry
- Dept. of Finance
- Dept. of Road Construction
- Dept. of Rural Development
- Dept. of Urban Development
- Dept. of Cabinet Coordination (Civil Aviation)
- Dept. of Rural Works
- Dept. of Information and Public Relations
- Dept. of Planning & Development

Active integration of stakeholders have been planned with inclusion of multilateral agencies, corporate bodies and International and National level NGOs and Civil Societies. DDMAs are

present in various bordering districts and the combined institutional arrangement is presented in **Table 4.17**.

Table 4.17. SDMA and DDMA for Bordering Districts in Bihar

<table>
<tr><td colspan="12">Bihar State Disaster Management Authority (BSDMA)</td></tr>
<tr><td colspan="2">Honourable Chief Minister (Chairperson)</td><td colspan="2">Vice Chairman (with Cabinet Minister rank)</td><td colspan="8">Few experts as its Members (with Minister of State rank).</td></tr>
<tr><td colspan="12">State Executive Committee (SEC) as Crisis Management Group (CMG)</td></tr>
<tr><td colspan="12">SEC is not defined in the State Disaster Management Plan of Bihar, however BSDMA have 5 divisions for working on Disaster Risk Reduction.
Natural Disaster
Human Induced Disaster
Human Resource Division , Capacity Building & Training
Environment & Climate Change Adaptation
Administration and Finance</td></tr>
<tr><td colspan="12">State Nodal Department – Department of Disaster Management</td></tr>
<tr><td colspan="12">Nodal State Ministries/ Departments for Disaster Coordination</td></tr>
<tr><td>Dept. of Disaster Management</td><td>Dept. of Home</td><td>Dept. of Water Resource</td><td>Dept. of Minor Water Resources</td><td>Dept. of Agriculture</td><td>Dept. of Food & Consumer Protection</td><td>Dept. of Panchayati Raj</td><td>Dept. of Health</td><td>Dept. of Education</td><td>Dept. of Labour Resources</td><td>Dept. of Public Health Engineering</td><td>Dept. of Transport</td><td>Dept. of Social Welfare/Backward Classes</td><td>Welfare/SC & ST Welfare</td></tr>
<tr><td>Dept. of Building Construction</td><td>Dept. of Energy</td><td>Dept. of Environment & Forest</td><td>Dept. of Industries</td><td>Dept. of Animal Husbandry</td><td>Dept. of Finance</td><td>Dept. of Road Construction</td><td>Dept. of Rural Development</td><td>Dept. of Urban Development</td><td>Dept. of Cabinet Coordination (Civil Aviation)</td><td colspan="2">Dept. of Rural Works</td><td colspan="2">Dept. of Information and Public Relations</td><td>Dept. of Planning & Development</td></tr>
<tr><td colspan="12">District Disaster Management Authority (DDMA)</td></tr>
</table>

District Disaster Management Plan for districts of Bihar is under preparation.

Emergency Operation Center (EOC) is an essential part of disaster management system. EOCs are present in State level (SEOC), District level (DEOC) and Field level. The State Emergency Operation Centre (SEOC) shall operate on round the clock basis and be the Command Centre during disaster response period. It shall function as the data collection, programme monitoring and response providing centre for Disaster Management Department and cautioning and warning centre for the people at large. As a control room, SEOC shall be the seat of Incident Command for which it shall be suitably equipped and manned. As a monitoring cell, SEOC shall be an exchange of data collection, processing and dissemination. The Emergency Support Groups would be located in the SEOC and perform their functions under overall command and control of SEOC.

A shadow SEOC shall be located in the State Police Headquarter building which is being constructed in Patna. If the SEOC becomes dysfunctional, the shadow centre shall also function as SEOC for providing material support for relief and rehabilitation.

For the effective disaster management, BSDMA shall have the support of Bihar State Institute of Disaster Management (SIDM) for providing inputs to formulate guidelines on prevention, mitigation, preparedness, and research and development on vulnerability management related issues. The main objectives of BSIDM shall be:

- Hazard mapping and vulnerability studies.
- Strengthening of information technology for Natural Disaster Management.
- Monitoring and impact assessment of natural hazards.
- Human Resource Development mainly by imparting training.
- Early Warning System.

The Bihar State Govt. also constituted State Disaster Response Force (SDRF) as part of the disaster management. SDRF is hazard specific, i.e. separate force for Earthquake, Flood, Fire, Drought and Cyclonic Storm. SDRF, in association with NDRF, shall also prepare Civil Defence, Home Guard, Fire Brigade, Police, BMP and local youth in disaster response. They shall be trained to equip Gram Panchayat and communities with necessary skill of self-help which is the first help one is forced to bank upon at the time of disaster.

The District Disaster Management Authority (DDMA) consisting of District Magistrate as Chairman & 'Adhyaksa,' Zila Parisad as Co-Chairman shall be over all in-charge of response

to L1 level incident. It shall be an extended arm of Department of Disaster Management during responses to L2 & L3 level incidents. Since the Urban Local Bodies will play an equally important role, it is envisaged to make the Mayor/Chairman of the municipal bodies also as co-chairman of the Authority. DDMA shall associate Local Bodies and Local Voluntary Organizations both in mitigation and preparedness as well as in incident management.

Bihar is one of the most disaster prone States of the county. Floods, droughts, earthquakes, heat/cold waves, river erosions, fire incidence etc. are various forms of disasters prevalent in the state. Among natural disasters, flood is the most common and a regular annual phenomenon in Bihar resulting in enormous loss of life and property. In addition to floods, the seismic vulnerability of the State is another frequent disaster. (*Source: Disaster Management Plan 2015-16)*

From the review of existing DM system functional in the State of Bihar, it is to be concluded that

- Since, inland water transport related disasters are not listed in the disasters identified, with proposed incremental cargo operation, it is to be added in the disasters list in SDMP.
- The Secretary, Department of Transport is already part of SDMA. He could be represented for handling the IWT related disasters. The same department shall act as nodal department in case of IWT related disasters within the State.

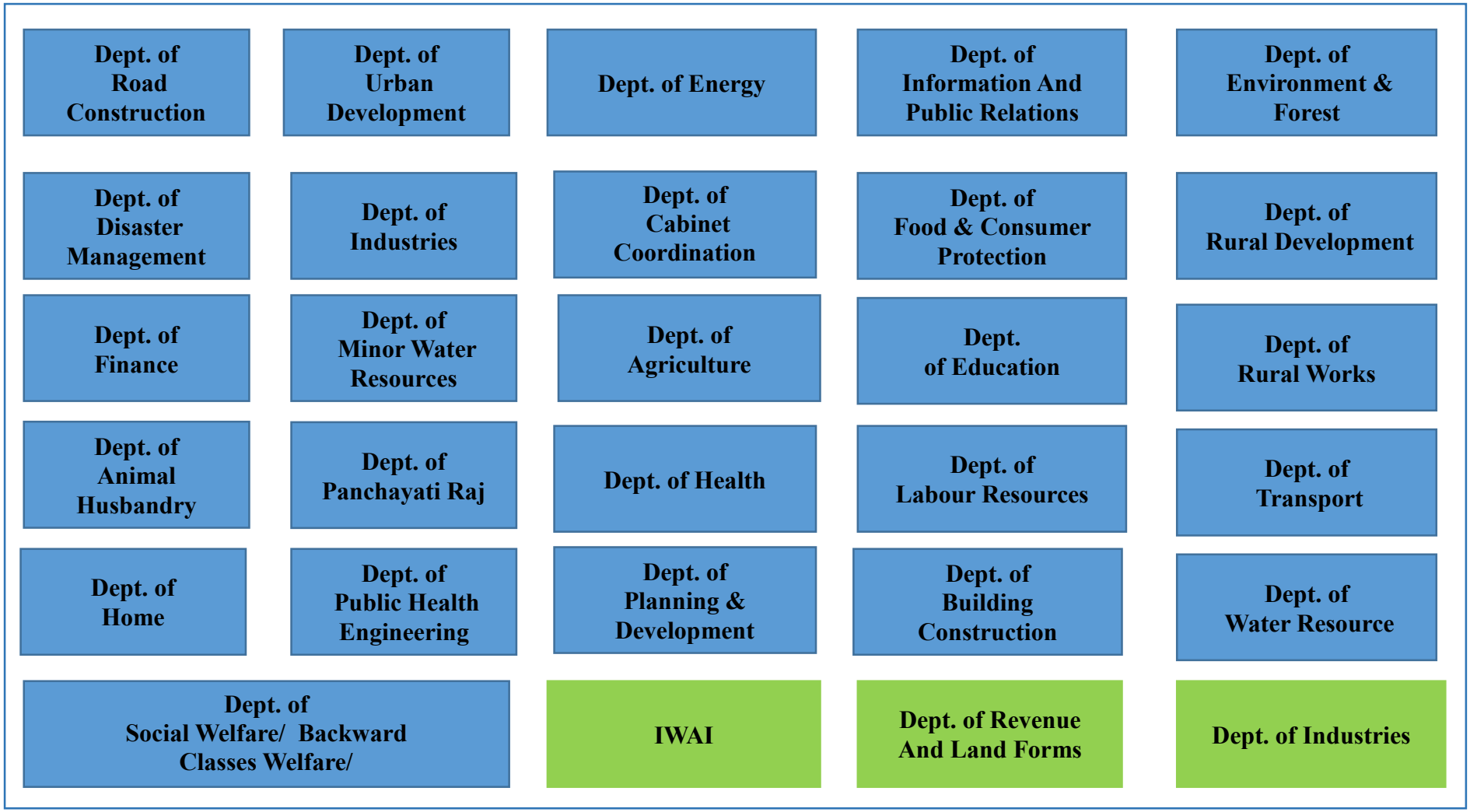
To integrate the proposal of IWT related risk to SDMP, the activities identified during the literature review and reconnaissance visit were analyzed towards identifying the vulnerable users. The State government operational profile was reviewed in detail to understand the line departments functional having responsibility over the resources which may be affected due to any incident. The vulnerable users of NW 1 in State of Bihar and the line departments are concluded in **Table 4.18.**

Table 4.18. Vulnerable Users along NW 1 in the State of Bihar

Sl. No	Users along NW1	Departments identified
1.	IWAI floating jetty	IWAI
2.	Water Supply (WS) intake	Dept. of Public Health Engineering
3.	Ghats, Rural and Urban settlements Pilgrim centre	Dept. of Revenue and Land forms & Dept. of Panchayati Raj

Sl. No	Users along NW1	Departments identified
4.	Road Cum Railway Bridge	Dept. of Road Construction & Ministry of railway
5.	Transportation through country boats including ferry crossing Passenger and Ro –Ro facilities Passenger boats Floating navigation lights	Dept. of Transport
6.	Agriculture fields	Dept. of Agriculture
7.	Gangetic Dolphin Sanctuary, Important Bird Areas	Dept. of Environment & Forest
8.	Fishing activities in country boats /with cage culture/Net Fishing	The Department of Animal Husbandry and Fisheries
9.	Road Bridge	Dept. of Road Construction
10.	Bank Protection	Dept. of Water Resource
11.	Bhagalpur College of Engineering	Dept. of Education
12.	Water supply scheme	Dept. of Public Health Engineering
13.	H T lines	Dept. of Energy

Considering the existing line departments which are already included in the DM Mechanism of State of Bihar, it is understood only very few departments has to be additionally added in the DM mechanism as presented in **Figure 4.14**.



Note: IWAI is a central government Institutions and would act as resource agencies and would not be a permanent reprsentative in DDMA.

Figure 4.14. Existing and Proposed Departments and Agencies in SDMA

The key role to be played by the line departments for managing any incidents are presented in **Table 4.19.**

Table 4.19. Key Role to be Played by Additional Stakeholders during IWT Related Disaster

Sl No	Additional Stakeholders Identified	Role of Additional Stakeholders
1	Dept. of Industries	Extend support for response operation in coordination with the Industrial units in terms of Cargo related aspects as experts, rescue operational team, resources
2	Dept. of Revenue and Land Forms	Warning people living on banks of NW 1 during disaster-people engaged in cleaning, cremation, cattle rearing, agricultural activities etc.
3	IWAI	Response Coordination with availing the vessels / facilities available and coordination with DDMA and core responsibility in coordinating the cargo /vessel securing efforts of owner.

4.7.3. Integration of IWT Related Disasters in DDMAs of Jharkhand

Jharkhand is a State in eastern India, carved out of the southern part of Bihar. The state shares its border with the States of Bihar to the north, Uttar Pradesh to the northwest, Chhattisgarh to the west, Odisha to the south and West Bengal to the east. The NW 1 passes through one district of Jharkhand – Sahibganj.

Jharkhand State Disaster Management Authority (JSDMA) has been constituted vide Notification # 425, dated 28 May, 2010 in exercise of the powers conferred by sub section (1) of section 14 of DM Act 2005 (Act no. 53 of 2005) by His Excellency , Governor of Jharkhand. The JSDMA has two distinct objectives viz.

- Development and updating of Plans and Strategies to handle any type of disaster at various levels
- Undertake projects for restoration and strengthening of infrastructure damaged by disasters.

JSDMA is mandated to develop disaster preparedness plans for the State to meet any eventuality arising out of all kinds of disasters such as cyclone, flood, drought, chemical explosion, etc.

SDMA headed by Chief Minister as the Chairperson and Minister-in-Charge, Department of Disaster Management as Vice Chairperson with 7 members from Nodal Departments and Chief Secretary as Chief Operating Officer. The State Authority is responsible for:

- Development of Multi-hazard response plan
- Establish and maintain a failsafe communication network interconnecting the State, district, block and GP Headquarters for dissemination and collection of information relating to disaster management.
- Institutional capacity building
- Capacity building of the communities and Community Based Organisations to handle emergencies
- Preparation of Geographic Information System (GIS) for disaster mitigation and development planning.
- Design and development of training programme for decision makers, elected representatives and the Civil Society groups.
- Coordination of NGO efforts

State Executive Committee (SEC) is proactively strategizing and functioning for the disaster management of the State. State Steering Committee has also been formed at the department level to govern the Govt. of India and UNDP sponsored disaster risk reduction program in the state.

SEC is headed by Chief Secretary as Chair person and Secretary to Disaster Management Department as member secretary and three members - Principal Secretary to Health department, Principal Secretary to Home department and Secretary to Finance department. Emergency Operation Centre (EOC) will act as nerve centre for coordination and management of disasters of all kind and magnitude. EOC will be a central command and control facility provider, responsible for carrying out the principles of disaster preparedness, response and management functions at a strategic level in emergency situation in their notified area. The present structure of SDMA and DDMA of Sahibganj in Jharkhand is presented in **Table 4.20.**

Table 4.20. Structure of SDMA, Jharkhand and DDMA, Sahibganj

Jharkhand Disaster Management Authority (JDMA)								
Chief Minister- Chairperson	Minister in charge Disaster Management Department- Vice president	Chief Minister) Home Affairs Department - (Member)	Minister in charge – Finance- (Member)	Minister in charge – Department of Health, Education, Family Welfare- (Member)	Minister in charge – Agriculture and Sugarcane Development Department- (Member)	Minister in charge – Water Resources- (Member)	Minister in charge – Road Construction- (Member)	Chief Secretary- Chief Operating Officer
State Executive Committee (SEC) as Crisis Management Group (CMG)								
Chief Secretary - Chairperson		Principal Secretary to Health Department - Member		Principal Secretary to Home Department - Member		Secretary to Finance Department - Member	Secretary to Disaster Management Department - Member Secretary	
State Nodal Department – Department of Disaster Management								
Nodal State Ministries/ Departments for Disaster Coordination								
Department of Disaster Management	Department of Home	Department of Health	Department of Agriculture	Department of Irrigation & Flood Control	Department of Urban Development	Department of Building construction	Department of Transport & Civil Aviation	
Department of Energy	Department of Road Construction	Department of Finance	Municipal Corporation of Ranchi & Dhanbad	Bomb Disposal Squad	BSNL	Department of Food and Civil Supply	Department of Drinking Water & Sanitation	
District Disaster Management Authority (DDMA)								
Sahibganj District								

Source: A draft on Jharkhand State Disaster Management Plan 2011, Prepared by Disaster Management Department

Disaster Management Department proposes comprehensive training program to build the capacity of functionaries of all the line departments at State, District and Block level to integrate and mainstream disaster management into development planning and programmes. Department proposes Knowledge cum Demonstration centers to be created for making aware the community and the common people about various types of probable disasters and their vulnerability to that, through technologies and tools and various ways to mitigate and cope up with the incumbent disaster.

An Incident Site Operation Centre (SOC) is also proposed as a complimentary unit to EOC, especially during disasters, which will operate close to the disaster site and will be linked directly with the State and District Emergency Operations Centre. The concerned Additional Collectors at District as Nodal Officer and CEO of DDMA will be the nodal officer from the district administration at this Centre. In the event of a serious disaster, the Chief Secretary will have sole right to appoint senior officers of any State Government Department, posted in the district as 'Field Relief Managers' for monitoring and co-ordinating the relief operations in the affected area.

The Chief Secretary is the official Incident Response Team Leader to activate the response system and to control and coordinate the resources required at the site of disaster. The Deputy Commissioner is the official Incident Response Team Leader to activate the command system and to control and coordinate the resources required at the site of disaster.

At the District level, DDMAs will act as the planning, coordinating and implementing body for DM and will take all measures for the purposes of DM in the respective Districts in accordance with the Guidelines laid down by NDMA and the concerned SDMA. Each DDMA is headed by the respective District Magistrate, District Collector (DC), Dy. Commissioner as the case may be with the elected representative of the Local Authority as the Co-Chairperson. DDMA will act as the planning, coordinating and implementing body for DM at District level and take all necessary measures for the purposes of DM in accordance with the guidelines laid down by the NDMA and SDMA.

Emergency Support Functionaries (ESFs) are identified for the state to be activated during a disaster. The list of function, nodal agency/officers and supporting agencies are listed in the **Table 4.21**.

Table 4.21. ESFs to be Activated during a Disaster in Jharkhand

ESFs	Function	Nodal Agency/ Officer	Supporting Agencies
ESF 1	Communication	BSNL	Private telecom service operators, mobile phone services operators
ESF 2	Evacuation	Department of Home	Jharkhand Police Force, Delhi fire Service, Directorate of Health Service and Civil Defence etc.
ESF 3	Search and Rescue	Jharkhand Fire Service	Department of Home, Jharkhand Police, Civil Defence and Directorate of Health Services..
ESF 4	Law & Order	Department of Home	
ESF 5	Medical Response and Trauma Counseling	State Health Department	CATS, MCD, DGHS (Central Govt), Indian Red Cross, Civil Defence, Delhi Fire Service
ESF 6	Water Supply	Drinking Water & Sanitation Department	MCs, CGWC, CWC, Irrigation and Flood Control.
ESF 7	Relief (Food and Shelter)	Department of Food and Civil Supplies	Department of Revenue, Urban Development, MCs, DWSD,
ESF 8	Equipment support, debris and road clearance	Department of Home	DWSD, Building department , MCs, Cant Board, Military Engineering Services
ESF 9	Help lines, warning dissemination	Department of Disaster Management	Department of Information and Publicity, BSNL, AIR, Doordarshan, UNI, Press Information Bureau, Press Trust of India, PTI
ESF 10	Electricity	Secy. Power	PTPC,DVC , NTPC JSEB
ESF 11	Transport	Secy. Transport	JTDC, Eastern railways, MCs, Civil Aviation, DWSD and Civil Defenceetc.
ESF 12	Bomb Disposal	Jharkhand Police	Bomb Squad, Dog Squad, Anti- Terrorist Squad, NSG

All ESFs have to assist the Incident Commander, i.e. Chief Secretary at state level and Deputy Commissioner (S) at District level. A detailed organisational setup of all ESFs and team leaders at state and district level has been given below.

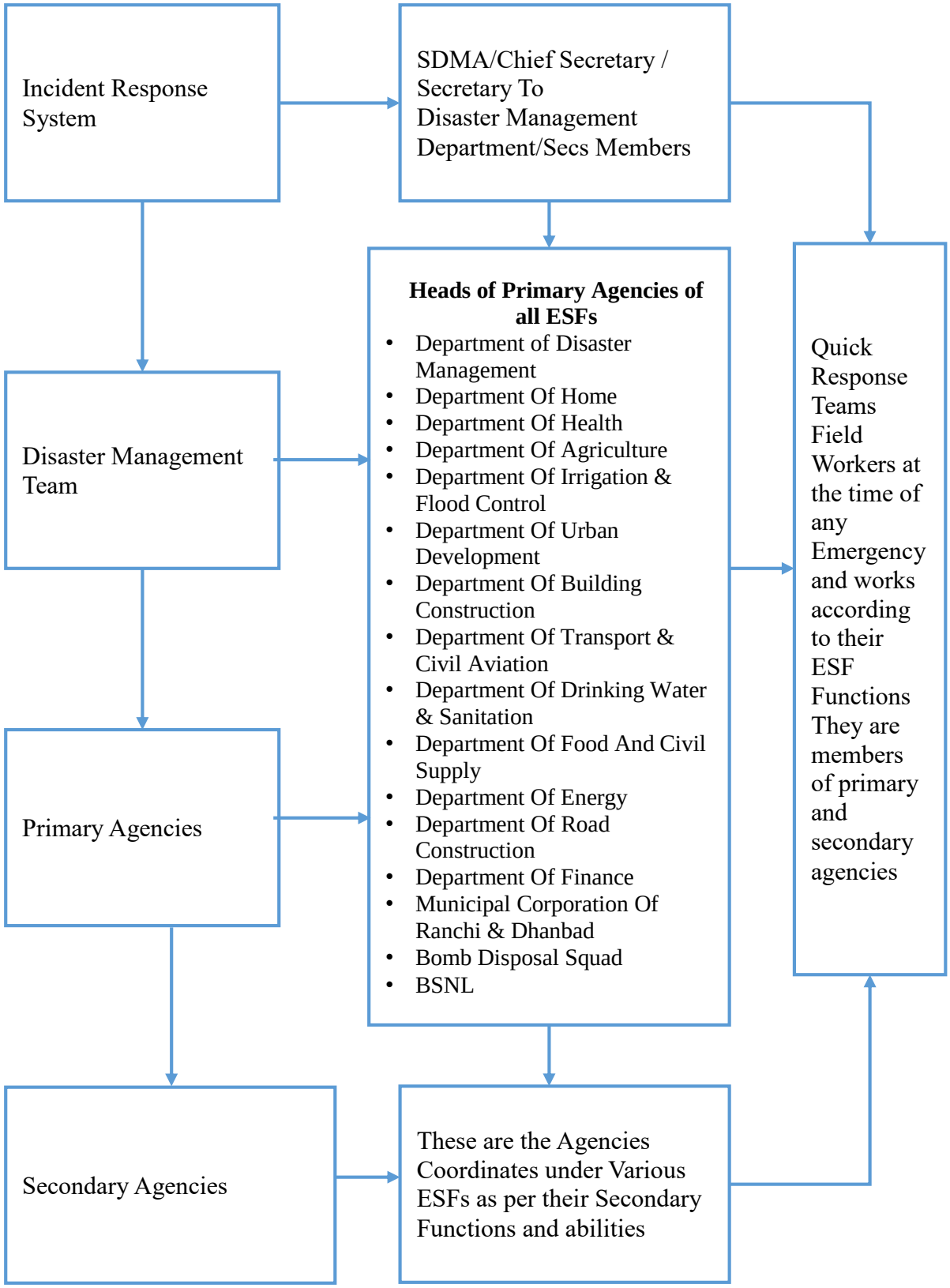


Figure 4.15. Organizational Set-up of the ESF at State Level

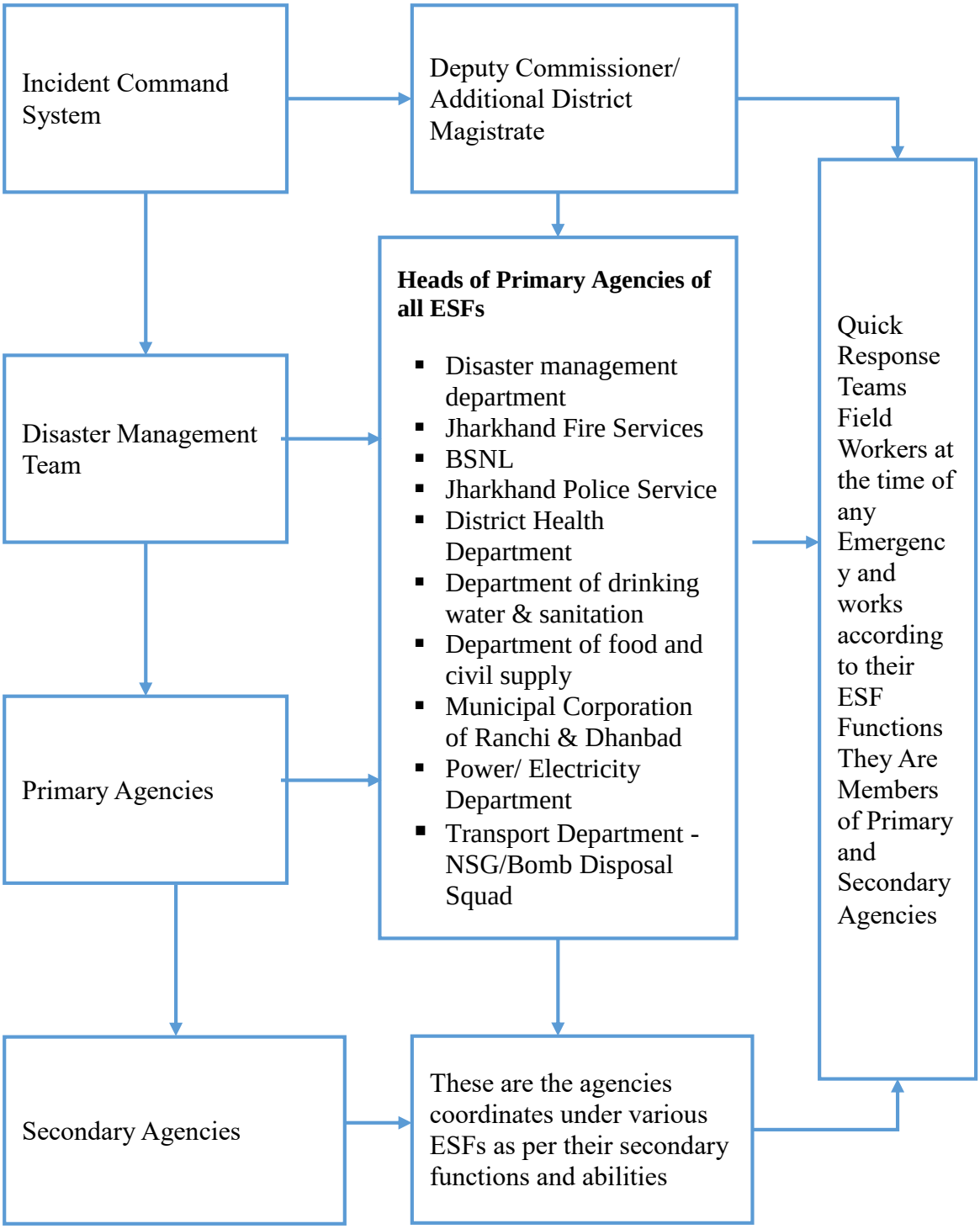


Figure 4.16. Organisational Set-Up of the ESF at District Level

Almost all the 24 districts in Jharkhand are affected by different kind of Disaster. The major disasters identified in the State are presented below.

Table 4.22. Disasters Identified in the State of Jharkhand

Sl No	Disasters
1.	Drought
2.	Mining Accidents

Sl No	Disasters
3.	Chemical and Industrial Hazards
4.	Lightning
5.	Bird Flu
6.	Flood
7.	Earthquake
8.	Fire / Forest Fire
9.	Elephant Attacks
10.	Climate Change
11.	Biodiversity loss
12.	Naxalism/ Landmine Blasts

From the review of existing DM system functional in the State of Jhrkhand, it is to be concluded that

- Since, inland water transport related disasters are not listed in the disasters identified, with proposed incremental cargo operation, it is to be added in the disasters list in SDMP.
- The Secretary, Department of Transport is already designated as one of the ESF in the SDMA. Hence, the department can be represented for handling the IWT related disasters. The same department shall act as nodal department in case of IWT related disasters within the State.

To integrate the IWT related risk to DDMP, the activities identified during the reconnaissance visit were analysed towards identifying the vulnerable stakeholders. The State government operational profile was reviewed in detail to understand the line departments functional having responsibility over the resources which may be affected due to any incident. The vulnerable users of NW 1 in State of Jharkhand and the line departments are included in **Table 4.23.**

Table 4.23. Vulnerable Users along NW 1 in the State of Jharkhand

Sl. No	Vulnerable Users along NW1	Departments Identified
1	Fishing activities, Agricultural activities	Agriculture, animal husbandry & Fisheries Cooperative department
2	Ro - Ro facilities, Country Boat Operations, Passenger Boats, Stone Chips Carrying Boats	Transport
3	Terminal Construction	IWAI
4	Municipal Water Intake Structure	Drinking Water and Sanitation department
5	Burning Ghats, Temple, Cattle Rearing,	Revenue, Registration and Land Reforms Department

The respective line departments of vulnerable resources are already included in the state disaster management authority except Industries Department and Forest, Environment and Climate Change Department.

The institutional mechanism proposed for integration of IWT related disasters in existing DM structure of the State of Jharkhand is presented in **Figure 4.17**. The key role to be played by the line departments for managing any incidents are presented in **Table 4.18.**

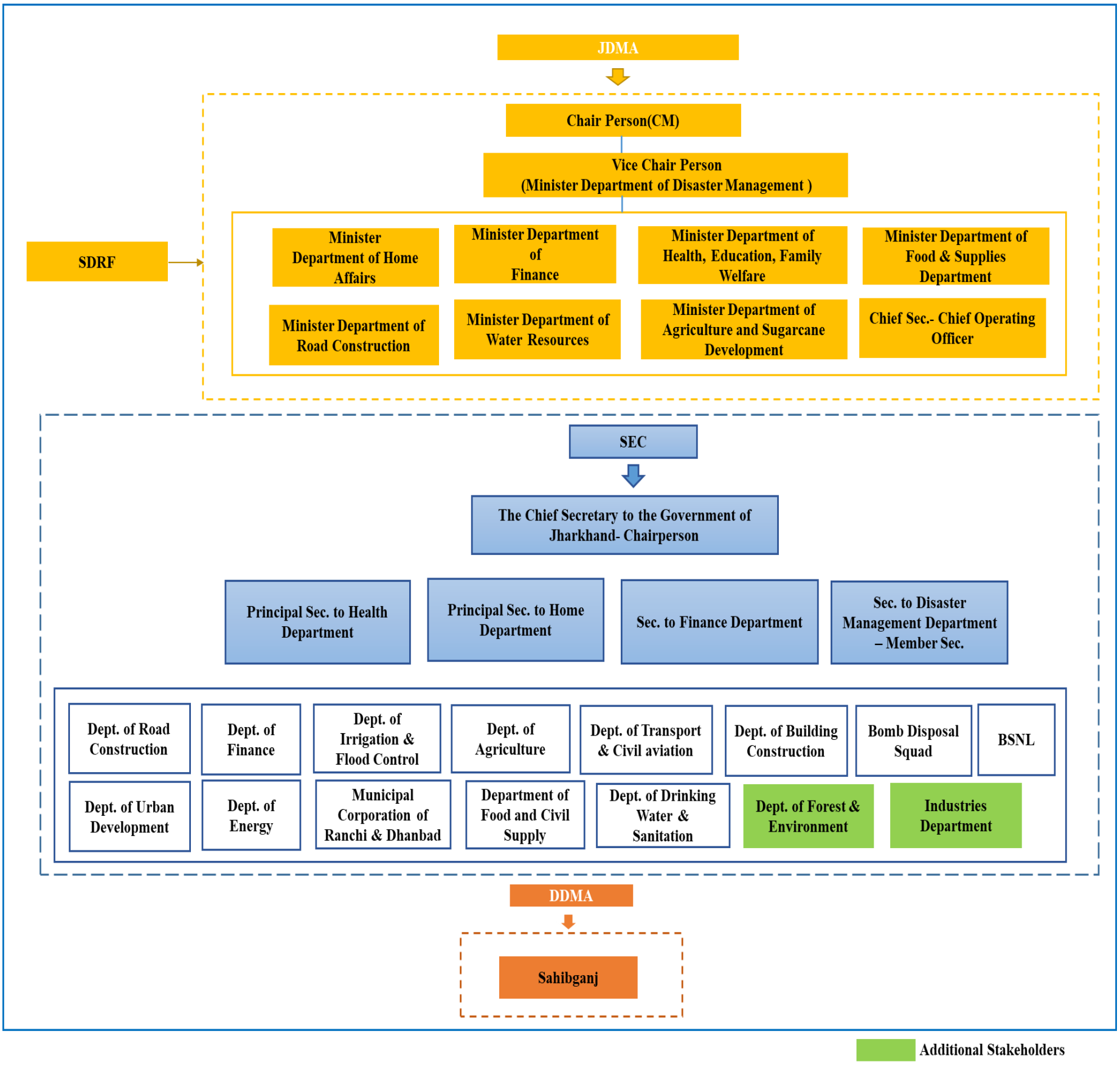


Figure 4.17. Existing and Proposed Departments in SDMA of Jharkhand

4.7.4. Integration of IWT Related Disasters in DDMAs of West Bengal

State of West Bengal is the state in eastern India, between the Himalayas and the Bay of Bengal. Ganga flows eastwards and its main distributary, the Hooghly River, flows south to reach the Bay of Bengal. As seen in **Section 2.3.5** and Section **2.3.6** of report, the Farakka to Haldia strech of NW 1 is falling in West Bengal for a total length of 500 km. NW 1 is boardering through 10 districts of the State- Burdwan, Hooghly, Howrah, Malda, Kolkata, Murshidabad, Nadia, North 24 Pharanga, Purba Mednipur and South 24 Parganas.

Under Section 23(1) of the DM Act 2005, for the State of West Bengal, SDMA has been constituted. Disaster Management Department has prepared the Draft DMP in 2015-16 for the State. SDMA headed by Chief Minister as the Chairperson and Minister-in-Charge, Department of Disaster Management as Vice Chairperson with 7 members from Nodal Departments and Chief Secretary (CS) to the Government of West Bengal as Chief Executive Officer Ex-Officio. The State Executive Committee (SEC) under with State CS as Chairperson (ex officio) and four Secretaries to the Government of the State of such departments as the State Government may think fit, ex officio members. Powers and functions of State Authority are

- Lay down the State disaster management policy;
- Approve the State Plan in accordance with the guidelines laid down by the National Authority;
- Approve the disaster management plans prepared by the departments of the Government of the State;
- Lay down guidelines to be followed by the departments of the Government of the State for the purposes of integration of measures for prevention of disasters and mitigation in their development plans and projects and provide necessary technical assistance therefor;
- Coordinate the implementation of the State Plan
- Recommend provision of funds for mitigation and preparedness measures;
- Review the development plans of the different departments of the State and ensure that prevention and mitigation measures are integrated therein;
- Review the measures being taken for mitigation, capacity building and preparedness by the departments of the Government of the State and issue such guidelines as may be necessary.

The SDMA and DDMA functional at State is presented in **Table 4.24**.

Table 4.24. SDMA and DDMA of Bordering Districts in West Bengal

West Bengal Disaster Management Authority (WBDMA)									
Honorable Chief Minister (Chairperson)	Minister-in-Charge, Department of Disaster Management, (Vice Chairperson)	Minister-in-Charge, Finance Department (Member)	Minister-in-Charge, Department of Health and Family Welfare (Member)	Minister-in-Charge, Department of Irrigation & Waterways (Member)	Minister-in-Charge, Department of Public Works Department (Member)	Minister-in-Charge, Department of Agriculture (Member)	Minister-in-Charge, Food & Supplies Department (Member)	Minister-in-Charge Department of Power (Member)	Chief Secretary to the Government of West Bengal & Chief Executive Officer Ex-Officio (Member)
State Executive Committee (SEC) as Crisis Management Group (CMG)									
The Chief Secretary to the Government of West Bengal (Ex-officio Chairperson)		The Secretary, Home Department.		The Secretary, Finance Department		The Secretary, Irrigation & Waterways Department		The Secretary, Disaster Management Department	
State Nodal Department – Department of Disaster Management									
Nodal State Departments for Disaster Coordination									
PWD	Health & Family welfare	Electricity Boards	Development Authority	Finance	Roads and Buildings	Water supply and Sanitation Department	Agriculture	Transport	Ports & Fisheries
District Disaster Management Authority (DDMA)									
Burdwan (Bardhaman)		**Hooghly**		**Howrah**		**Malda District**		**Kolkata**	
Murshidabad		**Nadia**		**North 24 Pharanga**		**Purba Mednipur**		**South 24 Parganas**	

Source: Draft Disaster Management Plan 2015-16, West Bengal prepared by Department of Disaster Management

Emergency Operation Centers (EOC) are essential part of disaster management system. EOCs are present in State level (SEOC), District level (DEOC) and Field level. SEOC is an off-site facility functioning from State / District HQ. The SEOC will take stock of the emerging situation and assist the incident managers in mobilising the respective line department's resources, manpower and expertise along with appropriate delegated authorities for the on-scene actions / response. State EOC will keep the DEOC and field EOC informed of the changing situation and extend support. Emergency communication, SMS alert and warning system, decision support system and resources management system are few of critical components inbuilt into SEOC infrastructures.

Each DDMA will be headed by the respective District Magistrate, District Collector (DC), Dy. Commissioner as the case may be, with the elected representative of the Local Authority as the Co-Chairperson. DDMA will

- Act as the planning, coordinating and implementing body for DM at District level and take all necessary measures for the purposes of DM in accordance with the Guidelines laid down by the NDMA and SDMA.
- Prepare the District DM plan for the District and monitor the implementation of the National Policy, the State Policy, the National Plan, and the State Plan concerning its own District,
- Ensure that the guidelines for prevention, mitigation, preparedness and response measures lay down by NDMA and SDMA are followed by all departments of the State Government, at the District level and the Local Authorities in the District.

Various stakeholders identified in the Disaster Management System of the State include resource agencies, emergency service departments, corporates, volunteers as presented in **Figure 4.18**. Seven Companies from West Bengal SAP (State Armed Police) Battalion and three from Kolkata Police have been working as State Disaster Response Force (SDRF).

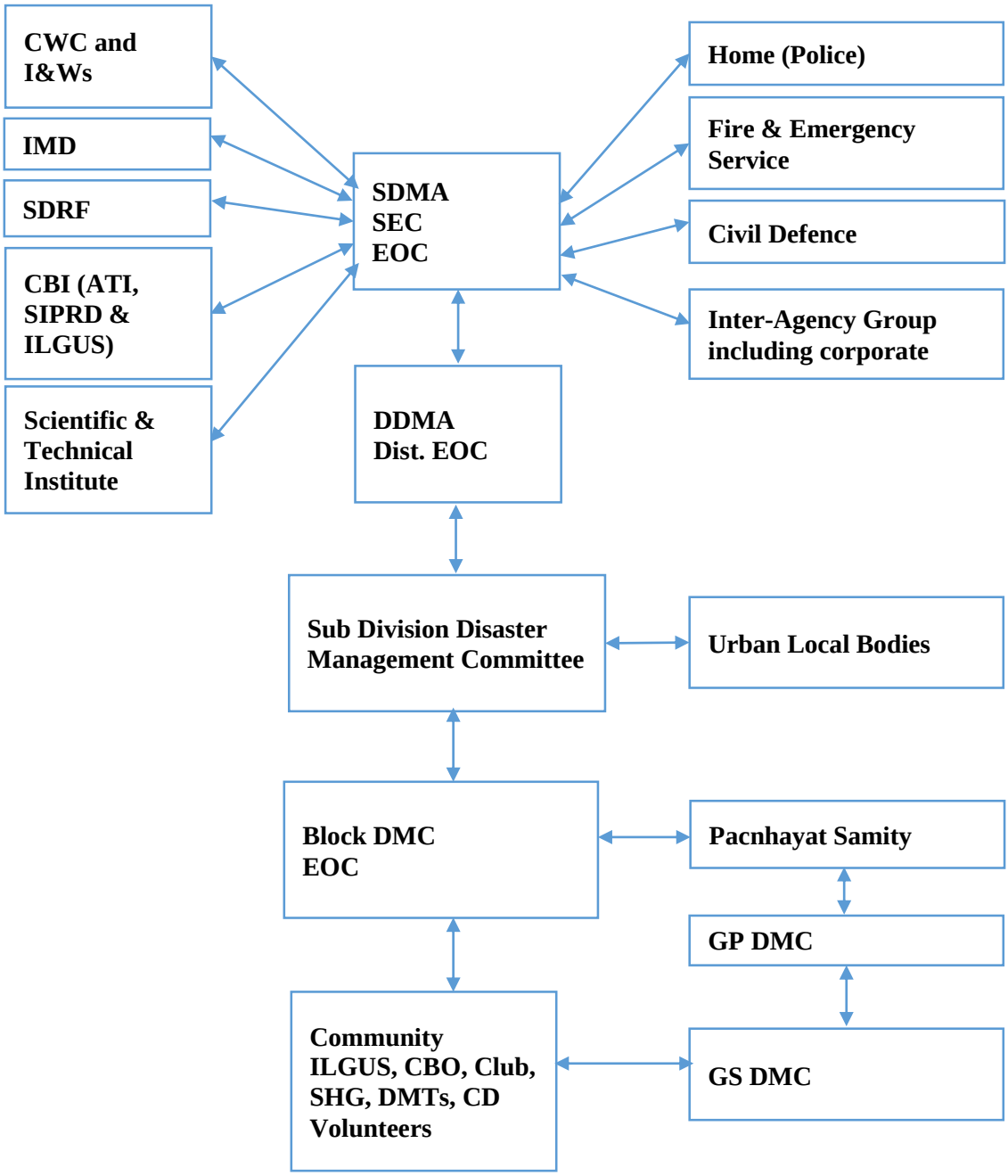


Figure 4.18. Stakeholder Integration in West Bengal Disaster Management System

Note: **CWC**- Central Water Commission; **SIPRD**- State Institute of Panchayats and Rural Development; **SHG**- Self-help Group and Self Employment, **CBO**-Community Based Organizations**; I&Ws-** Irrigation & Waterways dept.; **ILGUS**- Institute of Local Govt. And Urban Studies; **CBO**- Community Based Organizations; **ATI**- Administrative Training Institute; **SDMA**- State Disaster Management Authority; **SEC**- State Executive Committee; **EOC**- Emergency Centers; **DMTs**- Disaster Management Teams; **DMC-** Disaster Management Centers

Different parts of the State are vulnerable to the natural calamities like flood, cyclone, hailstorm - kalbaishakhi, earthquake, landslide, drought and erosion. In fact, there are multiple High Risk Multi Hazard Zones. Apart from these natural hazards, there are chances of man-made disasters

like major fire, industrial accidents, terrorist attacks etc. The major disasters identified in the state are as presented in **Table 4.25.**

Table 4.25. Vulnerability of State of West Bengal to Various Disasters

Classification Criteria	Disasters
Natural	Earthquake
	Flood
	Cyclone
	Storm Surge
	Tsunami
	Drought
	Land Slide
	Epidemics
Human Made Disasters	Fires
	Explosions
	Building or bridge collapses
	Transportation crashes
	Dam or levee failures,
	Nuclear reactor accidents
	Breaks in water lines
	Breaks in gas lines
	Breaks in sewer lines

Source: Disaster Management Plan 2015-16 West Bengal,

From the review of existing DM system functional in the State of West Bengal, it is to be concluded that

- Since, inland water transport related disasters are not listed in the disasters identified, with proposed incremental cargo operation, it is to be added in the disasters list in SDMP.
- The Secretary, Irrigation & Waterways Department is already part of SDMA. He could be represented for handling the IWT related disasters. The same department shall act as nodal department in case of IWT related disasters within the State.

To integrate the proposal of IWT related risk to DDMPs, the activities identified during the literature review and reconnaissance visit were analysed towards identifying the vulnerable stakeholders. The State government operational profile was reviewed in detail to understand the line departments functional having responsibility over the resources which may be affected due to any incident. The vulnerable users of NW 1 in State of WB and the line departments are included in **Table 4.26.**

Table 4.26. Vulnerable Users along NW 1.

Sl. No	Vulnerable Users along NW 1	Line Department/Agency
1.	Floating tetty, bank protection, irrigation water supply intake	Irrigation and Waterways
2.	NTPC water outlet from Industry	NTPC – Central Government Institution Department of Industries and Commerce – from State Government side.
3.	Fishing activities, Sea going fishing vessels, fishing harbour	Fisheries
4.	Railway line, railway station, rail bridge	Ministry of Railway – Central Government Institution
5.	Ferry services, country boats, passenger vessels	Transport
6.	H T lines	Power and Non-Conventional Energy Sources
7.	Agriculture activities	Agriculture
8.	Tourism jetty	Tourism
9.	Port related traffic	KoPT
10.	Defence vessels/establishments	Ministry of Defence
11.	Road Bridge	Public Works Department
12.	Hospital	Health and Family Welfare
13.	Human settlements and public uses	Land and Land Reforms & Refugee Relief and Rehabilitation
14.	Drinking Water Supplies	Water Supply and Sanitation

Considering the existing line departments which are already included in the DM Mechanism, it is understood that in order to protect the stake of the vulnerable resources of NW 1 the additional departments identified above shall be included as presented in **Figure 4.19**.

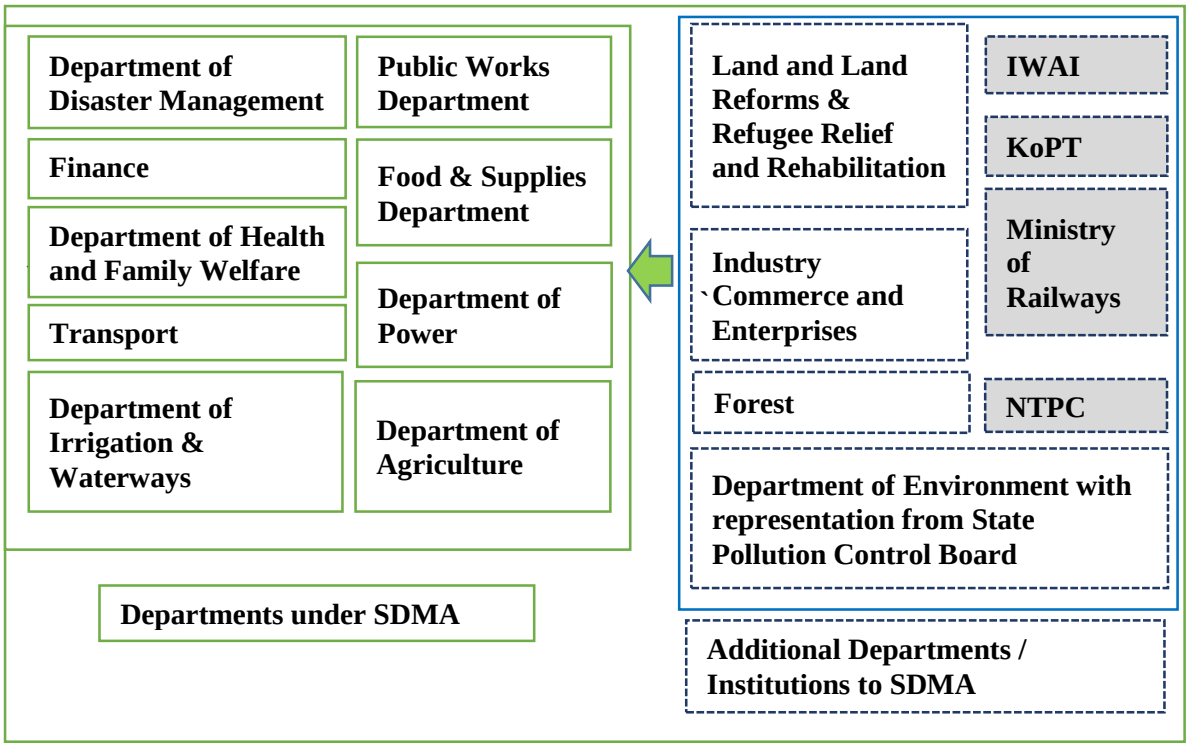


Figure 4.19 Existing and Proposed Departments and Agencies in SDMA

Note: IWAI, KoPT, NTPC and Ministry of Railways are Central Government Instituions and would act as resources agencies and would not be permanent reprsentation in DDMA.

The institutional mechanism proposed for integration of IWT related disasters in existing DM structure of the State of West Bengal is presented in **Figure 4.20**. The key role to be played by the line departments for managing any incidents are presented in **Table 4.27**.

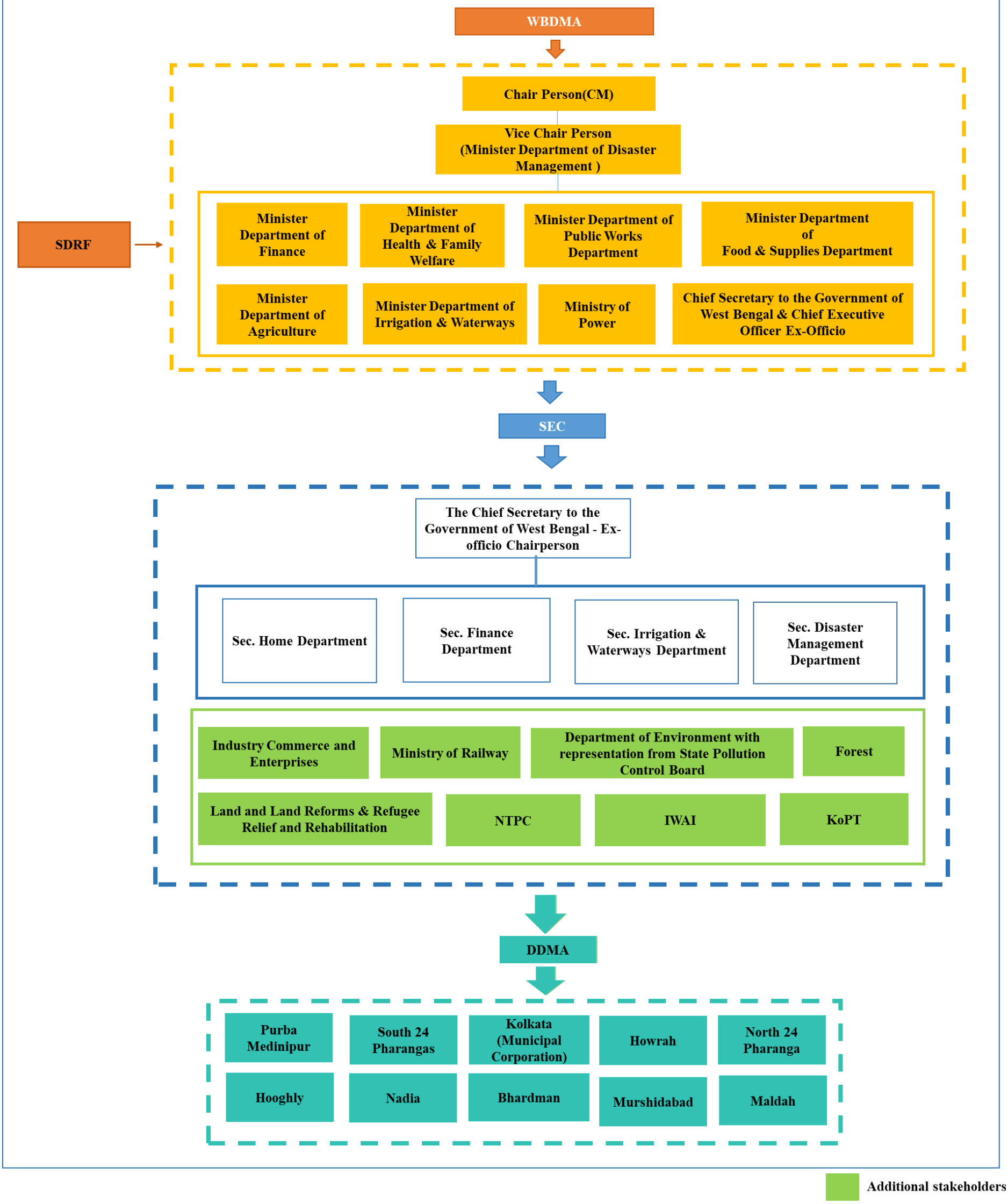


Figure 4.20. Existing DM structure of the State of West Bengal

Table 4.27. Key Role to be played by Additional Stakeholders during IWT Related Disaster

Sl No	Additional Stakeholders Identified	Role of Additional Stakeholders
1	Industry, commerce and enterprise	Extend support for response operation in coordination with the Industrial units in terms of Cargo related aspects as experts, rescue operational team, resources
2	Fisheries	Warning fishermen and local people engaged in fishing activities during disaster. Arranging quality checking of the affected area for fish consumption related aspects. Facilitating fisherman for losses if any.
3	Transport	Warning inland vessel operators during disaster Availing vessels or boats during disaster Support land side transport requirements for disaster management.
4	Forest	Guide response operation in protected areas with site specifying priority of protection and response strategy to be adopted.
5	Tourism	Alerting tourism establishments /tourists vessel in the impact zone and safe evacuation if needed.
6	Land and land reforms, refugee relief and rehabilitation	Warning people living on banks of NW 1 during disaster-people engaged in cleaning, cremation, cattle rearing, agricultural activities etc.
7.	Ministry of Railway	Resource agency.
8	IWAI	Response Coordination with availing the vessels / facilities available and coordination with DDMA and core responsibility in coordinating the cargo /vessel securing efforts of owner.
9.	KoPT	Support response efforts with availing the experienced staff, equipment and vessels as per the request from DDMA especially with utilising the sector specific experience.
10.	NTPC	Extend support for response operation in cargo related aspects as experts, rescue operational team, resources on request of DDMA.

4.8. Offsite Emergency Operation by DDMAs of Bordering Districts of NW 1

The DDMAs of the respective districts bordering NW 1 would required to act on emergency support requirement received from IWAI. The EOC of respective DDMA shall be immediately activated and the departments who has to get involved in IWT related as mentioned in section above of each state shall be shifted for the emergency operation requirement as deemed necessary. Head – IWAI RO shall play key role in coordinating with DDMA for operation.

In case of terminals where emergency is along the land mass, the existing facilities of DDMA shall be immediately mobilized with specific lead operation from the Fire and Emergency

services Department supported by the Health Department. In case the emergency require an offshore operation involving vessels, DDMA shall plan for operation from the nearest jetty /terminal with available vessels of locality – passenger/cargo/fishing etc.

4.9. Emergency Response Equipments for DDMAs

Apart from the existing DM mechanism and land based response facilities part of each DDMA, it is proposed that additional facilities shall be ensured such as portable firefighting facilities and adequate PPEs to cater the specific response requirement for the IWT related disasters as presented below.

Table 4.28. Minimum Facilities Required at each DDMA and Block Cost Estimate

Gloves; coveralls; safety glasses; Face shield; and Chemical resistant, steel-toe boots or shoes.	10 Sets
FAST ACT (First Applied Sorbent Treatment against Chemical Threats) Neutralization agent - 4kg Cylinder	5 No
Portable Inflatable Emergency Lighting System	5 No
High Pressure Water Mist &CAFS (10L)	2 No
Block Cost for Procurement of Facilities above (Rs)	**19,64,000.00**
(Rupees Nineteen Lakh Sixty Four Thousand only)	

DDMA of each bordering district shall train the response personal specifically for operation in riverine situations taking extreme care on the personal safety to handle the IWT related disasters under their jurisdiction.

4.10. Specialized Protection for Environmental Sensitive Areas

Vikramshila Gangetic Dolphin sanctuary, being the most environmental sensitive area along the stretch warrants an additional precautionary measure in case of accelerated cargo transport as part of JMVP. Being under the complete jurisdictional limit of District of Bhagalpur in the state of Bihar, it is proposed to empower the respective DDMA with an additional provision of weir boom with supporting accessories to contain the oil spill if any within the least time possible. DDMA shall suitably locate the facilities at a near accessible point considering the priority of protection area in coordination with the Forest Department having control over the sanctuary limit for operational aspects in case of an emergency.

Similarly, Kashi Turtle Sanctuay also require specialized protection on account of the environmental sensitivity where an additional provision shall be given similar to the above. Since both Chandauli and Kashi districts are bordering the waterway, any of the DDMA shall

take hold of the responsibility of suitably locating the facility and IWAI may support any response operation with availing the terminal facilities, vessels and crews in case of an emergency.

The total cost for providing the above facilities works out to **Rs. 78.85 Lakhs**. The specification of the boom proposed including the cost provision is presented in **Table 4.29.**

Table 4.29. Provision for Gangetic Dolphin Sanctuary and Kashi Turtle Sanctuary

Description	Quantity (Rs.)	Amount (Rs.)
River Booms with accessories (Material: Neoprene / rubber / Neoprene rubber)	600 with 2 Power Pack	39,42,550.00
Total Cost towards setting up of facilities at two locations		78,85,100.00
(Rupees Seventy Eight Lakhs Eighty Five Thousand and One Hundred Only)		

The above facilities shall be provided on initiation of FO transport through NW 1.

4.11. Oil Spill Contingency Handling in Offshore Incidents in NW 1

As presented in Section – above, FO is the only persistent oil requiring dedicated clean up requirements in case of spillage in NW 1. Considering the response requirement in case of an offshore incident, it is proposed that IWAI shall have an administrative arrangement through MoS for availing the support from Kolkata Port Trust/Indian Coast Guard (ICG) in case of an emergency.

4.12. Project Implementation Plan

Based on the risk assessment study, disaster Management (DM) proposal the following implementation plan is proposed.

- IWAI shall ensure that the proposed disaster management plan for cargo terminals shall be implemented along with commissioning of the terminal including setting up of facilities, providing essential training and regular mock drills.
- All cargo handling terminals shall be provided with essential emergency management facilities proposed and the OSR equipment purchase could be planned on a phased manner considering the FO handling.
- The proposal towards integration of IWT related disasters with the respective DDMPs shall be submitted on due communication with SDMAs of respective States.

- IWAI shall actively coordinate with DDMAs for mainstreaming mock drill to handle IWT related disasters and remain prepared for handling emergencies. The additional provisions for the DDMAs shall be allocated from the state /central reserves on mutual interactions.
- IWAI shall ensure that the proposed ECC facilities are established at RO and HO and essential trainings are given for the personals identified as part of Incident Management Team.
- Specialised protection for Vikramshila Gangetic Dolphin Sanctuary and Kashi Turtle Sanctuary to be implemented on initiation of FO transport through the respective regions.
- For oil spill emergencies, each IWAI terminals shall be equipped with in built facilities and for offshore exigencies an administrative arrangement with KoPT and ICG shall be operationalized.

5

BEST MANAGEMENT PRACTICES

Best Management Practices (BMP) are essential prerequisites for an efficient and sustainable IWT system. BMP for transportation through waterways include different aspects related with waterways, vessels, terminals, cargo handling and storage, other users embedded in Quality Safety base. BMP of waterways have been adopted in the countries with extensive waterway system depending on the priority of the region. Countries of European Union, Myanmar are a few example. They are able to utilise the waterways efficiently by focusing on its benefits and introducing state of the art technical and managerial practices for better utilisation with improved performance. Major aims are to ease road congestion and the pollution by switching to greener transport modes away from residential areas.

NW 1 is a multi-user inland waterway where several development activities are underway at different planning and execution levels for enhancing the cargo transport and other uses of the waterway. Therefore, it is essential to initiate implementation of BMP for IWT in NW 1. This is more so in the backdrop of highly diverse uses and environmental sensitivity of the waterway, land use and socio-economic environment of the banks. Adoption of best practices will lead to achieve responsible IWT operations.

At present, the other countries extensively utilised for inland waterway navigation other than India are the North America, Europe, China, Thailand and Bangladesh.

- North America – Missouri- Mississippi and Inter Coastal Traffic in the Great Lake, which together accounts for over 630 million tonnes of cargo movement per annum.
- Europe – The Rivers Rhine and Danube are the major modes of transportation through European Union (EU). It is estimated that at around 7 % of the total freight traffic is supposed to be carried by the IWT operations. The modal share in EU by ton-kilometre percentages are 48 %.
- China - IWT accounts for almost 10 % of the total freight tonnage carried in the country and of the two- third is carried on the Yangtze river including the bulk commodities like coal, steel, cement, containers and LPG.

- Thailand - IWT operations are having around 20 million tons of cargo handling annually, representing 4.5 % of the total inland cargo volume.
- Bangladesh – IWT accounts for 14 percentage of countries annual passenger volume and 35 % of its annual freight volume.

After considering the peculiarities of NW 1 stress areas for implementing BMPs are identified as below:

- Waterway
- Vessels
- Operator/Tenant
- Terminals & Supporting Infrastructure Facilities
- Navigation & Traffic Management Systems
- Management of Dredged Material
- Environmental Protection & Sustainability
- Quality & Safety
- Administration
- Competing Uses
- Emergency Response
- Technology and Innovations
- Training
- Casualties and incidents

5.1. Waterway

- Giving more attention to hot spots area and critical sections like curves, sensitive banks, critical structures, high siltation area, high eroding banks etc. Check out the possibility of reducing the risk elements so that hotspots will be brought to critical sections and critical sections to non-critical sections.
- Identify parking, repair and halting areas along the waterway. Identify zones based on type of user and make arrangements for multiple user.
- Ensure proper visibility of signage at place throughout the waterway and provide additional signage were ever required for E.g. demarcation of channel diversions, accident prone areas etc.

- Provide appropriate fender to all bridges and all other cross structures.
- Provide lighting in areas with curvature, low width etc. to support night navigation through the waterway.
- Impose speed restrictions, no turning etc. to prevent accidents at hotspot and critical sections.
- Erosion control measures in the banks should be provided by planting erosion resisting plants.
- Monitoring of Waterways to avoid dumping of municipal and industrial solid waste with the help of local people.
- Removal of wrecks and other obstructions from time to time impeding navigation.

5.2. Vessels

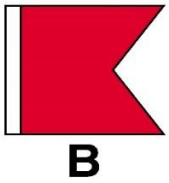
- Each Inland water vessel will have a unique identification number indicating its important features and its area of operation,
- Ensure Global Positioning System (GPS) and Automatic Identification System (AIS) facilities in each vessel.
- Barges having separate ballast and product tanks, as well as vapour return and efficient stripping facilities according to the latest technical standards are preferred so that not only will it minimise product residues by eliminating the need for cleaning and degassing, it will reduce the number of personnel along the supply chain who handle products thus allowing for greater levels of training.
- All the vessels should have on board all Life Saving Appliances, Light and Sound Signals and Fire Fighting Appliances required as per the Rules and regulations.
- Official log book shall be maintained at each vessel and any occurrence should be entered without fail.
- Double-hulled barges with diamond shaped tanks will help to minimise product residues.
- Barges equipped with deep well pumps or equivalents are preferred for self-priming purpose and for minimising pollution due to leakages.
- Efficient line draining should be available on the barge as recommended in the International Safety Guide for Inland Navigation Tank-barges and Terminals (ISGINTT guide.).
- Use of barges with a slop tanks for carrying loading residues should be ensured for better waste management.

- Barges with low-emission sampling points are preferred ideally by having a closed sampling system to avoid spillages as recommended in the ISGINTT.
- Use of Barge Trucks (Barges combined together with Push Boats) to utilise smaller waterways or to navigate smaller section of waterways and lock gates. This is feasible in the case of Dry & Liquid Cargo. They also help to modal shift in smaller waterways.
- Integrating Particulate Matter reduction and removal of noxious gases mechanisms such as selected catalytic reduction to the vessel. Use of low sulphur fuels.
- Implementing flow meters in fuel tank to determine the rate of fuel consumption so that real time monitoring is possible,
- Propeller shafts equipped with cutter to shred the entangling debris.
- Ensuring VHF Communication between Vessels.
- Implement Oil Filtration devices on bilge pumps.

5.3. Operator

- Checking vessel safety standards periodically and ensure proper operation and maintenance. Periodically check for the leakage of fuel storage facility. Quality of welding should be checked regularly.
- Training, appraisal and development schemes to be integrated as a part of Human Resource Development with specific orientation to current technology, regulation, disaster management, first aid, emergency response, interdepartmental operation and equipment usage. This will increase confidence and morale.
- Plan the activities and get together for enhancing interpersonal relationship and for developing a team culture among crew of different age, culture and experience.
- Training on the usage of appropriate Personal Protective Equipment (PPE) and Personal Flotation Devices (PFD) or Life Preservers are to be ensured.
- Appointing experienced vessel managers to make voyage efficient, safer, greener as well as economical.
- At least one employee of the vessel should have proficiency in regional language.
- Keep waste segregated and stored inside the vessel instead of throwing into waterway. They shall be transmitted to waste disposal facility on the land from time to time.
- Avoid overloading of cargo.
- MSDS of cargo carried shall be made available at each vessel
- All vessels should bare the International Flag B for marking that it is carrying a hazardous cargo and in night shall display all round red lights as shown in **Figure 5.1.**

Use of dedicated barges especially for the movement of hazardous cargo shipments will minimize product residues by eliminating the need for cleaning and degassing especially for liquid cargo.



International Alphabet Flag B

All Round Red Signal

Figure 5.1. Signages for HAZCHEM Vessel

- Every mechanically propelled inland vessel carrying goods of dangerous or hazardous nature shall be fitted with a spark arrester in all the ventilators and air pipes of the compartments carrying dangerous goods.
- Emergency information panel should be legible and conspicuously displayed on each side of the Upper Deck. Such panel shall contain details of cargo with label, contact details of emergency services, consigner and experts. All writing should be legible.
- Master of mechanically propelled inland vessel engaged in carriage of dangerous or hazardous goods shall, on the occurrence of an accident involving any dangerous or hazardous goods transported by his mechanically propelled inland vessel, report forthwith to the nearest IWAI office (RO/Sub unit), notify and report to the Administration and also inform the owner of the goods carriage or the transporter regarding the accident.
- Company and the master of the vessel shall be responsible for compliance with the applicable provisions of the Regulations and for management of the vessel so as to achieve safety in operations and protection of the environment.

5.4. Cargo

5.4.1. Dry Bulk Storage and Handling

- All the cargo are to be stored in closed ware house facilities to the possible extent, this will prevent the issues of ground water contamination and generation of dust particles.
- Warehouse should have impermeable surface, and there should be a dedicated storm water drain, which shall be routed through an ETP on requirement basis.

- In case of open storage, heaps shall be made steep to minimize the percolation pollution load and also, if possible a temporary barrier shall be kept in the most prominent direction to prevent the spillages.

5.4.2. Non-Bulk Chemical Storage and Handling

- Locate outdoor storage areas on impervious surfaces with no storm drains and within berms low enough to permit equipment access but capable of containing spills/releases;
- Outdoor storage areas can be constructed with a slightly sloping surface to a dead-end sump to collect precipitation. Sump pumps should be manually operated. Collected precipitation should be closely examined and tested, if necessary, to ensure there is no contamination from the contents of stored drums. if no contamination is observed or analyzed, collected precipitation can be pumped to the storm water collection system; If contamination is suspected or analyzed, the collected precipitation should be pumped to a drum or other container and managed as a hazardous waste
- For outdoor storage areas for containers of petroleum product, pumping the precipitation through an oil-water separator will then allow the water portion to be discharged to the storm water collection system [Note: oil-water separators will not remove chemical pollutants from water].
- Locate long-term storage areas under cover and within a secondary containment structure capable of holding the contents of the largest container plus at least 10 percent of its volume;
- Erect barriers at the perimeter of storage areas to prevent vehicle collisions, but that will permit access by loading/unloading equipment;
- Frequently inspect equipment used to unload/load containers off/on vessels, trains and trucks;
- Employees handling chemical containers should ensure labels, placards and other identification affixed to containers is not removed or defaced;
- Segregate chemicals and chemical products by compatibility; store flammables in a separate area and usually, per local codes, at a greater distance from the property line;
- Do not dispense product from containers in the storage area - - this should not be necessary or permitted for cargo in transit.
- Store drums upright (bungs-up), not horizontally, to prevent leaks from improperly closed or poorly fitted bungs and possible movement (rolling) on the storage area surface or from a horizontal storage rack;

- Forklifts equipped with drum grapplers should be used to move individual drums;
- Pallets of drums should be moved only when the drums are securely banded together;
- Move single drums only with a drum dolly, never roll drums on their side or bottom edge;
- Locate over pack drums (usually 80 gallons) with spill response equipment into which leaking drums can be placed and their contents contained.
- Other cargo handling structures such as restrict double-stacking plastic totes.
- Forklift drivers need to employ caution in lifting and moving totes and be particularly observant of the location and configuration of the top fill portal and (on some totes) a discharge valve near the bottom;
- Frequently inspect tote storage areas for leaking valves (if totes are equipped with these.

5.4.3. Liquid (Flammable/ Toxic Cargo) Bulk Storage and Transfer

- No leaky tank or container shall be used for transportation of HAZCHEM.
- Filled barrels and drums should be loaded with their bung upwards.
- No vessel shall carry the petroleum if passengers or any combustible cargo is present on board.
- Smoking, matchsticks, lighters or other fire inducing appliances should be strictly prohibited during loading/unloading and while transportation.
- Loading/unloading of petroleum after sunset shall be prohibited unless adequate lighting and firefighting facilities with trained personnel are available.
- Petroleum in bulk shall be necessarily carried in a vessel which is licensed for the stated purpose and stored in the standardised mandated manner approved by the licensing authority in water transportation.
- It should not be transported in a barge or flat-bottomed boat unless it is self-propelled or is in tow of, or attended by a steamer or tug and carries fire extinguishers.
- After complete discharge of petroleum from the vessel, its holds, tanks and bilges shall be rendered free from inflammable vapour.
- Gas free certificates for dock entry, man entry and hot work by the appointed officers are obligatory.
- Handling facilities in all cases shall be approved by the Terminal/Vessel Manager along with Terminal Safety Office rafter evaluating the various safety reports.
- Use of naked lights, fire or smoking on board in vessel are prohibited.

- Fire-extinguishing appliances should always be kept ready
- Prepare a spill prevention and emergency response plan for the facility and all storage/transfer operations and submit it to the federal and/or state/provincial environmental regulatory authority for approval;
- Provide initial and follow-up training to employees responsible for facility operations and for emergency spill response;
- Locate spill clean-up materials and equipment in known and convenient locations
- Ensure that the loading/unloading area drains to a catchment basin or other similar containment structure; the capacity of the containment structure must be equivalent to the largest compartment of a tank car or truck loaded/unloaded;
- Ensure that secondary containment holds the volume of the largest storage container plus sufficient freeboard for precipitation;
- Regularly inspect fixed and mobile tanks, transfer equipment and piping for drip marks, tank discoloration, puddles of leaked liquid, puddles of water with a sheen (indicating petroleum product), corrosion, localized dead vegetation and stains on the ground, leaks/seepage from valves and seals, deformities (e.g., bulges, cracks, bends) in pipes and tanks.
- Regularly inspect secondary containment structures for cracks, discoloration, corrosion, erosion (of inside walls and outside perimeter), valve leaks, loose mortar, sealer, sizing or grouting used to construct walls, presence of leaked or spilled material within the containment area, debris within the containment area and the operational status of drainage valves [closed] regularly inspect and test liquid level sensing devices and audible alarms on each storage tank to ensure proper operation.
- Periodically conduct integrity testing of above ground storage tanks and leak testing of valves and piping;
- Inspect and record inspection results of storm water released from any drainage system in the bulk tank storage area directly to waterways;
- Regularly inspect and test liquid level sensing devices and audible alarms on each storage tank to ensure proper operation;
- Inspect valves that permit the outward flow of tank or secondary containment contents to ensure that they will remain closed when not operating;
- Inspect starter controls for pumps within secondary containment to ensure that they will remain locked in off position when not operating;

- Inspect loading/unloading connections of pipelines to ensure that they are securely capped or blank flanged when not in service;
- Inspect valves and valve operation, piping, flange joints, expansion joints, valve glands, catch pans, pipeline supports and metal surfaces;
- Use physical barriers, warning signs, wheel chocks or vehicle brake interlock systems to prevent tank cars/trucks from departing before complete disconnection of transfer lines;
- Inspect drains and outlets on tank cars/trucks prior to filling and departure and tighten, adjust or replace as necessary;
- Use pans or containers to catch drips/spills when making or breaking connections with hoses, nozzles or other transfer equipment;
- Ensure that buried piping has protective wrapping or coating and is catholically protected or otherwise meets corrosion protection requirements;
- Install and maintain vapor recovery systems for product transfer to bulk tanks;
- Ensure that transfers are supervised by facility employees who are thoroughly familiar with normal and emergency operations procedures.

5.4.4. Gaseous Flammable/ Toxic Cargo

- No portion of the cylinder carrying gaseous HAZCHEM should project from the vessel and there should be no other flammable or corrosive articles in it.
- These cylinders need to be prevented from falling, rough handling, excessive shocks or local stresses.
- No lifting magnet shall be used in loading or unloading of filled cylinders.
- No person shall transport any leaky cylinder. In case of a leak during transport the same shall be removed to an isolated open place away from any source of ignition.
- Cylinders containing flammable gases should not be transported along with cylinders containing other type of compressed gas.
- Toxic or corrosive gas cylinders shall not be transported along with food-stuffs.

5.4.5. Loading & Unloading of Cargo

- Safety data sheet for each material should be available at the terminal as well as in each vessel and should be available before loading the cargo.
- Loading& Unloading operations should be carried out according to the Standard Operating Procedures (SOP).

- For liquid cargo, the loading lines are to be emptied into product tanks to avoid emissions or spillages. The loading location should be able to handle barge vapour residues. Closed loading systems are preferred, i.e. vapour return facilities, incineration or vapour absorbing systems should be considered.
- Sampling after loading of vessel's tank should be executed with lowest emission possible, ideally via a closed sampling system.
- When the previous cargo was incompatible, then the barge should be presented clean, dry and odourless and at atmospheric pressure. Any necessary cleaning should not result in a release of the substances in to the water. Contaminated water must be treated according to the regulations.
- Barges should either to be connected to a vapour return line of the land tank in to which the product is to be discharged or land tank to be connected to an off-gas handling system i.e. vapour return facilities, incineration or vapour absorbing system.
- Unloading facilities should always be provided with installations to use the efficient stripping system of barges to ensure that product tanks can be ensured liquid free.
- Arrangements for facilitating the draining of the barge's tanks can comprise of suction by a terminal's pump, Discharge by a barge's pump (stripping pump) and Purged by inert gas or air through a stripping line.
- When draining is complete, and before hoses or arms are disconnected, the barge's manifold valves and shore valves should be closed and the drain cocks at the barge's manifold should be opened to drain into fixed drain tanks or portable drip trays.
- Cargo manifolds and marine arms or hoses should be securely blanked off after being disconnected. The contents of portable or fixed drip trays should be transferred to a slop tank or other safe receptacle ashore.

5.4.6. Cargo Handling Equipment and Rail/Truck Operations

- Clean Fuel: change to advanced clean diesel fuel, such as low or ultra-low sulfur diesel (LSD) (ULSD), emulsified diesel, bio-diesel, compressed natural gas, liquefied natural gas, liquefied petroleum gas (propane, which requires a dedicated engine);
- Retrofit with essential equipments such as diesel particulate filters, oxidation catalysts, closed crankcase ventilation, selective catalytic reduction, lean NOx catalyst, exhaust gas recirculation, idle reduction devices;
- Rebuild and properly maintain engines;

- Replace an older engine with a newer, cleaner engine, especially one that can use alternative fuels and/or has been manufactured to stricter on-road emission standards;
- Replace older vehicles or machines with one built to stricter emissions standards;
- Investigate the feasibility of using hydraulic hybrid vehicles as replacements for diesel engine equipment.
- Conduct an emissions inventory to quantify air quality impacts of the current operations and assess potential impacts of port expansion and/or growth in port activities;
- Implement an anti-idling policy and distribute information to tenants and transportation providers about idle reduction technologies;
- Implement an educational program for tenants to inform them of strategies and options for reducing diesel emissions;
- Include incentives for emissions reduction in leases and contracts with tenants, contractors and transportation service providers;
- Expand operating hours to reduce truck queuing, idling and traffic congestion;

5.4.7. Hazardous Wastes

- Designate a permanent storage facility constructed and operated per regulatory requirements, including - covered area with impervious base and secondary containment;
- Signage designating Hazardous Waste Storage and restricting entry by unauthorized persons;
- Sufficient space to allow the segregation of non-compatible wastes and to permit movement of persons within the facility;
- Use of containers that are compatible with their waste contents; ensuring that containers are closed, except when adding waste;
- Required fire, emergency, communication and security measures implemented;
- Locate drums for the collection of hazardous waste in the operations areas
- where the waste is generated (satellite accumulation areas, per U.S. EPA regulations; drums must be moved to the permanent storage facility within three days of being filled);

5.4.8. Non-hazardous Waste

- Locate waste collection areas on impervious surfaces with a bermed perimeter;
- use covered dumpsters or roll-offs as the primary waste collection receptacles;

- Conduct a waste minimization study, to include alternatives to current practices for reducing the number and volume of wastes generated;
- Conduct a reduce/recycle/reuse (waste minimization) study to identify sources of current waste streams and alternatives to disposal; include a perimeter (and beyond) survey of trash to identify its origins;
- Place marked waste containers at locations convenient to visitors, truck operators, employees and vessels;
- Cover and berm trash collection areas and containers (e.g., roll-offs, barrels) to avoid dispersion by wind and storm water;
- Ensure that waste from vessel is received and managed properly;
- Publish a Used Materials Exchange for distribution to tenants and lessees advertising used materials that potentially could be re-used at another facility.

5.5 Navigation &Traffic Management

- Usage of Water Traffic Management System (WTMS) which will interface the voyage data and channel data to develop a geo-referenced data and helps in data analysis, interpretation and decision making.
- For IWAI, WTMS would serve as information system to optimize personnel at terminal, locks, and to provide higher safety due to traffic surveillance with exact vessel positions. This would reduce accidents and ensure quick and easy access to information to provide best possible help.
- The above communication infrastructure needs to be developed to provide better operating condition by ensuring safe and efficient traffic flow and the protection of the riverian environment.
- Implementation of Vessel Traffic Management System (VTMS), which is always a part of WTMS with Automated Identification System (AIS). AIS shall be at all RIS station and the informations collected at the stations need to be transmitted to IWAI terminals, regional office and sub offices. The collected informations need to be shared with district authorities from the nearest office. Electronic Navigational Chart (ENC) display with supporting facilities such as Radar, GPS etc. and integration with GPS facility of the vessel shall be providedat the RIS station.

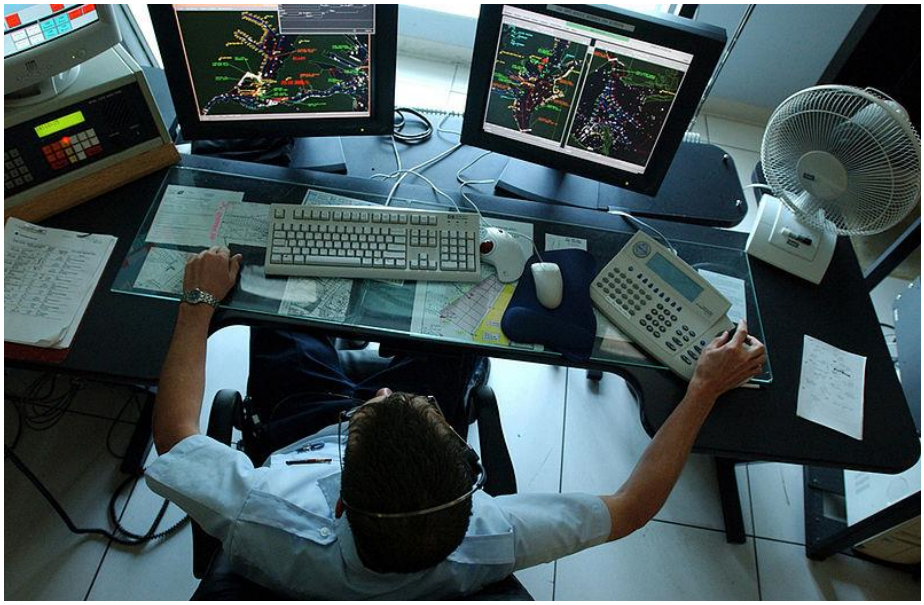


Figure 5.2. Traffic Control System

5.6. Management of dredged material

- To prevent or limit the impacts from dredged materials, many national and international conventions have been developed. One component of the LC-DMAF (London Convention- Dredged Material Assessment Framework) is the conduct of a thorough Environmental Impact Assessment (EIA) to identify potential effects of a given dredging project prior to its execution and to reduce uncertainty about the scales of those impacts.
- PIANC has published, in close co-operation with the World Dredging Association (WODA) and International Association of Dredging Companies (IADC), a number of valuable reports about the environmentally sound handling and management of dredged material (see http://www.pianc-aipcn.org/ and Bray 2008).
- Based on this knowledge, the most recent PIANC reports Dredging Management Practices for the Environment – A Structured Selection Approach' (PIANC, 2008b) and 'Dredged Material as a Resource – Options and Constraints' (PIANC, 2008c) provide up-to-date guidance and a number of recommendations including the benefits of relocating dredged material into aquatic systems, and of monitoring to minimize uncertainty about the interaction between dredged material and its receiving environment.
- A clear trend is to develop a better understanding of the sediment quantity and quality dynamics on a river basin scale and to set up sediment management plans for each single river.

5.7. Environmental Protection &Sustainability

An Environmental Management System should be in place for the IWT as a whole and for various departments as a part of BMP. This system shall be in accordance with prevailing environmental laws and rules along with statutory regulations such as Water Act, Air Act, etc.,

- 'Polluter Pay' principle should be adopted and channelize fund to protect important ecological areas such as notified sanctuary along the waterway.
- Prevent waterway activities that will create environmental problems such as scour damage, changes to the riverine regime.
- Promote habitat creation/enhancement at degraded areas.
- Declaration of valuable waterway sections as zero pollution areas, associate with NGOs & local people for achieving it.
- Prevention harmful emissions such as CO2, NOx and PM during activities related to IWT.

5.8. Quality & Safety

- Dedicated Quality, Health, Safety & Environment (QHSE) officers shall be appointed to consider the matters related to quality and safety at all terminals
- Quality manual should be made and followed for vessel operation by owner/operator of the vessel.
- Formal training schemes for improving the quality awareness of the employees especially in the operation side of IWT.
- Nurture a "no accusation / blame" culture while discussing matters in the areas of Quality &Safety among the employees.
- Use integrated Quality & Safety solution typically comprising of complete on board-onshore reporting for all findings and incidents, structured descriptions, conditions, root cause analysis functionality, fleet-wide action tracking etc. which shall be reviewed in a joint meeting of administrator & operators and proper corrective actions are to be taken.

5.9. Administration

- Focus on investment plans. Authority may invest for lands near Terminals and facilitate industries to invest on handling and storage facilities
- Develop Terminals-Establish CCTV Camera for Terminals. Ensure regular maintenance of Terminals, Vessels and allied facilities

- Provision of pilotage facilities for River-Sea vessels entering the waterway may be extended.
- Interact with prospective clients for inviting traffic to NW 1 and identify new Origin-Destination (O-D) Pairs. Organise O-D pairs to improve the channel performance. Schedule the vessel movements to avoid haphazard operation and reduce the probability of accident.
- Intimate with lock gate operators on timing of passing.
- Discuss with National Highway authorities for arriving at mutually amicable solutions in the expansion/development plans. Negotiate with responsible authorities for dismantling old bridges posing threat.
- Implementation of risk abatement and management measures with coordination of district authorities and ensuring that the disaster management mechanisms are familiar and would effectively function in case of an emergency.
- Provide Green Certification to less polluting vessels and provide fee exemptions for limited periods for them.
- Contracts for various outsourced operations are to be provided and extended on performance base.
- Registered users of inland waterways must be informed by the authorities on the day to day matters of waterway relevant to them which may include details related to fairway, traffic, restriction etc.
- To provide Information Centre that will be providing information, advice and directions regarding vessel movements, timing etc. to users other interested personals. This will be very useful for new users. The users shall be also possible to deliver their grievance at this number.
- Interactive Data bases which are accessible to the public through internet can be developed.
- Conduct a public survey to understand their needs related to NW1. Concerns of Transit & Residential communities in and around NW1 shall be passed on to the respective departments/agencies/organization on identification.
- Improving public awareness regarding various aspects of IWT through seminars/workshops and other media. This will attract more support and involvement of the public.

- Conduct awareness classes and exhibitions on the waterway its importance and potential. Invite entries on Innovative ideas from academic/ research institutions.
- Improvement of existing jetties along NW 1.
- Provide loading and unloading facilities that does not require any land acquisition. Ro-Ro services can be effectively utilized for shorter distances of IWT operation.
- Testing of the dredged material to identify the presence of undesirable elements.
- Safe disposal of dredged material according to safe disposal plans.
- Discussing with industries on prohibition of discharge of untreated effluent into the waterway.
- Planning with local self-governments on diversion of municipal sewage from the waterway.
- Introduction of private sector management for the IWT systems or a part there of in the initial stage. Implement project management agency to review the efficiency of implementation of project.

5.10. Competing Uses

- Scheduling of cargo movements by fixing time for channel crossing for other vessels like Ro-Ro ferries, Passenger ferries, Cargo ferries etc.
- Fixing of low speed areas, no parking areas in high traffic areas after having discussion with respective authorities.
- Determine the peak hours for high and medium traffic areas based on activities like tourism, port activities, passenger crossings etc.
- Patrolling/Sudden inspection in high risk areas
- Estimation of carriage capacity & augmentation planning
- Marking Buffer Zones between waterway & multiuser areas.
- Low speed zones near moored vessels, fixed objects, swimmers, anglers etc.
- Recommend control on issue of permit in areas already having high traffic density

5.11. Emergency Response

- Implement SOPs for responding to emergency
- Promote joint mock drill of different agencies
- Provide temporary diversions from spill scene

5.12. Technology &Innovations

- Efficiency improving measures such as Eco-speed coating on the hull to reduce the viscous resistance. Z-drive counter-rotating propeller systems
- Energy-efficient and environmentally friendly systems such as Diesel electric propulsion.

5.13. Training

- Purchase of Navigation Simulators for trainees and students which will be highly useful in navigating inland waterways which is much more restricted compared to open sea it will be helpful in safe manoeuvring, crossing etc.

5.14. Casualties and Incidents

- In the event of a casualty or incident involving the vessel resulting in loss of life or the vessel being materially damaged, stranded, abandoned or lost, the master or the Company shall inform the Administration immediately. If it is not possible to inform the Administration directly, information on the casualty or incident shall be provided to the nearest surveyor, registrar of vessels, police officer or harbour master, who shall immediately notify the Administration.
- In the case of the death or disappearance of any person on or from the vessel the information notified to the Administration shall include at least:
- the date, time and location of the accident or occurrence;
- the name of each person that died or disappeared;
- the identification number and name of the vessel; and
- the name and address of the Company.
- The Company shall submit a report to the Administration when as a result of a casualty or incident that involves the vessel or its equipment:
- a person dies;
- a person is injured and requires medical treatment beyond first aid;
- a person disappears from a vessel in circumstances that indicate probable death or injury; or damage occurs to the vessel or other property.
- The report required shall be made:
- within 48 hours of the casualty or incident if a person dies within 24 hours of the occurrence, requires medical treatment beyond first aid or disappears from a vessel; or within 10 days of the occurrence

- The report required shall be in writing, dated and signed on completion by the person or persons that prepared it. The administration should conduct an investigation into any occurrence meeting the criteria specified.

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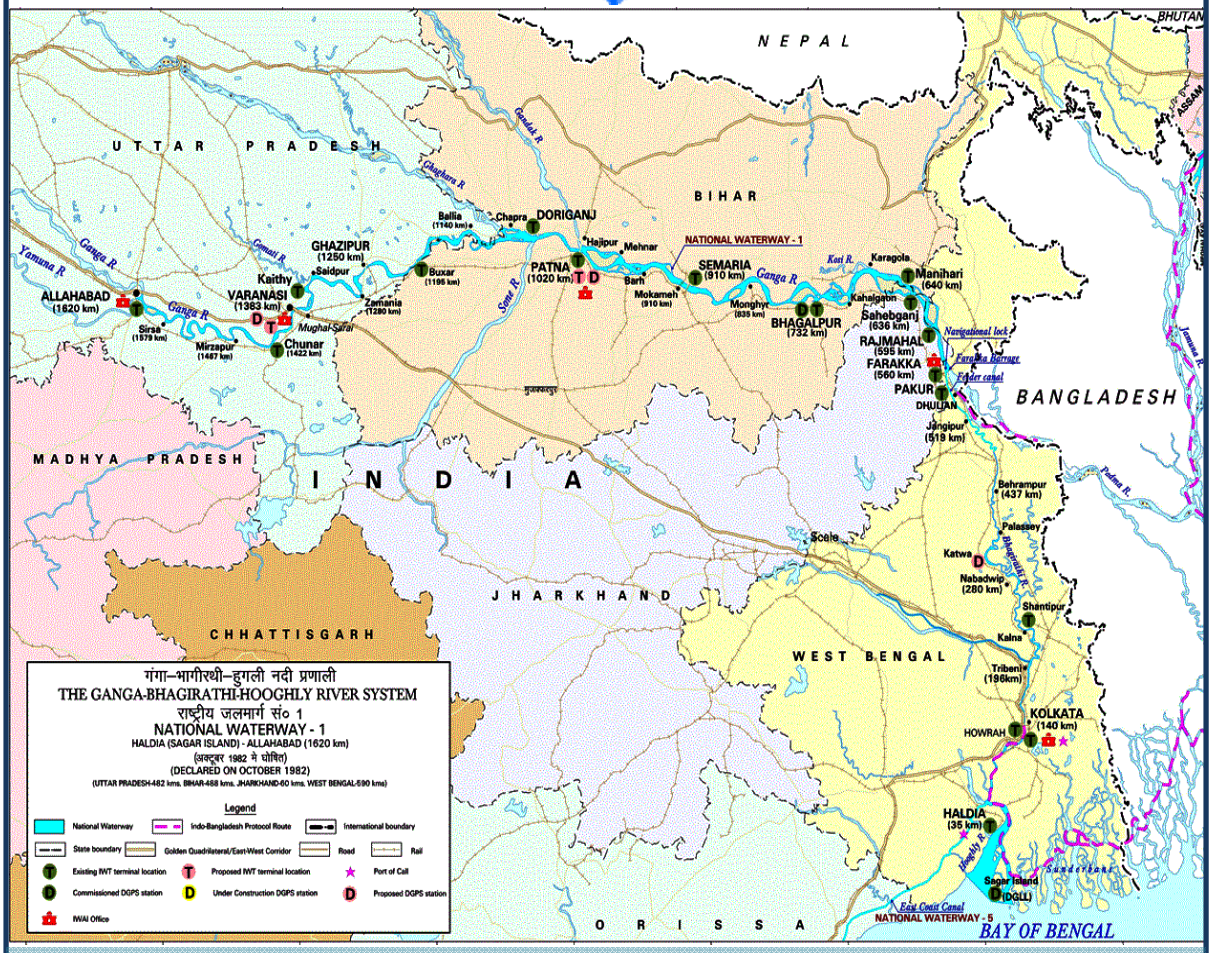
INLAND WATERWAYS AUTHORITY OF INDIA



Consulting Services for Risk Assessment and Disaster Management Plan for National Waterway-1 (River Ganga)

Final Report
Volume II - Annexures, SOPs and Protocols

KITCO
the consultants

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LIST OF ANNEXURES

ANNEXURE I - DETAILED DESCRIPTION OF WATERWAY

The entire stretch of waterway extending from Allhabad to Haldia has been described in detail by deviding in to the various sections as presented below.

1.1. Allahabad (km 1454) - Varanasi (km 1350)

Allahabad – Varanasi section of NW 1 starts at km 1454 at IWAI Floating Jetty close to the New Naini Bridge, which is accessible from the banks near the Minto Park. Allahabad city occupies on the LHS and Naini Town is located on the RHS; both banks are at present connected by multiple bridges. Here the banks on the LHS are part of a Cantonment area, there are a number Ghats in the location associated with the temples in the immediate banks on the LHS. This area is having great religious and historical importance. The banks are having natural embankment and the river is accessible from the main road through a flight of steps. Small recreational boats could be seen in the locality moving parallel to the banks between Saraswathi Ghat close to Mankamaheswar Temple to Sangam Prayag on the LHS at Allahabad.

New Naini Bridge between km 1454 to km 1452

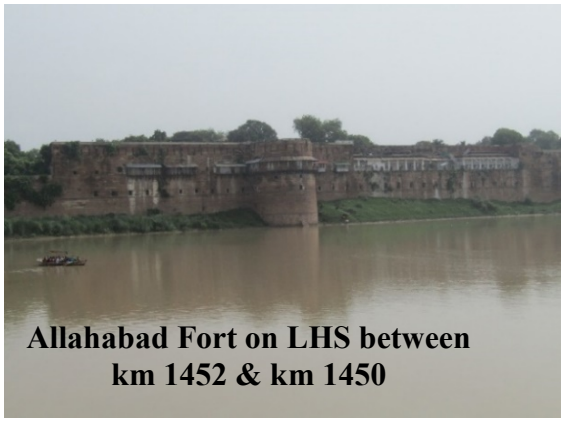
As mentioned earlier, between km 1454 to km 1452, New Naini bridge runs North - South across the Yamuna river which form part of NH 27 connecting Allahabad and Naini. This is also known as Shyama Prasad Mukherjee Bridge and is a cable-stayed bridge. The bridge was constructed by the end of 2004 with the aim of minimizing the traffic over the Old Naini Bridge, upstream. This location is just before the confluence of Yamuna river with Ganga. The IWAI has floating jetty at km 1454 on LHS abutting the boundary of Minto Park. Very close to the Jetty, on the LHS, further landward is Sankat Mochan Hanuman Temple, which is frequented by the devotees.

IWAI Floating Jetty on LHS at km 1454

Mankamaheswar Temple on LHS at km 1454

LHS is a thickly populated area, which also features public places, including the landmark of the area Allahabad Fort. Hathi Gate Fort, Mankamaheswar temple, serial Ghats including Saraswathi Ghat are the other important features along LHS.

Saraswathi Ghat on LHS

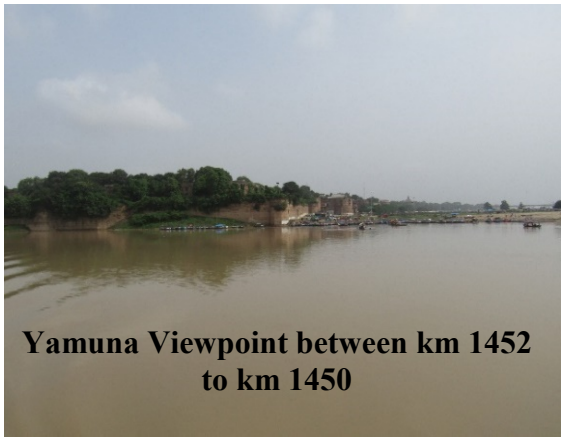


Allahabad Fort on LHS between km 1452 & km 1450

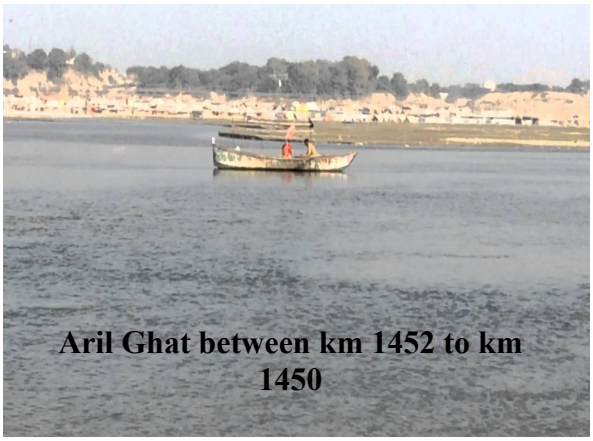
Soon after the Allahabad Fort, there comes the Sangam Prayag area, which are the vast shoal areas at the confluence of Yamuna River with Ganga at km 1450. As per the Hindu holy scripts,

this is the location of Triveni Sangam, where three holy rivers, Ganga, Yamuna and mythical Saraswathi merges. It is the most prominent mass gathering location during Kumbhamela. This is also, one among the important locations of holy bathing, which is considered highly auspicious especially during the lunar month of Shravan.

At km 1450, one important ferry terminal is located near Yamuna viewpoint on the LHS, which is also the Western boundary of Sangam Prayag area. A large number of vessels could be seen parked there; from this point, there are parallel ferry operations to locations like Saraswathy Ghat on the LHS and also ferry operation occurs connecting the Ghats in the opposite to it including Arail Ghat especially during pilgrim season. This is a high traffic area, even during off –season.



Yamuna Viewpoint between km 1452 to km 1450



Aril Ghat between km 1452 to km 1450

Satellite imageries during the pilgrim season and off-season as presented below highlights the extant of the mass gathering in the sand bars of Prayag.

Banks of Prayag during Off Season

Banks of Prayag During Pilgrim

The stretch is wide and the area is having heavy traffic due to pilgrim boats and Ghats are located in the Sangam Prayag in the LHS. As per the RNA, 2008, km 1519.0 marks the starting point of National Waterway 1, officially at the Daraganj - Jhusi Rail bridge which is located at around 2 km upstream of the Prayag towards north in River Ganga. The site visit for present

study in this stretch was started at IWT floating jetty, near Minto Park in the LHS and it was taken as the starting chainage which is around 2 km upstream of Prayag towards West in Yamuna River. Thus, this coincides with the official starting point of the chainage of NW1 at Allahabad.

Triveni Sangam Prayag @ km 1452 during Kumbhamela (File Pic)

RHS area just opposite to the Triveni Sangam is the Naini area. This is one among the thickly populated area along the banks of Ganga, having residential, commercial and institutional buildings. However, they are far and not readily visible from the banks since the waterway is having more than 600 m width along this stretch. The immediate banks are vegetated, and there is a watch tower and a water tank visible. Here both the banks are accessible.

At the confluence, in the RHS opposite to the Prayag area, there is Arail Ghat connecting Prayag with the Naini area located towards the RHS. Naini area is a residential area. Mahesh Yogi Ashram as well as Someshwar Mahadev Temple is located in the RHS, further downstream km 1450. Further moving downstream, there are vegetated areas, which are populated. RHS close to km 1448 also has unprotected vegetated steep banks and cattle were resting on bank, and this is village area of Mawaiya Lawan.

Vegetated Bank Close of Aril Ghat in Naini Area between km 1452 to km 1450

Further, downstream, the waterway takes a turning and there are two tower line crossings between km 1450 to km 1446. Both of them are having multiple towers within riverine section, however, they are having sufficient vertical and horizontal clearances.. Between km 1450 to km 1446, the channel is moving very close to RHS, here the bank is having slopped embankments. Along the RHS, there are flat plains, which are cattle grazing areas and shoals exists on both LHS & RHS.

Both the banks are accessible and eddy formation could be seen here. Close to km 1446, both LHS and RHS are occupied by shoal formations, and the channel shifts towards LHS. There is a Nallah entering the river from the LHS at this chainage. From km 1446 to km 1444, the

channel is running along the center and both banks are shoal-forming areas, which are not accessible.

Small flocks of birds could be seen in this area. Between km 1444 to km 1442, small huts of Lavain Kalan villages could be seen along RHS on the natural vertical banks. On the LHS, there are unoccupied vegetated flood plains. These are also eddy-forming areas. There are small fishing boats in the area and small settlements on the RHS.

Settlements of Lawayan Kalan @ km 1444

This area is followed by another small settlement area of Lawayan Khurd, between km 1442 to km 1440 on the RHS. Also, there exists an industrial area known as Bishambharpur at km 1440 on the RHS. Important factories operating in the area are Indian Petrochemicals Limited and Universal Tyre Factory. Also, institutions like United Institute of Pharmacy and United Institute of Management are functioning here. The channel is very close to RHS and the location is having good accessibility.

At this chainage a land parcel in the adjoining the industrial area have been identified for proposed Allahabad terminal, with provisions for training hydrographers. Opposite to this location are Char areas on LHS. They have been utilized for agriculture and are grazing lands for cattle, horse and camel.

Fishing Vessels near Lawayan Kalan

Proposed Terminal Location along RHS near Bishambarpur @ km 1440

Bird Flocking Location @ km 1438 on LHS

Close to km 1438 along the RHS, there is village location of Chandi, where the banks are accessible through roads. The area has sloping vegetated banks and this is a bird flocking area. The corresponding location on LHS has thick vegetation and is unoccupied. Babul trees are dominating the area and are mainly utilized as grazing lands. During the course through km 1436, the alignment is central, both the banks are grazing areas. LHS has more or less the nature of Char. Similar pattern continues till km 1432 and small traditional vessels could be seen on the RHS. Approaching km 1432, there are vertical eroding banks along RHS.

Vertical Eroding Banks @ km 1432 on RHS

Between km 1432 to km 1430, there are extensive grazing areas surrounding the settlements. Diha village is present on RHS, which is accessible and here, the alignment is close to the RHS. The village has traditional Ghats, with small boats moored. Further down until km 1426, the river section is becoming wider and the alignment shifts to center. Chars occupy both LHS and RHS, they are important bird flocking areas. They are more or less sandy in nature and covered with grasses. The banks are unoccupied.

Traditional Ghats on Diha Village @ km 1432 on RHS

Further, from km 1426 to km 1424, the river is wide and the channel shifts to LHS. Here, the banks on the LHS are vertical and is undergoing erosion. On RHS is grass grown sandy areas, with boats parked near km 1424. At km 1422 on the LHS, the location is known as the Nauka Char, i.e., a boat shaped Char. In general, this stretch is having extensive eddy formations. Between km 1422 to km 1420, there are grazing lands of the Dumduma on both LHS and RHS. Bayaria Nallah enters from LHS close to km 1420. The section here is wide and the channel is close to LHS. Pontoon bridges are erected connecting Duma Duma on LHS and Babura on RHS between km 1422 to km 1420.

At km 1420, along the RHS, the banks are sloping and currently utilized as grazing lands. There is a Ghat on LHS near the premises of scattered settlements of Duma Duma. RHS has unoccupied grazing lands. At km 1419, the stretch is wide and the alignment is towards the LHS and is occupied by vegetated white sand chars, which are not easily accessible. Behind these chars are the villages of Rasulpur. The banks here are occupied by Babool trees and are widely used for grazing. Vertical eroding banks are present on RHS.

Burning Ghats @ km 1419 in Rasulpur

Between km 1418 to km 1416, wider section continues where the channel is aligned towards RHS. Features here are similar to the previous chainages. Around km 1416, Tons (Tamas) river is joining Ganga from RHS. Downstream the river entering area, at km 1416, on the RHS is the settlement of Sisra. Small and open type fishing boats are operating close to white sand shoal areas on the LHS. On the RHS, there are grazing lands, which are vegetated and sloping.

There is a ferry crossing near km 1416, connecting Sisra and Rasulpur. Close to km 1414 settlements of the town could be seen on the RHS and there are boats parked in the Ghats here.

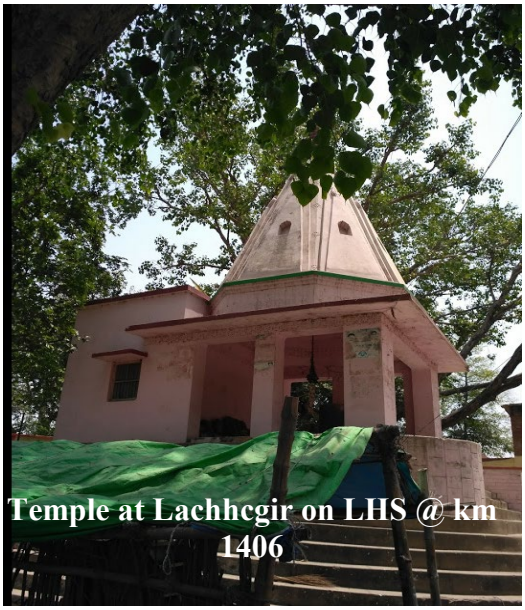
Tons River Joining between km 1448 to1416 on RHS

The immediate downstream is a pontoon bridge location and is also a ferry area. Here, LHS is occupied by white sand mud flats of Chars. On the RHS, there are cremation Ghats and boat parking areas. Fishing nets are also present at this section.

At km 1414, river is narrow and LHS is a sand covered area, with grass-grown shoals. These are unoccupied banks. Along the RHS, there is an intake well, which is under construction for NTPC Power Plant. This area is occupied by covered country boats used for fishing. Sparse water hyacinth shoots could be seen spread along the stretch. Between km 1414 to km 1408, the watercourse is wide and channel running along center. RHS is having small-scattered settlements. As moving further downstream, between km 1414 to km 1412, Bijaura village area is present on the RHS and on the LHS are grasslands, which are bird flocking areas. Fishing nets are present in watercourse here.

The fairway between km 1412 to 1410 is a less wide stretch, where the alignment is moving along LHS. There are a number of bathing Ghats on the LHS where as there is a floating pumping station on RHS, close to the settlement area. This is an important ferry crossing location between Indravar on the LHS and Dubepur on the RHS. Also, two ferries are operating close between km 1412 and 1410. There is a tower line crossing in this location, with towers erected on the banks with sufficient clearance. From km 1410 to km 1404 is a wider section,

where the alignment is along the center. There are grazing lands on gently sloping banks on either side, while there are scattered settlements of Barhauli on the LHS. Between km 1408 to km 1406, there is a tower line crossing with single tower within the watercourse having sufficient clearances. In addition, there are remnants of collapsed tower lines projecting immediate downstream. At km 1406, there are settlements of Kandala Mavaia and Lachhagir on the LHS are sloping vegetated banks. There is an important temple location near Lachhagir, which commemorate the historical counterpart with same name at this chainage. Close to the banks on the LHS, country boats could be seen and there exists sand dumping yard with Ghats.



Temple at Lachhcgir on LHS @ km 1406

km 1408 to km 1406 - Collapsed Tower line

On the RHS, there occupy shoal like features and also vegetated sloping banks, which are grazing lands. Till km 1400, the section is wide and aligned central. At km 1400, there is the pumping station for the Gyanpur Lift Irrigation Canal on the LHS. Further, downstream, there are settlements of Khemanpur village on LHS, there is also a floating pumping station on the RHS.

Between km 1400 to km 1398, there are vegetated sloping banks on either side. The section is wide and the alignment of channel is towards the LHS. Tela Khas Village is located on LHS, which is a ferry crossing location, connecting the village with Madara Mukundpur on RHS at this chainage. This is also a pontoon bridge location during the lean season. RHS is having vegetated banks with gentle slope. Between km 1398 to km 1396 is Parva Uparhar village area, which is an important fishing area where numerous fishing vessels could be seen close to RHS. This is also an important bird flocking area. The channel here is central, stretch is narrow, and both the banks are having villages and settlements.

Pumping Station of Gyanpur Lift Irrigation Canal on LHS km 1400

From km 1396 to km 1392, the waterway is wide and the alignment shifts to RHS. These stretches are generally accessible from both LHS and RHS, if the hindrance posed by the chars are neglected. Both banks are having scattered settlements of the villages viz., Dhuki Ka Pura, Arar and Parwa on the RHS, while Doguna and Bhatgawan on LHS. Close to km 1396, there are temples and houses on vertical banks. LHS is generally less occupied vegetated slopes in Char areas on which fishing vessels were seen berthed. At km 1394, a Nallah is entering from the RHS. Close to km 1392, there are shoal-forming areas fishing could be seen towards the LHS. Vertical banks on the RHS are having erosion and also, there are cremation grounds of Jera village. Small fishing boats were halted in the LHS, close to the shoal areas. At km 1390, there are vertical banks showing erosion in the RHS of Achhola Kachar while LHS continues to have more or less similar pattern of previous chainage and belongs to Bahapura village.

Further downstream, till km 1384, the river has a wide section with RHS alignment, extended chars followed by grazing areas were seen on the LHS. At km 1388 at Umanpur, there is a floating pumping station, fishing vessels and Ghats in the RHS. Till km 1384, the channel moves close to RHS and at km 1382, the channel is having transition to central alignment.

There is a floating pumping station that fetch water to Railways at km 1384, in the RHS near Chaka Kaun. There is a pontoon bridge location connecting Hari Rampur Thari and Mahewa Khurd at this chainage. This is also a ferry location. In addition, there are fishing vessels plying in the area. This is followed by a wide stretch from km 1382 onwards where the channel shifts to center and soon it swings to LHS.

Between km 1380 to km 1376, the river takes a large smooth curve and the water body is very wide at this section. LHS is occupied by settlements of Checchuwa on the high vertical banks and there are low-lying grazing lands along RHS; where sheep flocking could be seen. Fishing boats are plying in the area. There two water pumping station on the RHS, between km 1380 to km 1376. Between km 1376 to km 1370 is an extensive shoal forming area, here the channel is moving close to LHS. There exists vegetated banks on the LHS and water pumping station on the vertical banks of RHS. Further, towards km 1368, the channel enters a narrow section, where both banks are occupied, with immediate banks vegetated. There is a ferry operating between Dig on LHS and Khaira on RHS. Lav – Kush, Inter College, Sithamarhi, an educational institution is located on the LHS is an important landmark close to km 1364. Sithamarhi is a pilgrim location connected with the historical figure Sita of Ramayana. There are small temples and Ghats on the LHS. Both banks are having vegetated banks which are utilized for grazing.

Sitamarhi Temple on LHS at km 1364

Between km 1362 to km 1358, a wider section of waterway exists with channel aligned close to LHS. Here, the LHS is occupied by vertical banks with vegetated grass, whereas the RHS has vegetated sandy mudflats. LHS and RHS are settlement areas, LHS is mainly the Gajadhapur area and the RHS has the villages of Ajaipatti, Haswar and Jagdishpur. Past these settlement areas, the banks are vertical and eroding. Small fishing vessels were berthed in the traditional Ghats.

Between km 1362 to km 1360, fishing boats were occupying the area adjoining the sandy areas of RHS. Vegetated vertical banks and a temple could be seen on the LHS. These are buffalo grazing areas and on immediate downstream white sandy Char areas exist. RHS is gently sloping areas used for grazing. Further, downstream between km 1360 to km1358 was a fishing boat halting area. Between km 1358 to km 1348, the river is very wide with the channel aligned close to the RHS. Vegetated banks with fishing vessels occupying Ghats in the RHS. At km 1356, there is a cremation Ghat on the RHS. Close to km 1352 on the RHS, at Bijar, there is a floating pumping house on the vertical banks. On the immediate chainage downstream at km 1350, on the same side of the bank is located the Naugav pumping station. These banks are having erosion. Between km 1350 to km 1348, the channel takes a curve and is moving close to the RHS. Banks on the RHS are having settlement areas, in and around the villages of Dharampur, Nandini and Bhaidpur. LHS is having the sloping banks, further downstream the sandy banks in LHS, where fishing boats were parked. Aquatic weeds were seen at this location in the channel.

Pontoon Location @ km 1342

Further, upto km 1342, riverine section is more or less wide and is having the channel at centre. Here, both the banks are occupied and at km 1342, the channel shifts to LHS. Gulauri Tari village area in the LHS is an important sand mining area and this is also an important boat halting area. Shrubs makes the major portion of vegetation. Another important feature is the Rampur Ghat pontoon bridge connecting Amilaur Uparwar on the LHS and Bhaidpur on the RHS. This is an important pontoon bridge location since the premises are populated and there is no bridge location nearby.

Between km 1328 to 1336, this is an extremely wide section, here the channel alignment moves close to the RHS. This is an important siltation area marked by sand beds in the waterway of almost 2.5 km width, which get exposed during the lean period. There is a cremation ground in the LHS. Close to km 1332, the Karanavati River joins from the RHS, on the banks of which Akhori town is located. Corresponding location on the LHS is marked by the Majhara area, which is a vast Char area, which is utilized as agricultural areas.

Between km 1332 to km 1320, RHS hosts, thickly populated banks, of Mizarpur and its surroundings including the villages of Gopalpur, Rasulpur, Vindyachal, Ganja, Narghat. On RHS, the Ojhala Nallah enters the major river course. The Vindyachal railway station is located within 800 m from the bank on RHS. Birlapur Guest house and Jaipura Guest house is located close to it. After km 1326, up to km 1322, the channel shifts to the LHS, which is the location of the thickly populated village, Mawaiya.

Mirzapur Town between km 1332 to 1320 on RHS

Mirzapur Bridge between km 1322 to 1324

The Mirzapur road bridge is located between km 1324 to km 1322, which connects the Puran Bada in the LHS and Pakka Pul in the RHS. This is a critical bride having very low vertical

clearance i.e., only 2.5 m. This is also a ferry crossing location. Between km 1332 to km 1316, a narrow stretch exists where the channel is having central alignment; there are settlements on the RHS. There is a pumping station close to km 1316 on the RHS. From km 1316 to km 1310, the section becomes wider and is having central alignment. Between km 1310 to 1308 is a narrow section, and close to km 1308, there is a tower line crossing. Further, downstream, there are gently sloping banks on the LHS and on the RHS are thickly populated area of Jausara. At km 1298, a poonton bridge operates in lean season and its immediate downstream marks the Jausara Bridge location.

Jasura Road Bridge between km 1296 to 1298

There are two agriculture water intakes in the RHS before km 1290. There is a nallah entering the river from RHS. Between km 1288 and km 1284, three streams enter the river from the RHS namely, Belwan, Bahariya and Kathnehi. There is a pumping station between km 1284 to km 1282, close to the vegetated area of Bargwan in the RHS. Towards LHS, the corresponding location is the Ramgarh Village.

Further, between km 1282 and km 1274, the water body is relatively narrow and the alignment is close to the RHS. There are settlements in the RHS namely the villages of Bari, Saraiya, Dhahauraha and on the LHS are Bithalpur, Bhualpur, Meghupur. At km 1274, there is an

important landmark; the Chunnar Fort location, having historical and tourism importance located on the RHS. It is located on a small hillock projecting into the waterway.

Chunnar Fort @ km 1274

Towards downstream, both the banks are occupied, by shoal areas with grasses at km 1272. The stretch is extremely wide and shoal formation could be seen on either side of the channel. Between km 1272 to km 1268, there are two tower line crossings with sufficient vertical and horizontal clearances. At km 1268, the channel alignment is extremely close to the LHS and the location is the Adalpur. Near Sultanpur on the LHS, there is a floating pumping station. In the upcoming section, settlements and temples could be seen; the banks are sloping with thick vegetation. Here, on the RHS, there are vacant grassland areas. Again, at km 1264, the water body becomes narrow and passes through an area with both banks occupied by settlements. There are two-tower line crossings near km 1264 and four floating water intake locations, 2 on LHS and 2 on RHS at this chainage. The important settlements of the area are Gangapur, Chak Jhori and Sherpur on the RHS, Gosainpur, Madhopur, Muradev and Tara pur on the LHS. Jigro river enters the waterway from the RHS at km 1258. Here the channel is aligned more or less central and moves to RHS at km 1254.LHS is occupied by moderately sloping banks with thick vegetation. There are grazing areas on the RHS. Along the LHS, there are gently sloping banks

which are also a boat-halting area, close to km 1260. km 1258 marks the Muradev Ghat, this is an important bathing Ghat. Along the RHS, there are water intake points. At km 1257, there are vertical banks in the LHS; also fishing boats stationed could be seen. RHS on the other hand are gently sloping banks. Tarapur water intake location is at km 1256; this is a fishing boat area where as the RHS continues to be gently sloping vertical banks.

Between km 1255 to km 1254, the watercourse represents a wide section with channel aligned to central. There are gently sloping grass grown banks where occupies small settlements. There are vegetated vertical banks on the RHS. At km 1254, the channel shifts towards the right, close to Sherpur. There is a small irrigation pump house located here. At km 1253, the channel continues to be close to RHS. There are extensive shoals located towards the LHS; whereas on the RHS are gently sloping banks. Boats could be found moored along the RHS and also, there are cremation Ghats here. Up to km 1252, the banks are gently sloping in the LHS and vertical eroding banks in the RHS. Also, the Lift Irrigation pump house, Narayanpur, is one among the largest of the kind projects, is located at this chainage. Immediately after it enters the Lachmi Nallah.

Narayanpur Lift Irrigation Project on RHS between km 1254 to km 1252 @ Ramnagar

Between km 1251 to km 1250 the section becomes narrow and the channel becomes aligned central. At km 1250, there are thickly populated vegetated banks on the RHS; on the LHS are eroding. Fishing activities are prominent in this area. Further downstream until, km 1250, LHS is fishing areas with gently sloping banks and on the RHS are vertical eroding banks in a thickly

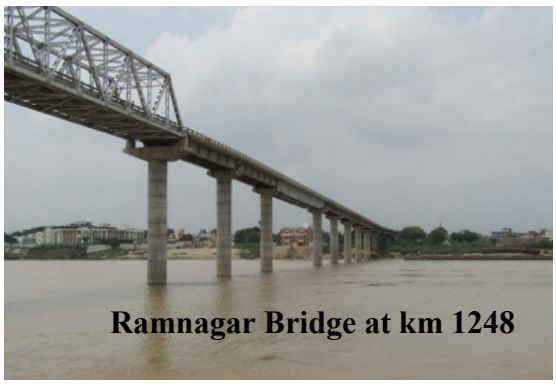
populated area, here the stretch becomes narrower and alignment remains central. The channel is approaching Varanasi Terminal Location near Ramnagar, passing the banks of Milkipur, a residential area on the outskirts of Varanasi on the RHS.

1.2. Varanasi (km 1250) - Ghazipur (1132)

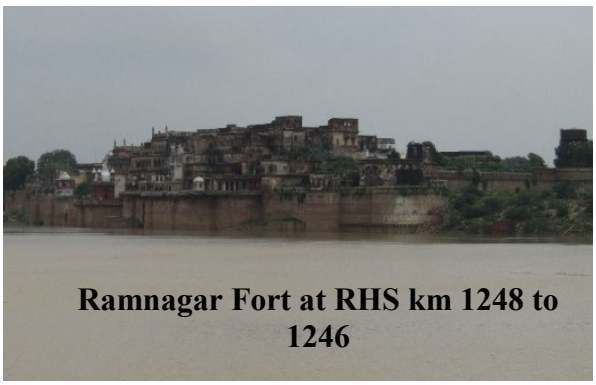
From km 1250 to km 1248, Milkipur residential area on RHS is characterized by Palm (Thal) Trees. The residential area has scattered houses with vast homesteads. This location is characterized by elevated flat plains, which are now a part of the new city of Varanasi. There is a floating pump house for lift irrigation located on the RHS and an industrial drain empties downstream to it. Also, fishing vessels were seen halted in this area. On the LHS are settlements of Derapar. Between km 1250 to km 1248, the new terminal at Ramnagar is located on the RHS, adjoining the Milkipur residential area.

Varanasi Terminal between km 1254 to km 1252 @ Ramnagar (under construction)

Past the terminal location is Ramnagar bridge at km 1248. It is a road bridge connecting Varanasi City on the LHS with Ramnagar on the RHS. The bridge is having sufficient clearances and there is a pontoon location in its immediate downstream. There is a tower line crossing at this chainage, prior to the bridge.



Ramnagar Bridge at km 1248



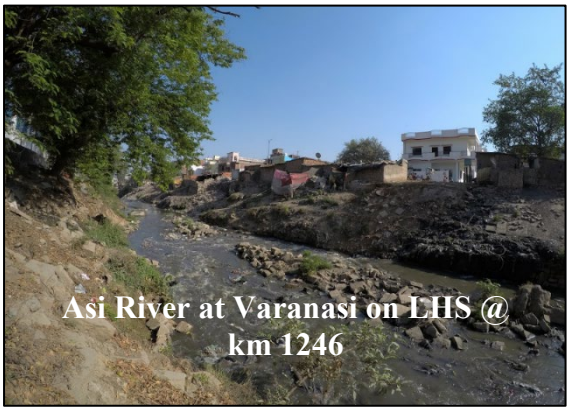
Ramnagar Fort at RHS km 1248 to 1246

Here, the LHS is occupied by Banaras Hindu University and on the RHS is Ramnagar Fort. Ramnagar fort is built abutting the banks. Old holy town of Kashi has grown from its historical limits and new city, Varanasi including its outskirts is extremely populated.

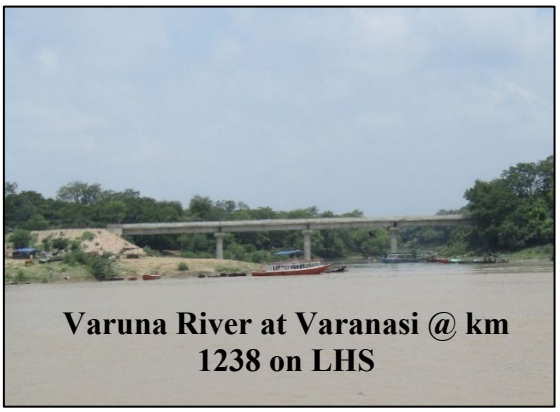
Varanasi between km 1246 to km 1240 on the LHS

Upto km 1246, the watercourse is wide and channel is running central, with thickly populated banks on the LHS. Between km 1246 to km 1240, marks the historical right hand curve of Varanasi, the land between the rivers Varuna and Asi - renowned Kashi. The LHS here is occupied by the numerous temples, Ghats and religious centers of the immortal city, which exclaimed to be the final destination of every Hindu devotee. Kila Ghat is located on RHS, adjoining to it is a residential area and fishing vessels could be seen resting here.

Banaras University on LHS between km 1248 to km 1246



Asi River at Varanasi on LHS @ km 1246



Varuna River at Varanasi @ km 1238 on LHS

Close to km 1246 on the LHS, Asi river enters at this location which marks the beginning, the southern limit of the old city of Kashi. On its banks is located the Saint Ravi Das Memorial Park and a Ghat, mainly utilized by the tourists. Near to that, there exists an important pump house location for drinking water.

The river stretch between Ramnagar bridge mentioned above and Raj Ghat bridge located downstream at km 1240, is declared as a wild life sanctuary for turtles and is known under the name, Kashi Turtle Sanctuary. Turtles are released to this stretch from the Saranath Hatchery of Varanasi. RHS here is agriculture areas. There are four important archeological sites in the area, they are Ramnagar Fort (RHS), Harish Chandra Ghat (LHS), Man Mahal Observatory (LHS) and excavated remains of erstwhile civilization, earliest dating from Sanga period by Archeological Survey of India (LHS) near Raj Ghat. These are sensitive locations.

Old NH Rail Road Bridge, RajGhat at km 1240

Here stretch is very wide and the channel is LHS is aligned and hosts, various Ghats and are thickly populated area with a number of multistoried buildings, mainly with religious background. RHS has gently sloping vegetated banks. At km 1240 to km1238, the watercourse is wide and channel along central. The Raj Ghat occupies on the LHS, which is a thickly vegetated area. Also, there enters the Shahi Nallah at this location from LHS. This is also the location of old NH Rail Road Bridge; this is the second among the two critical bridge and has only 6.5 m vertical clearance. Towards the RHS, there is Aghora Ashram and also both the banks here are thickly populated areas. At km 1238, the channel is aligned along LHS and this chainage marks the entry of the Varuna River, the Northern limit of old city. There are a number of Ghats in the locality towards RHS. Between km 1238 to km 1234, there are three tower line-crossings and all of them are having sufficient clearances. LHS is the location of Bhahadurpur and fishing vessels were seen halted on the banks. Gently sloping banks with vegetation occupy the RHS. At km 1234, the section is wide and aligned central. There are fishing vessels parked in the location. Here, both LHS and RHS are having vegetated banks. Also, there is a pumping station close to the RHS.

Between km 1232 to km 1230, the banks are generally unoccupied, the sections are wide and channel along center. Grass grown flat sloping areas present along the LHS were fishing vessels are berthed and there are gently sloping scouring areas on RHS. Similar situation is occurring

between km 1230 and km 1228; there are more shoal areas on the LHS. There is one Amul factory on the RHS close to km 1226. Pump house of Lift Irrigation scheme of Bhoupali is present at km 1224 on the RHS.

Bhopauli Lift Irrigation Pumphouse @ km 1228

From km 1224 to km 1216, scattered settlements are present on the banks. The section here is wide and central. The downstream sections are continuations of shoal areas on the LHS. Along the RHS, there are important settlements of Mahuwari Khurd, Bisspur and Sasari. Fishing vessels could be seen close to this area. The channel slowly shifts to RHS. Banks are gently sloping; generally in these prominent fishing areas. RHS has vertical eroding banks at few locations. Approaching km 1216, there are settlements on both the sides of the bank. There are shoal areas on the LHS, which are prominent fish areas, scouring is also prominent in this stretch.

At km 1216, Balua bridge connects Sasual in the LHS and Balua in the RHS. This bridge is having sufficient vertical and horizontal clearances. Immediate downstream of the bridge is a cremation Ghat on the RHS. Fishing vessels are berthed close to the gently sloping banks. This is a pontoon bridge location and there is a floating water intake close to the Ghats in the downstream.

Balua Road Bridge between km 1214 to km 1216

Cremation Ghat on RHS

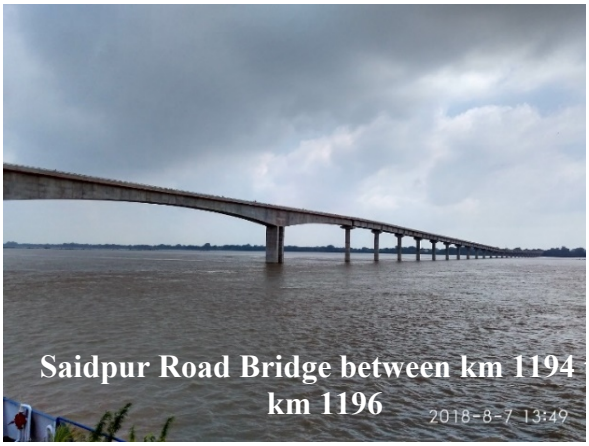
Between km 1216 to km 1210, the channel is central and the section becomes wider. Towards the RHS, there are settlements of Dehrawan Khurd and Mahuri Kalan. While proceeding further towards km 1210 to km 1206, the riverine section becomes extremely wide and both the banks are unoccupied shoal areas. At km 1208, the channel is very close to the bank and is a thickly populated area of Chandrawat village. On the RHS, there are shoal-forming areas. The section narrow downs between km 1206 to km 1202, where the width comes to around 400 m and it moves close to the LHS.

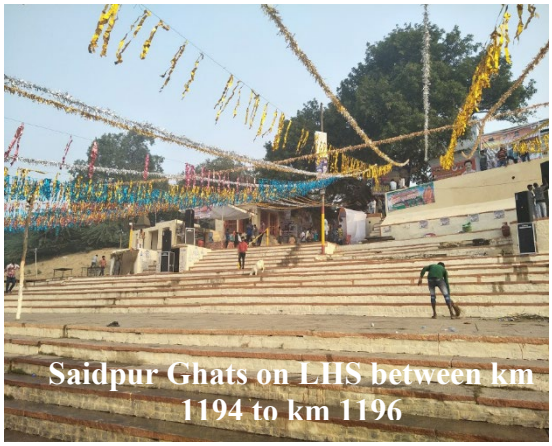
At km 1208, LHS is occupied by floating pump house. There are settlements in this area and km 1206 marks the end of a wide stretch, with centrally aligned channel; the LHS here is occupied by Gauri Shanker Mahadev Temple. RHS has shoal forming unoccupied areas. There is another water intake location present in the LHS at km 1205; this section is wide and have central channel, here, the LHS is accessible by road. On the RHS are unoccupied areas. Wider section continues along km 1203, with almost central alignment for the channel, with vegetated banks without erosion on either side. This is an important location due to the presence of boats and ferry crossing, connecting Tanda Kalan on RHS and Kaithi on LHS. The famous tourist place, at Markandeya Temple, which is visited by Bhol - Bhum pilgrims during the month of Shrawan is located here on the LHS. There have been a kind of tourist activities like boating in connection with the during the time of site visit.

Gomati River Confluence at km 1202

The stretch along km 1202 is a wide river close to LHS. LHS at this chainage marks the confluence of Gomati River. This is also an important fishing area. From km 1200 to km 1196, the watercourse becomes wider by nature and channel exists close to LHS. Gently sloping banks with settlements surrounded by grazing lands exists along the LHS. Shoal areas are present in the RHS. At km 1198 on the LHS are gently sloping grasslands. This is an important dolphin frequenting area. Fishing vessels were also seen in this area. LHS is Gopalpur area and there are settlements, temples and Ghats on the vertical banks. On the RHS, there are vegetated gently sloping banks.

Very wide sections are present between km 1196 to km 1192, fairway is aligned close to LHS. There is a pumping station for irrigation water supply to Shekpur area at this location. There are settlement and cremation ground also at this location. Further downstream, channel is aligned to LHS, this is a very wide section of river and it approaches Saidpur bridge connecting Saidpur on LHS and Hasanpur on RHS. LHS is a thickly populated area. Fishing vessels were seen in the shoal forming areas here.





At km 1192, the channel shifts to RHS. Between km 1192 to km 1182, the watercourse is less wide and both banks are unoccupied and also, channel is centrally aligned till km 1184, which further shifts to RHS. Close to km 1184, LHS is Chakeri settlements occupied by Government Girls Inter College. Fishing by poles were seen on the gently sloping banks. There is a curve between km 1182 to km 1180 with extensive shoal formations. Here, the RHS has unoccupied vertical banks, while there are vegetated shoal areas with grasses on the LHS. The section is very wide and close to RHS. A similar pattern continues further 4 km downstream. Close to the RHS, there exists Naughara settlement areas and fishing vessels were seen halted here. There is a floating pumping station close to km 1180.

Kasthurba Gandhi College at Chakeri Upraw on LHS at km 1184

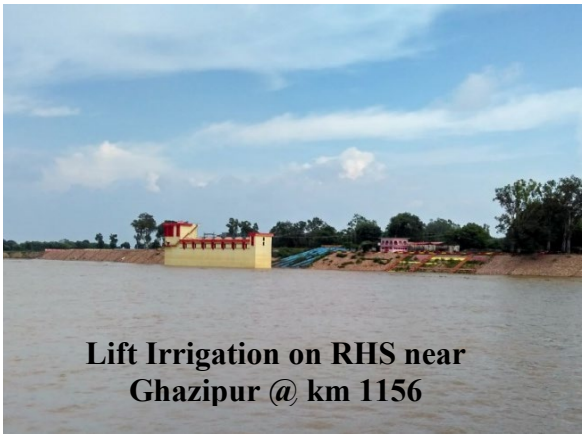
An extremely wide river stretch marks between km 1184 to km 1178, where alignment is very close to RHS, there are scouring areas close to LHS. Thickly vegetated banks occupy on the

RHS. At km 1178 to km 1176, the river stretch is very wide with central aligned channel. There are vacant unoccupied land with grazing on the LHS, this is a fishing vessel occupied area. Along km 1174 to km 1170, the riverine section is narrow with channel aligned to LHS, both sides has gently sloping vegetated banks. Settlements of Chandipur is present at km 1172 in the LHS, with accessibility. There are gently sloping unoccupied banks in the RHS.

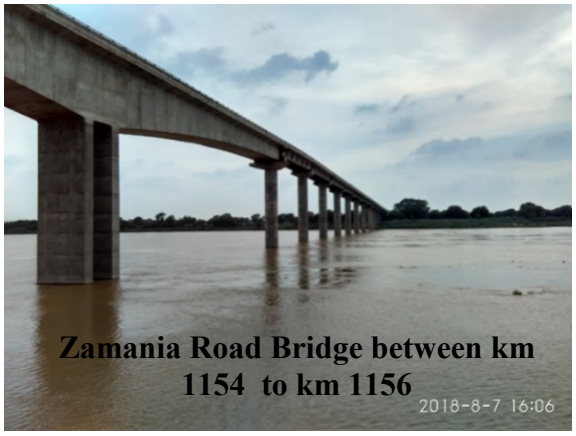
Past km 1172 until km1170, river has a narrow stretch, where fairway is centrally aligned, Chochakpur area occupies in the LHS, with temple and Ghat and there are gently sloping banks on the RHS. This is a pontoon bridge location as well as a ferry crossing area, There is a pumping station on the LHS and Barwa Nallah location on the RHS between km 1172 to km 1170. Wider stretch continues and channel is aligned close to RHS. This is a fishing vessel operating area and a tower line crossing location.

From km 1170 to km 1160, the section is wide with channel aligned to RHS. LHS is mainly shoal forming area. Thickly vegetated vertical banks without erosion occupy the chainage from km 1170 to 1168. From km 1168, the section is moderately wide and alignment runs close to RHS. Shallow area close to Shalara Char was seen on the LHS and Kaulpara region in the RHS. There is a sand dumping yard at km 1168 along RHS. At km 1164, the features are similar. However, there are pump house, vegetated vertical banks and small settlements on the RHS. Along km 1162, water body is wide, aligned to RHS, with unoccupied banks, gently sloping banks in the LHS and vertical banks in the RHS.

From km 1160 to km 1158, the stretch is wide and the channel is close to RHS. Between km 1160 to km 1158, RHS represents the settlements of Majhui village. There is a small ferry operating here. On the RHS, there are sand mining and fishing areas. There are eroding sections near km 1158 on the RHS and Laumi Nallah enters the area and a Lift Irrigation is located beside km 1156. Both the banks are vegetated. At km 1154, there are brick kiln on the RHS as continuation to the settlement.



Lift Irrigation on RHS near Ghazipur @ km 1156



Zamania Road Bridge between km 1154 to km 1156

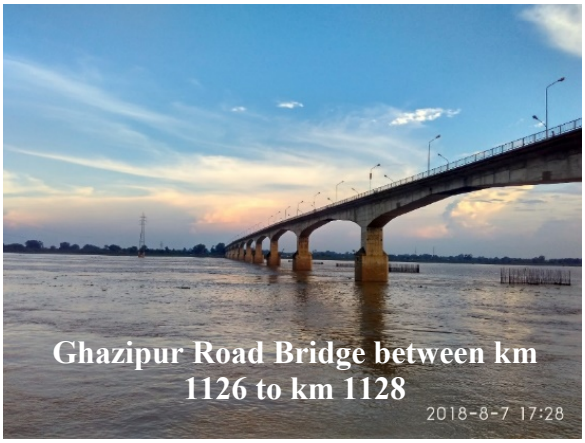
Between km 1156 to km 1154, the water body is wide and channel is aligned to RHS. LHS is gentle sloped banks, which are unoccupied. These are sheep grazing areas. Along RHS, settlements of Badesar is located. River protection works were observed in the area. At km 1152, Zamania bridge connecting Dharampur in the LHS and Zamania in the RHS is located. There are settlements in thickly populated areas on both the banks and they are vegetated too. Thal trees are occupying the banks.

The channel is wide and the alignment is close to the LHS. LHS is vegetated unoccupied bank; RHS is also unoccupied. This is a pontoon bridge location and also a ferry exists here. Towards km 1150, in the LHS, there are settlements of Katharia where sugar cane farms are present. At km 1148, there is a floating pump house in the LHS and close to this location is Saranpur area, river protection works are done with rubble pitching in the settlement areas near km 1148. Thickly vegetated banks occupy the RHS.

Between km 1146 to km 1140, riverine section is wide and channel aligned to LHS along km 1143, channel shits to centre where as LHS is shoal area. On the RHS, there are eroding islands. Along km 1142, riverine section is very wide and the channel is aligned to RHS. Both LHS and RHS are occupied with eroding banks. There are Ghats in RHS. Between km 1140 to km 1138, the stretch is very wide and channel is aligned along the centre; these areas are experiencing severe scouring. RHS has eroding banks. At km 1138, the channel shifts to LHS, Gangi River enter from LHS at this chainage. Along km 1135, riverine section is wide, with channel aligned close to LHS. A nala is entering from LHS. Along km 1134 a wide section marks the river with alignment along LHS with both banks occupied. Baikunthpur occupies the LHS and Bhagirathpur occupies the RHS. The channel approaches the banks of Ghazipur.

1.3. Ghazipur (km 1132) - Patna (km 969)

From km 1134 to km 1128, the riverine section is wide and channel along center. LHS is the urban locality of Ghazipur and RHS are its villages. This is a very thickly populated area. km 1130 marks an opium factory. This is also an important boat-plying area. This is a wide stretch and channel is aligned along LHS. Ghats occupy the area, important among them is the Collector Ghat. Also, there is a river gauge station located in the LHS. Close to km 1128, Ghazipur bridge connecting Ghazipur in the LHS and Medinipur in the RHS is located. On its immediate upstream, adjoining to it, there is a bridge under construction. This is the only multiple bridge location in the Allahabad – Munger stretch. Bridges are having sufficient clearances. This is also a tower line crossing location. This tower line is critical, since they are having sagging High Tension lines. An accident is reported to have averted, here in which the boat appendage had hit the tower line during 2002.



Source: IWAI

There are temples and Ghats on the LHS between km 1127 to km 1126. Here the section is wide and the channel left aligned. Sloping banks with vegetation occupy both LHS and RHS. Dolphin was sited at the location and km 1123 has a farmland area on the LHS. The location for the land earmarked for the Ghazipur terminal is located on the LHS. Here, the stretch is very wide and close to LHS, with vertical eroding unoccupied banks, which are grasslands on the LHS and there are sand chars with grasses on the RHS. At km 1119 to km 1116, the river is very wide channel close to LHS. Vegetated banks, which are farmlands, occupy the LHS.

Proposed Terminal Location at km 1122 in Ghazipur

Moving towards km 1116 is a critical location, due to low width and the channel is very close to the LHS. The thickly populated settlement of Sultanpur area occupy the LHS with Ghats, temple etc. At km 1115, the water body becomes very wide and central both the banks are unoccupied. The sandy banks are exposed on the LHS. At km 1114, two-ferry crossings are seen side by side between km 1112 to km 1111, the water body is very wide and channel aligned to center, there is sheep grazing areas in the RHS. Between km 1116 to km 1112, the river is very wide and channel shifts from LHS to central. RHS is shoal forming areas and grass grown sand areas. A pontoon bridge is located at km 1112 connecting Mohamadabad in the LHS and Rampur on the RHS which are thickly populated area. On the immediate banks are located the Hariharpur at km 1110 on the LHS.

Downstream of km 1110, LHS is settlements of Semera, which are villages with bank protection. At km 1106, the section is wide and channel along central. LHS has vertical unoccupied banks. RHS has grassland like areas, which are also unoccupied. Till km 1100, the river is very wide and continues to be central and is very wide. Gently sloping unoccupied banks are present along both RHS and LHS, which are mainly agricultural fields. At km 1100, the stretch is very wide, with channel aligned to RHS, LHS is in general eroding banks. These are thickly populated area of Ghamar and Ghats and recreational areas are present in the RHS and these banks are eroding. LHS is occupied by grazing lands, at km 1098 there are flooded

chars, with thickly grown grasses and are unoccupied. Also there is a water intake location in the RHS close to the Ghamar settlements. LHS has vertical unoccupied banks.

Between km 1096 to km 1092, the channel is centrally aligned in wide river. Gently sloping banks runs in LHS and vertical vegetated banks occupy the RHS. At km 1096, Barh town marks the RHS, where settlements and sheep grazing are visible along the vertical eroding banks. This is ferry crossing location. RHS close to km 1095 is Barh; where settlements, Ghats, temples, multi-storeyed buildings occupies the bank. This is a less wide stretch.

On the LHS is settlement of Birpur, which has multi-storeyed buildings surrounded by grazing lands. At km 1094, there is a floating water intake; Ghats and temple on the LHS, and grazing land are present in the RHS.

Karamnasa River Joining Ganga on RHS @ km 1093

At Km 1093, the channel is aligned central and the stretch is wide. On the right bank at this chainage, Karamanasa River joins Ganga. RHS is Narbatpur settlement area. There are gently sloping banks on the LHS. On the RHS is Chausa pump house, on protected banks. There is a ferry crossing just upstream of km 1088.

Chausa Pump House on RHS @ km 1092

At km 1088, there is a very narrow section with channel aligned to central. Palia area is located in the LHS, Misharvallia village is located on the RHS. At km 1088, there are gently sloping unoccupied banks with vegetation in the LHS. Vertical banks are slightly eroding on the RHS. These are prominent fishing areas. Here the river is wide and alignment is central. Settlements of Loharpur, is located downstream of km 1088 in the LHS. There is a ferry as well as a tower line crossing at this location. Until km 1084, the section is wide and channel is aligned central. Settlements occupy both the banks, which are vegetated. LHS is Narainpur area and bank shows erosion. RHS is Lachhmipur. There are fishing boats plying in the area. At km 1084, a Nallah is entering the river from LHS.

Between, km 1084 to km 1080, the river is comparatively less wide and centrally aligned. At km 1080, both the banks are thickly populated and on the LHS is Buxar town with a well-developed riverfront. There is a jail in the RHS and also numerous public buildings and places. This is also an important ferry crossing location connecting, Ujair in the LHS and Buxar on the RHS. There is a floating water intake on the LHS, close to this chainage. Also, there are settlement areas, there are fishing boats halted between km 1080 to km 1078 on the LHS. At the corresponding chainages, there are burning Ghats on the RHS.

Highly Eroding Banks on LHS near Ghazhipur @ km 1067

Buxar Bridge connecting Barhauli and Buxar is located at km 1078. At km 1078 to km 1076, the riverine section becomes wider and central. There is a tower line crossing at km 1074. Towards RHS is located the Arjunpur. There are settlements in the LHS, with gently sloping banks. Close to km 1073, there are settlements on the RHS. River is very wide at km 1072, and channel aligned to RHS. In the RHS, there are unoccupied gently vegetated banks. Unoccupied banks, grass-grown areas are present on RHS while there are sand Chaur areas from km 1070 to km 1068 in LHS. Banks are protected in this area using sand bags, grass like areas on the vertical non-eroding sections of the bank in the RHS. Close to km 1068, there are vegetated sloping banks. From km 1067 to km 1065, the riverine section is very wide and alignment for the channel is towards RHS. There are sandy chars in LHS, whereas settlements on the eroding bank are located in the RHS. This is a very important scouring area.

Along km 1066, river is wide with central alignment. LHS area is occupied grassy Char. RHS has unoccupied vertical eroding banks with some areas covered with vegetation at Nagapura area. Between km 1066 to km 1064, narrow river with fairway along central alignment, grassy Char in the LHS and vegetated sloping banks with settlement in the RHS. There are also fishing vessels seen halted in the area. From km 1064 to km 1062 are sandy chars on the LHS.

Vegetated sloping banks, sheep grazing areas with sand pitching occupy the RHS. At km 1064 on RHS is the location of Keshopur settlements. The section is wide and central and are sheep grazing areas. From km 1064 to km 1056 are occupied by vast Char areas on the LHS and agricultural farmlands on the RHS close to Bijalpur area.

Between km 1056 and km 1054, LHS is occupied by the Ballia town and two rivers, Chotti Saju Nadi and Katha Nadi are entering into Ganga at these chainages from LHS. At km 1054, there is an important ferry location. At km 1047, there are settlement areas of Kanspur in the LHS; vessels can been seen halted. On the RHS is the area under the name Brigu ashram. There are vegetated grassland in the RHS. Ballia Bridge connecting Haralal Chapra and Chapra is nearing completion at km 1046. The RHS is highly eroding banks. Just upstream of the bridge, a pontoon bridge is used to operate during the lean period.

Cable Stayed Road Bridge under Construction at Ballia @ km 1046

Downstream of the bridge, at km 1044, the section is very wide section, which has vast flood plains, with grass grown. Till km 1038, the stretch is very wide and both side are unoccupied. From km 1038 to km 1022, the river is less wide and both the banks are unoccupied. On the LHS, there are mainly the Char areas and on the RHS are agricultural lands in the flood plains.

Between km 1038 to km 1032, the section is wide and alignment close to RHS. Both the banks are unoccupied Char areas utilized as agricultural lands. At km 1032, there are settlements in the RHS and Char areas in LHS. Along km 1030, the channel is aligned to central, this is a pontoon bridge location and there are ferry services in the area. Wide central aligned section, extensive bank protection works on LHS close to km 1028. There are Char areas in RHS at this

chainage. The wider section continues between km 1028 to km 1026, where the channel is along central. LHS marks Durjanpur area, where banks are protected with settlements. Nauranga is located in the RHS. At km 1021, the stretch is wide and central aligned, there are settlements in the protected banks in LHS. At km 1020, the section is extremely wide and the channel is central. LHS is grass grown chars. Similar pattern continues till km 1018.

At km 1018, LHS is Srirampur area, the river is extremely wide and channel close to RHS and it is a pontoon bridge location. Dredging pipeline could be seen and fishing boats are halted in these area. Unoccupied vegetated banks exists near Muril Chapra. Farmlands are used for grazing. There are sandy Char in the LHS and gently sloping banks, which is followed by eroding banks. Very wide stretch with central alignment of the channel, occupied the km 1014. Sopalpur Chaur is located in the LHS. Banks are eroding in the RHS. At LHS is located Bhusola Ghat, settlement vertical banks with grass. Sloping banks occupy the RHS. Along km 1012 to km 1009 is a very wide section close to LHS. Along km 1009, there are sand unloading areas; large no. of boats, tractors on the bank to take sand in LHS. There are gently sloping banks on the RHS.

Between km 1005 to km 1003, the river is very wide and fairway is aligned towards RHS. LHS is Char areas within grasses in the initial sections. Water hyacinth was observed near km 1003. Also, there is fishing activity in the locality. Here, the RHS is very thickly populated with the buildings very close to the banks. There are sugarcane fields in gently sloping banks. The area marks high erosion with bank protection done with sand bags.

Along km 994, there exists a narrow channel with fairway close to RHS. This is Mauzampur settlement area and boat could be seen halted. At km 993, a pontoon bridge is located. Mauli Ghat area with double storied buildings occupy the RHS. River is very wide along km 991 and fairway close to RHS. Banks are flat flood plains with vertical eroding banks. Only sparse vegetation exists on the RHS. Very wide riverine section occupies km 989, vegetated banks with settlements are there on the LHS. Unoccupied flood plains present on RHS. From km 986 to km 984, is the water body is extremely wide and is having fairway aligned along RHS, as it moves from central at km 986. These banks are highly eroding at LHS. There are geo-tubes placed at km 986, to prevent bank erosion. There is Ghaghara river confluence at km 986. RHS is having unoccupied banks.

Ghaghara River joining Ganga on LHS @ km 986

Riverine section is extremely wide along km 982, and both sides are occupied by Char areas. Similarly, km 980 is also an extremely wide stretch, with RHS aligned channel. LHS is Murli Chapra area, which is very wide, second line of Ghaghara river enter from the LHS. Chainage km 976 is an extremely wide water body with channel aligned to RHS. LHS is extremely wide. RHS is Char area with eroding vertical banks. Between km 967 to km 975 is an extremely wide section with centrally aligned channel with Char areas in LHS. Char areas with sand boats are stationed at the RHS.

Between km 971 to km 974, the river is very wide and the channel is aligned on LHS. In the RHS there are Chaur areas. Between km 973 and km 972, the banks are highly eroding, some of them are utilized as grazing areas. Downstream of km 971 is also extremely wide; central aligned channel, the area is unoccupied grazing land. From km 969 to km 968, the river is very wide and channel aligned to LHS. There are farmlands and grazing lands on both banks. Villages with very small houses and grazing lands on the RHS. Ferry services can be seen at this chainage. There are fishing activities.

Cable Stayed Arrah – Charpra Road Bridge between km 968 to km 966

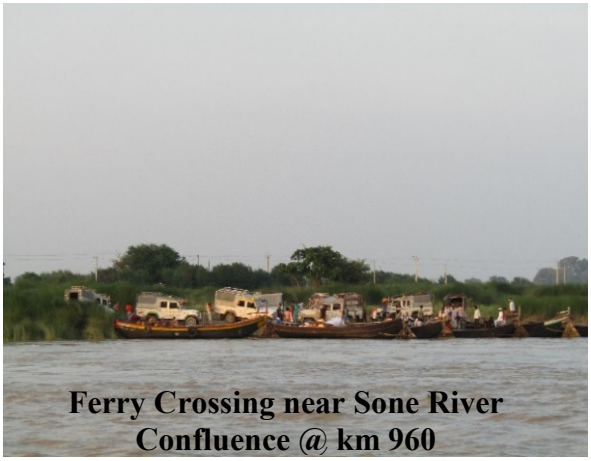
Downstream of km 967 is an extremely wide section where channel is centrally aligned. Doriganj is located in the LHS and vast grazing lands in the RHS. Along km 966, river is extremely wide with channel centrally aligned. This is a thickly populated area. Also, a bridge is connecting Chappra in the LHS and Arrah on the RHS exists in this location.

At km 965, the section is extremely wide channel, with central aligned fairway. There is a Chaur in the LHS and the area is a sand carrying boat plying area. On the RHS is located Bikari Takore ke Gav. The wider section continues till km 964. This is an important sand carrying boat plying area, this section has sand markets on the banks which extends more than 3 km. This settlement area on the LHS has multistoried buildings. Thal trees could be seen grown in and around the homestead. Close to it, small hut of workers could be seen and country trucks were seen parked. These are the important features in the LHS.

Towards the downstream of km 964 is having the maximum wider river section; LHS is Sone river confluence area. Sand transport is active in this area. This is also a ferry location. Both LHS and RHS has Char areas. Far away banks of RHS is the Maner settlement area. A similar land use pattern continues till km 960. Between km 958 to km 950, the section is very wide and alignment almost along center. From km 957 to km 955 is a high traffic section. Large no. of sand boats are plying in the area. There exists chars in LHS and there are settlement in the

area which are surrounded by vertical eroding banks in the RHS. It is the Kita Chauhattar area. Along km 950, the alignment is central. LHS in this section is Char areas. At km 952, RHS is Vyapur area - an important populated area, however located away from the banks. These areas has vertical eroding banks, there are also brick kilns. LHS is occupied by Gangahara settlements from km 948 to km 946, where the banks are vegetated. RHS is unoccupied. The river here is very wide and the alignment is towards LHS.

Between km 946 to km 942, the stretch is very wide; channel aligned very close to LHS. There are settlements, mainly huts located in the LHS. There are agricultural fields in Chars occupied in the RHS. Sand can be seen dumped at certain locations along LHS. From km 942 to km 939, in the wide stretch, channel aligned very close to LHS. There are settlements, mainly huts located in the LHS. There are agricultural fields occupied. There are agricultural areas; sand can be seen dumped at certain locations along LHS



Ferry Crossing near Sone River Confluence @ km 960

Sone River joining Ganga on RHS @ km 960

At km 938, it marks a very wide section where alignment is close to LHS. There is a sand mining Ghat on LHS, boats carrying sand have been parked in the area close Panpur area. On the RHS enters the Sone River. The RHS location in Dhanapur. There is a ferry moving in between. At km 936 marks the beginning of a very wide stretch with channel aligned towards RHS, unoccupied Char areas in the LHS and Diga bazar in the RHS. This is a thickly populated area, at the outskirts of Patna.

Digha Rail cum Road Bridge between km 934 to km 936

At km 936, the river is very wide and the channel alignment is close to RHS, the banks are protected. This is also the location of very long railway bridge; from Sonepur to Digha halt railway station of around 5.5 km length. From km 934 has sheep grazing areas on the RHS. From km 934 to km 914, wider section exist. Sand carrying boats are plying in the area, Patna City could be seen far on the RHS. Very wide chars covered with grass in the immediate RHS. At km 928, the stretch is approaching Patna area, the stretch is very wide and the channel shifts to RHS. LHS is the unoccupied Char.

1.4. Patna (km 936) – Munger (km 762)

Between km 934 to km 927, the channel moves in between the Char areas close to Patna. At km 927, there is a Ferry Ghat close to the city area in RHS, also there are other Ghats including Burning Ghats. Presently riverfront is being developed here, RHS is thickly populated. There is ferry crossing, immediate downstream close to Mahathma Gandhi Setu, connecting Patna to Minapur-between km 924 to km 922. There are unoccupied Char area in the LHS. The fairway remain close to RHS and is wider section. Close to km 922 on RHS is the Patna IWAI terminal,

there are a number of vessels parked in the stretch such as Floating Pontoon, Barges, sand boats etc. There are numerous multistoried building and small houses on the RHS.

Most of them are abutting the banks. Here the channel alignment moves close to RHS. There are a number of Ghats adjacent to the terminal location in the RHS. Of them, the important one is the Kanghan Ghat. This is also a pontoon bridge location during lean period. There are barges of Eastern Private Navigation Corporation, Calcutta moored to the banks on the LHS. Km 920 to 916, is an extremely wide section of around 4 km width. There are brick kilns far away on the RHS. Mainly both the sides are occupied by Char areas with vegetation. On the RHS, there are eroding banks. Vessels of Eastern Private Navigation Corporation was seen on the LHS, near km 915 arrived from Kolkata for various construction works. There is a tower line crossing at this location, with both the towers located on the banks. The stretch is wide and the alignment is close to LHS. Also, here there is a bridge under construction at km 914.Close to it towards the downstream is pontoon bridge location as well as a ferry crossing area. On the LHS, there are Char with settlements. Raghavpur Island is located on the LHS. On the LHS, there were large number of sand carrying boats. It has a large number of thickly populated Ghats. One important among them is the Kachi Darga Ghat, of Fatwa on the RHS.Again, km 910 is marked by thickly populated banks on the LHS and sand carrying boats halted. There is a ferry crossing at Jaidety Ghats on the RHS. There are brick kilns on the RHS. Milk is being transported from the villages on the left to Patna town on the right through ferries. This is a high traffic area.

Passenger and Commodity Ferry Crossing from Raghopur Island for Fatuha Area @ km 910

In the RHS, there are thickly populated locations; also plywood factories are occupying the banks. Km 910, the section is less wide and alignment is central. LHS is vegetated area and there is a medicine factory on the RHS. Km 908, is a very wide stretch in which the alignment is very close to RHS. There is police station on the RHS, followed by Sanshan Ghat. RHS is

thickly populated location, in a vegetated area. The banks are protected. Also, Punpun river entering at RHS at km 907, on the banks of which stands the Fatwa City on the RHS, fishing nets can be seen and the banks are thickly populated.

Punpun River Joining Ganga on RHS @ km 907

At km 906, there is a ferry crossing from Kevula Ghat from the RHS to Pir Mohamadpur on LHS. At km 904, IWAI dredger was seen moving upstream to Patna. These banks are unoccupied banks, which are vegetated and are having bank erosion in the LHS. On the RHS, there are kilns, fishing vessels parked. The RHS is occupied by Thal trees, Urdha Ghat is a ferry location here. Also, vessels could be seen moving along the bank. These areas are occupied by settlements of Phul Vadiya, Fishing nets could be seen in this area and the boats plying in this area mainly carrying sand. There is fort land marking the RHS here, but it is far away from the bank, ie. Rajamansingh's fort. RHS here are mainly farm lands. Km 902 to 900 is a very wide section, where the channel is very close to RHS. LHS is occupied by Juramanpur ferry. The banks are vegetated and on either side of them and on the RHS, there are farm lands. At km 900 the channel alignment is very close to RHS. LHS is marked by sandy Char areas. RHS are the banks are covered by grasses and are grazing lands. At km 894, there is a ferry operation and pontoon bridges are deployed here during the lean period. There are occupation on both banks. There are brick kilns occupying the RHS, the location is Lakhipur. At km 892, there is bank protection in the LHS and the area is locally known as Kalar Island and the RHS is Gyaspur.

Between km 894 to km 892 in the LHS, there are settlements, which are village areas and also used as grazing lands. There are temples on the banks. There exists, Chirayya ferry Ghat occupied by fishing vessels. In between the km 888 to km 886, the location is Bhaktyarpur in the RHS. There are farmlands in chars of Bhaktyarpur, which are also sheep grazing areas in the LHS. The stretch is becoming very wide and alignment is close to LHS. Bhaktyarpur is an area of village occupied with settlements having mostly small houses. This is also a ferry location and there are Ghats in the LHS. Here the LHS is showing bank erosion. RHS is a grass grown island area. Between the km 886 to km 884, both the banks are occupied by extensively wide grazing areas, with bank erosion. Between the km 882 to km 880, the LHS is occupied by agricultural fields of Rampur settlement in Diyaras. RHS is also having similar land use.

Veer Kunwar Singh Bridge @ km 872

At km 882, on the LHS is Rampur agricultural fields in Diyara and on the RHS there are settlements on the protected banks. These are vegetated areas, which are also utilized for grazing horses. Km 880, has a very wide stretch, with the alignment close to RHS. LHS are vegetated chars, which are also low-lying areas. There are bank protection works in the RHS, very extensive fields. From km 872 to km 878 are extremely wide stretches. Km 878 the alignment is central, Pathal Ghats are located in the LHS. The alignment of the channel is almost wide. LHS is Mohantipur area. There is a bridge close to km 872, connecting Mohantipur on LHS and Admalgola on RHS, nearing completion. This is the largest river bridge across Ganga. This is a very wide stretch. RHS is grazing lands.

Km 868 to km 870 is an extremely wide river; alignment is close to RHS, there is a tower line crossing here. There are extensive farmlands on either side at this chainage. Km 868 to 862 is also a very wide stretch, on the RHS are the settlements of Barh. From km 860 to km 862 are the section, which are extremely wide and the alignment is close to RHS. RHS is vegetated banks. NTPC, Barh could be seen from this location which is located at km 862 on the RHS. There are multistoried buildings on the banks. At km 860, IWAI vessel was observed, also Sati Ghat, were historically Sati was practiced is located in the RHS. Here temples with their walls flushed on the banks could be seen. Between km 860 and km 858, there is a tower crossing location with low vertical clearance.

Water Intake for NTPC Barh @ km 862

Km 858 to 856 is a very wide central channel, with both the banks as thickly populated. LHS is Samastipur area where as RHS is outskirts of Patna. There are chars at this chainage towards the Samastipur areas at the same time the RHS has settlements surrounded by Thal trees occupying the banks. Km 857 is a also a very wide, stretch, with channel aligned close to LHS. LHS is Chamda settlement area. There is NTPC area in the RHS. LHS is vegetated farmland with vertical eroding banks, there are small settlements. Later onwards, in the downstream section, the RHS is occupied by extensive flood plains. Km 856 to 850 is a very wide section, with Char occupying on the LHS and RHS. The channel is aligned towards LHS, the area is Madhurapur. RHS is flood plains close to Punarak town, marks the km 848.

From km 850 to km 848, the stretch is extremely wide, during the flood, however, these are silt-forming areas and during the site visit, the channel was following a shift from LHS to central. Sand carrying boats could be seen in the waterway. Between m 846 to km 844, channel

is very narrow with width around 500 m and at km 846 on RHS is the 'English' village, which is occupied by small houses and huts. These banks on the RHS are highly eroding and the boats carrying sand could be seen in this area at a large. At km 844 is Diyara Makda on the LHS and Khandapur Makda in the RHS, which are settlements close to the Town, Pundharakh. Between km 828 to 824 is Mokama area, channel is very close to the RHS. The section is very wide during the monsoon, with alternate routes possible for the vessel while which chars make the section narrow and restrict the waterway during the lean period.

From, km 842 to km 834, the waterway section is very wide and the alignment moves very close to the LHS, here the channel is showing bank erosion. During lean season, these are sand bar forming location. LHS is showing bank erosion and extensive elevated chars, are present on the LHS. RHS is occupied by vegetative banks, adjoining the villages between Mor and Sultanpur. Between km 842 to km 840, there are some farmlands in the LHS. At km 840 and 838, are the Morasdabad Urf Sadipur, in the LHS and Sultanpur on RHS. These are very vast agricultural lands in the chars. A notable feature here is extensive afforestation near Diara Sultanpur on the LHS close to km 835. This is an important bird flocking area. Farming were extensively undertaken in the area.

Between, km 836 to km 834, the water body section is wide and alignment is close to RHS. This area belongs to Chatrapura Settlements in RHS and farming areas in Diyara, towards its LHS. Between, km 824 to km 822, the river is around 1.5 km width and channel is central. LHS is the settlements of Semariya; on the RHS is Hathida Buzurg. This is a thickly populated area. Mokama Bridge is located here and connects the above two towns, between the km 822 to km 820. Rajendra Pul railway station is located nearby on the LHS, soon after the entry of the bridge on to the banks. It is having an important landmark location of Barauni Thermal Power Station, Malhipur.

Between km 822 to km 820, on the LHS there are burning Ghats of Beghusarai. There are bank protection works and small settlements in the LHS. RHS is Hatada area, Bata – Chappel factory could be seen in the area. Here, the channel moves from RHS to LHS. On the RHS, towards km 820, brick kilns occupy the banks. The banks are vegetated and occupied by settlements. Between km 820 to km 818, the river is extremely wide and is located central, the LHS is eroding banks and are vertical which are part of Char. RHS is Maranchi, which is a part of Lakhisarai district, which has vegetated banks. Between km 818 to km 814, the riverine section is wide and channel along central, RHS is the location of Rampur Dumra. Between km 814 to

km 808, fairway gently shifts to the RHS and till km 800, the trend is similar and RHS is more or less farm lands of Jaitpur and Sihman Barari Bandosti.

Mokama Rail cum Road Bridge between km 822 to km 820

At km 806, the waterway is extremely wide and the alignment is close to RHS and on both sides are occupied by chars of Mathihani and Laldiyara respectively. Between km 806 to 800, is an extremely wide section i.e., around 6 km, this is an important channel diversion area, especially during, the lean period. At km 802, the channel is aligned on the LHS is Mathihani area, where there exists a Ferry Ghat, here on the RHS are extremely eroding banks. From km 798 to km 796, which is a very wide stretch having, chars on the LHS and there are vertical eroding banks on the RHS. Between km 798 to km 796, chars are located on both LHS and RHS. The location is Samho on the RHS and Singhpur on the LHS. Here both the banks are unoccupied.

Between km 800 to km 796, the sections are very wide, where channel is aligned to LHS. After this, between km 796 to km 794, the channel shifts to RHS, and then it becomes narrower. Between km 794 to km 792, the stretch is very wide and the alignment is close to RHS. This is also a tower line crossing location. They are having gently sloping banks. There is one tower line on eroded banks, showing exposed pile heads on the banks, pointing out the instability of the structures. At km 792, the channel moves to RHS, which is also a very eroding bank. From km 792 to km 786, the channel is having central alignment and both the banks are occupied by

chars. Between km 786 to 784, the section is very wide stretch, grazes to LHS, here the banks are highly eroding on the RHS is Madini Chauki, Diyara.

From km 782 to km 778, an extremely wider stretch marks; channel is having more or less central alignment, with channel slightly shifting to RHS. There are Char areas located in the RHS, beyond them are Hemsapur settlement area. Here, the stretch is very wide, with LHS occupying the Char area. Kuel Nadi entering in the RHS, which marks the beginning of extensive settlements at km 780. At km 778, LHS is occupied by Diyara or chars of Herudiyara where riverbed are utilized for agriculture especially during the lunar month of Karthika, by the local inhabitants. These banks are vegetated and there are settlements in the area in the RHS. Close to km 776, is a wise stretch, alignment runs close to RHS. RHS is Herudiyara settlements. Similar pattern continues between km 778 to km 770. Between the km 770 to km 766, which is one among the widest sections, the channel moves almost central, these are also populated areas, on which banks are occupied with numerous kiln. Close to the km 769, the channel is located very close to RHS, here banks are eroding.

Between the km 766 to km 764, is located the Seethacharan Diyara in LHS and towards the RHS is Sochi Ghat. Close to km 764, there situated the IWAI Floating Jetty (F.J. Ganga II) in the RHS. There is a water supply intake location at Babuva Ghat. Between km 762 to km 764, Munger town marks the RHS. The area has thickly populated banks with settlements including multistoried buildings, public places and gardens. Munger – Kurha Rail cum Road Bridge, could be seen further downstream at this location. There are a number of Ghats in the area, among them famous are the Kastha Harni Ghat, Lal Darwaja or Munger Fort, is a famous heritage as well as a tourist location on the RHS and is an important landmark, other important features on the bank on the RHS are Mir Khazim Fort, Munger Central Jail and Ballon Bazar area. These areas are in general thickly populated.

Munger Fort @ km 764 on RHS

1.5. Munger - Rajmahal

Munger to Bhagalpur Section forms part of Ganga having alluvial deposits along its way leading to shoal formation on its course. IWAI has the floating jetty installed at Munger at Ganga Ghat. The section is charecterised by wider stretches of River Ganga where the sandy islands are located at many locations along its way. The floating jetty is located along RHS of the waterway at km 762 and is immediately followed by a Water Supply (WS) intake at RHS. The area observes 10-11 m difference between HFL reaching to top level of Ganga Ghat in Munger.

Ganga Ghat in Munger

The Road Cum Railway Bridge across the river Ganga is connecting Laldarwaja on RHS to Malhipur Karari on LHS just before km 762 and Kuel River is joining on LHS immediately after the same. The fairway is running towards center and slowly shifts to LHS to negotiate the morphology of the river as a curve from km 760 at Shaligrami to km 746 at Parostimpur. The fairway is running in a main channel of waterway of length more 1 km along all-thorough the stretch and a temporary sloping sandy bank has been formed along the curving areas on RHS.

LHS is getting eroded and RHS is getting deposited along its way and there by leading to island formation on RHS. The section between Shaligrami to Parostimpur is characterized by temporary sandy banks which will be flooded during the monsoon. There is no major settlement within the immediate vicinity of bank where proximity to fairway exists.

Road Cum Rail Bridge - Munger

Burning Ghat on RHS near Sultanganj

After Munger, the major settlement comes at Sitakund on RHS in between at km 746. The ferry crossing through country boats is happening between Sitakund to opposite bank and a temporary island formation is visible on RHS of fairway. Agriculture fields are present along the LHS of the water body especially wheat and the harvest transportation from LHS to RHS through country boats are common in this area. Sitakund area is characterized by agglomerations of settlements and the fairway is running within 250 m from the settlements where brick houses are widely seen and public utilization of waterbody for bathing, cleaning etc. are visible. Dolphins are also rarely seen in this area. Between km 746 to km 744, Maniyarchak area, a village setting is coming along RHS where the settlements and cultivations are continued, whereas, LHS is characterized by almost flat sandy banks which will be flooded during the monsoon. Settlement are close to riverbank but located more than 5 m from the existing water level having a sloping bank. The country boat operations are common along this way.

Between km 744 – km 740, LHS Tarapur Diara and RHS Tilakpur area are having agricultural activities along its way and are active rural areas having buffalo rearing, fishing activities in country boats and through fixed nets and cage culture. From km 740 to km 738, the fairway negotiate through a curve on right angle whereas from km 734 to km 726 along left angle, ie., between Madhopurpatpar on LHS and Ghorghat Milik on RHS. Just before Ghorghat area, where Khara Nadi and Mar Nadi along with a stream is joining river Ganga on RHS. Island formations are present along LHS whereas continuous deposition of sand has been observed on RHS. The areas are also noticed with presence of birds along the small islands formed and LHS of the banks have been eroded with nests of birds visible along the eroded banks just like holes.

Passing Kumarganj, where a Shiv Temple is present and Jahangira on RHS which are rural human settlements, the fairway continues along RHS to approach Sultanganj. The human settlements and activities are continuing along these areas while the main building lines are seen slightly away from the slopping bank and having vegetation. Being the active areas, Burning Ghats are also visible along the stretch.

Ajgaivinath Dham on RHS marks the entry to Sultanganj area at km 718 where the waterway is wider by nature and the area is having a mosque along the bank at the top of a hilly terrain. Burning ghats are present along the RHS close to the Dham and bank is characterized by rocky masses on RHS. The area is an important pilgrim center and marks mass people gathering in the month of Shraawan. The village life continues along RHS where the fairway is towards the same bank side and buffalo rearing is common in this area. A bridge connecting Sultanganj with Aguani Ghat across River Ganga is underway along this area. The fairway continues along center and slides to LHS where open slightly sloping banks are visible. The fairway further negotiates through the curve between km 708 – km 698. Bank erosion is exposed on LHS near Gopalpur Kali Patti covered with grass and rural agglomeration is present in Dudhalia area on LHS. The areas are marked with extended sand deposition along RHS till km 698 on RHS at Athgama and island at Saiduddinpur on LHS. Fishing activities with cage culture is visible along LHS and people are active with country vessel operations. LHS is represented with extended sandy areas along its way.

Ajgaivinath Dham

Bridge under construction - Sultanganj with Aguani Ghat

Cage Culture in Saiduddinpur

Bank Erosion Gopalpur

Between km 698 to km 690 the fairway negotiates through an "S" shaped curve where Raghopur area is along the RHS and Bishanpur running along LHS. Bank Protection is done along Raghopur area where the fairway is close to RHS, where as in between km 690 to km 688, island formation is visible on RHS. LHS is also having bank protection and approaches Bhagalpur area where villages are present on bank after the built bank protection. Floating Jetty of IWAI is present along LHS of the water body in Yamuniya nadi which joints Ganga.

Villages in Bhagalpur Area

Bhaglpur area on LHS represents one of in the important municipal corporation along the bank of river Ganga where extensive developments have been already undertaken. The developments continues till Raghopur area while the RHS is having sandy plain flooding banks extending without human settlements in proximity. The Bhagalpur area has got sand bank formation along the centre of the river and hence the fairway takes a left hand curve followed by right hand curve in between the chainage from km 684 to km 680 to reach Raghopur on RHS. The fairway proceeds through center and the Vikramshila Bridge connecting Bhagalpur to Tetari is crossing the fairway at km 678. Watercourse in this area is more than 1 km in width even during the driest season of the year. Bhagalpur College of Engineering is present on RHS near to Bank and a collapsed temple also visible during driest season. The fairway runs along center negotiating the river geometry between km 674 to km 662 where Raziunddinpur and Emadpur are sandy bank areas along LHS. Between km 666 to km 658, where Ismailpur village on LHS is crossing by island formations are quiet visible. Ismailpur area represents a rural settlements and where the fairway is close by, the bank erosion is visible and bank represents active human areas. Bank protection has been done in certain areas.

Vikramshila Bridge Connecting Bhagalpur to Tetari

Ismaipur area is having extensive agriculture activities behind the bank and other major activities of the people in this area include dry docking of country boats, buffalo rearing etc. Bank protection has been done on settlement areas with sand bags, country boats are extensively present along the area, and stone chips are carried by boats, fishing is common with cage culture. Splitting of channel is visible in this area. Birds are extensively visible along this area with their nests along the bank such as Black and white stork.

Bhagalpur College of Engineering

Birds Nests in Bhagalpur Area

Ismaipur Village

Dry Docking in Ismailpur

After Ismailpur village setting, there are a few spur constructions observed along LHS whereas huge sand depositing areas are present in RHS. Sand mining activities ongoing in the region and Burning Ghats are also visible. Further moving forward the fairway pass by Tintanga village on LHS where human activities are visible as passenger boats are crossing the fairway.

Sand Mining after Ismailpur Area

Spur Construction after Ismailpur Area

The fairway negotiate through a smooth curve between km 654 to km 636 along RHS proceeding from Tintanag area to Kasri area through Kahalgaon. Between km 654 to km 646 shoal formation is critical and bank along the RHS is predominately agriculture areas by nature. LHS is dominated by continuous and intermittent island formations due to huge sand deposits. Koa Nadi is joining River Ganga in Kahalgaon on RHS,

Kahalgaon is marked by presence of 3 rocky islands along LHS of the fairway almost 300 m from permanent bank. Temples are present on these three islands and crossing of the fairway happens in this area during pilgrim season. People are taking bath, and the area marked by depth more than 20m. Stone chips carrying vessels, ferry crossing, etc. are visible; Constructed Ghats are present in this area. A water supply scheme is present just after the Kahalgaon built up area on RHS where as LHS is too far at this point. Between km 646 to km 640, Kahalgaon built up area is present which is an extensively built up urban agglomeration on the bank of the river. Banks are occupied by mango planation (37) and also burning Ghats (40, 41) are present on the river bank. Human habitations are continuing along the RHS of the bank and Kashri

area followed by a human agglomeration area and the RHS of the watercourse is marked by Bateshwar Sthan, a temple in a landmass protruding to the river with high level of human activities. LHS represents sandy banks more than 1 km away from the fairway during the driest season of year. Dolphins are visible in this area.

Island in Kahalgaon

Mango Plantation in Kahalgaon

Bateshwar Sthan in Kasri Area

Splitting of channel occurs between km 636 to km 612 leading to a vast island formation in the river, where both banks are occupied by agriculture files. Permanent banks are present along RHS with more than 10 m height and Ekchari represents a passenger vessel crossing area where grain harvested are transported in between the banks. Human settlements are concentrated in Ekchari area where as the island on LHS has been extensively utilized for cultivation.

Passenger Movement between the Islands Related with Agriculture

Birds Near the Eroding Islands

Fairway continues to run along RHS, passing Kamalpur Ogaireh, Baijnathpur, Mahreshpur, on RHS and parallaly, Nanadnpur, Jot Talih, Baghmara on LHS. Several islands are seen in this area and bank erosion is visible. Birds are widely seen in this area. Fishing activities, buffalo and cattle rearing, country boat operations etc. are prominent along this area.

Fairway is aligned towards LHS passing through Manihari village settlement where passenger and Ro –Ro facilities are prominent. Manihari is a highly active area where the long queue of Trucks are seen for getting the RO – RO service to opposite bank. Passenger boats are actively present in this area marking this as a highly human interfering area. Stone chips carrying boats are also plenty in number. Villages on LHS are having bank protection to certain extend and houses are present on the top portion of bank around more than 5 m above the water level in driest season of year. Moving through the center, the fairway travels towards RHS passing the Sahibganj Municipal Corporation area, which is a substantially built up town along the Bank of River Ganga. The fairway negotiates through the various island formations in this area and passes through the area where terminal Construction is ongoing. Sahiganj area is having high.

Boats Carrying Stone Chips

Sahibganj Multi Model Terminal under Construction

Sahibganj area represents the area where hillocks are visible from the waterway away from the river bank on RHS and thus the watercourse enters in to the administrative limit of the State of Jharkhand. Further proceeding the fairway leads through LHS through Dayanand Nagar were banks are protected to some extend and then exposed eroding banks are also visible passing through Bhawanipur a rural settlement having eroding banks and brick manufacturing units are present along the bank. RHS represents Kishunpur area where banks are exposed and eroded indicating human activities such as cattle rearing, fishing etc. The banks along the river on both sides are having agriculture activities prominent in continuation and passing through the Kesarpur, Harachandapur, Chandipur Tafir and Paschim Narayanpur the fairway approaches Rajmahal near km 541, a middle class town in the state of Jharkhand.

Bhawanipur Rural Settlement

1.6. Rajmahal- Farakka

Rajmahal is located along the RHS of fairway near km 541 km. A Ro- Ro ferry service operates between Rajmahal and Manikchak diara near a chainage 537 km in West Bengal, where cargo trucks were transported across the waterway.

Ro- Ro ferry between Rajmahal and Manikchak

Water Intake on RHS at Rajmahal

Burning Ghat on RHS at Rajmahal

Fishing on Island near Manikchak

Municipal water intake structure lies along RHS near chainage 540.5 km for supplying water to Rajmahal area. Burning ghat and Kali mandir are there on the RHS downstream of water intake structure. The riverine section are wider along this section with a width more than 2 km from chainage 541 to 503 km. The channel runs close to RHS from chainage 534 to 541 km and shift to LHS from 531 to 516 km. Islands are formed during lean flow along RHS of the channel from 538 to 517 km. Fishing and grazing are the major activity on these islands. Temporary huts can be seen on these islands near to cultivated area.

Grazing on Islands near Farakka

TemporaryHuts in the Island near Manikchak

Fishing in Country Boats near Manikchak

Net Fishing near Island

Fishing on country boat and net fishing were observed along RHS from chainage km 534 to km 528. The entire banks from Rajmahal to Farakka are unprotected with sandy banks on both sides. Island formation due to accretion were observed along RHS from km 530 to km 521. Birds are also seen on shallow water near to island on RHS from chainage km 528 to 524 km. Channel moves through the centre from chainage 516 to 505 km and continues through RHS from km 505 to km 503. The wider sections narrow down while entering feeder canal near km 503. The average width of feeder canal upstream of Farakka lock gate is about 100 m. Active erosion were observed near Paranpur area near chainage 516 km, where a school building collapsed due to bank erosion on RHS of the channel.

Collapsed School Building near Paranpur

Grazing near Eroding Banks near Paranpur

Grazing of baffalos were observed along RHS on eroding banks near Paranpur and Hazitola area near km 518. Islands were also observed along RHS and LHS from km 514 to km 505. Water intakes for irrigation were observed along the RHS near km 514. Farakka barrage for holding and diverting water to Bhagirathi-Hooghly river system lies close near km 503 km where the IWT route takes a left turn leading to feeder canal. Floating navigation lights were seen near km 503 at the mouth of feeder canal.

Floating Navigational Aids near Farakka Barrage

Shmashan Kali Mandir on LHS at Farakka Township

Gandhi ghat, Hanuman Mandir, Shmashan Kali Temple and Burning ghat were along the LHS near chainage 503 km in Farakka Barrage. Water intake structure lies along the LHS near chainage 503 km upstream of burning ghat. Birds can be seen in the island along RHS at the mouth of feeder canal. A River Information System (RIS) station is on the LHS near Farakka Lock gate near chainage 500.5 km. A floating terminal of IWAI is on the LHS near chainage 500.5 km at Farakka Barrage upstream of lock gate.

Farakka Barrage Lock gate Upstream Side

RIS Station and Floating Terminal at Upstream of Farakka Lock Gate

1.7. Farakka – Behrampur

In the downstream side of Farakka lock on LHS, IWAI Fixed cum Floating Jetty is present. The area represents an area of controlled water flow along a built in canal having 4m draft during the site visit. Navigational lock has a width of 30 m and followed canal area is having 180 m length. Downstream of Farakka is having barges on halt. From km 500 to km 494, the RHS of the waterway is occupied by NTPC, Farakka and Farakka town is situated on LHS of the fairway. NH 38 and North Eastern Railway line connecting Farakka to Kolkata with station at Farakka are present along the LHS of the Canal area. In between km 498 – km 496, the main operation area of NTPC exists on RHS. Human settlement are also present on the RHS and the crossing of the canal by country boat supported with ropes. Fishing activities in small country boats, fish catch through nets are in plenty. Public utilization of n waterway is quite visible with bathing cleaning etc. The area is represented as a typical canal where the banks are covered extensively with grass and shrubs. Other types of fishing using fishing nets, poles are present along its way. Being a manmade canal connected with Farakka Barrage, water is controlled and released from the barrage to the canal. Ferry is operational between Nisindra Ghat on RHS and opposite side using Country boats in this area using fixed ropes.

Downstream of Farakka Lock

Water Level at IWAI Farakka Jetty

Barge in front of IWAI Farakka Jetty

Passenger Ferry from Nisindra Ghat on RHS

After km 498, the built canal joins the flow line of downstream of Farakka Barrage. Barges were present in this area. The fairway proceeds to the area where the bank to bank distance of waterbody is nearly 300m. Dedicated roads are running along both sides of the bank and the area represents a planned developed area where NTPC establishments are presented on LHS; NTPC hospital is present along the LHS of the watercourse. Kedarnath Bridge which is a series of bridge connecting to Fatepur area crossing the fairway including 2 Railway bridge, 1 road bridge and 1 bridge under construction presents the 1st vertical structure in this area.

NTPC Hospital on LHS

Kedarnath Multiple Bridge

NTPC has been utilizing the waterway for the transit requirements. Fixed cranes are established for cargo transit and associated vessels remain present on RHS of the fairway. Considering the Coal transit requirements of NTPC from Haldia, IWAI has already entrusted an agency for maintaining minimum Least Available Depth (LAD) for the section from Farakka to Haldia. Cargo vessels including the dredgers were also remain present in the area during the visit. Water intake structure is present on RHS whereas the opposite bank represents secured NTPC Colony. Ferry crossing exist between the banks and an incomplete bridge is existing followed by HT Line Crossing the fairway and NTPC water outlet is discharged from RHS. While

Ballalpur railway station area is followed in LHS, the RHS is extensively grown with shrubs, Ballarpur area continues and ferry crossing, temple, burning ghats are presented along with the settlement.

NTPC Operational Area on RHS

NTPC Water Intake on RHS

NTPC Outfall and HTL Crossing on RHS

Aqueduct – View to RHS

Shankar bridge– a road bridge exists as the vertical structure crossing fairway. Both banks are having agriculture activities – banana, tamarind etc. are grown in plenty. Many small country boats are operating in this area along its way and ferry crossing is followed and Canal intake is present on RHS toward Pachula gram. RHS of the fairway shows high human activities associated with the watercourse LHS is grass covered sloping bank. An aqueduct is crossing the fairway for Bagmati River near km 485, where eddy was observed during the visit.

Bhagmari ferry is operating just downstream of aqueduct area. Electric lines are also crossing this area. Rural settlements are continuing along both sides of the banks and Dhulian Pakur brige comes as the major vertical structure crossing the fairway.

Dhulian- Pakur Bridge

Putimari Jetty is present on RHS canal section continues with rural settlements along its way. Downstream of Pakur Dhulian Bridge onwards extensive agriculture fields are present along both sides of the Canal. Bahadupur Ferry is operational at km 470 near Amuha area and public utilization of water courses for bathing cleaning etc. are predominant in this area. Passing Ekatia on LHS and Lokaipur on RHS the waterway move forwards where a jetty which is not presently in use is present followed by lift irrigation system operational on LHS in Hazipur area. Both banks are having human activities, shurbs and agriculture areas behind the bank and road cum rail bridge - Ahiran Bridge is present at km 465. Roshanpur ferry is operating along with HT Lines are crossing after km 462 and abandoned Jungipur Barrage is present on LHS of the watercourse.

Lift Irrigation System on LHS – Hazipur Area

Abandoned Jungipur Barrage

The fairway takes a meandering route primarily traversing through Char Sekandara on LHS and Alampur and Kanupur on RHS where Bansloi Nalla is joing the river towards approaching Khidirpur area. The areas represents a highly human activity area where people are utilizing the watercourse for bathing, washing etc. and there is sand mining activities ongoing in this area. After Khidirpur, the fairway slides to RHS where Palga N is joing the main river and further proceeds forward to Jangipur a Sub division town substantially built up on RHS.

Govt. Poly Technic at Jangipur marks the entry to the major built up area of Jangipur where fairway is towards RHS. A well maintained park namely Subhash Dweep is present on RHS of the bank where as the opposite bank is settlements. Sadar Ghat to Jangipur Ferry is operational. Both banks are completely built along the area and Bhagirathi setu in Jangipur near km 454 marks the vertical structure along the fairway and a ferry operational is happening just before the bridge, the water way width is limited to less than 200m in this area. Sewer outfall and a water intake just at its downstream exists on LHS.

Government Poly Technic Jungipur - RHS

Subhash dweep park on RHS

SaDar Ghat to Jungipur Ferry on RHS

Bhagirathi Setu

Sewer Outfall – RHS

Water Supply Intake - RHS

Raghnathaganj burning Ghat is present on RHS with industrial activities in its proximity. LHS is having abundant Lichi Planation and Mango Plantation and all through the areas are substantially build up along RHS. Both banks are dense settlements having the Bahura area on LHS and Rampura area on RHS and ferry services exists in between. Brick manufacturing units are presents on LHS and further the Sahajadpur ferry operation is present between Sahajadpur (LHS) and Dafarpur (RHS). Agriculture activities occupies both banks further and between km 446 to km 444, the channel is meandering after HTL crossing. Meandering areas are having width of less than 200 m and having dense human settlements along the bank. Agriculture intakes are present on LHS. Fairway takes sharp curve at Nutangaj area between km 444 to km 442 and further proceeds through agriculture field areas where several intakes are present. Liaspur ferry is present and further Nasirpur ferry is present near km 435. Between km 436 to km 434 the fairway negotiates through the river geometry along RHS where bank erosions is primarily observed along RHS near km 436 leading to more erosion on LHS near the curving chainage of km 434. Area is primarily occupied by agriculture intakes where a school is present on LHS close to fairway.

Brick Manufacturing Units -LHS

Liaspur Ferry - RHS

The water body is having less than 200 m width in this location. Rural area continues with settlements predominantly on LHS, birds are cited where RHS is far and occupied by agriculture fields. Channel take a sharp turn at Gadde area where LHS is continuously eroding after turn the channel is too close to RHS where human settlements are just along the bank. Gadi khal a small stream is joining on RHS.

Primary School on LHS

Human Settlements Close to Bank along Gadde Area

Baliya comes on RHS where RIS is present. Rajarampur ferry is operational near km 426. Between km 420 to km 406 the fairway marches through a series of windings at Arijpur on RHS, Basantapur on LHS and Mohammad pur on LHS. Arjipur area is plain agriculture area and many water intakes are present along its way. Fairway meanders through LHS and Dukhi Khal a stream joins on LHS followed by Lataguri Ferry. Sundalpur Irrigation Canal is present on LHS just after km 412 where LHS represents habitation and RHS is sandy bank. The fairway proceeds along water course where agriculture activities are mainly occupied along Muhammadpur are channel deflection due to splitting of channel is present where the Bhandals are present. Mosque is present on RHS and the agriculture area continues along LHS where as human settlements are close to right bank. Muhammedpur ferry is operational just after km 406, further agriculture activities especially Jute cultivation is prominent. Char Bangla Mandiralay and educational institutional areas are present on RHS. From Badanagar area onwards the human settlements are present along both sides of the bank and Binod Nala joins on RHS and Azimganj Jiaganj Ferry Crossing is presented in between the built town.

Sundalpur Irrigation Canal - LHS

Lataguri Ferry - RHS

Bhandal in Muhammadpur Area

Char Bangla Mandiralay

Educational Institution on RHS

Azimganj Jiaganj Ferry Crossing

Azimganj Railway Junction is present on RHS, the urban settings continues, and Nimtalaghat ferry is present. Water intake structure, crematorium etc. are present on LHS and the town settings slowly transits to village setting. At km 396, HT Line crossing occurs and Nazipur Rail Bridge is followed at km 395. The watercourse is having mostly agriculture areas on both banks and Dahapara ferry comes on reaching km 392.

Azimganj Railway Junction

Nazipur Rail Bridge

Hazardwari area is having historical monuments on LHS including Hazardwri and a State museum, which was closed during visit period. Mo many old structures are present along the LHS. Fairway runs almost along the center where the agriculture fields are predominating around RHS and the continued rural settings are visible on LHS with a mosque just before the Hazardwari palace. There is a state museum also existing next to Hazardwari Palace where the IWT terminal is present on LHS. Ferry operation is present between Sahanagar Ferry Ghat on LHS to Elahiganj Ferry Ghat on RHS is having bank to bank operation before km 390.

Hazardwari

IWAI Terminal at Hazardwari

After which, Lalbagh Ferry is operational in between the banks just after km 390. LHS of the water body is having Behrampur built along its way and New Motijhil Park is behind the bank on LHS. Burning ghats are present on LHS along the bank where water body is more than 250 m in width. While banks are occupied by settlements and various activities along its way on LHS the RHS is mostly occupied by plain agriculture fields passing through Dair Chaitanpur and Karbala reach on RHS. Kunju Kghat Ferry is operational followed by Niallishpara-Ghatbondor Ferry followed by Khagraghat-Gopalghat Ferry.

Both banks represents densely populated areas. Refugee Ghat - Bhairba Tala Ghat ferry Radhar Ghat Ferry. All these ferry crossing are in between km 382 to km 386. Ramendra Sundar Tribedi Bridge represents the next vertical structure connecting Berhampur to Radharghat crosses the fairway.

Ramendra Sundar Tribedi Bridge connecting Berhampur to Radharghat

1.8. Behrampur – Katwa

After Ramedera Sundar Tribedi Bridge the first ferry crossing comes before km 380 between Gorabazar and Bazarpara Ferry Ghat. While LHS of the area represents dense urban settlement, RHS of the bank is having greeneries with no settlement rightly along the bank. Water supply intake is present on LHS where as agriculture fields are present on RHS mainly banana plantation and an agriculture intake (pump) is present on RHS. Further, a stream Nasi Khal is joining on RHS and followed by a bridge under Construction around km 377 followed by HT Line Crossing. The channel continues along LHS and Elli, Bamboo, Banana Plantations along with country operations are visible marking the areas as human active rural areas. LHS is highly eroding in these sections and bird nests are seen on the eroded banks. The channel slowly swifts to centre and move forward where LHS are marked with open agriculture fields of Char Narayanpur where as RHS are having human settlement along its way in the Sungai area. A ferry crossing is operational at km 374. Both banks are occupied by extensive agriculture fields especially banana plantations along its way. The fairway slowly slide towards LHS and passing Charkhidirpur village area on RHS. Eroding exposed banks are visible in this area. While LHS represents extensive agriculture fields, human settlements are present along the bank and a dense settlement is present on RHS at Char Halal Pur and a ferry is operational between Parhalalpur on LHS and Charhalalpur on RHS 17-19. While vast agriculture fields continues on LHS the Mahula settlement area passes through on RHS where bank protection is visible 22 and bullock carts with rice harvested marks the agriculture activities connected with Mahula village area. A ferry crossing is present between the agriculture fields of both banks.

Bridge Under Construction - Behrampur

Settlements in Sungai Area

Rice Harvest Transport in Bullock Cart – Mahua

Channel negotiates through LHS and negotiates through a curve between km 368 and km 366 agriculture fields are present on both sides of the river course, agriculture intakes are visible. Island formation is visible on RHS of Parkatalia area where the meandering areas the width of the channel hence reduce to nearly 160m during the driest season. Sliding through the centre, fairway negotiates through RHS towards further negotiating a smooth curve towards left pass through Charkushadanga on RHS. Bank erosion is visible in meandering areas 45. Moving further with lush agriculture fields of Banamalipur, the fairway take a right turn through a smooth curve by sliding through LHS occupied by Radhaballaphpur and Barlu area where many agriculture intakes are present with rice harvesting ongoing on LHS and a HT Line is crossing while the fairway negotiates through the subsequent left curve passing through Chumarigacha area. Fixed net fishing are widely seen in the Chumarigacha area.

Rice Harvest at Radhaballaphpur

Fixed Net Fishing at Chumarigacha

The fairway slides over to LHS passing through settlement area of Jalalpur where birds are visible along RHS where island formation is evident reaching Kumarpur area on LHS where RIS is established. There are two ferry services operational in this area; one between Chaoricacha and Jalalpur and Kumarpur Ferry Service at km 356. Both Kumarpur area and Satui area are dense human settlement areas and fairway moves through LHS towards Kumarpur area along this way. Fixed net fishing is common in this areas. Both banks have extensive agriculture fields along its way and fairway proceed further along centre and then sliding to LHS to pass through Mirzapur area which is a settlement along its way. Brick Kilns are visible in Mirzapur area and people are active in agriculture activities with tractors etc. are present.

Channel takes a right turn in Mirzapur area followed by initiating a left turn where fairway run through RHS and a Ferry Crossing is present between both banks. The agriculture fields extensively covers along Mirzapur area on LHS whereas agriculture fields mixed with human settlements in between are present on RHS. After negotiating the curve, the fairway run through centre of the river course, the areas are having the water body width less than 200m along many stretches along its way.

Ultrasan River joins the main water course from RHS after the same, Saharbati area is present where agriculture fields occupy the LHS. The Alikpur area after the river joining is charecterised with shoal formation and hence Bhandals are erected on RHS for diverting the water to fairway running along LHS, island formation is visible in this area along RHS. The fairway further negotiates through LHS and then sliding over to RHS to cover the right turn curve between km 346 to km 344 passing through Mashimpur and Chandpur area. Bank erosion is visible in LHS along curving areas 89. A ferry crossing is operational between both banks Saktipur on RHS and Suniyapara on LHS before km 342.

Bhandal and Island Formation behind it in Alikpur Area

While agriculture fields predominates along LHS, RHS is covered by dense settlements of Mahata area and Dopukuria area Garhdwara area where the fariway takes a negotiation for left turn. Ferry crossing is present between Garduara and Nalahati area. Betel leaf and banana plantations are visible in this area and from being a less than 200m stretch the waterbody takes an increase in width to more than 400m before km 338 where fairway run along LHS to negotiate the right curve at Manganpara area. Splitting of channel occurs along the curving areas where the fairway run through right arm. Both banks and island in between the bank on LHS are agriculture fields of banana, betel leafs etc. and birds are visible along the island. HT Line crossing is present at the rejoining area of split channel. The fairway negotiate through LHS following the geometry of the river reaching Ramnagar area on RHS.

Ferry crossing is present at Ramnagar 107 -110 between Plassey and Ramnagar. Survey vessels and private vessels were observed in this area and rice harvesting transport is quite common. The fairway proceed further through LHS along Char Palasi area where bhandal is erected prior to island. Channel run close to LHS and island formation is visible along RHS. Along curving area, exposed eroding banks are visible and shoal formation is also seen. Rice has been extensively cultivated in this area and transport is done between the banks. Private vessels and IWAI dredger was present in this area. Proceeding through LHS the channel move forward where both banks are occupied by extensive agriculture fields. From Ghasardanga on LHS the channel follows the river morphology with a smooth right turn and further makes a

left turn where Char Gopalpur area falls on LHS and whereas Sujapur fall on RHS by sliding to RHS. Rice and Jute are extensively cultivated in this area and extended island formation is visible on LHS in the meandering areas. Fishing activities with bamboo poles fixed nets are active in this area.

Ferry Crossing between Plassey and Ramnagar

Shoal Formation at Char Palasi

Serious Bank Erosion in Nutangram on RHS

Negotiating through RHS, fairway proceeds further with a dense village settlement area of Nutangram. The meandering areas of exposed Nutangram is having serious erosion and bird nests are visible on RHS. LHS is extensively covered with agriculture fields. Moving through the centre the fairway slides down to LHS after the meandering section and Nutangram ferry is operating between Nutangram on RHS and Manikhidi Ghat on LHS before km 332. Agriculture intake is present on RHS of Nutangram area.

Channel proceed further along LHS taking a smooth right turn reaching Narayanpur area. Naryanpur area where public activities are visible along the bank with presentce of temple, Ghats etc., after the meandering section, Kalyanpur ferry is operational connecting Kalyanpur on RHS and Raghopur area on LHS. Extended agriculture fields interspersed with human settlements are visible along its way and sliding through the centre the fairway negotiates to LHS near km 316 and taking left turn through Phulbagan area. After km 316, Naliapur ferry service is operating from the Naliapur area to Phulbagan area and also a ferry service is operation between Naliapur and Udhanpur which will be abutting the cargo operations along the fairway known Bhagyabantapur Ferry. Udanpur area is a village setting and along LHS is Bhagyabantapur area where a water supply scheme is functional from the main river course. While the fairway continues along RHS, LHS is having extended agriculture fields along its way and whereas RHS is represented with continuous human settlements.

Tourism Jetty - Katwa

LHS continues to be agriculture fields till km 308 Ballavpara area where as RHS is having continuous human settlements of Benepara followed by Sakai area. Ajoy River joining the main river course from RHS and a ferry is operational between Sakai on RHS crossing the river mouth to Goalpara Ghat on RHS. Dense built ups of Katwa is followed on RHS from km 308 to km 306. While LHS represents open fields RHS is the extensive built up. A ferry is operational between Pakur Tal Jeti Ghat on RHS to opposite bank and Tourism Jetty, Katwa comes on RHS.

1.9. Katwa to Nabadweep

In Katwa built up section, the waterway is having a total width less than 250 m along its way. From Katwa Tourism Jetty on RHS, the fairway runs further along the centre where Katwa built up section continues on RHS where as LHS is represented by open green grassy areas.

Towards the end of Katwa built up area, a water intake is present on RHS. The fairway negotiates towards LHS. The waterway width is gradually increasing Bhandal is erected before km 306 on RHS to channelize the flow of water to the fairway running on LHS. Along LHS, in the rural areas, people are engaged in fishing activities. Agriculture intakes are present on LHS, Gobindopur area comes on RHS which is far away since the water way width are substantially increased more than 600m and occupied by agriculture fields. Huge island formation is visible on RHS and proceeding with the fairway further on LHS the next important settlement comes is Matiari. The areas along LHS from Katwa to Matiari is represented with extensive vegetable cultivation areas. The important species including pointed gourd, Sweet potato and corn and paddy are cultivated here. At km 302, ferry is operating between both banks while the RHS is having an extensive delta.

Further downstream Daihat Ferry is operating between the banks, the area is an area of rapid shoal formation, and cross-surveys are carried out to ensure LAD. Channel slides to RHS and rural areas are visible on RHS where the water body width during the survey was more than 300m. Extensive agriculture fields are marked along both sides of the river and the fairway on RHS negotiates through the areas of Char Bajnathpur on RHS. Both banks are occupied by extensive agriculture fields and birds like kingfishers were visible in the area. RHS is highly eroding and red beacon lights are visible on RHS and agriculture intake is present. The fairway further proceed through an area having extended shoal formations where RHS is represented by Raghunathpur, Srikrishnapur Channel Slides down to LHS where exposed banks are eroding, LHS is having sand deposition extending till Kabirajpur at km 296.

Daihat Ferry

Bank Erosion on LHS

Bhandal has been erected in Char Bishnupur area after km 296 towards diverting the flow for the fairway along LHS. A ferry crossing is operational between the banks in this area. Fixed net fishing with bamboo nets are present in this area and Cage culture is also quite common. The fairway proceeds further to LHS to take a right turn smooth curve between km 294 –km 292. While Agradwip area, which is a settlement area occupies on LHS along the curve, extensive open cultivable area is seen far away on RHS. Agradwip ferry is operating between both banks and continuing further the fairway passess through the Gajipur and Narayanpur settlements where agriculture fields are occupied in between them.

The area between Gajipur and Narayanpur is a rural setting where agriculture activities are predominating. The bank protection with bamboo barriers exists and the area is marked with numerous agriculture intakes. Fishing activities with bamboo nets and cages are quite common in this area. Burning Ghat is present quite close to the fairway and banana plantation, bamboo, mango plantation, etc. are common in this area. Banks are having approx. more than 3m height and banks are eroding and bird nests are visible in the exposed banks. The agriculture activities are active and many water intakes are present in this area. Agradwip ferry is operational before km 292.

Bank Protection with Bamboo

Agriculture Intake

Moving ahead on RHS where banks are close to fairway rural settlements are visible and agglomerations comes where the Patuli area comes on RHS between km 288 – km 286. Agriculture areas are occupied on LHS, Patuli ferry is operational between both banks. Further proceeding, a ferry is operational between Patuli on RHS and Gangapur on LHS, fairway negotiates through centre towards LHS to move forward through a smooth right turn curve between km 286 -280. Jhaudanga settlement on LHS marks the human inhabitation areas where as RHS is marked with continuation of Patuli area majorly covering agriculture areas. Coconut trees are visible in this area, mango plantation is extensive and country fishing boats are widely seen in this area. Opposite to Jhaudanga settlement island formation is visible and birds are seen along the island during the visit. LHS marks active human intervening area especially agriculture activities - bullock cart, tractor etc. are seen. Udaychandpur area comes on LHS where a ferry operational in between both banks before km 282. Reed bamboo transports are visible in this area. Fishing with bamboo cage and fixed bamboo nets are present in this area. Bank protection is done with grass pitching in this area. RHS is marked by grassy plain banks having agriculture activities along the area.

Reed bamboo Transport at Udaychandpur

Agriculture Area

Grass Pitching Bank Protection at Udaychandpur

Water Supply Scheme on RHS - Mayapur

Along km 280, the alignment runs along LHS where as channel diversion is visible with island formation and dual channel is formed. Channel shifts to RHS to negotiate the geometry of the river of a left turn curve and comes Narayanpur settlement on RHS. Narayanpur areas are marked with shoal formation and Dampal ferry is operational between both banks inthis area. Cage culture is widely seen in this area. After Narayanpur Village, Dampal Ferry is operating. Channel shift to RHS to negotiate through the geometry of smooth left turn and many water intakes are present along RHS of the fairway. Buffalo rearing, banana plantation, reed bamboo plantation etc. are quite common in this area. Baghpara ferry is operational after km 272, the channel shifts to LHS where delta formation is visible on RHS.

Passing further, Tamaghata area comes on RHS and the channel shifts to LHS on Kashidhanga area and the channel takes a smooth right turn where delta formation is visible on RHS. Plain agriculture fields are visible on RHS, fishing is very common. Channel shifts from LHS to RHS and proceeding further Kamal Nagar ferry is operational before km 262. Purbasthali WTP is functional slightly away from the Right Bank in this area. Channel Splitting is happening in Chandipur area where the fairway continues on LHS. Bholadanga Ferry is operating after km 258 and brick manufacturing kilns are visible on LHS and delta formation marks RHS. The channel proceed further but takes a sharp turn at Sajiara area and Kanksali Ferry is operational at km 252. Channel splitting is there with fairway slides to LHS and Iskon temple could be seen far away. Ramachandrapur Ferry is operational at km 248. Channel slides to RHS to negotiate the left turn of the river geometry where delta formation is visible on LHS.

Channel moves forward and negotiates through the smooth left turn reaching Paschim Mayapur area on RHS and LHS comes the Mayapur area before km 246. A water supply scheme of 238

MLD is functional where intake is from the main river course on RHS. A ferry is operational further down and while the river meanders channel shifts to LHS and around km 235, Jalangi river joins from LHS. Nabadweep and Mayapur area marks important urban agglomeration and important tourism location. So many passenger vessels are functioning in this area and also the water supply scheme is under construction on LHS. Further down two Ferry crossings are happening from the two immediate Jetties of Nabadweep at km 243 connecting Swarupganj area on LHS and Mayapur area on LHS.

1.10. Nabadwip to Kolkata

Nabadwip to Kolkata stretch is characterised by moderately wide sections with small islands formed in the middle of the river. Nabadwip is a municipality along RHS at km 243 in the Nadia district in West Bengal. Gouranga setu at km 240 connects Nabadwip on RHS with Mayapur and Krishnanagar on the opposite banks.

Gouranga Setu at Nabadwip

New Railway Bridge under Construction

High Tension Tower Line Crossing Near Nabadwip

Bamboo Transportation near Nabadwip Area

Bamboo Bandaling near Chainage km 227

Railway line along RHS Julidanga Area

A new railway bridge is under construction near km 238 and a high tension tower line crosses between the two bridges. Bhandals were observed near km 227. Bamboo from the hilly areas near Jharkhand were transported through these waterways to Kolkata. Passenger ferry and Ro-Ro ferry services connects the opposite banks for cargo movements and passenger movements. The locations of ferry and passenger crossings between Nabadwip and Kalna are Nasaratpur and Julidanga. Hatkalna, Gramkalna, Nasaratpur, Mathurapur, Krishnadevpur, Dengapara and Kalinagar area are locations of brick fields between Nabadwip and Kalna. Navigational poles at regular intervals facilities night navigations across the waterways.

Julidanga Ferry Service

Nasaratpur Ferry Ghat

Brick Fields near Nasaratpur

Brick Field near Kalinagar

Fodder Transportation near Kalna

Food Grain Transportation near Kalna

The transportation of mined sand across waterway on country boats to brickfields are prominent between Nabadwip and Kalna. The other commodities transported between banks observed during site visit are fodder, food grains etc. Fishing in country boats and net fishing were also prominent in this stretch between Nabadwip and Kalna. Most of the area along the banks were cultivated and water intakes for agricultural were visible. The entire river banks between Nabadwip and Kalna are unprotected with sloping or steep banks. Birds nests are observed on the steep banks (vertical banks). Wooden tetrapod's and broken bricks were used for preventing erosion near settlements along the banks.

Transportation of Mined Sand for Brick Fields

Bank Protection with Broken Bricks Near Kalna

Kalna is a small municipality on the banks on NW1 located at km 208 on RHS. Central Water Commission (CWC) has established a gauge station at Kalna. There is an existing water intake structure for serving Kalna municipality, ferry services is operated at Kalna towards Nrisnghapur area.

CWC Gauge Station Kalna

Water Intake Structure on RHS Kalna

Passenger Ferry Ghat at Kalna

Houseboat at Kalna for Tourist

Between Kalna to Sarputi, channel moves along RHS and channel shift to LHS between Sarputi and Balichar. Channel runs along the LHS from Balichar to Gutipara area and then shift to RHS for about one kilometer. From Shantipur to Balagarh the channel moves mainly along the LHS and through the centre for a distance of about 16 km. Channel continue along the LHS from Balagarh to Gurunagar and from Gurunagar it moves along RHS for about two kilometer and returns to LHS and runs about three kilometer upto Bareswarpur. While negotiating the curve near Santierchar area, the channel moves from LHS to RHS and will continue along the RHS for about two kilometer and returns to LHS. Near Tarinipur to Raydanga area the channel moves along the LHS and shift towards the RHS for negotiating curves at Chandrahati. From Chandrahati for about two kilometer the channel moves along RHS upto reaching Tribeni and continue along the center while passing through the Iswar Chand Gupta Bridge reaching Kanchrapara area. Channel runs close to LHS further upto Naihati area at Hooghly bridge and shift towards RHS and runs about four kilometer upto reaching Titagarh area. Further, the channel moves mainly along LHS negotiating the curves through centre to reach the Manirampur and Barrackpore area. From Barrackpore, the channel moves towards the RHS upto reaching Titagarh area and from Titagarh onwards channel runs mainly through the centre of the waterway upto reaching Dakshineshwar area. The channel moves to RHS after Swami Vivekananda Bridge and shift towards LHS and then to the centre between Rabindra Setu. Between Rabindra setu and Vidya sagar setu, channel moves through the center of waterway and continue upto the IWAI terminal.

Four water intake structures for irrigation and municipal supply were installed between Kalna and Sukurai. Of the four water intakes three are on the RHS and one on LHS of the channel. The major water intake is at Kalna at km 208 on RHS and used for municipal water supply of Kalna Municipality. The other prominent water intake structure is at km199 on LHS, used for water supply to the Narasingha nagar area. The other two water intake structures are for small scale irrigation purposes and located at km 192 km and km 189 on RHS of the channel.

Water intake on LHS near Guptipara

Water Intake on RHS Narasingha Nagar

Fishing is a prominent activity between Kalna and Sukarai. The major type of fishing observed are net fishing and fishing on country boats. Country boats for fishing were visible near Kalna at a km 208 km on RHS and Santipur at km 198 on LHS. Other major activity along this area are transportation of mined sand between the banks to brick fields. Area marks country boat operation carrying mined sand between km 202 –km 210. Sand heaps were observed near brickfields. A tower line crosses the banks near km 189 at Sundalpur area. The prominent locations of brick fields are Nandagram at km 210, Kalna at km 207 and Guptiapara at km 202. Sabujdwip forest area fall along RHS between km 186 to km 187.

Tower line Crossing at Sundalpur Area

Sabujdwip Forest area on LHS

Bank erosion on LHS near Rasulpur Area

Eroding banks near Narasingha Nagar Area

Bank erosion was observed near Rasulpur at km 187 on RHS and Narasingha nagar on LHS at km 197. Near Narasingha nagar bank erosion has lead to the collapse of a brick kilns and uprooting of mango trees along LHS. Birds nests were seen near the eroding banks along the channel. The major locations of ferry crossings are Chaudhuripara at km 210, Kalna at km 208, Guptipara at km 201, Shantipur at km 194 and Rampura at km 198. The floating terminal of IWAI is located near km 203 on LHS of the channel. Navigational lights are installed at regular intervals for making the night navigation possible.

Ro- Ro Ferry Operation at Guptipara Area

Shantipur Ferry Ghat

IWAI Floating Terminal near km 203 on RHS

Fishing on Country Boats near Shantipur Area

The major locations of water intake structures between Sukurai and Kalayani area up to Iswar Chand Gupta bridge are Bandel Thermal power plant, Tarinipur, Baneswarpur, Balagari and Jagapur area. Six water intake for catering industrial, domestic and irrigational water demand are constructed between these stretches. The water intake near Jagapur area on LHS at km 178 and 177.5 km caters the irrigational and domestic requirement of the Jagapur area. Intakes near Balagari char and Tarinipur on LHS at km 176 and km 163.5 caters the irrigational water demand and intake at Baneswarpur on RHS at km 168 meets the irrigational demand. Bandel thermal power station intake at km 157.5 km on RHS meets the industrial demand. Industrial discharge from cooling tower can be seen near km 157 on RHS.

Irrigational Water Intake Structure at Jagapur on RHS

Domestic Water Intake Structure at Jagapur on RHS

Irrigational Water Intake near Balagari Char on RHS

Irrigational Water Intake near Baneswarpur on LHS

Industrial water intake for Bandel Thermal Power Plant

Water Discharge from Bandel Thermal Power Plant

Bhandals were constructed near km 181 for diverting the flow into the main navigational channel. The major locations of ferry crossings between Sukurai and Kalayani area are Balagarh, Char Bhawanipur at km 175, Khairamari char at km 174, Bareswarpur at km 165.6 and Tribeni ferry at km 156. All the ferry in this stretch are mainly meant for movement of passenger between the banks and Balagarh ferry at km 183 km is also used for the transportation of Light Motor Vehicles like bikes across the banks.

Bamboo Bhandals near km 181

Char Bhawanipur Ferry

Balagarh Ferry Crossing near km 183

Tribeni Ferry near km 156

Overhead tower lines crosses the waterway at three locations namely Rukespur, Char Naosarai and Bandel thermal power station. Of the three locations tower line at Rukespur near km 169.5 km collapsed during a flood event few years back due to the failure of foundation of tower and presently West Bengal State Electricity Board (WBSEB) had abandoned the tower line. At km 162 at Char Naosarai. A multiple tower line is crossing where two tower lines crosses the waterway. A single tower line crosses the waterway near km 158 km at Bandal thermal power station. A boat building unit is located near km 183 on the RHS of channel.

Foundations of collapsed tower line at Rukespur

Multiple tower line crossing at Char Naosarai

Tower Line Crossing Near Bandal Thermal Power Plant

Boat Building Unit on LHS Near Balagarh

Bricks fields are located at Balagarh on both RHS and LHS near km 183. Other locations for brick fields are Sibpur and Jagapur on LHS near km 180 and km 178. Majherchar on LHS from km 158 to km 155 and Moktarpur on RHS near km 166 are prominent locations of brickfields. Navigational lights for night navigation are provided at regular intervals. Fishing in country boats and using nets are a prominent activity near Balagarh area and fishing is prominent in this area. Country boats for transporting sand bags were observed near Kalipur area near km 165. Shiv temple is located on the LHS near Jagapur area at km 178. Bank erosion is mainly observed on LHS at Malopara from km168 km to 172. Bank erosion is prominent along the LHS from chainage 176 km to 178 km. Stone pitching for bank protection is provided on the LHS near Mukundanagar. Island were formed at Balagarh and Naosarai area. Balagarh island runs from km 175 to km 183 and Naosarai island is from km 162 to km 166.

Brick Fields Near Balagarh Area

Brick Fields Near Kalyani Area

Stone Pitched Banks On RHS Near Mukundanagar

Eroding Banks On RHS Near Mangaldeep Area

The entire stretch is dominated by agricultural activities between km 159 to km 185 km and municipal limits on RHS runs upto a chainage of 159 km. Koltaka Port Trust (KoPT) has installed a tidal gauge station at Tribeni.

Kalyani to Kolkata stretch has the maximum number of water intake structures. The entire stretch from Kalyani to Kolkata passes through heavily built urban area and constructed with maximum numbers of cross structures. Nineteen water intakes structures were on the banks.

Mangal Pandey water treatment plant at Barrackpur is a major water treatment plant among the listed water intakes and Titagrah water intake for Calcutta Electric Supply Corporation (CESE) is an industrial water intake for power generation among the listed intakes. All the other intake structures are meant for serving the water demand at particular locations only.

CESC Industrial Water Intake at Titagrah

Mangal Pandey Water Treatment Plant on RHS at Barrackpur

Water Intake Structure at Belur Math on LHS

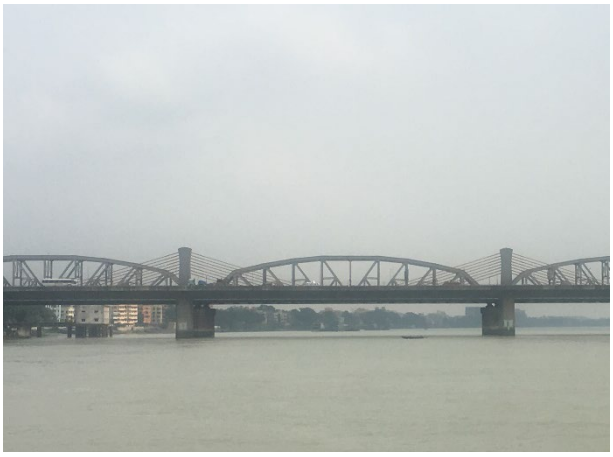
Water Intake Structure at Banshbaria on LHS

Overhead tower lines were constructed near Kanchrapara, Titagrah and Belur Math area. Kancharapara the tower line crossing is located downstream of Iswar Chand Gupta bridge near chainage 154 km and Titagrah tower line connects the Titagrah and Rampurai area near km 122. The other tower line this stretch is located at Belur math near km 109.5.

Tower Line Near Titagrah Area

Tower Line Near Kancharapara Area

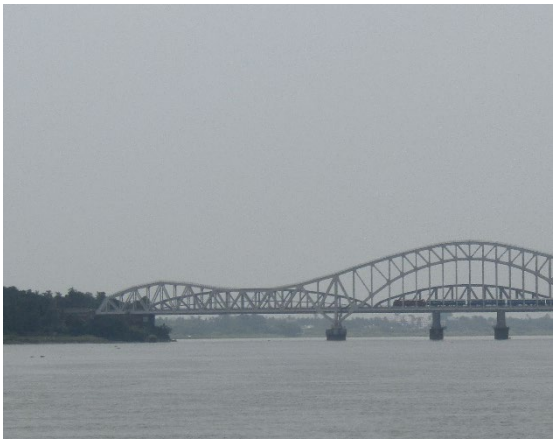
Five river bridges were constructed in this stretch namely Iswar Chand Gupta bridge, Jubilee bridge, Vivekananda bridge, Rabindra bridge and Vidya sagar bridge. Iswar Chand Gupta Road Bridge near km 154 connects Kalyani area and Chak Bansberia area. Jubilee and Sampreeti multiple rail bridge connects Naihati and Bandel area near km 147. Swami Vivekananda Setu, a multispan steel bridge linking the city of Howrah and Dakshineswar with road and rail connectivity crosses fairway near km 113. Rabindra setu, a road bridge with a suspended span linking the two cities of Howrah and Kolkata near km 105 Vidya Sagar setu, also known as second Hooghly Bridge connecting Howrah and Kolkata is located at km 101 km.



Vivekananda & Nivedita Bridge Near km 113

Vidyasagar Setu near km 101

Iswar Chand Gupta Bridge Near km 154



Jubilee and Sampreeti Bridge near km 147

Howrah Bridge near km 105

There are 39 ferry crossings along the stretch.From km 152 to km 154, brick fields occupies the LHS of channel and lies close to the banks. While RHS were heavily built section with scattered brickfields island is formed within the river at center from km 151 to km 152.

Saraswat Math Temple on RHS

Halisahar Crematorium on RHS

Saraswat Math temple and Halisahar crematorium exists on the LHS near km 151.5. From km 150 to km 152, heavily built section forming part of Halisahar area and Tegharia area remains on the RHS. Vacant vegetated areas occupy along RHS immediate to the banks in these stretches and built-up area lies beyond the vegetation. Sahaganj Dunlop tyre factory and jetty were located in the RHS along these stretch. RHS from km 148 to km 150 were almost vacant with green vegetation and brickfields occupies away from the banks. Heavily build section of Sahaganja were observed beyond vegetated areas on the RHS in this stretch. LHS at this stretch is Hajinagar area with heavily build section including jute and paper mills. Hukumchand and Naihati jute mills lies in this stretch and a jetty of Naihati jute mill is present on LHS. Kali mandir and Jagannath temple lies on LHS near km 150.

Naihati Jute mill on RHS

Jagannath Temple on RHS

Average width of the river in this stretch is 500 m. From km 146 to km 148, Hooghly area lies on the RHS which is heavily built and on the LHS is the Haji Nagar area. Jenson & Nicholson

and Gauripur Jute factory lies on the LHS. Hooghly Imambara is located along the RHS near km 148. The other features on the RHS in this stretch includes Ramsita Mandir, Jail Khanar Math, Mallick Ghat, Shiv Mandir, Mallick Bari Shiv Mandir, Burning Ghat, Shiv Mandir and Rani Rasmoni Mandir while on the LHS the features includes Ramghat Park, Chaighat Park and Naihati Goala Para Park. From km 144 to km 146, Naihati area on the LHS and Chinsura area on the RHS continues. Naihati Jute Mill lies in this stretch near km 144.5 and the Naihati jute mill jetty exists near to the mill. A ferry service is operated between Chinsura and Naihati area.

Hooghly Imambara on LHS

Naihati Passenger Ferry Services

Chinsura area continues upto km 142 on RHS and this stretch is also heavily built with brick fields near km 142 km. Jute and paper industries occupy LHS along this stretch and the major industries are Reliance Jute industry, Titagarh Paper mill and Kankinara Jute mill. Jetties along these stretch are Titagarh paper mill jetty, Titagarh paper mill pump house jetty and Titagarh paper mill gantry jetty are along the LHS.

Jagaddal- Chandannagar Ferry Service

Gandary Jagaddal Jute Mill along RHS

Kankinara Ghat on RHS

Authpur-Gondalpara Ferry Service

Jute mills continue from 140 to 142 km chainage along the LHS of the channel. The major jute industries along LHS are Anglo India Jute mill, Jagaddal Jute mill and Alexandra Jute Mill. Jetty along the LHS in this stretch are Anglo India Jute mill jetty, Jagaddal Jute Mill pump house jetty, Jagaddal Jute Mill Jetty and Alexandra Jute Mill Jetty. Chandannagar is on the RHS for the entire stretch and the this stretch is heavily built section with brick fields near chainage 142 km. Chandannagar continues on the RHS downstream from 138 to 140 km and this stretch continue to be heavily built up sections. Fishing in country boat is active in this area. While land use along the LHS continues as industrial with jute mills and the jute mill in this stretch is Auckland Jute mill. Major jetties along the LHS are Auckland Jute mill Jetty and Hindustan Lever Jetty. Authpur area is on the LHS near to chainage 138 km. Ferry services connecting Authpur area and Gondalpara area operate in this stretch.

Industrial area continues between km 136 to 138 with Jute mills on both sides. Guari Sankar Jute Mill is on the LHS and Gondalpara Jute Mill and Victoria Jute Mill lies along the RHS. Telinipara is a heavily built section along the RHS in this stretch and Shyamnagar area lies on LHS. Ferry services connects Tellinipara and Shyamnagar at km 137. Danbar cotton mills, Shyamnagar and Garulia area is on the LHS from chainage 134 to 136 km. A jetty of Danbar cotton mills is on the LHS along this stretch. Bhadreswar area is along the RHS with Samunganj Jute mill and Bhadreswar railyard. Ferry services are operated between Bhadreswar area and Garulia near chainage 135 km. Brick fields exist on the LHS near chainage 134 km. Ichapur Gun & shell factory is along the LHS from chainage 132 to 134 km and Garulia area continues upto Ichapur gun factory. Brick fields are located along the LHS near to chainage 134 km and drains joins the main river on both sides of the bank. Angus, North Brook and Dalhousie Jute mills are on the RHS along this stretch.

Monirampur Ferry Ghat

Burning Ghat near Srirampur

Temple Ghat on LHS near Srirampur

Drain Joining from Sheoraphuli on LHS

Gantry jetty of Angus Jute mill is on the RHS in this stretch. From chainage 130 to 132 km is the area of Mangal Pandey Water Treatment Plant on the LHS. Nawabganj area is on the LHS near chainage 132 km. The RHS along this stretch is Sitaram area with Champdani Jute Mill. Jetty of Champdani jute mill on the RHS is along this stretch. Brickfields and green belt area of Mangal Pandey Water Treatment Plant dominates the LHS from a chainage of 128 to 130 km. RHS along this stretch is Baidyabati area and this stretch is heavily built. Ferry crossing connects Baidyabati area with Sardar bazar near chainage 128.5 km. A drain joins the RHS near chainage 129 km. From chainage 126 to 128 km is the Chatra area on the RHS which is a densely populated area. LHS along this stretch is a vegetated area.

Ichapur Industrial Area on RHS

Gantry Jetty of Angus Jute Mill on LHS

Ferry service connecting Seoraphuli and Monirampur are there near chainage 128 km. Ferry services also connects Barrackpore and Srirampur near chainage 126 km. From chainage 124 to 126 km is the Barrackpur Cantonmnet area on the LHS and RHS is Srirampur area. RHS is a heavily built section with India Jute Mill and Srirampur residential area. Burning Ghat and shiva temple are on the LHS along this stretch. Residential area are close to the banks with drains joining the river at many locations. Fishing is predominant along this stretch.

The chainage from 122 to 124 km is Nehru Nagar along RHS and brick fields exist near a chainage 122.5 km. Titagarh area is on LHS along this stretch and the prominent feature along LHS include Titagarh Paper Mill. Jetty can be seen on the LHS for Titagarh paper mills. Ferry service is operated from Mahesh Jagannath Ferry ghat and Laxmi ferry ghat near a chainage 122.5 km. Water intake for Titagarh generating station CESE is on the LHS near a chainage 122km. Boat repair and manufacturing units lies along the LHS near chainage 123 km.

Boat Repair and Manufacturing Unit on LHS near Titagarh

26 Shiva temple on RHS

Rishra Ferry Ghat on LHS

Hasting Jute Mill Jetty near Rishra Area

Titagarh jute mill and Bose para area is on the LHS from chainage 120 to 122 km. Jetty of Titagrah jute mill can be seen on the LHS near chainage 122 km and a drain joins the LHS near chainage 123.5 km. 26 shiva temple is on the LHS near chainage 123 km. Ferry crossing connect Rishra area with Khardah area near chainage 121 km. Nehrupal burning ghat is on the LHS near chainage 120 km. Moirapara area with Bangoshri Cotton mill, Hasting Jute mill and Govind steel industries lies along the RHS in this stretch. The RHS is densely occupied by residential buildings and jetty of Hasting jute mill and Bangoshri cotton industries. From chainage 118 to 120 km, both the banks are densely populated with Hatirkul area on RHS while Sukhchar and Panihati is on the LHS. Ferry service connect Konnagar area on RHS near chainage 118.5 km on RHS and Panihati area on LHS near chainage 118 km. Panihati twelve temple is on the LHS near chainage 119 km. The port limits begins near chainage 118 km. Bamboo bundles stacks were seen near Panihati area on LHS. Chainage from 116 to 118 km is continuation of Panihati and Agarpara area on the LHS while RHS is continuation of Konnagar and Dharsa area. The stretch is beginning of KoPT limits area downstream. Brick fields exist on the RHS from chainage 116 to 118 km. The RHS vegetated area and building exist near to chainage 116 km close to bank.

Panihati Ferry Ghat on RHS

Kamarhati Jute Mill on RHS

Burning Ghat exist on the RHS near chainage 116 km. LHS is densely populated with Kamarhati Jute mill near to chainage 116 km. Jetty and Gandry structures of Kamarhati Jute mill can be seen on the LHS along this stretch. Uttarpara area lies along the RHS from chainage 114 to 116 km and the entire area is densely populated. Nodapara area lies on the LHS along this stretch. Ferry crossing connects Uttarpara area with Nadapara near chainage 114.5 km.

Kotrung and Bally area are on the RHS from chainage 112 to 114 km. This stretch is densely populated with a drain joining the main river near chainage 113.5 km. Dakshineswar and Barahanagar area lies along LHS in this stretch. The famous Dakshineswar temple is located near chainage 113 km on the LHS of the bank. Sarada ashram is located closed to chainage 114 on the LHS of bank and bank protection for the entire stretch are permanent on both sides. A ferry services is operated from Dakshineswar to Uttarpara near a chainage 114 km and ferry services are also operated between Dakshineswar to Belur Math.

Drain Inlet near Bally on LHS

Dakshineswar Temple Ghat on RHS

Sarada Ashram near Dakshineswar on RHS

Uttarpara Passenger Ferry

Barahanagar Jute mill lies on the LHS near chainage 112 km and a jetty exist on LHS for the Jute mill. From chainage 110 to 112 km the entire bank are permanently protected and Belur math lies along the RHS of the channel while Barahnagar continues along the LHS. A ferry service is operated between Belur Math and Barahnagar near chainage 111 km. Burning Ghat are seen both on RHS and LHS near chainage 112 km. Chainage from 108 to 110 km are densely populated areas with Ghusuri area along the RHS while Cossipore and Bag bazar area lies along LHS. A drain joins the main river near chainage 108 km on LHS and the entire stretch is heavily built on both sides with permanent banks. Ferry service connects Baranagar with Cossipore area and extend upto Dakshineswar area. Chainage from 106 to 108 km both the banks are heavily built and fully developed banks. Berthing of barges are predominant in this area. Beniatola area is on the LHS and Shalkiya area is on RHS. Ferry services are seen between Howarh, Sovabazar, Babu ghat, Outram Ghat, and Bag Bazar. This stretch is a heavy traffic area with barges and ferry crossings.

Belur Math on LHS

Barahnagar Ferry Services

Drain Joining River Upstream of Belur Math

Berthing of Barges along the Main River

Chainage from 104 to 106 km is Barabazar area on LHS and RHS is Howara area. The entire stretch is heavily built with permanent protections on both sides. Berthed barges can be seen in the entire stretch. Ferry ghats are located on both RHS and LHS of the channel. The ferry ghat along RHS are Golabari and Howrah ghat while Ahireetola ghat and Armenian ghat are the major ghat along the LHS on this stretch. Drains joining the main river can be seen on both sides of the river along this stretch. Naora area lies on the RHS from chainage from 102 to 104 km while Kolkata area lies on the LHS and the entire stretch is heavily built with permanent banks on both sides. Berthed barges can be seen throughout this entire stretch. Fishing and tourism activities are also prominent in these stretches. Ghats for washing and bathing can be seen on both RHS and LHS of the channel. Ramkristopur ferry ghat is on the RHS near chainage 103 km while Fairlye Place ferry ghat, Chandpal ferry ghat, Baboo ferry ghats and Outram ferry ghats lies on the LHS near chainages 104, 103, 102.5 and 102.4 km. Ferry services runs both parallel and perpendicular to the channel making the section a high traffic area. The major ferry services in this stretch are Howrah station- Babu ghat- Outram Ghat ferry service, Babu Ghat- Ramkrishnapur ferry services, Howrah Station- Fairlyplace ferry service and Kolkata –Howrah ferry services. Surface transport jetty is on the LHS near chainage 102.5 km and shed no 4 with jetty is on the LHS near chainage 104 km.

Babu Ghat

Armenian Ghat

Bathing Ghat at Howrah Area

Entry to Khidirpur dock lies along the section 100 to 102 km near the chainage 100 km on LHS of channel. Khidirpur area lies on the LHS of the channel along this stretch and RHS is Kazipara area. A drain joins the river near chainage 100.5 km on the LHS of the channel. Bidhan ghat and Prinsep ghat lies on the LHS in this stretch. The LHS is heavily built with office space close to waterbody. Shalimar rail yard is on the RHS near chainage 100 km. A.C Roy Dock lies on the RHS near a chainage 101.5 km. Banks are protected with permanent banks on both RHS and LHS and berthed barges awaiting for loading and unloading can be seen in the entire stretch. This stretch is an active area with container barges. Chainage from 98 to 100 km is an active zone with multiple activities along the banks. RHS in this stretch is occupied with barge repair and manufacturing unit. LHS is a heavily built section with TT Shed near chainage 99.5 km and BISN jetty near chainage 98.5 km. South Eastern Railway central hospital is on the LHS near chainage 99 km. Berthed barges can be seen throughout this stretch awaiting for loading and unloading activities.

TT Shed Jetty on RHS

Entry to Khidirpur Dock on RHS

Prinsep Ghat on RHS

Country Boats near Prinsep Ghat

BISN Jetty IWAI near km 98 on RHS

Kolkata to Haldia stretch part of NW 1 is the link connecting the inland waterways to the Bay of Bengal. The stretch falls under the maintenance of Kolkata Port Trust (KoPT) where IWT operation is happening along with shipping operations of Port. The 140 km stretch between Kolkata to Haldia could be categorized as a high traffic area where numerous vessels are under operation. The stretch can be categorised as a wider stretch where the width of the waterway is falling between 0.4 to 7.0 km. The fairway is maintained by KoPT and having sufficient draft all through the season.

The major activities include the sailing in and out of ships from Port, operation of defense vessels, traffic related with the ship manufacturing unit - Garden reach ship builders, cargo vessels supporting industrial units of Haldia, ferry crossings, operation of sea going fishing vessels including fishing harbor – Diamond harbour. This section forms part of the high traffic area of NW 1 stretch with numerous vessels and jetties all throughout.

1.11. Kolkata to Hooghly Point

Kolkata to Haldia section represents the major traffic route in NW1 where the Port based cargo operation, Indo Bangladesh protocol routes and IWT transport hare happening on the same region. BISN Jetty of IWAI is present on LHS opposite area is Indian Institute of Engineering Science and Technology on right bank and Botanical garden Jetty is present on the opposite bank. Garden Reach Jetty is immediately present on LHS followed by Connectivity to Netaji Subhash Dock followed by Surinam Jetty on LHS. CMWSA water intake Jetty is present on LHS. Bichalighat Ferry is operational in the area to Nazirganj Ghat on RHS.

Garden Reach Ship Builders & Engineers Limited, Main Unit comes on LHS at km 96 whereas Nazirganj Hooghly Dock is present on RHS. Howrah drainage channel inputs to river on RHS. Shalimar Jetty is present on RHS followed by Sita Ram Jetty on LHS. Raja Bagan Dock is present next to Sita Ram Jetty on LHS where Defense Vessels were present. Rajabagan Ghat is present on LHS Padara Ghat is present on RHS and ferry crossing is happening in between. Substantially built up residential area is present on LHS whereas open plain grass covered banks are present on LHS. Central Warehousing Corporation godown is present on RHS along the bank and the waterway section is more than 600m width along the way where the fairway is running along RHS. The fairway negotiates through RHS along Panchapara Crossing area bank protection is done partially along this area on RHS passing further through Sankrail reach along RHS. The fairway negotiates through centre to LHS to negotiate further through a right turn approaching Akra area. Brick kilns are widely seen in both Akra and Sankrai – Manikpur

area where ferry crossing is happening between Akra and Manikpur including old abandoned factories on both banks. Burning ghat is present after the Akra Ferry crossing area on LHS.

Garden Reach Ship Builders - LHS

Ferry between Rajabagan Ghat on LHS and Padara Ghat on RHS

Open Shrub Banks on LHS

The curvy area is characterized by protected and non-protected banks along its way vegetated banks are visible and after Akra area the channel shits towards sentre. Mahesthala area follows on LHS and Manikpur brick factory areas follows on RHS. Mahesthala is a completely built up residential area where plain sloping banks are present. A well-developed residential area Eden city is located in proximity to the river bank on LHS followed by Mahesthala Ferry Ghat on LHS where ferry service is operational to Sarenga Ferry terminal on opposite bank. Many kind of vessels were observed in between Country boats, police boat at Gedde, customes boat, barges, dredger etc.

Eden Garden at Mahesthala on LHS

Customs boat at Baj Baj

Barge

Cargo Vessel

Passing through the well-developed bank areas, Baj Baj Ferry is operational at km 80. Jetty is present on LHS where fairway has proximity, followed by extensive oil storage on LHS in Joychandipur having 6 series of jetties operational feeding to the storage tank along the bank. Bauria side has intake associated with industrial operations opposite to the oil jetty area. Bauria Ferry ghat is present on RHS. Jyoti Basu Park is present on LHS and the area is having more than 600 m width for water course in this way. Charial canal joins the major river course on LHS and from where the width of the river increases to more than 800m from this stretch onwards. Barges and cargo vessels are present along this area. RHS is too far but many country

boats are operational along RHS. Water supply intake is present on LHS as the fairway approaches Poojali area. Poojali TPS area occupies more than 1 km area along the length of the watercourse; on LHS water intake for TPS is present. Numerous sea going vessels are halting in this area for loading flyash. Fly ash loading is happening through Pontoon jetty and ferry crossing is immediately followed between Poojali area and opposite bank and Rajapur Drainage joins on RHS.

Poojali Thermal Power Station

Flyash Loading from Pontoon Jetty - LHS

Flyash Loading Vessels Near Poojali TPS

While channel continue along center, RHS is well developed areas of Boikunthopur whereas LHS is grassy slope banks of Aachipur area where brick kilns are present along the bank. Aachipur ferry ghat is present on LHS. Uluberiya ferry ghat is presents on RHS with numerous country boats indicating active rural areas along its way. Kadua Canal and Midnapur Canal are

joining the river from RHS on its course. Birla Jute Mill is present along LHS, the area i.e. Birlapur area follows on LHS with dense developments and water supply intake is present on LHS. Birlapur represents an area having high density of fishing vessel operations and the area is having more than 1.25 km width in this reach.

Developed banks are continuing along the LHS and RHS of waterway, Burul ferry operation is ongoing and the area on LHS marks series of fishing vessels along its way. Damodar river joins at km 54 on RHS, agriculture intakes are present on LHS where the fairway is sliding on to the same direction. Brick fields are continuing on both banks and cage culture is present along the area. The area represents clear domination of fishing activities with numerous vessels halted in New Kant a Kala Ghat and Falta ferry jetty is present at km 48. Rural settlement continues and agriculture fields are interspersed till reaching Hooghly Point where Roop Narayan River joins Hooghly River where width of river is more than 2.8 km in this section.

Fishing Vessels after Burul Ferry Ghat

1.12. Hooghly Point to Haldia

Between km 40 to km 38, fairway negotiates through RHS and rural settlements are visible. Water intake jetty is present on RHS, ferry is operational between Geonkhali (RHS) and Nurpur (LHS). Numerous fishing boats, and presence of brick factories marks this area. Agriculre areas extends over Noorpur area and vessel traffic operational is prominent like barges, fishing boats etc. Sloping exposed banks are present along the stretch.

Tallest electric line connecting to North Eastern region of the country is crossing Hooghly river with Matiram Chak on RHS and Paschim Bhabanipur on LHS. Water supply intake is present on RHS. Ferry is operational between Kukrahati on RHS and Roy Chak on LHS where fish harbor jetty is also present. Roy Chak area is a built up medium town area and the fairway slides over to LHS to negotiate through the curve between km 26 - km 10. Extensive brick fields are present on LHS and the water body width is substantially increased from km 26 onwards to more than 3 km where the area marks a highly traffic area where vessel transfer from mother vessels, barges, fishing boats etc. are visible. RHS of the area is dedicated anchorage for sea going vessels. Tidal Station of KoPT is present on LHS at km 24. Diamond Harbour Creek is joining the river from LHS and the fairway approaches active Diamond Harbour area. Diamond Harbour Jetty and KoPT Jetty are present on LHS where the fairway is running through and ferry service is operational. The Diamond Harbour area remains are a wider stretch of the NW 1section where the width of the watercourse is more than 5 km.

Tallest Electric Line Connecting North Eastern Region of Country Crossing Fairway

Mother Vessel Transfer

Seagoing Fishing Vessels of Diamond Harbour

Diamond Harbour area and continuing Sultanpur area on LHS is characterized by many sea going fishing vessels anchored on RHS and Fishing vessel jetty is present in Sultanpur. Sultanpur area is having plain exposed clayey bank on LHS where are RHS is too far. Fishing through fixed nets are widely seen tin this area. Protected banks are visible on LHS whereas RHS is too far and wider stretch continues till the fairway negotiate through a smooth curve between km 16 and km 12. Tidally exposed banks are present on RHS and the industrial areas active with people and vehicles especially the heavy duty trucks for industrial transits followed by Indian Oil Corporation (IOC) Haldia Refinery on RHS and IWAI Jetty is present on RHS. The area is marked with high vessel concentration connected with Refineries. More than 5 jetties including 2 oil handling jetties are present in this area followed by Haldia Dock on RHS.

Indian Oil Refinery - Haldia

ANNEXURE II - DETAILS OF CRITICAL SECTIONS

Critical Sections in NW 1 w.r. to IWT Related Risk

Sl. No.	Ch. Start	Ch. End	Start Location Name	End Location Name	Reason for Criticality
1	0	2	Haldia	Nayachar Island	High traffic area, Cargo Jetty
2	2	4	Haldia	Nayachar Island	High traffic area, Cargo Jetty
3	4	6	DurgaChak	Balari Char	High traffic area
4	6	8	DurgaChak	Durga Nagar	High traffic area
5	8	10	DurgaChak	Durga Nagar	High traffic area
6	10	12	Banerwar Chak	Kulpi	High traffic area
7	12	14	Begunbere	Kulpi	High traffic area
8	14	16	Begunbere	Chakrupelsakar	High traffic area
9	16	18	Begunbere	Harinarayanpur	High traffic area
10	18	20	Begunbere	Bhishnurampur	High traffic area
11	20	22	Begunbere	Rabindra Nagar	High traffic area
12	22	24	Erakhali	Diamond Harbour	High traffic area, Passenger ferry crossing
13	24	26	Erakhali	Diamond Harbour	High traffic area
14	26	28	Erakhali	Harinarayanpur	High traffic area
15	28	30	Kukrahati	Singal ganja Abad	High traffic area, Passenger ferry crossing
16	30	32	Kukrahati	Roychak	High traffic area, Tower line crossing
17	32	34	Latpatia	Roychak	High traffic area
18	34	36	Thenul Bariya	Sukdebpur	High traffic area
19	36	38	Suklalpur	Sukdebpur	High traffic area, Passenger ferry crossing
20	38	40	Gadiwara	Sukdebpur	High traffic area
21	40	42	Gurepol	Sriphalbaria	High traffic area
22	42	44	Kurchi Beria	Noorpur	High traffic area
23	44	46	Sibganga	Ramnagar	High traffic area
24	46	48	Dinga-Khola	Akalmegh	High traffic area
25	48	50	Alipur	Falta	High traffic area, Passenger ferry
26	50	52	Barkalia	Shyamsunderpur	High traffic area
27	52	54	Kasipur	Ahmadpur	High traffic area
28	54	56	Chandipur	Padmapur	High traffic area, Passenger ferry
29	56	58	Belari	Burul	High traffic area
30	58	60	Baganda	Bahirkunji	High traffic area
31	60	62	Dakshin Ramachandrapur	Godakhali	High traffic area
32	62	64	Hirapur	Godakhali	High traffic area
33	64	66	Hiraganja	Dakshin Raypur	High traffic area
34	66	68	Kajiakhali	Birlapur	High traffic area
35	68	70	Kalinagar	Jagatballavpur	High traffic area
36	70	72	Uluberia	Achipur	High traffic area, Passenger ferry

Sl. No.	Ch. Start	Ch. End	Start Location Name	End Location Name	Reason for Criticality
37	72	74	Fuleswar	Pujali	High traffic area, Cargo Jetty
38	74	76	Sijberia	Pujali	High traffic area, Passenger ferry
39	76	78	Chakashi	Pujali M	High traffic area
40	78	80	Hat Bauria	Joychandipur	High traffic area, Passenger ferry, Cargo Jetty
41	80	82	Radhanagar	Shyampur	High traffic area
42	82	84	Raghudebatti	Chakchandul	High traffic area, Passenger ferry
43	84	86	Sarenga	Palpara	High traffic area
44	86	88	Manikpur	Uludanga	High traffic area
45	88	90	Osmanpur	Dakshini Housing Estate	High traffic area
46	90	92	Sankralijala	Badartala	High traffic area
47	92	94	Hatgacha	Badartala	High traffic area
48	94	96	Chunavati	Siraj Basti	High traffic area, Cargo Jetty
49	96	98	Gaubari	Bichali Ghat	High traffic area, Cargo Jetty
50	98	100	Botanical Garden	NSDock (KoPT)	High traffic area, Cargo Jetty, Narrow/dense settlement
51	100	102	Kazipara	Kidderpore (KoPT)	High traffic area, Cargo Jetty, Road Bridge
52	102	104	Naora	Fort William	High traffic area, Passenger ferry
53	104	106	Howra railway station	Fairley Palace	High traffic area, Passenger ferry, Critical Bridge
54	106	108	Mali Panchghara	Ahiritola	High traffic area, Passenger ferry
55	108	110	Ghusur	Chitpur	High traffic area, Passenger ferry, Tower line crossing
56	110	112	Belur Math	Ratan Babu Ghat	High traffic area, Passenger ferry
57	112	114	Bally	Barahanagar	High traffic area, Passenger ferry, Critical Bridge
58	114	116	Kotrung	Jayasreenagar	High traffic area, Passenger ferry
59	116	118	Debaipukur	Nehabootnagar	High traffic area
60	118	120	Arabinda Pally	Angus Nagar Colony	High traffic area, Passenger ferry
61	120	122	Dharmadanga	Kulinpara	High traffic area, Passenger ferry
62	122	124	Mahesh Bose Para	KS Path	Passenger ferry, Tower line crossing
63	124	126	Manick Tala	Talpukur Bazar	Passenger ferry
64	126	128	Tin Bazar	Barrackpore	Passenger ferry
65	128	130	Sheraupulli	Sardar Bazar	Passenger ferry
66	130	132	Jora - Ashattala	North Barackpore	Passenger ferry

Sl. No.	Ch. Start	Ch. End	Start Location Name	End Location Name	Reason for Criticality
67	132	134	Champdany	Ichapur	Passenger ferry
68	134	136	Gauhati	Garulia	Passenger ferry
69	136	138	Telinipara	Bichali	Passenger ferry
70	138	140	Gondol Para	Authpur	Passenger ferry
71	140	142	Bagbazar	ESD Machinery	Passenger ferry
72	144	146	Ghatakpara	Nimbagan	Passenger ferry
73	146	148	Medicine Mart	Mirabagan	Passenger ferry, Multiple bridge
74	154	156	Panchanan Tala Park	Char Kancharapara P	Road bridge, Tower line crossing
75	156	158	Tribeni	Kalyani	Passenger ferry, Cargo Jetty
76	158	160	Refaitpur	Char Modhusudanpur	Tower line crossing
77	160	162	Noasari Char	Char Jajira	Tower line crossing
78	164	166	Durgapur	Tarinipur	Passenger ferry
79	166	168	Sija	Srikrishnapur	Passenger ferry, Critical curve
80	168	170	Baneswarpur	Malopara	Passenger ferry, Eroding banks, Eroding tower line, Critical curve
81	174	176	Bhabanipur Char	Chakdaha	Passenger ferry
82	176	178	Char Gaur Nagar	Balagari Char	Passenger ferry
83	182	184	Gournagar	Gosair Char	Passenger ferry
84	188	190	Char Noapara	Char Rasulpur	Tower line crossing
85	192	194	Champaklata	Jhau Mahal	Passenger ferry
86	194	196	Bruttichar	Charsimulia	Eroding banks
87	196	198	Gangadharpur	Malipota	Eroding banks
88	198	200	Ghoshra	Narasinha Nagar	Passenger ferry
89	202	204	Sultanpur	Char Sultanpur	Passenger ferry, Ro-Ro ferry
90	206	208	Kuledaha	Beltala	Passenger ferry, High traffic area, Ro-Ro ferry
91	208	210	Kalna	Nrisinghapur	Passenger ferry, High traffic area, Narrow/dense settlement
92	212	214	Bhangnapara	Piarinagar	Passenger ferry
93	222	224	Goalpara	Mohisunra	Passenger ferry
94	224	226	Hatsimla	Jalahati	Critical curve
95	238	240	Chak Rahatpur	Parmedia	Rail bridge, Tower line crossing
96	240	242	Chak Rahatpur	Gadkhali	Passenger ferry, Road bridge
97	242	244	Nabadwip	Char Brahmanagar	Passenger ferry, High traffic area
98	244	246	Ranirchara	Hulor	Passenger ferry
99	252	254	Chupi	Kuturia	Highly critical curve
100	254	256	Sajiara	Kuturia	Highly critical curve
101	262	264	Kamalnagar	Kararia	Passenger ferry
102	264	266	Kamalnagar	Chandanpur	Critical curve

Sl. No.	Ch. Start	Ch. End	Start Location Name	End Location Name	Reason for Criticality
103	286	288	Patuli	Babladanga	Passenger ferry
104	292	294	Kalikapur	Agradwip	Passenger ferry, Critical curve
105	294	296	Gazipur	Akandanga	Critical curve
106	300	302	Char Brajanathpur	Brajanathpur	Passenger ferry
107	302	304	Shatghar	Matiari	Ro-Ro ferry
108	306	308	Mondalhat	Ballavpara	Passenger ferry, Ro-Ro ferry, Channel Siltation Area
109	308	310	Katwa	Ballavpara	Passenger ferry, High traffic area
110	310	312	Enayetpur	Nasipur	Passenger ferry
111	312	314	Naihati	Gobra Paschimpara	Critical curve
112	318	320	Kalyanpur	Raghupur	Passenger ferry, Highly critical curve
113	320	322	Char Narayanpur	Kamalabari	Passenger ferry
114	330	332	Kadkhali	Char Palasi	Passenger ferry, Ro-Ro ferry
115	332	334	Ramnagar	Char Ramnagar	Tower line crossing
116	338	340	Mahammadpur	Maganpara	Passenger ferry
117	340	342	Arazi Jaykrishnapur	Nalahati	Passenger ferry
118	344	346	Chandpur	Chandpur Dair	Passenger ferry, Eroding banks, Critical curve
119	346	348	Mashimpur	Mashimpur Dair	Channel Siltation Area
120	350	352	Nagar	Char Mirzapur	Passenger ferry, Critical curve
121	352	354	Charkam Nagar	Mirzapur	Critical curve
122	354	356	Sona Diar	Meliani	Passenger ferry
123	356	358	Satui	Kumarpur	Passenger ferry
124	358	360	Chumarigacha	Barula	Tower line crossing
125	360	362	Bhabanandapur	Barula	Critical curve
126	362	364	Banamalipur	Radhaballabhpur	Critical curve
127	368	370	Charmahula	Hotnagar	Passenger ferry
128	370	372	Char Halal Pur	Parhalalpur	Passenger ferry
129	376	378	Jaganathpur	Char Begpur	Passenger ferry, Road Bridge, Tower line crossing
130	380	382	Ranibagan	Gora Bazar	Passenger ferry, High traffic area, Road bridge
131	382	384	Khagraghat	Khaghra	Passenger ferry, High traffic area
132	384	386	Bundhaipara	Mohon Roy Para	Passenger ferry, Narrow/dense settlement
133	390	392	Raitan Bag	Bhaduriapara	Passenger ferry, Narrow/dense settlement
134	394	396	Aminabazar	Kathgola	Rail Bridge, Tower line crossing

Sl. No.	Ch. Start	Ch. End	Start Location Name	End Location Name	Reason for Criticality
135	396	398	Mahinagar Diar	Azadhindbagh	Passenger ferry, High traffic area
136	398	400	Azimganj	Jiaganj	Passenger ferry, High traffic area
137	400	402	Badanagar	Bahadurpur P	Passenger ferry
138	404	406	Binod	Uttar Ganeshpur	Passenger ferry
139	406	408	Ganja Sinheswari	Maliapara	Critical curve
140	412	414	Char Sundarpur	Basantapur	Passenger ferry, Channel Siltation Area
141	416	418	Singechwari	Bhatpara	Highly critical curve
142	418	420	Arijpur	Bhatpara	Highly critical curve
143	426	428	Uladanga	Rajarampur	Passenger ferry
144	428	430	Balia	Syampur	Passenger ferry
145	430	432	Ujjal Nagar	Panisala	Passenger ferry, Critical curve
146	434	436	Fraser Nagar	Nasipur	Eroding banks, Critical curve
147	440	442	Mahammadpur	Bahara	Passenger ferry
148	442	444	Elaspur	Bahara	Highly critical curve
149	444	446	Ramnagar	Kasia Danga	Passenger ferry
150	446	448	Dia Ramanagar	Kasia Danga	Passenger ferry, Narrow/dense settlement
151	448	450	Rani Nagar	Char Dafarpur	Passenger ferry
152	450	452	Dafarpur	Sahajadpur	Passenger ferry
153	452	454	Koribona	Chhota Kalia	Tower line crossing, Narrow/dense settlement
154	454	456	Basudebpur	Tantipara	High traffic area, Road bridge, Narrow/dense settlement
155	458	460	Khidirpur	Char Sekandara	Highly critical curve
156	460	462	Alampur	Char Sekandara	Passenger ferry, Tower line crossing
157	462	464	Rosanpur	Sonapur	Passenger ferry
158	464	466	Jalangapara	Bahadurpur	Multiple bridge
159	472	474	Amuha	Ekatia	Passenger ferry
160	476	478	Bhagalpur	Mahisha Thali	Passenger ferry
161	480	482	Bhasaipaikar	Ghoramara	Critical Bridge, Tower line crossing
162	484	486	Malancha	Dhuliyan	Passenger ferry, Aqueduct crossing, Tower line crossing
163	488	490	Sankarpur	Jigri Kulagachhi	Passenger ferry
164	492	494	Ballalpur	Imamnagar	Passenger ferry, Tower line crossing
165	494	496	Jafar Ganj	Fatepur	Narrow/dense settlement, Road bridge
166	496	498	Chandipur	Chauki	Cargo Jetty, Narrow/dense settlement, Tower line crossing, Multiple bridge
167	498	500	Srimantapur	Farakka	Passenger ferry, Cargo Jetty

Sl. No.	Ch. Start	Ch. End	Start Location Name	End Location Name	Reason for Criticality
168	500	502	Bewa	Farakka	Lock gate, Critical curve, Cargo Jetty
169	502	504	Gobindarampur	Gobindarampur	Passenger ferry, Narrow/dense settlement, Highly critical curve
170	512	514	Dogacchi	Nayagram	Eroding banks
171	514	516	Paranpur	Islampur	Eroding banks
172	536	538	Raniganj	Narayanpur	High traffic area, Ro-Ro ferry,
173	538	540	Rajmahal	Paschim Narayanpur	High traffic area, Ro-Ro ferry
174	540	542	Rajmahal	Paschim Narayanpur	Passenger ferry, High traffic area
175	578	580	Sahibganj	Bhagwanpur	Passenger ferry, Ro-Ro ferry, Cargo Jetty
176	590	592	Lal Bathani Millk	Rampur Ogairah	High traffic area, Ro-Ro ferry
177	592	594	Lal Bathani Millk	Manihari	High traffic area
178	610	612	Hirdenagar Kant Nagar	Modi chak	Eroding tower line
179	644	646	Kahalgon	Tintanga	Passenger ferry, Vikramshila Gangetic Dolphin Sanctuary, High traffic area, Ro-Ro ferry
180	646	648	Kahalgon	Tintanga	Vikramshila Gangetic Dolphin Sanctuary, High traffic area
181	648	650	Kahalgon	Tintanga	Vikramshila Gangetic Dolphin Sanctuary
182	650	652	Kahalgon	Tintanga	Vikramshila Gangetic Dolphin Sanctuary
183	652	654	Rampur Gandharp Milik	Dimha	Vikramshila Gangetic Dolphin Sanctuary
184	654	656	Rampur Gandharp Milik	Dimha	Vikramshila Gangetic Dolphin Sanctuary
185	656	658	Rampur Gandharp Milik	Dimha	Vikramshila Gangetic Dolphin Sanctuary
186	658	660	Rampur Gandharp Milik	Ismail pur	Vikramshila Gangetic Dolphin Sanctuary, Eroding banks
187	660	662	Kamlakund	Ismail pur	Vikramshila Gangetic Dolphin Sanctuary, Eroding banks
188	662	664	Budhuchak	Ismail pur	Vikramshila Gangetic Dolphin Sanctuary, Eroding banks
189	664	666	Budhuchak	Emadpur	Vikramshila Gangetic Dolphin Sanctuary, Eroding banks
190	666	668	Salarpur	Emadpur	Vikramshila Gangetic Dolphin Sanctuary
191	668	670	Pharka	Emadpur	Vikramshila Gangetic Dolphin Sanctuary

Sl. No.	Ch. Start	Ch. End	Start Location Name	End Location Name	Reason for Criticality
192	670	672	Pharka	Raziuddinpur	Vikramshila Gangetic Dolphin Sanctuary
193	672	674	Bhagalpore	Mahadeopur	Vikramshila Gangetic Dolphin Sanctuary
194	674	676	Bhagalpore	Mahadeopur	Vikramshila Gangetic Dolphin Sanctuary
195	676	678	Bhagalpore	Mahadeopur	Vikramshila Gangetic Dolphin Sanctuary, Road Bridge
196	678	680	Jalalpur	Raghopur	Vikramshila Gangetic Dolphin Sanctuary
197	680	682	Jalalpur	Raghopur	Vikramshila Gangetic Dolphin Sanctuary
198	682	684	Jalalpur	Raghopur	Vikramshila Gangetic Dolphin Sanctuary
199	684	686	Jhau	Kazi Koraia	Vikramshila Gangetic Dolphin Sanctuary
200	686	688	Jhau	Kazi Koraia	Vikramshila Gangetic Dolphin Sanctuary
201	688	690	Mohanpur	Faridpur	Vikramshila Gangetic Dolphin Sanctuary
202	690	692	Mohanpur	Faridpur	Vikramshila Gangetic Dolphin Sanctuary
203	692	694	Ajmeripur	Tekwazpur	Vikramshila Gangetic Dolphin Sanctuary
204	694	696	Mirzapur	Tekwazpur	Vikramshila Gangetic Dolphin Sanctuary
205	696	698	Mirzapur	Saiduddinpur	Vikramshila Gangetic Dolphin Sanctuary
206	698	700	Mirzapur	Saiduddinpur	Vikramshila Gangetic Dolphin Sanctuary
207	700	702	Gangapur	Dudhaila	Vikramshila Gangetic Dolphin Sanctuary
208	702	704	Gangapur	Dudhaila	Vikramshila Gangetic Dolphin Sanctuary
209	704	706	Gangapur	Gaura	Vikramshila Gangetic Dolphin Sanctuary
210	706	708	Shahabad	Gaura	Vikramshila Gangetic Dolphin Sanctuary
211	708	710	Shahabad	Shahabad	Vikramshila Gangetic Dolphin Sanctuary
212	710	712	Shahabad	Shahabad	Vikramshila Gangetic Dolphin Sanctuary
213	712	714	Sultanganj	Madhopurpatpar	Vikramshila Gangetic Dolphin Sanctuary
214	714	716	Sultanganj	Madhopurpatpar	Passenger ferry, Vikramshila Gangetic Dolphin Sanctuary, Ro- Ro ferry, Road Bridge

Sl. No.	Ch. Start	Ch. End	Start Location Name	End Location Name	Reason for Criticality
215	716	718	Sultanganj	Madhopurpatpar	Vikramshila Gangetic Dolphin Sanctuary, High traffic area
216	730	732	Gangania	Madhopurpatpar	Channel Siltation Area
217	732	734	Binda Diara	Madhopurpatpar	Channel Siltation Area
218	744	746	Nankar	Parsotimpur	Passenger ferry
219	746	748	Nankar	Parsotimpur	Channel Siltation Area
220	748	750	Nankar	Sadullah Jagir	Channel Siltation Area
221	774	776	Jafarnagar	Singhia	Channel siltation area
222	776	778	Jafarnagar	Lagma	Channel siltation area
223	792	794	Mahindarpur	Sonbarsa	Tower line crossing
224	800	802	Mathihani	Sirnia Barari	Passenger ferry
225	802	804	Sihman Karari	Sihman Barari	Channel siltation area
226	806	808	Ramdiri	Sihman Barari Bandobasti	Channel siltation area
227	820	822	Simariya	Hathida	High traffic area, Tower line crossing, Critical Bridge
228	840	842	Jazira Mekra	Mamarkhabad	Eroding banks
229	846	848	Gobind Daspur	Ballipur Pachmahla	Channel siltation area
230	858	860	Raspur Patasia	Nawada	Tower line crossing
231	868	870	Ratanpur	Ratanpur	Tower line crossing
232	884	886	Barua Akhtarpur	Rawaich	Eroding banks
233	888	890	Mohaanadpur Kazi	Dedur	Channel siltation area, Passenger ferry
234	892	894	Ghansurpur Diara	Ghanspur	Pontoon Bridge
235	894	896	Gayaspur Mahazi	Bidhipur	Passenger ferry
236	900	902	Raghopur	Shafipur	Channel siltation area, Passenger ferry
237	902	904	Nagargwan	Phulwaria	Eroding banks,
238	906	908	Fatuha	Ranipur	Channel siltation area, Passenger ferry
239	910	912	Saidabad	Tilllak Nagar	High traffic area, Tower line crossing, Passenger ferry, Pontoon Bridge
240	914	916	Bidupur	Sabalpur	Eroding tower line, Road Bridge
241	916	918	Mayil	Deedarganj	Channel siltation area
242	920	922	Minapur	Sadikpur	Channel siltation area
243	922	924	Hajipur	Patna	High traffic area, Channel siltation area, Cargo Jetty, Pontoon Bridge, Road bridge, Narrow/dense settlement
244	924	926	Minapur	Muhammadpur	Passenger ferry, Narrow/dense settlement

Sl. No.	Ch. Start	Ch. End	Start Location Name	End Location Name	Reason for Criticality
245	928	930	Sabalpur	Mohammedpur Urf Chainpur	Channel siltation area
246	934	936	Sonepur	Patna	Channel siltation area, Road bridge
247	936	938	Nakta Diyara	Mithila	Cargo Jetty
248	938	940	Panapur	Takiapur	Pontoon Bridge
249	958	960	Diara Singahi	Haldi Chhapra	High traffic area,
250	960	962	Diara Singahi	Haldi Chhapra	High traffic area, Channel siltation area, Passenger ferry
251	962	964	Jatia Bajidpur	Todarpur	High traffic area,
252	978	980	Nagina	Mahaji Dharhara	Channel siltation area
253	984	986	Korrha Nobarar	Dakhinwari Chakki	Channel siltation area
254	990	992	Kondarha Uparwar	Parasrampur	Pontoon Bridge
255	1016	1018	Shri Nagar	Gangawali	Pontoon Bridge
256	1028	1030	Dagarabad	Dangrabad	Tower line crossing, Pontoon Bridge
257	1046	1048	Paikawali	Shivpur Diyar Saraju Khd	Passenger ferry, Pontoon Bridge, Road Bridge
258	1050	1052	Raghunathpur	Bhirgu Ashram	Narrow/dense settlement
259	1052	1054	Haibatpur	Rajpur Kalan	Passenger ferry
260	1054	1056	Khae Sarfudinpur	Taranpur	Passenger ferry
261	1074	1076	Gangbarar Govindpur	Arjunpur	Tower line crossing
262	1078	1080	Sarya	Ghola Ghat	High traffic area, Passenger ferry
263	1082	1084	Sarai Kota	Bibiganj	Channel siltation area, Eroding banks
264	1086	1088	Loharpur	Kamhariya	Tower line crossing, Passenger ferry
265	1088	1090	Pallia	Misharwallia	Passenger ferry
266	1092	1094	Araji Birpur	Kutubpur	Channel siltation area
267	1094	1096	Firojpur	Bara	Passenger ferry
268	1110	1112	Narainpur Urf Hariharpur	Andhi Tilwa	Pontoon Bridge
269	1120	1122	Nagwa Urf Nawapura	Gangbarar juvrajpur	Cargo Jetty
270	1122	1124	Ghazipur	Khalishpur Diyara	Passenger ferry
271	1124	1126	Chak Kutub	Diyara Dumariya	Channel siltation area
272	1126	1128	Foolpur	Gangbarar Mednipur	High traffic area, Channel siltation area, Tower line crossing, Multiple bridge

Sl. No.	Ch. Start	Ch. End	Start Location Name	End Location Name	Reason for Criticality
273	1128	1130	Barbarahana	Gangbarar Tari	High traffic area, Channel siltation area, Narrow/dense settlement
274	1130	1132	Kacheri	Saraiya	Channel siltation area
275	1132	1134	Lanka	Chakshah Hazi	Channel siltation area
276	1134	1136	Chak Mubarak Mahiuddin Ur	Bhagirathpur	Channel siltation area
277	1136	1138	kayakot Urf Kurtha	Manpur Urf Sulthanpur	Channel siltation area
278	1138	1140	Ganagbararpah Saiyad Raja	Malsa Khurd	Channel siltation area
279	1140	1142	Gangabarar Deoria Abhilash	Pah Saiyad Raza	Channel siltation area
280	1142	1144	Lakhanchandpur kala	Sabbalpur Kala	Channel siltation area
281	1144	1146	Maksudan Pah	Gangbarar Matsa	Channel siltation area, Eroding banks
282	1146	1148	Sokani	Kaseri	Channel siltation area, Eroding banks
283	1148	1150	Himardopur Upawar	Jamania Rural	Channel siltation area, Eroding banks
284	1150	1152	Dharamarpur	Karbala	Channel siltation area, Eroding banks, Pontoon Bridge
285	1152	1154	Dharamarpur	Bhabbanpur	Eroding banks, Passenger ferry, Road Bridge
286	1172	1174	Sarauli	Gangwara Nakanwa Medhw	Tower line crossing, Passenger ferry, Pontoon Bridge
287	1200	1202	Nakhwan	Tanda Khurd	Channel siltation area
288	1214	1216	Sapsaul	Balua	Tower line crossing, Road Bridge
289	1234	1236	Kamuli	Kunda Khurd	Tower line crossing
290	1236	1238	Kotwa	Bahadurpur	Tower line crossing
291	1238	1240	Ganga Nagar	Suzabad	Channel siltation area, Critical Bridge
292	1240	1242	Ghasi Tola	Ratanpur	High traffic area, Kashi Turtle Sanctuary, Narrow/dense settlement
293	1242	1244	Gauriganj	Katesar	High traffic area, Kashi Turtle Sanctuary, Narrow/dense settlement
294	1244	1246	Nagwa Lanka	Ramnagar	High traffic area, Channel siltation area, Kashi Turtle Sanctuary
295	1246	1248	Rajghat	Susabad	High traffic area, Tower line crossing, Kashi Turtle Sanctuary, Road Bridge

Sl. No.	Ch. Start	Ch. End	Start Location Name	End Location Name	Reason for Criticality
296	1248	1250	Varanasi	Ramnagar	High traffic area, Eroding banks, Tower line crossing, Cargo Jetty, Road Bridge
297	1262	1264	Churamanpur	Shivpur	Tower line crossing
298	1268	1270	Chaudharipur	Jalalpur Mafi	Eroding banks, Tower line crossing
299	1270	1272	Chak Basaratpur	Raipuria	Tower line crossing
300	1296	1298	Gadauli	Jasaura	Eroding banks, Road Bridge
301	1298	1300	Kewataveer	Chapaurkalan	Eroding banks
302	1308	1310	Bhuogaon	Digur patti	Tower line crossing
303	1322	1324	Puranebada	Mirzapur	Passenger ferry, Critical Bridge
304	1338	1340	Sanak Uparwar	Thani patti	Channel siltation area
305	1340	1342	Pureraji	Babhani Mu. Parawa	Pontoon Bridge
306	1348	1350	Ibrahimpur Uparwar	Arjunpur	Eroding banks
307	1368	1370	Sajhara	Khaira	Passenger ferry
308	1382	1384	Bhurra Tari	Mahewa Khurd	Eroding banks, Pontoon Bridge
309	1384	1386	Dhan Tulsi Tari	Umapur Kalan	Eroding banks
310	1386	1388	Lakhanpur Bhadraun Tari	Narvar Uparhar	Eroding banks
311	1388	1390	Sherpur Tari	Monai	Eroding banks
312	1390	1392	Bahupura	Chaukatha Gaura	Eroding banks
313	1398	1400	Tela Khas	Chak Vishun Dutt	Tower line crossing, Pontoon Bridge
314	1404	1406	Kandala Mavaia	Paranipur Uparhar	Eroding tower line, Passenger ferry
315	1406	1408	Dulapur	Paranipur Uparhar	Tower line crossing
316	1410	1412	Garhawa	Dubeypur	Tower line crossing, Passenger ferry
317	1414	1416	Teliyatara	Sisra	Eroding banks, Passenger ferry, Pontoon Bridge
318	1416	1418	Rasulpur	Arazi Panasa Kachhar	Channel siltation area, Eroding banks
319	1418	1420	Duma Duma	Patulaki	Eroding banks
320	1424	1426	Lilapur Kalan	Chauk Gadela	Eroding banks
321	1444	1446	Ustapur Mahmoddbad Kachar	Bharauha	Channel siltation area
322	1446	1448	Dewrakh Ka Char	Mawaiya Ta. Javthan Ka Char	Tower line crossing, Pontoon Bridge
323	1448	1450	Jhusi	Chak Beniram, Naini	Channel siltation area, Tower line crossing, Pontoon Bridge, Mass Gathering location

Sl. No.	Ch. Start	Ch. End	Start Location Name	End Location Name	Reason for Criticality
324	1450	1452	Daraganj & Jhusi	Chak Hiranand, Naini	High traffic area, Channel siltation area, Mass Gathering location, Passenger ferry
325	1452	1454	Allahabad	Maheshwa Patti Purba Uparhar, Naini.	High traffic area, Tower line crossing, Mass gathering location, Narrow/dense settlement, Road bridge, Passenger ferry

ANNEXURE III - CARGO ANALYSIS BASED ON THEIR APPLICABILITY TO IMDG AND IMSBC

Analysis of Cargo for their Applicability to IMDG and IMSBC

Sl.No	Cargo	Applicability of IMSBC	IMDG Code	UN No	Physical State of Transport
1	Liquid Ammonia Gas	NA	2.3	1005	Liquid
2	CNG	NA	2.1	1971	Gas
3	LNG	NA	2.1	1972	Gas
4	Petrol	NA	3	1203	Liquid
5	High Speed Diesel	NA	3	1202	Liquid
6	Furnace Oil	NA	9	1223	Liquid
7	Lube Oil	NA			Liquid
8	Edible Oil	NA	NA	NA	Liquid
9	Coal	Group A/B	4.1 - MHB	NA	Solid
10	Coke	IMO Class :NA IMSBC :Group C - Coke Breeze:Group A	NA		Solid
11	Cement	IMO Class :NA IMSBC :Group C	NA		Solid
12	Fly Ash	IMO Class :NA IMSBC :Group C	NA		Solid
13	Rock Phosphate - uncalcined	IMO Class :NA IMSBC :Group C	NA		Solid
14	Limestone	IMO Class :NA IMSBC :Group C	NA		Solid
15	Manganese Ore	IMO Class :NA IMSBC :Group C	NA		Solid
	Manganese Ore fines	IMO Class :NA IMSBC :Group A	NA		Solid
16	Ammonium based Fertiliser				
	Ammonium Nitrate based fertiliser	IMO Class: 5.1, IMSBC Group B	5.1	2067	Solid
	Ammonium Nitrate based fertiliser	IMO Class: 9, IMSBC Group B	9	2071	Solid
	Ammonium Nitrate based fertiliser (Non Hazardous)	IMO Class: NA, IMSBC Group C	NA	NA	Solid
	Urea	IMO Class: NA, IMSBC Group C	NA		Solid
17	Food & Food Stuff				
	Food grains	NA	NA		Solid
	Peas	NA	NA		Solid
18	Plastic Granules	NA	NA		Solid
19	Textile	NA	NA		Solid
20	Paper	NA	NA		Solid
21	ODC	NA	NA		Solid

Sl.No	Cargo	Applicability of IMSBC	IMDG Code	UN No	Physical State of Transport
22	Iron				
	Coarse Iron Streel Slag and its mixture	IMO Class: NA, IMSBC Group C	NA		Solid
	Direct Reduced Iron (A) - Briquettes, hot-moulded	IMO Class: MHB, IMSBC Group B	MHB		Solid
	Direct Reduced Iron (B) - Lumps, pellets, cold-moulded briquettes	IMO Class: MHB, IMSBC Group B	MHB		Solid
	Direct Reduced Iron (C) - Byproduct fines	IMO Class: MHB, IMSBC Group B	MHB		Solid
	Ferrochrome	IMO Class: NA, IMSBC Group C	NA		Solid
	Ferrochrome (exothermic)	IMO Class: NA, IMSBC Group C	NA		Solid
	Ferrous Metal Borings, shavigns, turnings or cuttings	IMO Class :4.2, Group B	4.2	2793	Solid
	Granulated Slag	IMO Class: NA, IMSBC Group C	NA		Solid
	Iron and Steel Slag and its mixture	IMO Class: NA, IMSBC Group A	NA		Solid
	Iron ore	IMO Class: NA, IMSBC Group C	NA		Solid
	Iron Ore Fines	IMO Class: NA, IMSBC Group A	NA		Solid
	Iron Ore Pellettes	IMO Class: NA, IMSBC Group C	NA		Solid
	Iron Oxide, Spent or Iron Sponge, Spent (obtained from coal gas purification)	IMO Class: 4.2, IMSBC Group B	4.2		Solid
	Iron Oxide (Technical)	IMO Class: NA, IMSBC Group A	NA		Solid
	Iron Sinter	IMO Class: NA, IMSBC Group C	NA		Solid
	Iron Smelting - By products	IMO Class: NA, IMSBC Group C	NA		Solid
	Iron Stone - Ore having moisture 1-2%	IMO Class: NA, IMSBC Group C	NA		Solid
23	Steel				

Sl.No	Cargo	Applicability of IMSBC	IMDG Code	UN No	Physical State of Transport
	Stainless Steel Grinding Dust	IMO Class: NA, IMSBC Group C	NA		Solid
	Taconite Pellets - Ore, Grey round steel pellets.	IMO Class: NA, IMSBC Group C	NA		Solid
	Steel bears	IMO Class: NA, IMSBC Group C	NA		Solid
24	Concrete				
	Coarse Iron Streel Slag and its mixture	IMO Class: NA, IMSBC Group C	NA		Solid
	Iron and Steel Slag and its mixture	IMO Class: NA, IMSBC Group A	NA		Solid
25	Wood		NA		
	Wood Chips	IMO Class: MHB, IMSBC Group B	MHB		Solid
	Wood Products - Logs, Timber, Saw Logs, Pulp Wood, Round Wood	IMO Class: MHB, IMSBC Group B	MHB		Solid
26	Vehicles		NA		Solid
27	Stone Chips	NA	NA		Solid
28	Aluminium block	NA	NA		Solid
29	Galvanized steel plain sheets	NA	NA		Solid
30	Iron ingots	NA	NA		Solid
31	Steel sheet	NA	NA		Solid
32	Tyres				
	Coarse Chopped Tyres	IMO Class: NA, IMSBC Group C	NA		Solid
	Granulated Tyre Rubber	IMO Class: NA, IMSBC Group C	NA		Solid
33	Boulders - Stone Chippings	IMO Class: NA, IMSBC Group C	NA		Solid
34	Ship block	NA	NA		Solid
35	Slag Oil	Not Available	Not Available		Solid

ANNEXURE IV - SILTATION AREAS

SILTATION AREAS IN NW 1

Sl. No.	Start Chainage (km)	End Chainage (km)	LHS	RHS
1	306	308	Mondalhat	Ballavpara
2	346	348	Mashimpur	Mashimpur Dair
3	412	414	Char Sundarpur	Basantapur
4	730	732	Gangania	Madhopurpatpar
5	732	734	Binda Diara	Madhopurpatpar
6	746	748	Nankar	Parsotimpur
7	748	750	Nankar	Sadullah Jagir
8	776	774	Jafarnagar	Singhia
9	778	776	Jafarnagar	Lagma
10	804	802	Sihman Karari	Sihman Barari
11	808	806	Ramdiri	Sihman Barari Bandobasti
12	848	846	Gobind Daspur	Ballipur Pachmahla
13	890	888	Mohaanadpur Kazi	Dedur
14	902	900	Raghopur	Shafipur
15	908	906	Fatuha	Ranipur
16	918	916	Mayil	Deedarganj
17	922	920	Minapur	Sadikpur
18	924	922	Hajipur	Patna
19	930	928	Sabalpur	Mohammedpur Urf Chainpur
20	936	934	Sonepur	Patna
21	962	960	Diara Singahi	Haldi Chhapra
22	980	978	Nagina	Mahaji Dharhara
23	986	984	Korrha Nobarar	Dakhinwari Chakki
24	1084	1082	Sarai Kota	Bibiganj
25	1094	1092	Araji Birpur	Kutubpur
26	1126	1124	Chak Kutub	Diyara Dumariya
27	1128	1126	Foolpur	Gangbarar Mednipur
28	1130	1128	Barbarahana	Gangbarar Tari
29	1132	1130	Kacheri	Saraiya
30	1134	1132	Lanka	Chakshah Hazi
31	1136	1134	Chak Mubarak Mahiuddin Ur	Bhagirathpur
32	1138	1136	kayakot Urf Kurtha	Manpur Urf Sulthanpur
33	1140	1138	Ganagbararpah Saiyad Raja	Malsa Khurd
34	1142	1140	Gangabarar Deoria Abhilash	Pah Saiyad Raza
35	1144	1142	Lakhanchandpur kala	Sabbalpur Kala
36	1146	1144	Maksudan Pah	Gangbarar Matsa
37	1148	1146	Sokani	Kaseri

Sl. No.	Start Chainage (km)	End Chainage (km)	LHS	RHS
38	1150	1148	Himardopur Upawar	Jamania Rural
39	1152	1150	Dharamarpur	Karbala
40	1202	1200	Nakhwan	Tanda Khurd
41	1240	1238	Ganga Nagar	Suzabad
42	1246	1244	Nagwa Lanka	Ramnagar
43	1340	1338	Sanak Uparwar	Thani patti
44	1418	1416	Rasulpur	Arazi Panasa Kachhar
45	1446	1444	Ustapur Mahmoddbad Kachar	Bharauha
46	1450	1448	Jhusi	Chak Beniram, Naini
47	1452	1450	Daraganj & Jhusi	Chak Hiranand, Naini

ANNEXURE V - MULTIPLE FERRY CROSSING LOCATIONS

Multiple Ferry Crossing Locations

Sl. No.	Start Chainage km	End Chainage km	LHS	RHS
1	22	24	Erakhali	Diamond Harbour
2	28	30	Kukrahati	Singal ganja Abad
3	36	38	Suklalpur	Sukdebpur
4	48	50	Alipur	Falta
5	54	56	Chandipur	Padmapur
6	70	72	Uluberia	Achipur
7	74	76	Sijberia	Pujali
8	78	80	Hat Bauria	Joychandipur
9	82	84	Raghudebatti	Chakchandul
10	102	104	Naora	Fort William
11	104	106	Howra railway station	Fairley Palace
12	106	108	Mali Panchghara	Ahiritola
13	202	204	Sultanpur	Char Sultanpur
14	206	208	Kuledaha	Beltala
15	306	308	Mondalhat	Ballavpara
16	330	332	Kadkhali	Char Palasi
17	578	580	Sahibganj	Bhagwanpur
18	644	646	Kahalgon	Tintanga
19	714	716	Sultanganj	Madhopurpatpar
20	1412	1410	Garhawa	Dubeypur

ANNEXURE VI - CONSEQUENCES & RESPONSE ACTION FOR SHORTLISTED CARGO

Consequences and Response Actions for Cargos to be Transported Thwough NW - 1

Sl.No	Cargo	Applicability of IMSBC	IMDG Code	Risk of Toxic Contamination	Risk of Toxic Cloud	Risk of Emission of			Consequences	Response Action
						Flammable Liquid	Flammable Solid	Flammable Gas		
1	Liquid Ammonia Gas	NA	2.3	√	√	×	×		Gas escapes - Heat evolution - changes to alkaline pH - threat to aquatic organism	Change vessel position with regard to wind direction so that plume moves away from windward areas, e.g. Boarding area for response crew. As a part of response readiness following shall be kept 1.self-contained breathing apparatus. 2. Rubber overclothing (including gloves). 3. Gas tight goggles 4. Emergency shower and eye bath
2	CNG	NA	2.1	√	×		×	√	Gas escapes - Fire can spread on to banks	
3	LNG	NA	2.1	√	×		×	√		Wear cold insulating gloves/face shield/eye protection. Extinguish with powder, foam, carbon dioxide or water mist.
4	Petrol	NA	3	√	×	√	×		Liquid Spill - Fire on surface can affect aquatic - can spread on to banks	Gloves,Eye protection preferred. Foam, Carbon dioxide, Dry Chemical Powder. Water may be used to cool fire-exposed containers.
5	High Speed Diesel	NA	3	√	×	√	×			
6	Furnace Oil	NA	9	√	×	×	×			Oil Spill Response equipment such as Oil Spill Boom, Skimmers, sorbents and Dispersing agents shall be kept. Following PPE Shall be kept:- Emergency Life Saving Apparatus (ELSA) / Self contained Breathing Apparatus (SCBA). Gloves (PVC) Bolier Suit.
7	Lube Oil	NA		√	×	x	×			
8	Coal	Group A/B	4.1 - MHB	√	×	×	√	√	Dust explosion in confined space, self heating and fire at storage. Volatie release leads to health issues for public.	NIOSH-approved self-contained breathing apparatus and protective clothing. Small fires: Carbon dioxide dry chemical powder, sand. Large fires: regular foam.
9	Coke	IMO Class :NA IMSBC :Group C - Coke Breeze:Group A	NA	√	x	×	√	√	Liquifaction	NIOSH-approved self-contained breathing apparatus and protective clothing. Chemical goggles, full-face shield, or a full-face respirator is to be worn at all times when product is handled. Small fires: Carbon dioxide dry chemical powder, sand. Large fires: regular foam.
10	Cement	IMO Class :NA IMSBC :Group C	NA	√	x	×	×		Heat evolution with inrease in pH. Toxic to aquatic organisms.	No extinguish required. Wear approved glasses or safety goggles

Sl.No	Cargo	Applicability of IMSBC	IMDG Code	Risk of Toxic Contamination	Risk of Toxic Cloud	Risk of Emission of			Consequences	Response Action
						Flammable Liquid	Flammable Solid	Flammable Gas		
11	Fly Ash	IMO Class :NA IMSBC :Group C	NA	√	√	×	×		Fly ash dust is injurious to health	Ash poses no fire-related hazard. A SCBA is recommended to limit exposures to combustion products when fighting any fire.
12	Mangaanese Ore fines	IMO Class :NA IMSBC :Group A	NA	×	×	×	√		Liquifaction	Goggles. Extinguishers are not required
13	Ammonium based Fertiliser									
	Ammonium Nitrate based fertiliser	IMO Class: 5.1, IMSBC Group B	5.1	√	×	×	√		Ammonium Nitrate is flammable. Enhances eutrophication	Self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.
	Ammonium Nitrate based fertiliser	IMO Class: 9, IMSBC Group B	9	√	×	×	√			
	Ammonium Nitrate based fertiliser (Non Hazardous)	IMO Class: NA, IMSBC Group C	NA	√	×	×	√			
	Urea	IMO Class: NA, IMSBC Group C	NA	√	×	×	×		Aid eutrophication	Special Equipments are not required
14	Iron									
	Direct Reduced Iron (A) - Briquettes, hot-moulded	IMO Class: MHB, IMSBC Group B	MHB	×	×	×	√		Liquifaction	Goggles and Protective Clothing Powder Extinguisher is suitable.
	Direct Reduced Iron (B) - Lumps, pellets, cold-moulded briquettes	IMO Class: MHB, IMSBC Group B	MHB	×	×	×	√		Self heating	
	Direct Reduced Iron (C) - Byproduct fines	IMO Class: MHB, IMSBC Group B	MHB	×	×	×	√		Self heating	
	Ferrous Metal Borings, shavigns, turnings or cuttings	IMO Class :4.2, Group B	4.2	×	×	×	√		Self heating	
	Iron and Steel Slag and its mixture	IMO Class: NA, IMSBC Group A	NA	×	×	×	√		Self heating	
	Iron Ore Fines	IMO Class: NA, IMSBC Group A	NA	×	×	×	√		Liquifaction	
	Iron Oxide, Spent or Iron Sponge, Spent (obtained from coal gas purification)	IMO Class: 4.2, IMSBC Group B	4.2	×	×	×	√		Self heating	
	Iron Oxide (Technical)	IMO Class: NA, IMSBC Group A	NA	×	×	×	√		Liquifaction	
15	Concrete									Special Equipments are not required
	Iron and Steel Slag and its mixture	IMO Class: NA, IMSBC Group A	NA	×	×	×	√		Self heating	
16	Wood									
	Wood Chips	IMO Class: MHB, IMSBC Group B	MHB	×	×	×	√		Self heating	

Sl.No	Cargo	Applicability of IMSBC	IMDG Code	Risk of Toxic Contamination	Risk of Toxic Cloud	Risk of Emission of			Consequences	Response Action
						Flammable Liquid	Flammable Solid	Flammable Gas		
	Wood Products - Logs, Timber, Saw Logs, Pulp Wood, Round Wood	IMO Class: MHB, IMSBC Group B	MHB	×	×	×	√		Self heating	

ANNEXURE VII - STANDARD OPERATING PROCEDURES

Inland vessel act, 1917 amended time to time serve as the apex act on Inland Vessel operation in India. The acts focusses on the following key aspects of inland navigation

- Survey of Inland mechanically Propelled Vessels
- Registration of Inland Mechanically Propelled Vessels
- Master including Seragns and Engineers including Engine Drivers inland mechanically propelled vessels
- Investigation in to causalities
- Removal of obstructions and similar hazards in navigation
- Suspension and cancellation of certificates granted under the act
- Protection of an carriage of passenger in inland mechanically propelled vessels
- Insurance of mechanically propelled vessels against third party risk
- Prevention and control of pollution an protection of inland water
- Penalties and legal proceedings

Relating the most relevant sections of act to risk assessment and disaster management plans, SOPs has been framed for

- Removal of obstructions and similar hazards in navigation
- Investigation in to causalities
- Prevention and control of pollution and protection of inland water

1. SOP FOR THE REMOVAL OF OBSTRUCTIONS AND SIMILAR HAZARDS IN NAVIGATION

1.1. Objective

The objective is to delineate a procedure with allocation of responsibility for the removal of obstruction and similar hazards in navigation caused by mechanically propelled vessel or other vessel when wrecked, stranded or sunk in any inland water. The section also discuss on procedure with allocation of responsibility for the removal of obstruction caused by timber, raft or other thing, floating and including fouling/hooking of mechanically propelled vessels in buoys or moorings laid down by the authority in the inland water.

1.2. General

The obstruction, impediment or danger of the inland water for the safe and convenient navigation or use of inland water or the landing place or embarkment or part thereof, any officer empowered by the State Government by notification in the Official Gazette will be responsible for clearing the obstruction. The major obstruction envisaged are wreck of mechanically propelled vessels, other vessels, timber, raft, or other things floating or being in any part of the inland water. Other hindrance for navigation are obstruction or impediment to the navigation of the inland water lawfully made or due to fouling of government moorings by hooking of mechanically propelled vessels.

1.3. Responsibility

- Officer empowered by the State Government shall cause the vessel to be raised, removed, blown up or otherwise destroy as the circumstances may warrant or remove any timber, raft or other thing, floating or being in any part of the inland water obstructing or impeding the free navigation thereof or the lawful use of any landing place or embankment or part thereof.
- Competent officer acting for the property recovery may sell the property by public auction, if the property recovered is unclaimed or the person claiming it fails to pay reasonable expenses incurred for recovery.
- The officer shall pay the balance after recovery of expense to the person entitled to the property recovered or if no such person appears to claim the balance, the amount will be deposited for payment without interest, to the person establishing his right thereto.

- Competent officer shall recover deficiency from the owner of recovered property if the property are not sufficient to meet the expenses and further sum aforesaid for the recovery.
- The officer shall report of obstruction/impediment to the State Government to navigation of inland water and removal of the same or alteration after making reasonable compensation to the person suffering damage by such removal or alteration.
- The officer shall clear fouling when a mechanically propelled vessel hooked on a buoys or mooring laid down by authority on receipt of information of such accident.

1.4. Methodology

1.4.1. Raising of or Removal of Wreck Impeding Navigation etc.

- Obstruction, impediment or danger to the safe and convenient navigation or use of inland water or the landing place or embarkment or part thereof with the wreck of vessels, shall be cleared by raising, removal, blowing up or otherwise destroying as the circumstances may warrant for vessels.
- Selling of the property by public auction if any property recovered by a competent officer is unclaimed or the person claiming it fails to pay reasonable expenses incurred by the competent officer under that sub-section and a further sum of twenty-five per cent. of the amount of such expenses.
- The expenses and further sum shall be payable to the competent officer out of the sale proceeds of the property, and the balance shall be paid to the person entitled to the property recovered, or, if no such person appears and claims the balance, shall be held in deposit for payment, without interest, to the person thereafter establishing his right thereto.
- Where the sale proceeds of the property are not sufficient to meet the expenses and further sum aforesaid, the owner of the vessel at the time the vessel was wrecked, stranded or sunk shall be liable to pay the deficiency to the competent officer on demand, and if the deficiency be not paid within the month of such demand, the competent officer may recover the deficiency from such owner as if it were an arrear of land revenue.

1.4.2. Removal of Obstruction in Inland Water

- Removal of timber, raft or other thing, floating or being in any part of the inland water, which, in his opinion, obstructs or impedes the free navigation thereof or the lawful use of any landing place or embarkment or part thereof.
- Owner of timber, raft or other thing shall be liable to pay the reasonable expenses of the removal thereof, and if such owner or any other person has without lawful excuse caused any such obstruction or impediment, or causes any public nuisance affecting or likely to affect such free navigation or lawful use.
- If the owner neglects to pay the expenses incurred in the removal thereof, within one week after demand or within fourteen days after such removal has been notified in the Official Gazette, the materials of any public nuisance so removed can be sold by public auction and may retain all the expenses of such removal and sale out of the proceeds.

1.4.3. Removal of Lawful Obstruction

- For obstruction or impediment to the navigation of any inland water has been lawfully made or has become lawful by reason of the long continuance of such obstruction or impediment or otherwise.
- Removal or alteration, making reasonable compensation to the person suffering damage by such removal or alteration.
- Settling of dispute arising out of or concerning such compensation shall be determined according to the law relating to like disputes in the case of land required for public purposes

1.4.4. Fouling of Government Moorings

- For hooking of mechanically propelled vessel or gets fouled in any of the buoys or moorings laid down by or by the authority of the State Government in any part of inland water, the master of such vessel shall not, nor shall any other person, except in the case of emergency lift the buoy or mooring for the purpose of unhooking or getting clear from the same.
- The competent officer immediately on receiving information of such accident, shall assist and superintend the clearing of such vessel and the

master of the vessel shall, on demand, pay such reasonable expenses as may be incurred in clearing the same.

2. SOP for Investigation in to Causalities

2.1. Objective

Objective of the SOP is for understanding the proceedure as per IV Act on investigations of casualities assocated with Inland vessels. In line with IV Act, the report of causalities has be to made to the nearest Police Station whenever

- Any inland mechanically propelled vessels has been wrecked abandoned or materially damaged or
- By reason of any casualty happening to or on board or any inland mechanically propelled vessel, loss of life has ensured
- Or any inland mechanically prospered vessel has caused loss or material damage to any other vessel

2.2. Responsibility

The master of the vessel shall forthwith give notice of the wreck, abandonment, damage, casualty, or loss to the officer in charge of the nearest police station. State government is authorised to investigate the casualities associated with Inland Vessels.

2.3. Methodology

State government shall exercise the various powers on investigation in to casualities as presented below.

2.3.1. Power of State Government to Appoint Court of Investigation

Any case reported under section defined above or otherwise brought to its notice, the state government may

- Appoint a special court and direct the Court to make the investigation at such place as the State Government may fix in this behalf , or
- Direct any principal court of ordinary criminal jurisdiction or the court of any District Magistrate to make the investigation.
- A special court shall be appointed consisting of not less than two nor more than four persons. One shall be a magistrate, one shall be person conversant with maritime affairs or with the navigation of inland mechanically propelled vessel.

- Others shall be conversant with either maritime or mercantile affairs, or with the navigation of inland mechanically propelled vessel

2.3.1.1. Power of Court of investigation to inquire into charges of incompetency or misconduct.

Court making an investigation under section 33 may inquire into any charge of incompetency or misconduct arising in the course of the investigation against any master, engineer, or engine driver, or any person holding a certificate granted under chapter III, as well as into any charge of a wrongful act or default on his part causing any wreck, abandonment, damage casualty, or loss referred in section 32 of IV Act.

- In every case, in which any charge arises against the master, engineer, or engine driver, or any person holding a certificate granted under Chapter III in the course of an investigation, the court shall, before the commencement of the inquiry shall furnish him a copy of the report or any statement upon the case upon which the investigation has been directed.

2.3.2. Power of State Government to Direct Investigation Otherwise than under Court of Investigation

- The state government may send a statement of the case to the principal Court of ordinary criminal jurisdiction, or the Court of the District magistrate , or at nearest to the place at which it may be convenient for the parties and witness to attend and may direct the Court to make an investigation into the charge.
- Before commencing an investigation, the court shall cause the person charged to be furnished with a copy of the statement of the case sent by the State Government.

2.3.2.1. Person Charged to be Heard

- For the purpose of the investigation, any charge against the a master, engineer, or an engine driver, or any person holding a certificate granted under Chapter III, the court may summon him to appear, and shall give him full opportunity of making a defence , either in person or otherwise.
- The court may summon the person to appear for the purpose of investigation.
- The investigation involves or appears the cancelling or suspension of the certificate of a master, engineer, or engine driver, or any person holding a certificate granted under Chapter III of IV Act.

- The court shall appoint assessors for the purpose of the investigation, two persons having experience in the merchant service or in the navigation of inland mechanically propelled vessels.
- In every other investigation, the court may appoint as its assessor, any person conversant with maritime affairs or the navigation of inland mechanically propelled vessel and willing to act as assessor.
- Every person appointed as an assessor under this section shall attend during the investigation and deliver his opinion in writing to be recorded on the proceedings.

2.3.2.2. Powers of Court as to Evidence and Regulation of Proceedings

- For the purpose of any investigation, the court making the investigation shall so far as relates to compelling the attendance and examination of witness, and the production of documents and the regulation of the proceedings , have
- If the court is a special court- the same powers as are exercisable by the principal Court of ordinary criminal jurisdiction for the place at which the investigation is made , or
- If the Court is a principal Court of ordinary criminal jurisdiction or the Court of the District magistrate- the same powers as ae exercisable respectively by either Court in the exercise of its criminal jurisdiction.

2.3.2.3. Power of Court to Effect Arrest of Witnesses by Entry and Detention of Vessels

- Any court making an investigation issues a warrant of arrest to compel the attendance of any person whose evidence is in its opinion necessary.
- For the purpose of effecting the arrest, but subject to any general or special instructions issued by the State Government in this behalf, authorise any officer to entry any vessel.
- Any officer so authorised to enter any vessel may for the purpose of enforcing the entry can call any officers of Police or Customs or any other persons to his aid and may seize and detain the vessel for such time as is reasonably necessary to effect the arrest
- Every such officer or other person shall be deemed to be a public servant within the meaning of the Indian Penal Code (45 of 1860)
- No person shall be detained under this section for more than forty- eight hours.

2.3.2.4. Power of Court to Commit for Trial and to Bind Over Witnesses

In the course of investigation, it appears to the court making the investigation that any person has committed an offense punishable under any law in force, the court making the investigation may

- Cause such person to be arrested
- Commit him to hold him to bail to take his trial before the proper court
- Bind over any other person to give evidence at such trial and
- Exercise al the powers of a Magistrate of the first class or of a Presidency Magistrate.

2.3.2.5. Depositions of Absent Witness

Whenever in the course of trial, the evidence of any witness is required in relation to the subject matter, any deposition previously made by him in relation to the subject matter before any court making an investigation shall if authenticated by the Signature of the magistrate or presiding Judge of such Court, be admissible in evidence on proof-

- The witness cannot be found within the jurisdiction of the Court before which the trial is held, and
- The deposition was made in the presence of the person accused, and that he had held an opportunity of cross- examining the witness.
- A certificate signed by such a Magistrate or presiding Judge that the deposition was made in the presence of the accused, and that he had an opportunity of cross-examining the witness shall, unless the contrary be proved, be sufficient evidence that it was so made and that the accused had such opportunity.
- The Court shall in the case of every investigation , transmit to the State Government a full report of the conclusions at which it has arrived, together with the evidence recorded and the written opinion of any assessor.
- Notwithstanding the appointment of an assessor or assessors by a Court making an investigation, the exercise of all powers conferred on such Court shall rest with the Court alone.
- Whenever any explosion occurs on board any inland mechanically propelled vessel, the State Government may direct that an investigation into the cause of the explosion be made by such person or persons as it may appoint in this behalf.

- The person or persons so appointed may for the purpose of the investigation, enter into and upon the mechanically propelled vessel with all necessary workmen and labourers and remove any portion of the vessel or of the machinery thereof, and shall report to the State Government, in his or their opinion was the cause of the explosion
- Every person making an investigation under this section shall be deemed to a public servant, within the meaning of the Indian Penal Code (45 of 1860).

3. SOP FOR PREVENTION AND CONTROL OF POLLUTION AND PROTECTION OF IN LAND WATER

3.1 Objective

The main objective of this procedure is for prohibition as to discharge of oil, oily mixture, etc. from a mechanically propelled vessel in the inland water. This section also describes the facilities to be maintained at inland port for the treatment and disposal of waste from vessels. The disposal of waste should be in line with the central and state rules for prevention and control of pollution. The section also narrate on the inspections of authorized persons.

3.2 General

For minimizing the pollution already caused or for preventing the pollution threatened to be caused in the inland water from vessels by order in writing, the owner or operator of an inland port, at cargo or passenger terminal is to provide or arrange for the provision of such pollution containment equipment and pollutant removing materials at such inland port, cargo and passenger terminal.

3.3 Responsibility

- The owner/operator of an inland port shall provide reception facilities to discharge oil, oil mixture, and hazardous chemicals or obnoxious substance at such inland port terminals
- The owner/operator shall facilitate surveyor/any person authorized under this act to inspect any inland port facilities for the purposes of prevention and control of pollution and protection of inland water at any reasonable time.

- The authorized surveyor/person by the state government shall verify the pollution containment equipment and pollutant removing materials in conformity with the order of the state government or rules.
- The authorized surveyor/person shall give notice to the owner or operator of inland port, cargo or passenger terminal in writing, pointing out the deficiency and also what in his opinion is requisite to remedy the said deficiency.
- The State Government may direct, by order in writing, the owner or operator of an inland port, at cargo or passenger terminal to provide or arrange for the provision of such pollution containment equipment and pollutant removing materials at such inland port

3.4 Methodology

No oil or oily mixture, hazardous chemical or obnoxious substance from a mechanically propelled vessel shall be discharged in inland water:

- Reception facilities shall be provide to discharge oil, oily mixture, hazardous chemical or obnoxious substance at such inland port, cargo or passenger terminal.
- Reception facilities at any inland port, a cargo or passenger terminal will be charges for the use of the facilities at such rates and may impose such conditions in respect of use thereof as may be approved by notification in the Official Gazette, by the State Government in respect of the inland port, cargo or passenger terminal.
- For minimizing the pollution already caused, or for preventing the pollution threatened to be caused, the State Government may direct, by order in writing, the owner or operator of an inland port, at cargo or passenger terminal to provide or arrange for the provision of such pollution containment equipment and pollutant removing materials at such inland port.

4 PENALTIES AND LEGAL PROCEEDINGS

The listed penalties in IV act are as follows a) Penalty for making voyage without certificate of survey b) Penalty for neglect to affix certificate of survey in inland mechanically propelled vessel c) Penalty for neglect or refusal to deliver up or surrender certificates of survey or registration d) Penalty for carrying excessive number of passengers on board e) Penalty for carrying excessive quantity of cargo on board f) Penalty for serving, or engaging a person to serve, as master or engineer without certificate g) Penalty for master failing to give notice of

wreck or casualty h)Penalty for failing to deliver up suspended or cancelled certificate i)Penalty for taking or delivering or tendering for carriage dangerous goods on board inland mechanically propelled vessels without notice j) Punishment for offences relating to accident k) Penalty for using uninsured mechanically propelled vessel l) Penalty for neglect or refusal to give information as to insurance or to produce certificate of insurance m)Punishment for offences relating to pollution and n) Penalty for misconduct or neglect endangering inland mechanically propelled vessel or life or limb. The legal proceeding for each violations should be followed as specified in IV Act.

ANNEXURE VIII – PROTOCOLS

1. Protocol for Speed Control, Monitoring and Vessel Tracking

IWAI has planned to utilise the River Information System (RIS) as the facility for monitoring and vessel tracking of inland vessels plying through NW 1. RIS is a combination of tracking and meteorological equipment with specialized software designed to optimize traffic and transport processes in inland navigation. The system enables swift electronic data transfer between mobile vessels and shore (base stations) through advance and real-time exchange of information so as to ensure navigation safety in inland waterways.

The implementation of the latest information and communication technologies will help IWAI in several ways. First and foremost is safety. River Information Services (RIS) drastically improve safety of inland waterway navigation by utilization of the AIS (Automatic Identification System) and VHF networks in order to enable vessel tracking and tracing, vessel-vessel and vessel-shore communication, both data and voice communication, the ability to "see another vessel behind the bend" etc.

1.1. Objective

The objective of this protocol is to guide IWAI on the operational aspects of RIS under implementation for achieving the following main objectives.

- To enhance the traffic safety by monitoring and managing the traffic on the Ganga river waterway.
- to optimize the utilization of the Ganga river.
- to establish manageability of the traffic on the Ganga river by providing the possibility. of giving navigational/directional aids to traffic.
- to enable the authorities to manage and plan the traffic operation and strategy
- to enable quick and timely response in the event of an accident or incident which involves hazardous cargo
- to enable the authorities to share information to other operators and organizations
- to integrate the information in logistic chains and enable seamless transport operations
- to reduce environmental hazard and polluting emissions and spills due to accidents.

1.2. Components of RIS and Voice VHF systems

An architecture of RIS setup is depicted in **Figure 1** with following major components.

- Automatic Identification System (AIS)
- Radar

- Meteorological and Hydrological equipment
- Software information technology (IT) related services.

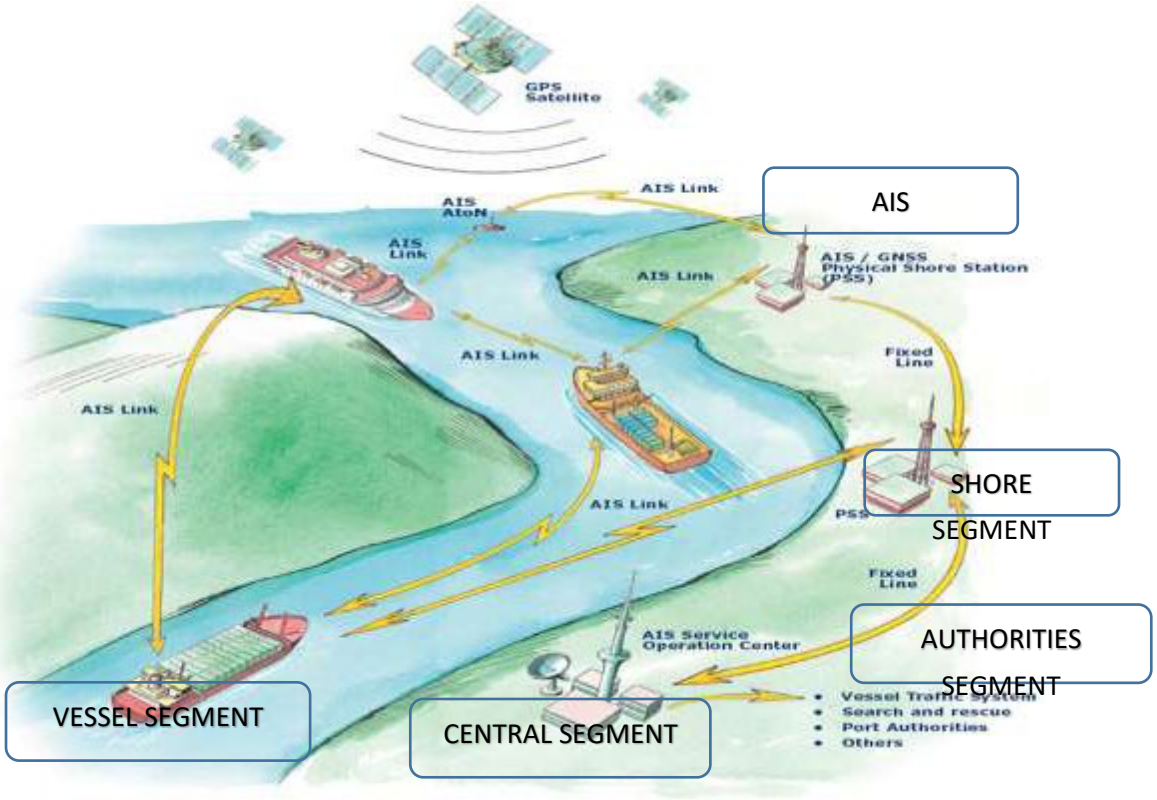


Figure 1. Architecture of RIS System

An RIS set up consists of components for automatic tracking and provision of vessel positions makes use of the Inland AIS technology. The pilot infrastructure comprises of bellow described segments and communication network ensuring the link between them:

1.2.1. Vessel Segment

Generates and exchange the static and dynamic tactical traffic information of own and other vessels by means of Inland AIS transponders within AIS coverage and with the base stations in the shore segment. It also generates and receives safety relevant messages by means of an Inland ECDIS viewer and broadcasts them to other vessels with AIS coverage. This segment can display actual tactical traffic information and safety relevant messages from other vessels within AIS coverage by means of an Inland ECDIS viewer.

1.2.2. Shore Segment

Receives and stores static and tactical traffic information of vessels within AIS coverage of the Inland AIS base station and sends it to the operator segment. It furthermore broadcasts safety relevant messages, or generates Differential GPS (dGPS) correction data and broadcast them to vessels within AIS coverage of the base station. AIS base station consisting of base station transponder and controller connected via internet to AIS network.

1.2.3. Central Segment

Receives static and tactical traffic information of vessels within AIS coverage of the base stations of the shore segment and store it in the database server and provides this information for national and international exchange of traffic data to governmental, commercial users, for triggering purposes of automatic forwarding of other relevant data or to 'Calamity Abatement Service' for enhanced information provision in case of calamities.

1.2.4. Authority Segment

Displays actual and historic static and tactical traffic information of vessels within AIS coverage as the tactical traffic image for the authorities by means e.g. Inland ECDIS Viewer. For the purposes of tests, different authorities have been equipped with work stations, consisting of personal computers with the electronic navigational chart connected to the RIS System, incl. national and international data exchange

1.2.5. Automatic Identification System (AIS)

The automatic identification system (AIS) is an automatic tracking system that uses transponders on ships and is used by vessel traffic services (VTS). AIS information supplements marine radar, which continues to be the primary method of collision avoidance for water transport.

Information provided by AIS equipment, such as unique identification, position, course, and speed, can be displayed on a screen or an electronic chart display and information system (ECDIS). AIS is intended to assist a vessel's watch keeping officers and allow concerned authorities to track and monitor vessel movements.

AIS integrates a standardized VHF transceiver with a positioning system such as a GPS receiver, with other electronic navigation sensors, such as a gyrocompass or rate of turn

indicator. Vessels fitted with AIS transceivers can be tracked by AIS base stations located along coast lines or, when out of range of terrestrial networks, through a growing number of satellites that are fitted with special AIS receivers which are capable of de-conflicting a large number of signatures.

1.3. Benefits of RIS

RIS aims to streamline the exchange of information between various stakeholders of Inland water transport. The system will facilitate exchange of real time information like, wind speed, fog conditions, danger areas, depth information, route details between operators and vessel masters. This would facilitate enhancement of inland navigation safety in ports and rivers and optimize the resource management of the waterborne transport chain which will enhance the efficiency of inland navigation. This will also help in providing traffic and transport information to the operators for an efficient calamity & optimal navigation in Ganga.

This will immensely help in optimization of navigation and minimize collision risks in the waterway thus benefitting the users greatly.

2. Protocol for Waste Management System

The increases in cargo operation pattern through NW 1 will require to have a scientific solid waste management system in place to handle diverse nature of waste generated. As per the proposed operational pattern the vessels to be plied in NW 1 include Bulk Carriers, Tankers, Container Vessels, Ro-Ro Vessels, passenger vessels, barges, push boats etc. The waste generated could be classified as:

- Waste containing oil and grease
- Waste from cargo
- Other wastes.

Waste Containing Oil and Grease: This category covers waste from the engine room such as bilge water, used oil, filters, used cleaning rags and used grease. This waste must be deposited (and a delivery receipt obtained) with a collecting facility at the terminals/jetties or handed over to firms approved by the pollution control board. Proper records shall be maintained on board both for the quantity of waste generated and for the quantity of waste handed over from the vessel. The competent authority should make arrangements for the inspection of these record books and take necessary actions against the master of the faulty vessels.

Waste from Cargo: Cargo waste is generated during the transshipment and transport of dry and liquid cargo. The recipient or consignor of the cargo is responsible for the costs of cleaning the vessel's holds and gangways after loading/unloading. The handling facility at the terminals indicates where waste or washing water can be deposited. Proper records should be maintained on board the vessels for the quantity of the deposited waste.

Other Wastes: Other wastes from ships cover the following kinds of wastes: domestic waste, domestic waste water, slops from the holds and tanks and all waste not containing oil, including small hazardous waste such as batteries. There are waste containers for domestic waste at the public berths in the port area. For disposing of all other wastes from the vessel, the master should make necessary arrangements with terminals, well before the arrival of the vessel in terminal.

2.1. Objective

Objective of this protocol is to guide IWAI on meeting the regulatory compliance requirements with respect to the waste management aspects in line with IV Act, and related rules thereto.

2.2. Legal Compliance Requirement

IV act, 1917 amended from time to time and Inland Vessels (Prevention and Control of Pollution and Protection of Inland Water) Rules, 2016 are the relevant guidelines on handling the waste generated in Inland vessels.

In line with IV act, "No oil or oily mixture, hazardous chemical or obnoxious substance from a mechanically propelled vessel shall be discharged in inland water: Provided that nothing in this section shall apply to the discharge of such oil or oily mixture, hazardous chemical or obnoxious substance from a mechanically propelled vessel for the purpose of securing the safety of a mechanically propelled vessel, preventing damage to a mechanically propelled vessel, cargo or saving of life at inland water." The following definitions are made under the act,

- "Hazardous chemical" or "obnoxious substance" means any chemical or substance as the case may be which has been designated as such by rules made under this Chapter.
- "Oil" means any persistent oil such as crude oil, heavy diesel oil, lubricating oil and white oil whether carried on board a tanker as cargo or fuel;
- Oily mixture means a mixture with any oil content.

As per the act, it is mandated to have waste handling and reception facilities at the Inland Ports as per the approval of competent authorities and also the same could be inspected by approved surveyors or any person authorized under the act and certify or issue notice to the owner of the facility on non-compliances. Inland Vessels (Prevention and Control of Pollution and Protection of Inland Water) Rules, 2016 further defines the statutory requirements as per the provision of rules. IWAI has the responsibility of maintaining NW 1 as well as owning few vessels and terminals; in due consideration of the same, the following section defines the protocol to be followed by IWAI towards compliance with the provision of said act and rules.

Under Schedule I of said rule, the details of chemicals attracting the provision of rule as hazardous chemical or obnoxious substance has been listed out. Under the proposed cargoes through NW 1, furnace oil, petrol, diesel and lube oil will be falling under the category of oil.

To comply with the requirements, IWAI shall ensure that:

- All IWAI Terminals shall have a waste reception facility and facility for oily mixture treatment and sludge or waste and designated pollutants (as specified in of Schedule II & IV) and maintain a record book on operation of facility as specified in Schedule V, within one year from the date of coming into force of these rules.
- Every IWAI Vessel above 1000 Gross Tonnes shall be equipped with oily mixture treatment equipment on board as specified in Part I of Schedule III, within one year from the date of coming into force of these rules.

In line with the rule, the specific waste management facility requirements are as follows.

General Provision

- The treatment facility shall be established at Inland Port, but the collection equipment can either be mobile or shore based at a central point.
- Collection of oily wastes can be either by floating reception facilities like barges of adequate capacity either towed if non-propelled or self propelled or by fixed reception facilities such as one central shore based waste collection point in inland port. The State Government may prescribe the type of facility based on the size and nature of operation of the Inland port.

Port Reception Facilities for Hazardous Chemicals or Obnoxious Substances: - Details of Components:

Buffering and equalizing

In buffering/equalizing tanks, the process flow is continuous by using the tanks as buffers and the composition of the waste stream is equalised by mixing several batches of oily waste.

Plate Separation

Plate separators work on the principle of increasing the surface area of separation, resulting in a better separation. The water phase effluent reached with a plate separator is approximately 20-100ppm.

Flocculation

The water phase effluent quantity of 20-40 ppm shall be achieved with this technique. A large variety of chemicals are available for emulsion breaking. Most frequently iron or aluminum salts and charged polymers are used for emulsion breaking.

Flotation

This is a unit operation used to separate solid or liquid particles from a liquid phase. Air bubbles are injected into a waste water tank and the rising air bubbles will attach to the flocculated oil particles and increase their buoyancy. The combined particles and gas bubbles will rise to the surface and the floating particles can be collected.

Biological Treatment

Here the use of micro-organisms for degrading dissolved organic components in wastewater streams is done. For treatment of oily waste, standard aerobic activated sludge treatment can be used. The discharge level of oil in the effluent shall be reduced to less than 1 ppm by this treatment.

Oily Mixture Treatment Equipments

Preliminary Treatment

Settling tanks: The effluent oil concentration for an API separator shall be 50-200 ppm.

Secondary Treatment

- **Chemical emulsion breaking or flocculation and floatation**:, The water phase effluent quantity of 20-.40 ppm shall be achieved .with this technique. A large variety of chemicals are available for emulsion breaking. Most frequently iron or aluminum salts and charged polymers are used for emulsion breaking; ,

- **Filtration**: The water phase effluent oil concentration shall be approximately 20 ppm, which can be lowered to 5 ppm, when flocculation chemicals are added.
- **Hydrocyclones**: Hydrocyclones use the density difference between oil and water for separation and separation is achieved by centrifugal force. The waste water effluent concentration shall be reached with hydro cyclones is approximately 5-15 ppm.
- **Centrifuges:** They work on the same principle as hydro cyclones. However, they are not static, as the equipment is rotated. They can be used for 3 phase separation (Oil, water and solids).
- **Molecular Coalescence oil or water separator**: The main principle is the molecular coagulation of like molecules. The coagulation is achieved by changing the energy pattern from a tranquil phase to a rapid phase. The water content of the oil is less than 10% and frequently less than 1%.

Tertiary Treatment

Biological treatment: Here the use of micro-organisms for degrading dissolved organic components in wastewater streams is done. For treatment of oily waste, standard aerobic activated sludge treatment can be used. The discharge level of oil in the effluent shall be reduced to less than 1 ppm by this treatment.

Specification for Oily Mixture Treatment Equipment on Shore

- The oil content of the effluent from the treatment unit shall be as minimum as possible but in no case it exceed 15ppm.
- The treatment equipment shall be strong and robust in construction and suitable for use.
- Any electrical equipment that is part of the treatment unit shall be located in a non-hazardous area or certified by the competent authority as safe for use in hazardous areas.
- The treatment unit shall be so designed that it functions automatically. A fail-safe arrangement to avoid any discharge in case of malfunction shall be provided.
- The system shall require minimum maintenance and attention to bring it into operation. It shall be capable of operating at least twenty four-hours of normal duty without attention.
- A ppm display and alarm shall be provided
- The accuracy of the ppm alarm shall be checked as per manufacturer's instruction s periodically as directed by the competent person. A copy of calibration certificate, certifying the date of calibration shall be retained by the port for inspection purpose.

The facility established shall be inspected at any time by the statutory surveyors /competent authorities and a certificate of compliance or conformity shall be issued in the form prescribed in the rule. Surveyors may issue a notification on non-compliance in the format prescribed in the notification and the owner of the inland port need to take remedial action and report compliance within a period of thirty days from the date of receipt of notice and after compliance is reported and the surveyor is satisfied a certificate of compliance or conformity shall be issued in the specified in the rule.

The form and record book to be maintained at IWAI terminal is as follows.

Record Book for Receipt of Designated Pollutants in Inland Port,----------(Period From----------to ----------)

Sl. No.	Name of the Vessel	Time and Date of Receipt of Designated Pollutants/Oil/Oily Mixture or Sludge Waste	Name of Inland Port	Type of Pollutant Received	Quantity of Pollutants Received	Fee Levied for the Receipt	Method of Disposal Adopted	Remarks
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Name and Signature of Authorised Official

Seal or Stamp of the Authority

3. Protocol for the Protection of Biodiversity including Accident Reporting with Aquatic Mammals

3.1. Introduction

India's rivers support high levels of biodiversity. This includes the globally endangered species such as the country's National Aquatic Animal, the Ganges river dolphin, the fish-eating crocodile—the Gharial, and numerous freshwater turtles, fishes, and birds. The waterways form part of the declared Kashi Turtle Sanctuary in Uttar Pradesh and Vikramshila Dolphin Sanctuary in the state of Bihar. Biodiversity protection measures to be implemented has been extensively studied through reputed research institutes like Wildlife Institute of India (WII) and Central Inland Fisheries Research Institute (CIFRI) and the compliance requirement w.r.to protection and conservation aspects are already delineated which IWAI will implement during the course of implementation of JMVP. Further specific measures as per the clearance accorded from National Wild Life Board (NWLB) is also integrated by IWAI in the implementation plan.

3.2. Objective

Objective of this protocol is to guide IWAI on the measures to be implemented apart from the studies undertaken in the biodiversity rich areas of NW 1.

3.3. Measures to be Implemented

Recommendation of the studies conducted shall be strictly implemented with additional measures as below.

- IWAI shall make markings along the entry and exit areas of the sensitive areas as above indicating the extra precaution to be adopted and the rules and regulations in force for protection of such areas including the consequences on violation.
- The barge speed restriction may be imposed in dolphin dominated areas, in hilsa sanctuaries during breeding season and narrow stretches for reducing the wave action and thereby minimizing possibilities of bank erosion.
- Pumping out over board any pollutants or oils contained within water courses are strictly prohibited. IWAI shall implement provision for waste reception facilities at its terminals and also vessel shall have in built facilities as per the statutory requirements. State government shall closely monitor compliance with the regulations. All provisions

under Inland Vessels (Prevention and Control of Pollution and Protection of Inland Water) Rules, 2016 shall be mandatorily followed.

- In case of an accident reporting with aquatic animal, the same shall be immediately intimated to the nearest IWAI sub unit or RO. IWAI shall intimate the same to respective state government, further to be taken up with the respective line department of State government.
- A sample format which may be implemented is appended.

4. Protocol for Defining Hazardous Chemical as per the law of India

4.1. Introduction

International Maritime Organisation has developed a systematic classification of cargo to be transported in maritime industry which has been worldwide approved as the basis for categorisation of cargo and also to follow the specific guidelines for safe transport. This classification is applicable for all modes of transport (sea, air, rail, road and inland waterways) the classification (grouping) of dangerous goods, by type of risk involved, has been drawn up by the United Nation's Committee of Experts on the Transport of Dangerous Goods (UN). Other related regulations include IWAI Rules, MSIHC Rules and IV act and other relevant rules related to IWT operations.

4.2. Objective

The protocol is to guide IWAI to assess whether a cargo is a hazardous chemical as per the law of India and the cautionary measures to be adopted while handling the same cargo.

4.3. IMO Classes for Dangerous Goods

A comprehensive statement of IMDG Class description and corresponding guidelines followed by IWAI is given in the **Table 1** below.

Table 1. IMDG Classification and Guidelines

Sl.No.	IMDG CLASS (DESCRIPTION)		R E M A R K S
1	Class 1	Explosives	Under the approval of explosives (commercial Explosives) by Chief Controller of Explosives.
2	Class 2	Flammable/ Non Flammable /Toxic or Poisonous Gas	Follow the Gas Cylinder Rules, 2016 / Port Bye Laws etc. and the Static Mobile Pressure Vessel (Unfired) Rules, 2016.
3	Class 3	Flammable Liquids	Follow the Petroleum Rules.
4	Class 4	Flammable Solid / Water Reactive Solid etc.	Chemical safety data sheet.
5	Class 5	Oxidizing / Organic Peroxide	Follow IMO Guidelines / Chemical Safety data sheet. Ammonium Nitrate Rules, 2012.
6	Class 6	Toxic/Poisonous Substances	Follow IMO Guidelines / Chemical safety data sheet
7	Class 7	Radio Active Substances	As per the safe handling certificate from Directorate of Atomic Energy Regulatory Board (AERB), Govt. of India, Mumbai.

Sl.No.	IMDG CLASS (DESCRIPTION)		R E M A R K S
8	Class 8	Corrosive Substances	Follow IMO Guidelines / Chemical safety data sheet.
9	Class 9	Misc. Dangerous Substances	Follow IMO Guidelines / Chemical safety data sheet.

The list of cargo attracting IMDG guidelines is presented in **Annexure III**. For any other cargo, the latest IMDG Code / IMSBC shall be referred to.

4.4. Procedure to be adopted while Handling Hazardous Cargo

Whenever a vessel intends to import hazardous cargo or to load & export hazardous cargo to/from the Terminals of IWAI, the agent shall furnish a list of all hazardous cargo with full particulars to the Officer- In- charge before arrival or prior to shipment of such hazardous cargo. This list should indicate the IMDG Code/Class, UN No., Flash Point, Packing Group (PG)/IMDG Packing Certificate (i.e. multi modal dangerous goods Form) from Cargo Operators etc. against each of the hazardous items.

The provisions governing the carriage of solid bulk cargoes are amplified in the International Maritime Solid Bulk Cargoes Code (IMSBC Code) and as such the same is excluded from this protocol. The prime hazards associated with the shipment of solid bulk cargoes are those relating to structural damage due to improper cargo distribution, loss or reduction of stability during a voyage and chemical reactions of cargoes. Therefore the primary aim of this Code is to facilitate the safe stowage and shipment of solid bulk cargoes by providing information on the dangers associated with the shipment of certain types of solid bulk cargoes and instructions on the procedures to be adopted when the shipment of solid bulk cargoes is contemplated. The handling, loading, unloading, transport by road and also stowage, packing, segregation etc. for all classes of hazardous goods, following rules and regulations are to be adhered to:

- IMDG Code 2016 (Amendment 38-16) & IMDG Code Supplement,
- Gas Cylinder Rules, 2016
- Petroleum Rules 2016,
- The Static Mobile Pressure Vessel (Unfired) Rules, 2016
- Manufacture, Storage & Import Of Hazardous Chemicals Rules, 1989
- Calcium Carbide Rules, 1987
- Hazardous Waste (Management, Handling & Trans Boundary Movement) Rules, 2016
- Dock Workers (Safety, Health & Welfare) Regulation 1990

- IWAI Rules,
- Ammonium Nitrate Rules, 2012
- Central Motor Vehicles Rules 1989
- AERB safety guidelines for importation & safe handling of "Radio Active material".

As regards to safe transport & handling of this hazardous cargo in bulk & in packaged/ containerized form, following safety measures (not limited to)are to be adhered to:

- Appropriate IMDG danger label, sign & symbol are to be pasted on all four sides of the containerized hazardous cargo and its stowage, packing, segregation etc. are to be made as per the relevant provisions of IMDG Code for inland vessel transportation.
- Fire fighting personnel with appropriate fire fighting equipment are to remain standby throughout the period of handling & loading/unloading operation of the Containers containing Hazardous Cargo.
- Appropriate type of Personal Protective Equipment (PPE), Tools, Gears & Lifting appliances etc. are to be used at the time of handling / unloading and delivery of such consignments.
- The unloading / loading area is to be isolated by restraining all unauthorized persons from entering into the area. Adequate security arrangements are to be made during the handling of such cargo.
- The Containers containing hazardous cargo are to be handled with precaution to avoid any shock, jolt or knock. They must not be dropped, bumped, rolled or otherwise mishandled.
- All electrical lights & equipment including Walkie-talkie Sets, Mobile Phone for communication between the Ship & the shore should be certified 'intrinsically safe'.
- Trained Personnel as per IMO guidelines are to remain standby during the operation with appropriate equipment to avoid spillage/leakage as well as to combat in case of any spillage, leakage, fire etc. "No Smoking" and "No Naked Light" are to be strictly observed and maintained throughout the time of handling & loading / unloading operation.
- Such Containers containing hazardous cargo are to be kept away from direct source of ignition, heat & spark etc. even when in transit and should be kept in well ventilated and cool place.

Specific guidelines for individual cargoes as per IMDG Code or IMSBC shall be ensured by IWAI while transporting cargo through NW 1 and handling at IWAI terminals.

5. Protocol for Lessons Learned and Corrective Actions Programme

5.1. Introduction

It is necessary, during every stage of any project starting from the preparations of the project, to make a proper checklist for monitoring and for assessing the various parts of work done by the different members of the project team. The checklist may be made stage wise and the jobs to be done are detailed out as shown in the attached specimen checklist. During the course of work if any problems or difficulties are experienced, they should be noted down as either "positive" or "negative" or listed out according to the number (depending on the gravity of the problem) as shown in the checklist.

Once the problem/difficulty/non-conformity is experienced, root cause analysis is done and the necessary applicable corrective actions are applied. Where found necessary, preventive measures are also taken to avoid the recurrence of the same elsewhere in the project. Developing and tracking corrective actions to closure may help institutionalize a lessons learned. Corrective actions can take many forms and may be used to verifiably document a change in the affected process. Developing and managing corrective actions associated with a lessons learned proactively reduces known risks, improves effectiveness and efficiency, and helps prevent recurrence of undesirable events. The term "corrective action" refers to a discrete action having a target completion date and a responsible person.

Lessons learned should be taken as an important component of the feedback and continuous improvement function within the Management System. This could be applied to Quality Management System / Safety Management System / Environmental Management System/ Risks Management System implemented and maintained in the organisation or for any project done within the organisation.

5.2. Objective

Objective of the protocol is to guide IWAI on the process to be implemented for implementing lessons learned from the work executed.

5.3. Process

5.3.1. Preparation

Before corrective actions are defined for a lessons learned, the following should be considered:

(a) Necessity of the Corrective Actions - A corrective action may not be necessary if the analysis indicates that the event which led to the lesson learned was not the result of a systemic problem.

(b) The risk, significance, cause, and applicability of the incident - Corrective actions may not be necessary if the incidents which precipitate lessons learned have corrective actions tracked in other programs (e.g., occurrence reports, non-conformance reports, etc.). Managers should coordinate their efforts to avoid tracking the same corrective actions in multiple systems.

Based on a thorough evaluation of the lessons learned, the corrective action could:

- mitigate risk to environmental, safety, and health as it relates to the incident in the lessons learned;
- prevent the recurrence of undesirable events;
- improve process efficiency and effectiveness.

Actions which address the root cause should prevent recurrence of the event. Actions taken should be concise, discrete, and closable. Developing corrective actions to improve processes is an example of using lessons learned as feedback for continuous improvement.

Consider cost, priority, action dependencies, interfaces, and schedules when developing a corrective action plan. The finished product should include realistic target dates with each action assigned to a responsible person.

5.3.2. Managing the Lessons Learned and the Corrective Actions

Corrective actions associated with lessons learned should be evaluated for impact and budgetary concerns, prioritized, and tracked to completion. Implementation of detailed corrective action may require multiple milestones. After final completion of any actions, the appropriate organization should verify that the original problems were appropriately addressed.

In the case of a project, when a project is finished, it is necessary that the organisation or the project team has prepared a lessons learned document. By collecting and recording the lessons

learned while completing the previous project, the organization as a whole can benefit. Solicit feedback from all stakeholders also. Summarise the results and pass the recommendations to future teams.

Share the lessons learned of one project team with other project teams. The basic objective behind documenting lessons learned is to provide other project teams with information that can increase their efficiency and effectiveness and build on the experience that has been earned by each completed project. Sharing the lessons learned with other teams helps improve the overall performance of the organization.

Store your lessons learned document in a central repository of the organization. This makes it easier for other project teams to access them whenever it is required.

Archive all the lessons learned documents. They should be archived as historical project data and incorporated into organizational lessons learned.

6. Protocol for Internal and External Auditing Procedure and Frequency

6.1. Introduction

Inland Water Transport (IWT) is the most energy and cost efficient mode of transport and is best suited for moving bulk and hazardous goods. The components of IWT infrastructure are: (a) fair waterway and navigation facilities; (b) terminals, jetties and repair yards, with connectivity to mainland; and (c) vessels (cargo vessels, barges, boats, passenger vessels, Ro - Ro vessels etc.). IWAI has the responsibility to maintain the fairway and infrastructure facilities associated with IWT along NW 1.

6.2. Objective

Objective of this project is to state the requirement on performance audit on effective utilization of NW 1and suggesting audit frequency for such audit.

6.3. Performance Audit Objectives

The objectives of the performance audit are whether

- There is effective utilisation of the NW-1 and the infrastructure created; and
- Passenger and cargo operations on inland waterways were economical, efficient and safe.

6.4. Audit Criteria

The activities of IWT Sector shall be examined with reference to the following:

- IWT Policy of Government of India, 2001;
- The Inland Vessels Act, 1917 as amended; and
- The Public Works Department Manual.

Areas/ functions to be audited

Waterways:

- Fairway, infrastructure, vessels, other allied facilities (Self owned as well as operated or leased or monitored).
- Poor progress in execution of development/ maintenance works.
- Under utilisation of developed waterways (NW-1).
- Lack of policy directions by State Government for increased utilisation of NW-1.
- Obstructions affecting navigability in NW-1 such as Fishing nets, temporary constructions, other encroachment of waterways
- Navigation channels were not dredged

Cargo Transport Operations:

- Deficiencies in executing transportation contracts of bulk cargo and liquid leading to consequential loss of business
- Excessive time taken for completion of trips
- Non-utilisation of full capacity of barges
- Non-operation of trips targeted
- Delay in repair of barges/vessels
- Uneconomic operation of services

Important interventions required as a part of the audit services are the following:

- Quality Management System (QMS) shall be implemented and ISO-9000:2015 certification shall be insisted.
- If the Quality Management System (QMS) implemented and maintained by the organisation is already certified to the international standard ISO-9000:2015 by an externally accredited agency, most of the critical functional areas, whose quality performance need to be measured, would have already included in that.
- If any of the important functions are left out, the same can also be brought under the QMS system. In this case, the internal audits are done by a team of qualified and trained

internal auditors selected from different departments of the organisation i.e., Traffic, Environment, Engineering, Hydrographic, Finance etc., led by the Asst. director at each terminals..

6.5. Frequency and Procedure for Auditing

The internal audits should preferably be done at least twice in a year i.e., at six monthly intervals, in the beginning. Once the system is established, the frequency may be made once in a year.

The QMS certificate issued to the organisation is valid for a period of three years. Before the expiry of the validity of the certificate, renewal audit will be done by the certification body and the validity is increased for a further period of three years.

Besides, statutory/ mandatory surveillance audits are done every year by the external certification body.

In addition to auditing of the QMS system, a separate performance audits (external audits) as stated above, are also done in Central govt. organisations by CAG (Controller of Audit General) at regular intervals.

The Internal audits are generally done, prior to external audits, by AGM/GM of the organisation at least once in a year.

In the case of performance audit, the internal audit parties are responsible to audit all financial accounts of departments and divisions whether they are done properly according to the financial regulations approved by the authorised organizations and to submit the audit reports directly to General Manager and Managing Director.

The internal audits as described above both for the performance audits and for QMS audits are done before the statutory yearly surveillance audit/ renewal audit by the external certification body and the statutory performance audit done by CAG.

After the completion of internal audits, the non- conformities found, if any, during the audits are recorded in the NCR (non-conformity report) by the auditor and the same got signed by the auditee.

Root cause analysis of those non-conformities is to be carried out by the auditee's department and they have to be closed within a stipulated given time as agreed in the NCR. The NCRs found during both the internal as well as the external audits have to be reported to the top management review and discussed in detail for taking improvement actions or for changing organisation's objectives/targets/policy.

All necessary records like Audit schedule, Audit Notice, NCRs and CAPA registers are maintained.

7. Protocol for Oil Spil Reporting and Control and Remediation

7.1 Introduction

Oil Spill is one of the major threats to marine environment. The consequences of an oil spill are profound. In addition, to the direct and immediate human health impacts it pose, an oil spill can trigger a chain of events that can seriously affect the river banks and its resources including wildlife, fisheries, tourism activities, industries etc., which can cause adverse consequences to the local economy of the affected coastal area, if left unmanaged. The following section details the protocol to be followed for reporting oil spill incidents within NW 1.

7.2 Onshore & Offshore Oil Spill Incidents Reporting and Management

In case of onshore incidents, the IWAI Terminals shall activate the emergencyr response unit of terminal and shall utilise the minimum equipments required to combat with the Tier 1 incidents. The Incident Management Team of terminal shall be utilised for the response operations with Head, RO (IWAI) shall keep informed of the situations. In case of Teir 1 incidents, Head RO (IWAI) shall immediately convene a meeting at ECC – RO, assess the situation and Coordinator of Emergency Response Operation at RO through the supporting team of nearest sub unit of IWAI shall keep on availing the progress report from incident site and periodically update Head (RO). IWAI RO will intimate inciedent progress to DDMA and DDMA will inturn intimate SDMA.

In Teir 2 incidents, RO – IWAI shall be initiated to respective DDMAs /SDMAs and DDMA will initate reponse action. RO with support of the nearest sub unit of IWAI shall organize entire response action in coordination with DDMA. The various facility operations available in the region such as oil handling facilities, ports, refineries etc would be extened support through mutual aid and RO will seek the assistance of HQ and through NCMC support shall be extended from nearest ICG unit for combat operations.

Tier 3 incident, being a major incident NCMC will play the key role and support from all national plan stakeholders shall be availed by IWAI HO through NCMC.

In case of offshore incidents, the facilities available in the vessel shall be utilised for control of spill and immediately the incident report shal be made to the nearest IWAI unit. As per the gravity of the incident, IWAI , HO shall seek support through NCMC for involvment of Indian Coast Guard with airside access with trained manpower and facilities to combat the response operation at the offshore area.

ANNEXURE IV - MATERIAL SAFTEY DATA SHEETS FOR LISTED CARGOS

LIQUIFIED NATURAL GAS

Last changed: 12/11/2012

1 Identification of the substance / mixture and of the company / undertaking

1.1 Product identifier

Trade name / designation Liquefied Natural Gas (LNG)

1.2 Relevant identified uses of the substance or mixture and uses advised against

RELEVANT IDENTIFIED USES Fuel.

1.3 Details of the supplier of the safety data sheet

NATIONAL MANUFACTURER / IMPORTER

Enterprise	STATOIL ASA
Address	Forusbeen 50
Postal code	4034 Stavanger
Country	Norge
Telephone	047 51 99 00 00
Fax	047 51 99 00 50

1.4 Emergency Telephone Number

Emergency Phone	Type of assistance	Opening Hours
+47 22 59 13 00	(Giftinformasjonen)	

2 Hazards identification

2.1 Classification of the substance or mixture

DSD Classification:

- .

CLP Classification: Press. Gas ref. liq. gasH281
At release, the product will immediately evaporate as gas. This data sheet describes the risks of such leaks. Contact with the liquid cooled gas is not likely. .

Most important HSE hazard effects: Contains refrigerated gas; may cause cryogenic burns or injury.

2.2 Label elements

Signal word: Warning

COMPOSITION

Methane (> 99,50 %)

H Statements	
H281	Contains refrigerated gas; may cause cryogenic burns or injury.

P Statements	
P282	Wear cold insulating gloves/face shield/eye protection.
P336	Thaw frosted parts with lukewarm water. Do no rub affected area.
P315	Get immediate medical advice/attention.

2.3 Other hazards

OTHER HAZARDS

Assessment to determine PBT and vPvB has not been made.

3 Composition/information on ingredients

3.1 Substances

Ingredient name	Reg.No	EC No.	CAS No.	Conc. (wt%)	DSD-Classification	CLP-classification
Methane		200-812-7	74-82-8	> 99,50 %	F+,R12	Flam. Gas 1 H220 Press. Gas ref. liq. gas H281

Full text of R-, H- and EUH-phrases: see section 16.

The EUH hazard statements mentioned in CLP-classification are only label elements.

4 First aid measures

4.1 Description of first aid measures

INHALATION

Seek fresh air. In case of respiratory stop, administer artificial respiration/oxygen (but not the mouth-to-nose method) Seek medical advice in case of persistent discomfort.

INGESTION

Not relevant, as the product is a gas.

SKIN CONTACT

Wash skin with soap and water. On frostbite: rinse with plenty of lukewarm water (max 37°C). Do not remove clothes until thawed. Seek medical advice.

EYE CONTACT

Flush immediately with water (preferably using eye wash equipment) for at least 5 minutes. Open eye wide. Remove any contact lenses. Seek medical advice in case of frostbite.

BURNS

Flush with water until pain ceases. Remove clothing that is not stuck to the skin - seek medical advice/transport to hospital. If possible, continue flushing until medical attention is obtained.

GENERAL

When obtaining medical advice, show the safety data sheet or label.

4.2 Most important symptoms and effects, both acute and delayed

MOST IMPORTANT SYMPTOMS AND EFFECTS, BOTH ACUTE AND DELAYED

Splashes in the eyes may cause frostbite. Direct contact may cause frostbite. The skin becomes numb and white. Pains, reddening and wounds follow.

4.3 Indication of any immediate medical attention and special treatment needed

INDICATION OF ANY IMMEDIATE MEDICAL ATTENTION AND SPECIAL TREATMENT NEEDED

Treat symptoms. In case of shortness of breath, give oxygen. Ensure that medical personnel are aware of the material involved, and take precautions to protect themselves.

5 Fire-fighting measures

5.1 Extinguishing media

SUITABLE EXTINGUISHING MEDIA:
Extinguish with powder, foam, carbon dioxide or water mist.

5.2 Special hazards arising from the substance or mixture

SPECIAL HAZARDS
Can generate harmful flue gases containing carbon monoxide in the event of fire.

5.3 Advice for fire-fighters

ADVICE FOR FIREFIGHTERS
Move containers from danger area if it can be done without risk. Avoid inhalation of vapour and flue gases - seek fresh air. Wear Self-Contained Breathing Apparatus (SCBA) with chemical resistant gloves.

6 Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

FOR NON-EMERGENCY PESONNEL
Stop leak if this can be done without risk. Smoking and naked flames prohibited. Wear gloves. Shut off gas supply. Provide adequate ventilation. In case of insufficient ventilation, wear respiratory protective equipment.

FOR EMERGENCY RESPONDERS
In addition to the above: Normal protective clothing equivalent to EN 469 is recommended.

6.2 Environmental precautions

ENVIRONMENTAL PRECAUTIONS
Avoid unnecessary release to the environment.

6.3 Methods and material for containment and cleaning up

METHODS AND MATERIAL
Provide good ventilation.

6.4 Reference to other sections

REFERENCES
See section 13 for instructions on disposal. See section 8 for type of protective equipment.

7 Handling and Storage

7.1 Precautions for safe handling

PRECAUTION FOR SAFE HANDLING
Smoking and naked flames prohibited. Running water and eye wash equipment must be available. Take precautionary measures against static discharges. Use spark-free tools and explosion proof equipment. All fixtures, pipes, wires and fittings must be free of oil, grease and other oxidizing materials (e.g. solvents).

7.2 Conditions for safe storage, including any incompatibilities

CONDITION FOR SAFE STORAGE, INCLUDING ANY UNCOMPATIBILITIES
Store safely, out of reach of children and away from food, animal feeding stuffs, medicines, etc. Take precautionary measures against static discharges. Use spark-free tools and explosion proof equipment.

7.3 Specific end uses

SPECIFIC END USE(S)
None.

8 Exposure controls / Personal protection

8.1 Control parameters

LEGAL BASIS

EH40/2005 Workplace exposure limits. Last amended December 2011.

MONITORING PROCEDURES

Compliance with the stated occupational exposure limits may be checked by occupational hygiene measurements.

OTHER INFORMATION REGARDING LIMIT VALUES AND MONITORING

Contains no substances subject to reporting requirements.

8.2 Exposure controls

APPROPRIATE ENGINEERING CONTROLS

Wear the personal protective equipment specified below.

EYE PROTECTION

Wear safety goggles if there is a risk of eye splash.

HAND PROTECTION

Wear gloves that protect against cold and pressure effects, e.g. strong leather gloves. The gloves must be loose enough to be shaken off easily.

RESPIRATORY PROTECTION

Wear fresh air respiratory protective equipment.

LIMITATION OF ENVIRONMENTAL EXPOSURE

Ensure compliance with local regulations for emissions.

9 Physical and chemical Properties

9.1 Information on basic physical and chemical properties

PHYSICAL STATE	Liquid Gas
COLOUR	Colourless
ODOUR	Odourless
WATER SOLUBILITY	Not miscible

Parameter	Value/unit	Method/reference	Observation
pH consentrate	No data		
pH in solution	No data		
Melting point	No data		
Freezing point	No data		
Initial boiling point and boiling range	-161,50 °C		
Flash point	-188 °C		
Evaporation rate	No data		
Flammability (solid, gas)	No data		
Flammability limits	No data		
Explotion limits	5 - 15 %		
Vapour pressure	No data		
Vapour density	No data		
Relative density	No data		
Partition coefficient	No data		
Auto-ignition temprature	No data		
Decomposition temprature	700 °C		
Viscosity	No data		

9.2 Other safety information

Parameter	Value / unit	Method / reference	Observation
Molvekt	16,04		
Kritisk temp.	-82 °C		
Kritisk tryk	46 bar		

Note no.	Comments

10 Stability and Reactivity

10.1 Reactivity

REACTIVITY

Reacts with the following: Oxidisers.

10.2 Chemical stability

CHEMICAL STABILITY

The product is stable when used in accordance with the supplier's directions.

10.3 Possibility of hazardous reactions

POSSIBILITY OF HAZARDOUS REACTIONS

None known.

10.4 Conditions to avoid

CONDITIONS TO AVOID

Avoid heating and contact with ignition sources.

10.5 Incompatible materials

INCOMPATIBLE MATERIALS

Oxidisers.

10.6 Hazardous decomposition products:

HAZARDOUS DECOMPOSITION PRODUCTS

None known.

11 Toxicological information

11.1 Toxicological effects

ACUTE TOXICITY - ORAL

The product does not have to be classified. Test data are not available.

ACUTE TOXICITY - DERMAL

The product does not have to be classified. Test data are not available.

ACUTE TOXICITY - INHALATION

The product does not have to be classified. Test data are not available.

SKIN CORROSION / IRRITATION

Direct contact may cause frostbite. The skin becomes numb and white. Pains, reddening and wounds follow. The product does not have to be classified. Test data are not available.

SERIOUS EYE DAMAGE/IRRITATION
Splashes of gas in the eyes may cause frostbite.

RESPIRATORY OR SKIN SENSITISATION
The product does not have to be classified. Test data are not available.

GERM CELL MUTAGENICITY
The product does not have to be classified. Test data are not available.

CARCINOGENICITY
The product does not have to be classified. Test data are not available.

REPRODUCTIVE TOXICITY
The product does not have to be classified. Test data are not available.

SINGLE STOT EXPOSURE
The product does not have to be classified. Test data are not available. The gas may displace atmospheric air, thereby causing risk of suffocation.

STOT-REPEATED EXPOSURE
The product does not have to be classified. Test data are not available.

ASPIRATION
The product does not have to be classified. Test data are not available.

OTHER TOXICOLOGICAL INFORMATION
None known.

12 Ecological information

12.1 Toxicity
ECOTOXICITY
The product does not have to be classified. Test data are not available.

12.2 Persistence and degradability
DEGRADABILITY
Not expected to be biodegradable.

12.3 Bioaccumulative potential
ACCUMULATION
No bioaccumulation expected.

12.4 Mobility in soil

12.5 Results of PBT and vPvB assessment
RESULT OF PBT AND VPVB ASSESSMENT
The product does not contain any PBT or vPvB substances.

12.6 Other adverse effects
OTHER EFFECTS
Can affect global warming.

13 Disposal considerations

Last changed: 12/11/2012

13.1 Waste treatment methods

GENERAL REGULATIONS

Avoid unnecessary release to the environment. Treat as hazardous waste. Return empty containers to the supplier.

14 Transport information

Classified as Dangerous Goods: Yes

Land transport (ADR/RID)			
14.1 UN-No.	1972	**14.4 Packing group**	-
14.2 Proper Shipping Name	METHANE, REFRIGERATED LIQUID	**14.5 Environmental hazards**	No
14.3 Class(es)	2		
Hazard label(s)	2.1		
Hazard ID:	223	**Tunnel restriction code**	B/D

Inland water ways transport (ADN)			
14.1 UN-No.	1972	**14.4 Packing group**	-
14.2 Proper Shipping Name	METHANE, REFRIGERATED LIQUID	**14.5 Environmental hazards**	No
14.3 Class(es)	2		
Hazard label(s)	2.1		
Enviromentally hazardous in tank-vessels	Nej		

Sea transport (IMDG)			
14.1 UN-No.	1972	**14.4 Packing group**	-
14.2 Proper Shipping Name	METHANE, REFRIGERATED LIQUID	**14.5 Environmental hazards**	No
14.3 Class(es)	2		
Hazard label(s)	2.1		
Sub Risk:	-		
IMDG Code segregation group	-		
Marine pollutant	No		
Substance name(s) on marine pollutant			
EMS:	-		

Air transport (ICAO-TI / IATA-DGR)			
14.1 UN-No.	1972	**14.4 Packing group**	-
14.2 Proper Shipping Name	METHANE, REFRIGERATED LIQUID		
14.3 Class(es)	2		
Hazard label(s)	2.1		

14.6 SPECIAL PRECAUTIONS FOR USER
None.

14.7 TRANSPORT IN BULK ACCORDING TO ANNEX II OF MARPOL73/78 AND THE IBC CODE
Not included.

15 Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

15.2 Chemical Safety Assessment

OTHER INFORMATION
Chemical safety assessment has not been performed.

16 Other information

ABBREVIATIONS
PBT: Persistent, Bioaccumulative and Toxic vPvB: Very Persistent and Very Bioaccumulative STOT: Specific Target Organ Toxicity

CLASSIFICATION METHOD
Calculation based on the hazards of the known components.

LIST OF RELEVANT R-PHRASES	
R12	Extremely flammable.

LIST OF RELEVANT H-STATEMENTS	
H220	Extremely flammable gas.
H281	Contains refrigerated gas; may cause cryogenic burns or injury.

TRAINING ADVICE
A thorough knowledge of this safety data sheet should be a prerequisite condition.

MATERIAL SAFETY DATA SHEET

1. Product and Company Identification

Product Name	**Compressed Natural Gas (CNG)**
CAS #	Mixture
Product use	Fuel
Manufacturer	Irving Oil Refining G.P. Box 1260 Saint John, NB E2L 4H6 CA Phone: (506) 202-2000 Refinery: (506) 202-3000 Emergency Phone: 1-800-424-9300 (CHEMTREC)

2. Hazards Identification

Emergency overview	DANGER Flammable gas. CONTENTS UNDER PRESSURE. Containers may explode when heated. MAY CAUSE EYE AND SKIN IRRITATION.
Potential short term health effects	
Routes of exposure	Eye, Skin contact, Inhalation, Ingestion.
Eyes	May cause irritation. Contact with liquid may cause frostbite.
Skin	May cause irritation. Contact with liquid may cause frostbite.
Inhalation	This product is an asphyxiant gas which can cause unconsciousness/death if OXYGEN levels are sufficiently reduced. Signs and symptoms of preceding asphyxiation include and are not limited to rapid respiration, loss of mental alertness and co-ordination, dizziness, nausea and vomiting. Oxygen concentrations in work spaces must not be permitted to fall below 19%.
Ingestion	Not a normal route of exposure as this product is a gas at room temperature and pressure.
Target organs	Blood. Bone. Eyes. Kidney. Liver. Respiratory system. Skin.
Chronic effects	The finished product is not expected to have chronic health effects.
Signs and symptoms	Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting.
OSHA Regulatory Status	This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.
Potential environmental effects	See section 12.

3. Composition / Information on Ingredients

Ingredient(s)	CAS #	Percent
Methane	74-82-8	60 - 100
Butane	106-97-8	1 - 5
Carbon dioxide	124-38-9	1 - 5
Ethane	74-84-0	1 - 5
Nitrogen	7727-37-9	1 - 5
Pentane	109-66-0	1 - 5
Propane	74-98-6	1 - 5

4. First Aid Measures

First aid procedures	
Eye contact	Flush with cool water. Remove contact lenses, if applicable, and continue flushing. Obtain medical attention if irritation persists.
Skin contact	Flush with cool water. Remove contact lenses, if applicable, and continue flushing. Obtain medical attention if irritation persists.
Inhalation	If symptoms develop move victim to fresh air. If symptoms persist, obtain medical attention.

Ingestion	Not a normal route of exposure as this product is a gas at room temperature and pressure.
Notes to physician	Treat patient symptomatically.
General advice	Keep away from sources of ignition. No smoking. If you feel unwell, seek medical advice (show the label where possible). Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Show this safety data sheet to the doctor in attendance. Avoid contact with eyes and skin. Keep out of reach of children.

5. Fire Fighting Measures

Flammable properties	Flammable by WHMIS/OSHA criteria. Ruptured cylinders may rocket.
Extinguishing media	
Suitable extinguishing media	Stop the flow of gas. Dry chemical. Carbon dioxide.
Unsuitable extinguishing media	Water may be ineffective.
Protection of firefighters	
Specific hazards arising from the chemical	It is extremely dangerous to extinguish the fire without stopping the flow of gas. Gas and air will mix resulting in an explosion which may be more destructive than the original fire. Vapors are lighter than air and may travel along the ground to some distant source of ignition and flash back. May accumulate in confined spaces, resulting in an explosion and/or asphyxiation hazard. Contents under pressure. Pressurized container may explode when exposed to heat or flame.
Protective equipment for firefighters	Firefighters should wear full protective clothing including self contained breathing apparatus. DO NOT EXTINGUISH A LEAKING GAS FIRE UNLESS LEAK CAN BE STOPPED.
Hazardous combustion products	May include and are not limited to: Oxides of carbon. Oxides of sulfur.
Explosion data	
Sensitivity to mechanical impact	Not expected to be sensitive to mechanical impact.
Sensitivity to static discharge	Vapor: Yes. May be ignited by static discharge.

6. Accidental Release Measures

Personal precautions	Keep unnecessary personnel away. Do not touch or walk through spilled material. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Keep people away from and upwind of spill/leak.
Environmental precautions	Do not discharge into lakes, streams, ponds or public waters.
Methods for containment	Stop leak if you can do so without risk. Prevent entry into waterways, sewers, basements or confined areas.
Methods for cleaning up	Evacuate area and keep it isolated until all gas is dispersed. Remove all sources of ignition. Ventilate area. Stop leak if it can be done safely. Water spray may be used to dissipate. Prepare an emergency plan in advance and have personnel trained in its implementation. Eliminate all sources of ignition. Prevent additional discharge of product if it can be done safety. Evacuate personnel who are not equipped with appropriate personal protective equipment to areas upwind of the spill. Wear appropriate personal protective equipment as designated in Section 8.

7. Handling and Storage

Handling	Avoid contact with eyes, skin and clothing. Use good industrial hygiene practices in handling this material. When using do not eat or drink. Wash hands before breaks and immediately after handling the product. Non-sparking equipment. Explosion-proof ventilation. Intrinsically safe electrical equipment. Ground all equipment. DO NOT PRESSURIZE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION; THEY MAY EXPLODE AND CAUSE INJURY OR DEATH. "Empty" containers retain product residue (liquid or vapor) and can be dangerous.

Storage

Keep out of reach of children.
Keep away from direct sunlight.
Keep away from sources of ignition. No smoking.
Do not store at temperatures above 120°F (49°C).
Store in a cool well-ventilated area. Consider leak detection and alarm equipment for storage area.
Keep away from heat, open flames or other sources of ignition.
Containers should be vented and equipped with a flame arrester.

8. Exposure Controls / Personal Protection

Exposure limits

Ingredient(s)	Exposure Limits
Butane	**ACGIH-TLV** TWA: 1000 ppm **OSHA-PEL** Not established
Carbon dioxide	**ACGIH-TLV** TWA: 5000 ppm STEL: 30000 ppm **OSHA-PEL** TWA: 5000 ppm
Ethane	**ACGIH-TLV** TWA: 1000 ppm **OSHA-PEL** Not established
Methane	**ACGIH-TLV** TWA: 1000 ppm **OSHA-PEL** Not established
Nitrogen	**ACGIH-TLV** Not established **OSHA-PEL** Not established
Pentane	**ACGIH-TLV** TWA: 600 ppm **OSHA-PEL** TWA: 1000 ppm
Propane	**ACGIH-TLV** TWA: 1000 ppm **OSHA-PEL** TWA: 1000 ppm

Engineering controls

Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits.
Oxygen concentrations in work spaces must not be permitted to fall below 19%.

Personal protective equipment

Eye / face protection

Face shield or chemical goggles.

Hand protection

Impervious gloves. Confirm with reputable supplier first.

Skin and body protection

Where contact is likely, wear chemical-resistant gloves, a chemical suit, rubber boots, and chemical safety goggles plus a face shield.

Respiratory protection	For confined spaces, wear a NIOSH-approved (or equivalent) full-facepiece airline respirator in the positive pressure mode with emergency escape provisions. Respirator should be selected by and used under the direction of a trained health and safety professional following requirements found in OSHA's respirator standard (29 CFR 1910.134), CAN/CSA-Z94.4 and ANSI's standard for respiratory protection (Z88.2).
General hygiene considerations	Handle in accordance with good industrial hygiene and safety practice. When using do not eat or drink. Wash hands before breaks and immediately after handling the product.

9. Physical and Chemical Properties

Appearance	Compressed gas.
Color	Colorless
Form	Compressed gas
Odor	Mercaptan
Odor threshold	Mercaptan - 1 ppb
Physical state	Gas
pH	Not applicable
Melting point	Not available
Freezing point	-296.68 °F (-182.6 °C) @ 1atm
Boiling point	-258.52 °F (-161.4 °C) @ 1atm
Pour point	Not available
Evaporation rate	Not applicable
Flash point	-305.86 °F (-187.7 °C) Tag Closed Cup
Auto-ignition temperature	1000.40 °F (538 °C)
Flammability limits in air, lower, % by volume	5 (estimated)
Flammability limits in air, upper, % by volume	15.4 (estimated)
Vapor pressure	522 KPa @ 37.8°C/100°F
Vapor density	0.56 (Air = 1)
Specific gravity	0.717 grams/L @ 0°C/0.871 grams/mL @ 60°F
Octanol/water coefficient	Not applicable
Solubility (H2O)	3.5% @ 17°C/62.6°F
Viscosity	Not available
Percent volatile	Not available

10. Stability and Reactivity

Reactivity	This product may react with strong oxidizing agents.
Possibility of hazardous reactions	Hazardous polymerization does not occur.
Chemical stability	Stable under recommended storage conditions.
Conditions to avoid	Extreme heat and freezing temperatures. Heat, open flames, static discharge, sparks and other ignition sources.
Incompatible materials	Oxidizers. Acids. Halogenated compounds.
Hazardous decomposition products	May include and are not limited to: Oxides of carbon. Oxides of sulphur.

11. Toxicological Information

Component analysis - LC50

Ingredient(s)	LC50
Butane	658 mg/l/4h rat
Carbon dioxide	Not available
Ethane	658 mg/l/4h rat
Methane Not	available
Nitrogen Not	available
Pentane Not	available
Propane	658 mg/l/4h rat

Component analysis - Oral LD50

Ingredient(s)	LD50
Butane	Not available
Carbon dioxide	Not available
Ethane Not	available
Methane Not	available
Nitrogen Not	available
Pentane	2000 mg/kg rat
Propane Not	available

Effects of acute exposure

Eye May cause irritation. Contact with liquid may cause frostbite.

Skin May cause irritation. Contact with liquid may cause frostbite.

Inhalation This product is an asphyxiant gas which can cause unconsciousness/death if OXYGEN levels are sufficiently reduced.
Signs and symptoms of preceding asphyxiation include and are not limited to rapid respiration, loss of mental alertness and co-ordination, dizziness, nausea and vomiting.
Oxygen concentrations in work spaces must not be permitted to fall below 19%.

Ingestion Not a normal route of exposure as this product is a gas at room temperature and pressure.

Sensitization Non-hazardous by WHMIS/OSHA criteria.

Chronic effects Non-hazardous by WHMIS/OSHA criteria.

Carcinogenicity Non-hazardous by WHMIS/OSHA criteria.

Mutagenicity Non-hazardous by WHMIS/OSHA criteria.

Reproductive effects Non-hazardous by WHMIS/OSHA criteria.

Teratogenicity Non-hazardous by WHMIS/OSHA criteria.

Name of Toxicologically Synergistic Products Not available

12. Ecological Information

Ecotoxicity See below

Ecotoxicity - Freshwater Fish - Acute Toxicity Data

Pentane	109-66-0	96 Hr LC50 Oncorhynchus mykiss: 9.87 mg/L; 96 Hr LC50 Pimephales promelas: 11.59 mg/L; 96 Hr LC50 Lepomis macrochirus: 9.99 mg/L

Ecotoxicity - Water Flea - Acute Toxicity Data

Pentane	109-66-0	48 Hr EC50 Daphnia magna: 9.74 mg/L

Persistence / degradability Not available

Bioaccumulation / accumulation Bioconcentration potential is low.

Mobility in environmental media Not available

Environmental effects No potential for food chain concentration.

Aquatic toxicity Not available

Partition coefficient Not applicable

Chemical fate information	Not available
Other adverse effects	Not available

13. Disposal Considerations

Disposal instructions	Review federal, state/provincial, and local government requirements prior to disposal. Do not puncture or incinerate container.
Waste from residues / unused products	Not available
Contaminated packaging	Not available

14. Transport Information

U.S. Department of Transportation (DOT)

Basic shipping requirements:

Proper shipping name	Methane, compressed or Natural gas, compressed (with high methane content)
Hazard class	2.1
UN number	UN1971
Additional information:	
Packaging exceptions	306
ERG number	115

Transportation of Dangerous Goods (TDG - Canada)

Basic shipping requirements:

Proper shipping name	METHANE, COMPRESSED; or NATURAL GAS, COMPRESSED with high methane content
Hazard class	2.1
UN number	1971

15. Regulatory Information

Canadian federal regulations This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

Canada - CEPA - High Priority Chemicals as Identified by DSL Categorization

Butane	106-97-8	Batch 4, published November 17, 2007

Canada - CEPA - Schedule I - List of Toxic Substances

Carbon dioxide	124-38-9	Present
Methane	74-82-8	Present

Canada - WHMIS - Ingredient Disclosure List

Butane 106-97	-8	1 %
Carbon dioxide	124-38-9	1 %
Pentane 109-66	-0	1 %

WHMIS status	Controlled
WHMIS classification	Class A - Compressed Gas, Class B - Division 1 - Flammable Gas, Class D - Division 2B

WHMIS labeling

Occupational Safety and Health Administration (OSHA)

29 CFR 1910.1200 hazardous chemical Yes

US Federal regulations This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

U.S. - CAA (Clean Air Act) - Accidental Release Prevention - Flammable Substances

Butane	106-97-8	10000 lb threshold quantity
Ethane	74-84-0	10000 lb threshold quantity
Methane	74-82-8	10000 lb threshold quantity
Pentane	109-66-0	10000 lb threshold quantity
Propane	74-98-6	10000 lb threshold quantity

U.S. - CAA (Clean Air Act) - Greenhouse Gases (GHG) - Findings under Section 202(a) - Final Rule

Carbon dioxide	124-38-9	Subject to Endangerment Finding; Subject to Cause or Contribute Finding
Methane	74-82-8	Subject to Endangerment Finding; Subject to Cause or Contribute Finding

U.S. - CAA (Clean Air Act) - Greenhouse Gases (GHG) - Global Warming Potentials

Carbon dioxide	124-38-9	1 GWP
Methane	74-82-8	21 GWP

U.S. - CAA (Clean Air Act) - Greenhouse Gases (GHG) - Mandatory Reporting of Emissions - Final Rule

Carbon dioxide	124-38-9	Present
Methane	74-82-8	Present

U.S. - CAA (Clean Air Act) - Reactivity Factors for VOCs in Aerosol Coatings

Butane	106-97-8	1.33 G Ozone/g VOC Reactivity Factor
Pentane	109-66-0	1.54 G Ozone/g VOC Reactivity Factor
Propane	74-98-6	0.56 G Ozone/g VOC Reactivity Factor

U.S. - CAA (Clean Air Act) - SNAP Program Listing of Substitutes for ODSs

Butane	106-97-8	Acceptable substitute for: 6
Carbon dioxide	124-38-9	Acceptable substitute for: 1, 2, 4, 6, 7
Nitrogen	7727-37-9	Acceptable substitute for: 6
Propane	74-98-6	Acceptable substitute for: 6, 7

U.S. - CAA (Clean Air Act) - VOCs with Negligible Photochemical Reactivity

Ethane	74-84-0	Present
Methane	74-82-8	Present

U.S. - CAA (Clean Air Act) - Volatile Organic Compounds (VOCs) in SOCMI

Pentane 109-66	-0	Present

CERCLA (Superfund) reportable quantity

None

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories Immediate Hazard - Yes
Delayed Hazard - No
Fire Hazard - Yes
Pressure Hazard - Yes
Reactivity Hazard - No

Section 302 extremely hazardous substance No

Section 311 hazardous chemical Yes

Clean Water Act (CWA) Not available

State regulations See below

U.S. - California - 8 CCR Section 339 - Director's List of Hazardous Substances

Butane	106-97-8	Present
Carbon dioxide	124-38-9	Present
Pentane	109-66-0	Present

U.S. - Massachusetts - Right To Know List

Butane	106-97-8	Present
Carbon dioxide	124-38-9	Present
Ethane	74-84-0	Present
Methane	74-82-8	Present
Nitrogen	7727-37-9	Present
Pentane	109-66-0	Present
Propane	74-98-6	Present

U.S. - Minnesota - Hazardous Substance List

Butane	106-97-8	Present
Carbon dioxide	124-38-9	Present
Ethane	74-84-0	Simple asphyxia nt
Methane	74-82-8	Simple asphyxia nt
Nitrogen	7727-37-9	Present
Pentane	109-66-0	Present
Propane	74-98-6	Simple asphyxiant

U.S. - New Jersey - Right to Know Hazardous Substance List

Butane	106-97-8	sn 0273
Carbon dioxide	124-38-9	sn 0343
Ethane	74-84-0	sn 0834
Methane	74-82-8	sn 1202
Nitrogen	7727-37-9	sn 1375 (compressed or liquefied)
Pentane	109-66-0	sn 1476
Propane	74-98-6	sn 1594

U.S. - Pennsylvania - RTK (Right to Know) List

Butane	106-97-8	Present
Carbon dioxide	124-38-9	Present
Ethane	74-84-0	Present
Methane	74-82-8	Present
Nitrogen	7727-37-9	Present
Pentane	109-66-0	Present
Propane	74-98-6	Present

U.S. - Rhode Island - Hazardous Substance List

Butane	106-97-8	Toxic; Flammable
Carbon dioxide	124-38-9	Toxic
Ethane	74-84-0	Toxic
Methane	74-82-8	Toxic
Nitrogen	7727-37-9	Flammable (liquefied)
Pentane	109-66-0	Toxic; Flammable
Propane	74-98-6	Toxic; Flammable

Inventory name

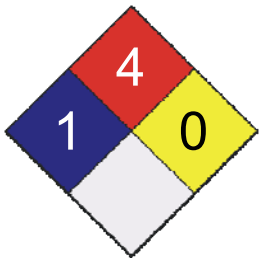
Country(s) or region	Inventory name	On inventory (yes/no)*
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)

16. Other Information

LEGEND HMIS/NFPA	
Severe	4
Serious	3
Moderate	2
Slight	1
Minimal	0

Health	/ 1
Flammability	4
Physical Hazard	0
Personal Protection	X



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Issue date	03-Apr-2013
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Prepared by	Dell Tech Laboratories Ltd. (519) 858-5021
Other information	For an updated MSDS, please contact the supplier/manufacturer listed on the first page of the document. This MSDS conforms to the ANSI Z400.1/Z129.1-2010 Standard.

AMMONIA, ANHYDROUS

AMA

CAUTIONARY RESPONSE INFORMATION

Common Synonyms			
Liquid ammonia	Liquefied compressed gas	Colorless	Ammonia odor

Floats and boils on water. Poisonous, visible vapor cloud is produced.

Avoid contact with liquid and vapor. Keep people away.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Stop discharge if possible.
Stay upwind and use water spray to ``knock down'' vapor.
Call fire department.
Isolate and remove discharged material.
Notify local health and pollution control agencies.
Protect water intakes.

Fire

Combustible.
Wear goggles, self-contained breathing apparatus, and rubber over-clothing (including gloves).
Stop flow of gas or liquid if possible.
Cool exposed containers and protect men effecting shutoff with water.
Let fire burn.

Exposure

CALL FOR MEDICAL AID.

VAPOR
POISONOUS IF INHALED.
Irritating to eyes, nose and throat.
Move to fresh air.
If in eyes, hold eyelids open and flush with plenty of water.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Will burn skin and eyes.
Harmful if swallowed.
Will cause frostbite.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
DO NOT RUB AFFECTED AREAS.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. CORRECTIVE RESPONSE ACTIONS

Dilute and disperse
Stop discharge
Do not add water to undissolved material

2. CHEMICAL DESIGNATIONS

2.1 CG Compatibility Group: Currently not available; Ammonia
2.2 Formula: NH_3
2.3 IMO/UN Designation: /1005
2.4 DOT ID No.: 1005
2.5 CAS Registry No.: 7664-41-7
2.6 NAERG Guide No.: 125
2.7 Standard Industrial Trade Classification: 52261

3. HEALTH HAZARDS

3.1 Personal Protective Equipment: Gas-tight chemical goggles, self-contained breathing apparatus, rubber boots, rubber gloves, emergency shower and eye bath.
3.2 Symptoms Following Exposure: 700 ppm causes eye irritation, and permanent injury may result if prompt remedial measures are not taken; 5000 ppm can cause immediate death from spasm, inflammation, or edema of the larynx. Contact of the liquid with skin freezes the tissue and then produces a caustic burn.
3.3 Treatment of Exposure: INHALATION: move victim to fresh air and give artificial respiration if necessary. Oxygen may be useful. Observe for laryngeal spasm and perform tracheostomy if indicated. SKIN OR EYES: flood immediately with running water for 15 min. Treat subsequently as thermal burn.
3.4 TLV-TWA: 25 ppm.
3.5 TLV-STEL: Not listed.
3.6 TLV-Ceiling: 35 ppm.
3.7 Toxicity by Ingestion: Not pertinent
3.8 Toxicity by Inhalation: Currently not available.
3.9 Chronic Toxicity: Not pertinent
3.10 Vapor (Gas) Irritant Characteristics: Vapors cause severe eye or throat irritation and may cause eye or lung injury; vapors cannot be tolerated even at low concentrations.
3.11 Liquid or Solid Characteristics: Causes smarting of the skin and first-degree burns on short exposure; may cause secondary burns on long exposure.
3.12 Odor Threshold: 46.8 ppm
3.13 IDLH Value: 300 ppm.
3.14 OSHA PEL-TWA: 50 ppm.
3.15 OSHA PEL-STEL: Not listed.
3.16 OSHA PEL-Ceiling: Not listed.
3.17 EPA AEGL: Not listed

4. FIRE HAZARDS

4.1 Flash Point: Not flammable under conditions likely to be encountered
4.2 Flammable Limits in Air: 15.50%-27.00%
4.3 Fire Extinguishing Agents: Stop flow of gas or liquid. Let fire burn.
4.4 Fire Extinguishing Agents Not to Be Used: None
4.5 Special Hazards of Combustion Products: Not pertinent
4.6 Behavior in Fire: Not pertinent
4.7 Auto Ignition Temperature: 1204°F
4.8 Electrical Hazards: Class I, Group D
4.9 Burning Rate: 1 mm/min.
4.10 Adiabatic Flame Temperature: Currently not available
4.11 Stoichometric Air to Fuel Ratio: 6.050 (Est.)
4.12 Flame Temperature: Currently not available
4.13 Combustion Molar Ratio (Reactant to Product): Currently not available
4.14 Minimum Oxygen Concentration for Combustion (MOCC): Not listed

5. CHEMICAL REACTIVITY

5.1 Reactivity with Water: Dissolves with mild heat effect
5.2 Reactivity with Common Materials: Corrosive to copper and galvanized surfaces.
5.3 Stability During Transport: Stable
5.4 Neutralizing Agents for Acids and Caustics: Dilute with water
5.5 Polymerization: Not pertinent
5.6 Inhibitor of Polymerization: Not pertinent

6. WATER POLLUTION

6.1 Aquatic Toxicity:
2.0 - 2.5 ppm/1-4 days/goldfish and yellow perch/LC
60 - 80 ppm/3 days/crayfish/LC_{100}
8.2 ppm/96 hr/fathead minnow/TL_m
6.2 Waterfowl Toxicity: 120 ppm
6.3 Biological Oxygen Demand (BOD): Not pertinent
6.4 Food Chain Concentration Potential: None
6.5 GESAMP Hazard Profile:
Bioaccumulation: 0
Damage to living resources: 2
Human Oral hazard: 1
Human Contact hazard: I
Reduction of amenities: X

7. SHIPPING INFORMATION

7.1 Grades of Purity: Commercial, industrial, refrigeration, electronic, and metaflurgical grades all have purity greater than 99.5%
7.2 Storage Temperature: Ambient for pressurized ammonia; low temperature for ammonia at atmospheric pressure
7.3 Inert Atmosphere: No requirement
7.4 Venting: Safety relief 250 psi for ammonia under pressure. Pressure-vacuum for ammonia at atmospheric pressure.
7.5 IMO Pollution Category: Currently not available
7.6 Ship Type: 2
7.7 Barge Hull Type: 2

8. HAZARD CLASSIFICATIONS

8.1 49 CFR Category: Poison gas
8.2 49 CFR Class: 2.3
8.3 49 CFR Package Group: Not listed.
8.4 Marine Pollutant: No
8.5 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue).....	3
Flammability (Red).....	1
Instability (Yellow).....	0

8.6 EPA Reportable Quantity: 100
8.7 EPA Pollution Category: B
8.8 RCRA Waste Number: Not listed
8.9 EPA FWPCA List: Yes

9. PHYSICAL & CHEMICAL PROPERTIES

9.1 Physical State at 15° C and 1 atm: Gas
9.2 Molecular Weight: 17.03
9.3 Boiling Point at 1 atm: –28.1°F = –33.4°C = 239.8°K
9.4 Freezing Point: –108°F = –77.7°C = 265.5°K
9.5 Critical Temperature: 271.4°F = 133°C = 406.2°K
9.6 Critical Pressure: 1636 psia = 111.3 atm = 11.27 MN/m_2
9.7 Specific Gravity: 0.682 at -33.4°C (liquid)
9.8 Liquid Surface Tension: Not pertinent
9.9 Liquid Water Interfacial Tension: Not pertinent
9.10 Vapor (Gas) Specific Gravity: 0.6
9.11 Ratio of Specific Heats of Vapor (Gas): 1.3 at 20°C
9.12 Latent Heat of Vaporization: 589 Btu/lb = 327 cal/g = 13.7 X 10^5 J/kg
9.13 Heat of Combustion: –7992 Btu/lb = –4440 cal/g = –185.9 X 10^5 J/kg
9.14 Heat of Decomposition: Not pertinent
9.15 Heat of Solution: –232 Btu/lb = –129 cal/g = –5.40 X 10^5 J/kg
9.16 Heat of Polymerization: Not pertinent
9.17 Heat of Fusion: Currently not available
9.18 Limiting Value: Currently not available
9.19 Reid Vapor Pressure: 211.9 psia

NOTES

AMMONIA, ANHYDROUS

AMA

9.20 SATURATED LIQUID DENSITY

Temperature (degrees F)	Pounds per cubic foot
-105	42.070
-100	42.200
-95	42.310
-90	42.410
-85	42.500
-80	42.570
-75	42.630
-70	42.680
-65	42.720
-60	42.740
-55	42.750
-50	42.750
-45	42.730
-40	42.700
-35	42.660
-30	42.600

9.21 LIQUID HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
-75	1.041
-70	1.043
-65	1.046
-60	1.049
-55	1.052
-50	1.054
-45	1.057
-40	1.060
-35	1.063
-30	1.066

9.22 LIQUID THERMAL CONDUCTIVITY

Temperature (degrees F)	British thermal unit inch per hour-square foot-F
	NOT PERTINENT

9.23 LIQUID VISCOSITY

Temperature (degrees F)	Centipoise
	NOT PERTINENT

9.24 SOLUBILITY IN WATER

Temperature (degrees F)	Pounds per 100 pounds of water
	MISCIBLE

9.25 SATURATED VAPOR PRESSURE

Temperature (degrees F)	Pounds per square inch
-40	10.470
-35	12.080
-30	13.900
-25	15.940
-20	18.220
-15	20.760
-10	23.590
-5	26.730
0	30.210
5	34.040
10	38.270
15	42.920
20	48.020
25	53.600
30	59.690
35	66.330
40	73.549
45	81.400
50	89.900
55	99.099
60	109.000
65	119.700
70	131.299
75	143.699
80	157.000
85	171.199

9.26 SATURATED VAPOR DENSITY

Temperature (degrees F)	Pounds per cubic foot
-40	0.03957
-35	0.04514
-30	0.05132
-25	0.05816
-20	0.06573
-15	0.07406
-10	0.08322
-5	0.09326
0	0.10420
5	0.11620
10	0.12930
15	0.14340
20	0.15880
25	0.17540
30	0.19340
35	0.21270
40	0.23350
45	0.25590
50	0.27980
55	0.30550
60	0.33290
65	0.36210
70	0.39320
75	0.42630
80	0.46150
85	0.49870

9.27 IDEAL GAS HEAT CAPACITY

Temperature (degrees F)	British thermal unit per pound-F
0	0.487
25	0.494
50	0.501
75	0.508
100	0.515
125	0.523
150	0.530
175	0.538
200	0.546
225	0.554
250	0.562
275	0.571
300	0.579
325	0.588
350	0.597
375	0.606
400	0.615
425	0.625
450	0.635
475	0.645
500	0.655
525	0.665
550	0.675
575	0.686
600	0.697

Material Safety data sheet
High Speed Diesel

MATERIAL SAFETY DATA SHEET

Diesel oil/HSD

1. Chemical identity

Chemical name: Diesel Oil	*Chemical classification*: Flammable liquid
Synonyms: Automotive Diesel Oil	*Trade name*: HSD
Formula Range: C_{13} - C_{18} *C.A.S. NO*.68476-30-2.	*U.N.NO*. 1202
Regulated identification Codes/Label: .	*Shipping name*: HSD *Hazchem code class 3* *Hazardous waste* : N.A.

Hazardous ingredients	*C.A.S.NO.*	*Hazardous ingredients*	*C.A.S.NO.*
Diesel	*68476-30-2*	*Benzene Trace*	*71-43-2*
		Naphthalene Trace	*91-20-3*
		Sulphur Trace	*7704-34-9*

Diesel is complex mixture of hydrocarbons .It's exact composition depends on the source of crude oil from which it is produced and the refining methods used

2. Physical and chemical data

Boiling point/Range (deg.C) : 215 - 376. *Physical state*: Liquid. *Appearance*: yellowish brown
Melting/freezing point (deg.C) : N. A.
Vapour pressure: 2.12 to 26mm Hg at 21 deg C.
Odour: Perceptible odour
Vapour density: N.A.
Solubility in water @ 30 deg.C: Insoluble
Specific gravity: 0.86 - 0.90 at 20 deg C
Others: Pour Point: 6 - 18 deg. C.

3. Fire and explosion Hazard data

Flammability: Yes	*LEL*: 0.6%	*Flash point(deg C)* : 32 (OC)
TDG Flammability: class 3 .	UEL: 6%	*Flash point(deg C)* : N.A. (CC)

Auto Ignition Temp : 225 deg. C
Explosion sensitivity to impact: not sensitive to Mechanical Impact.
Explosion sensitivity to static electricity: For vapors sensitivity exist
Hazardous Combustion Products: carbon monoxide, Nitrogen oxide. and other aromatic hydrocarbons
Hazardous Polymerization: N.A.

Material Safety data sheet

High Speed Diesel

Combustible liquid: Yes	*Explosive material*: Yes	*Corrosive material*: No
Flammable material ; yes	Oxidiser: N.A.	
Pyrophoric material: N.A.	*Organic peroxide*: N.A.	

4. Reactivity data

Chemical stability: Stable *Incompatibility with other material*: oxidizers such Peroxides ,Nitric acid and Perchorates
Hazardous reaction products: on fire it will liberate some amount of carbon monoxide, sulphur dioxide Nitrogen oxide. and other aromatic hydrocarbons

5. Health Hazard data

Routes of entry: : Inhalation, Skin absorption ,ingestion *Effects of Exposure / symptoms*: excessive inhalation Vapors cause rapid breathing, excitability, staggering, headache, fatigue, nausea and vomiting, dizziness, drowsiness, narcosis convulsions, coma, **Skin Contact**: Skin-dryness, cracking, irritation eyes watering, stinging and inflammation.				
Emergency treatment: In case of eye or Skin contact, flush with plenty of water. Remove soaked clothing. in case of excessive inhalation move the victim to fresh air, obtain medical assistance				
L.D$_{50}$ (Oral-Rat) : > 5g/kg		*L.C $_{50}$: (rat 4hrs)* 5g/m3		
Permissible Exposure limit: N.A.		*Odour threshold*: N.A.		
TLV (ACGIH) : 800 ppm		*STEL*: N.A.		
NFPA Hazard signals	*Health*	*Flammability*	*Reactivity/Stability*	*Special*
	1	2	0	-

6. Preventive measures

Personal Protective equipment: Canister type gas mask. PVC or Rubber. Goggles giving complete protection to eyes. Eye wash fountain with safety shower.
Handling and storage precautions: Do not expose to heat and naked lights, keep containers and valves closed when not in use.

7. Emergency and first aid measures

Fire:

Fire extinguishing media: Foam, Carbon dioxide, Dry Chemical Powder. Water may be used to cool fire-exposed containers. *Special procedure*: Shut off leak, if safe to do so, .Keep non-involved people away from spill site. Eliminate all sources of ignition. *Unusual hazards*: it will spread along the ground and collect in sewers
Exposure: **Skin contact** ; in case of contact with Skin flush with fresh water, remove containment clothing, **Inhalation**: in case of excessive inhalation move the victim to fresh air, If problem in breathing give artificial respiration; give oxygen. obtain medical assistance **Ingestion**: Give water to conscious victim to drink; do not induce vomiting. *Antidotes/Dosages*: N.A.
Spills: *Steps to be taken* Shut off leak, if safe to do so, .Keep non-involved people away from spill site. Eliminate all sources of ignition. Prevent spill entering in to sewers, for Major spillage contact Emergency services *Waste Disposal method*: N.A.

8 . Additional Information /reference

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9 . Manufacture/Suppliers Data

Manufacture(Name Of Firm.) : Hindustan Petroleum Corporation
Supplier/Dealers Data.
Name Mailing address Telephone Contact Persons

10 . DISCLAIMER

Information contained in this material data sheet is believed to be reliable but no representation, guaranty or warranties of any kind are made for suitability for particular application or result o be obtained from it. It is up the seller to ensure the Product sold by them is relevant to information contained in MSDS

Material Safety Data Sheet
Gasoline

MATERIAL SAFETY DATA SHEET
Gasoline/Petrol

1. Chemical identity

Chemical name: Petrol		*Chemical classification*: Flammable liquid	
Synonyms: Gasoline, Motor spirit		*Trade name*: Petrol	
Formula: mixture of hydrocarbons *C.A.S. NO*. 8006-61-9.		*U.N.NO*. 1203.	
Regulated identification Codes/Label:	*Shipping name*: Gasoline, Petrol *Hazchem code*: class 3 *Hazardous waste ID No*: N.A.		
Hazardous ingredients	*C.A.S.NO.*	*Hazardous ingredients*	*C.A.S. NO.*
Gasoline	*8006-61-9*	*n-Hexane Trace*	*110-54-3*
		Benzene Trace	*71-43-2*
Gasoline is complex mixture of hydrocarbons .It's exact composition depends on the source of crude oil from which it is produced and the refining methods used			

2. Physical and chemical data

Boiling point/Range (deg.C) : 30 to 215 C *Physical state*: Liquid *Appearance*: Orange, red	
Melting/freezing point (deg.C) : -90 to -75.	
Vapor pressure: 300 to 600 mm Hg (20 deg C)	
Odor: Characteristic odor *Vapor density*: 3-4	
solubility in water @ 30 deg.C: 1-100ppm /100 ml water	
Specific Gravity 0.75-0.85 at 20 deg C.	*ph* NA
Others: Floatability (water): Floats;	

3. Fire and explosion Hazard data

Flammability: yes ignited by Sparks/flames.	*LEL*: 1.4%	*UEL*: 7.6%.
Flash point(deg C) : typically about -38 to -42 (CC)		
TDG Flammability: Class 3		
Ignition Temp (deg C) : 456		
Explosion sensitivity to impact: not sensitive to Mechanical Impact		
Explosion sensitivity to static electricity: For vapors sensitivity exist		
Hazardous Combustion Products: carbon monoxide, Nitrogen oxide. and other aromatic hydrocarbons		
Hazardous Polymerization: N.A.		
Combustible liquid: Yes	*Explosive material*: Yes	*Corrosive material*: No

Flammable material: Yes	*Oxidiser*: N.A.	*Others*: N.A.
Pyrophoric material: N.A.	*Organic peroxide*: N.A.	

4. Reactivity data

Chemical stability: Stable
Incompatibility with other material: oxidizers such Peroxides ,Nitric acid and Perchorates

Hazardous reaction products: on fire it will liberate some amount carbon monoxide, Nitrogen oxide. and other aromatic hydrocarbons

5. Health Hazard data

Routes of entry: Inhalation, Skin absorption ,ingestion
Effects of Exposure/ symptoms: **Inhalation:** excessive inhalation Vapors cause rapid breathing, excitability, staggering, headache ,fatigue ,nausea and vomiting, dizziness, drowsiness, narcosis convulsions, coma,
Skin Contact: Skin-dryness, cracking, irritation eyes watering, stinging and inflammation.

Emergency treatment: in case of contact with Skin flush with fresh water, remove containment clothing, in case of excessive inhalation move the victim to fresh air, obtain medical assistance.

TLV (ACGIH) : 300 ppm *STEL*: 500
Permissible Exposure limit: *L.D$_{50}$ (Oral-Rat)* : 13.6 g/kg *L.C$_{50}$*: (rat for 4hrs) 43g/m3
Odor threshold: N.A.

NFPA Hazard signals	*Health*	*Flammability*	*Reactivity/Stability*	*Special*
	0	3	0	-

6. Preventive measures

Personal Protective equipment: Gloves, eye protection preferred.

Handling and storage precautions: eliminate all sources of ignition at storage, ensure good ventilation, ground and bond the containners

7. Emergency and first aid measures

Fire:
Fire extinguishing media: Foam, Carbon dioxide, Dry Chemical Powder. Water may be used to cool fire-exposed containers.
Special procedure: Shut off leak, if safe to do so, .Keep non-involved people away from spill site. Issue warning: " FLAMMABLE". Eliminate all sources of ignition.
Unusual hazards: Vapor heavier than Air it will spread along the ground and collect in sewers

Exposure:

First aid measures: **Skin contact** ; in case of contact with Skin flush with fresh water, remove containment clothing, **Inhalation**: in case of excessive inhalation move the victim to fresh air, If problem in breathing give artificial respiration; give oxygen. obtain medical assistance **Ingestion**: Give water to conscious victim to drink; do not induce vomiting. *Antidotes/Dosages*: N.A.
Spills: *Steps to be taken*: Shut off leak, if safe to do so, .Keep non-involved people away from spill site. Eliminate all sources of ignition. Prevent spill entering in to sewers, for Major spillage contact Emergency services *Waste Disposal method*: N.A.

8 . Additional Information /reference

.
.

9 . Manufacture/Suppliers Data

Manufacture(Name Of Firm.) : Hindustan Petroleum Corporation
Supplier/dealer Data.
Name Mailing address Telephone Contact Persons

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GUIDE 170 Metals (Powders, Dusts, Shavings, Borings, Turnings, or Cuttings, etc.)

POTENTIAL HAZARDS

FIRE OR EXPLOSION

- May react violently or explosively on contact with water.
- Some are transported in flammable liquids.
- May be ignited by friction, heat, sparks or flames.
- Some of these materials will burn with intense heat.
- Dusts or fumes may form explosive mixtures in air.
- Containers may explode when heated.
- May re-ignite after fire is extinguished.

HEALTH

- Oxides from metallic fires are a severe health hazard.
- Inhalation or contact with substance or decomposition products may cause severe injury or death.
- Fire may produce irritating, corrosive and/or toxic gases.
- Runoff from fire control or dilution water may cause pollution.

PUBLIC SAFETY

- **CALL EMERGENCY RESPONSE Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.**
- As an immediate precautionary measure, isolate spill or leak area in all directions for at least 50 meters (150 feet) for liquids and at least 25 meters (75 feet) for solids.
- Stay upwind, uphill and/or upstream.
- Keep unauthorized personnel away.

PROTECTIVE CLOTHING

- Wear positive pressure self-contained breathing apparatus (SCBA).
- Structural firefighters' protective clothing will only provide limited protection.

EVACUATION

Large Spill

- Consider initial downwind evacuation for at least 50 meters (160 feet).

Fire

- If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions.

In Canada, an Emergency Response Assistance Plan (ERAP) may be required for this product. Please consult the shipping document and/or the ERAP Program Section (page 391).

EMERGENCY RESPONSE

FIRE

- **DO NOT USE WATER, FOAM OR CO_2.**
- Dousing metallic fires with water will generate hydrogen gas, an extremely dangerous explosion hazard, particularly if fire is in a confined environment (i.e., building, cargo hold, etc.).
- Use DRY sand, graphite powder, dry sodium chloride-based extinguishers, G-1® or Met-L-X® powder.
- Confining and smothering metal fires is preferable rather than applying water.
- Move containers from fire area if you can do it without risk.

Fire involving Tanks or Car/Trailer Loads

- If impossible to extinguish, protect surroundings and allow fire to burn itself out.

SPILL OR LEAK

- ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area).
- Do not touch or walk through spilled material.
- Stop leak if you can do it without risk.
- Prevent entry into waterways, sewers, basements or confined areas.

FIRST AID

- Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.
- Move victim to fresh air.
- Call 911 or emergency medical service.
- Give artificial respiration if victim is not breathing.
- Administer oxygen if breathing is difficult.
- Remove and isolate contaminated clothing and shoes.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- Keep victim calm and warm.

Safety Data Sheet

Section 01 - Product And Company Identification

Product Identifier	Anthracite Filter Media
Other Means of Identification	Coal
Product Use and Restrictions on Use	Filter media.
Initial Supplier Identifier	ClearTech Industries Inc. 1500 Quebec Avenue Saskatoon, SK. Canada S7V 1V7
Prepared By	ClearTech Industries Inc. Technical Writer Phone: 1 (800) 387-7503
24-Hour Emergency Phone	Phone: 1 (306) 664 – 2522

Section 02 - Hazard Identification

GHS-Classification

Eye Corrosion/Irritation	Category 2
STOT-Repeated Exposure	Category 2

Physical Hazards

No known physical hazards.

Warning

Hazard Statements

H319 – Causes serious eye irritation.
H335 – May cause damage to organs through prolonged or repeated exposure.

Pictograms

Precautionary Statements

P264 – Wash hands thoroughly after handling.
P280 – Wear eye protection and face protection.
P305 + P351 + P338 – IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P337 + P313 – If eye irritation persists: Get medical advice/attention.
P260 – Do not breathe dust.
P314 – Get medical advice/attention if you feel unwell.
P501 – Dispose of contents/container in accordance with all federal, provincial, and/or local regulations including the Canadian Environmental Protection Act.

Section 03 - Composition / Information on Ingredients

Chemical Name	CAS Number	Weight %	Unique Identifiers
Anthracite Coal	8029-10-5	100%	Not Available

Section 04 - First Aid Measures

Inhalation Remove victim to fresh air. Give artificial respiration only if breathing has stopped. If breathing is difficult, give oxygen. Seek immediate medical attention.

Skin Contact / Absorption Remove contaminated clothing. Wash affected area with soap and water. Seek medical attention if irritation occurs or persists.

Eye Contact Contact lenses should never be worn when working with this product. Flush immediately with water for at least 30 minutes. Forcibly hold eyelids apart to ensure complete irrigation of eye tissue. If irritation persists, seek medical attention.

Ingestion No known health effects. Seek medical attention if any problems are experienced.

Additional Information Not Available

Section 05 - Fire Fighting Measures

Suitable Extinguishing Media Small fires: Carbon dioxide dry chemical powder, sand.

Large fires: regular foam.

Unsuitable Extinguishing Media NOTE: Violent steam generation and frothing may occur on direct application of water stream.

Specific Hazards Arising From the Chemical During a fire, toxic gases are generated.

Special Protective Equipment for Fire-Fighters Wear NIOSH-approved self-contained breathing apparatus and protective clothing.

Further Information Wet activated carbon removes oxygen from air and can lower the concentration of oxygen inside vessels containing carbon and other confined spaces. During a fire, toxic gases are generated.

Section 06 - Accidental Release Measures

Personal Precautions/ Protective Equipment/ Emergency Procedures Wear appropriate personal protective equipment. Ventilate area. Only enter area with PPE. Stop or reduce leak if safe to do so. Prevent material from entering sewers. Flush with water to remove any residue.

Environmental Precautions Prevent materials from entering sewers.

Methods For Cleaning Up Vacuum or shovel spilled material and place in closed container for proper disposal.

Section 07 - Handling and Storage

Precautions for Safe Handling Use proper equipment for lifting and transporting all containers. Use sensible industrial hygiene and housekeeping practices. Wash thoroughly after handling. Avoid all situations that could lead to harmful exposure. Minimize airborne spreading of dust.

Conditions for Safe Storage Store in a clean, well-ventilated area away from oxidizers, acids, ignition sources, heat, and combustible materials.

Incompatibilities Strong oxidizers such as ozone, liquid oxygen, chlorine, potassium permanganate. Strong acids, Acetone, Alkali metals.

Section 08 - Exposure Controls and Personal Protection

Exposure Limit(s)

Component	Regulation	Type of Listing	Value
Activated Carbon	Not established.		

Engineering Control(s)

Ventilation Requirements Mechanical ventilation (dilution or local exhaust), process or personnel enclosure and control of process conditions must be provided in accordance with all fire codes and regulatory requirements. Supply sufficient replacement air to make up for air removed by exhaust systems.

Other Emergency shower and eyewash must be available and tested in accordance with regulations and be in close proximity.

Protective Equipment

Eyes/Face Chemical goggles, full-face shield, or a full-face respirator is to be worn at all times when product is handled. Contact lenses should not be worn; they may contribute to severe eye injury.

Hand Protection Impervious gloves of chemically resistant material (rubber or PVC) should be worn at all times. Wash contaminated clothing and dry thoroughly before reuse.

Skin and Body Protection Body suite, aprons, and/or coveralls of chemical resistant material should be worn at all times. Wash contaminated clothing and dry thoroughly before reuse.

No special footwear is required other than what is mandated at place of work.

Respiratory Protection Respiratory protection is not normally required. If use creates dust formations, then a NIOSH-approved respirator with a dust cartridge is recommended. Wet activated carbon removes oxygen from air causing a severe hazard to workers inside confined spaces. Before entering such an area, sampling and work procedures for low oxygen levels should be taken (such as wearing a self-contained breathing apparatus).

Thermal Hazards Not Available

Section 09 - Physical and Chemical Properties

Appearance

Physical State Particulate solid, pellet or powder

Colour Black

Odour Odourless

Odour Threshold Not Applicable

Property

pH Not applicable. Activated carbon bearing inorganic and chemically active groups on its surface may alter the pH of liquids to which it is added.

Melting Point/Freezing Point >3500°C

Initial Boiling Point and Boiling Range Maximum 4000°C

Flash Point Not Applicable

Evaporation Rate	Not Applicable
Flammability	Not Applicable
Upper Flammable Limit	Not Applicable
Lower Flammable Limit	Not Applicable
Vapour Pressure (mm Hg, 20°C)	Not Applicable
Vapour Density (Air=1)	Not Applicable
Relative Density	Not Available
Solubility(ies)	Insoluble in water
Partition Coefficient: n-octanol/water	Not Applicable
Auto-ignition Temperature	~ 300°C [Depends on particle size and physical form.]
Decomposition Temperature	Not Available
Viscosity	Not Applicable
Explosive Properties	Airborne dust may create an explosion hazard.
Specific Gravity (Water=1)	0.25 – 0.60
% Volatiles by Volume	0%
Formula	C
Molecular Weight	12.011

Section 10 - Stability and Reactivity

Reactivity	Not Available
Chemical Stability	Stable under normal conditions.
Possibility of Hazardous Reactions	Self-heats due to slow oxidation by air. Presence of moisture accelerates self-heating.
Conditions to Avoid	High temperatures, sparks, open flames and all other sources of ignition. Minimize airborne spreading of dust. High concentrations of organics in air will cause temperature rise due to heat of adsorption. At very high concentration levels this may cause a bed fire. High concentrations of Ketones and Aldehydes may cause a bed temperature rise due to adsorption and oxidation.
Incompatible Materials	Strong oxidizers such as ozone, liquid oxygen, chlorine, potassium permanganate. Strong acids, Acetone, Alkali metals.
Hazardous Decomposition Products	Carbon monoxide may be generated in the event of a fire (especially with incomplete combustion in an enclosed space).

Section 11 - Toxicological Information

Acute Toxicity

Component	Oral LD_{50}	Dermal LD_{50}	LC_{50}
Activated Carbon	>10,000 mg/kg	Not Available	>64.4mg/L (rat, inhalation)

Chronic Toxicity – Carcinogenicity

Component	IARC
Activated Carbon	Not considered to be carcinogenic as per IARC, NTP, and OSHA.

Skin Corrosion/Irritation	Dust may cause mechanical irritation.
Ingestion	Non-toxic though ingestion
Inhalation	Non-toxic though inhalation
Serious Eye Damage/Irritation	Causes slight to mild irritation of the eyes.
Respiratory or Skin Sensitization	None known.
Germ Cell Mutagenicity	No adverse mutagenic effects are anticipated.
Reproductive Toxicity	No adverse reproductive effects are anticipated.
STOT-Single Exposure	May cause respiratory tract irritation
STOT-Repeated Exposure	May cause damage to organs through prolonged or repeated exposure.
Aspiration Hazard	Not Available
Synergistic Materials	None known

Section 12 - Ecological Information

Ecotoxicity

Component	Toxicity to Algae	Toxicity to Fish	Toxicity to Daphnia and Other Aquatic Invertebrates
Carbon	Not Available	Not Available	Not Available

Biodegradability	Not Available
Bioaccumulation	No evidence of bioaccumulation or tainting of seafood.
Mobility	Not Available
Other Adverse Effects	Not Available

Section 13 - Disposal Considerations

Waste From Residues/Unused Products	Dispose in accordance with all federal, provincial, and/or local regulations including the Canadian Environmental Protection Act.
Contaminated Packaging	Dispose in accordance with all federal, provincial, and/or local regulations including the Canadian Environmental Protection Act.

Section 14 - Transport Information

UN Number	Not Regulated
UN Proper Shipping Name	Not Regulated
Transport Hazard Class(es)	Not Regulated
Packaging Group	Not Regulated
Environmental Hazards	Not listed as a marine pollutant under Canadian TDG Regulations, schedule III.
Special Precautions	Not Available
Transport in Bulk	Not Available

TDG

Other	Secure containers (full and/or empty) with suitable hold down devises during shipment and ensure all caps, valves, or closures are secured in the closed position.

TDG PRODUCT CLASSIFICATION: This product has been classified on the preparation date specified at section 14 of this MSDS / SDS, for transportation in accordance with the requirements of part 2 of the Transportation of Dangerous Goods Regulations. If applicable, testing and/or published test data regarding the classification of this product are listed in the references at section 16 of this MSDS / SDS.

Section 15 - Regulatory Information

NOTE: THE PRODUCT LISTED ON THIS SDS HAS BEEN CLASSIFIED IN ACCORDANCE WITH THE HAZARD CRITERIA OF THE CANADIAN CONTROLLED PRODUCTS REGULATIONS. THIS SDS CONTAINS ALL INFORMATION REQUIRED BY THOSE REGULATIONS.

Section 16 - Other Information

Preparation Date September 15, 2015

Note: The responsibility to provide a safe workplace remains with the user. The user should consider the health hazards and safety information contained herein as a guide and should take those precautions required in an individual operation to instruct employees and develop work practice procedures for a safe work environment. The information contained herein is, to the best of our knowledge and belief, accurate. However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by the use of this material. It is the responsibility of the user to comply with all applicable laws and regulations.

Attention: Receiver of the chemical goods / SDS coordinator

As part of our commitment to the Canadian Association of Chemical Distributors (CACD) Responsible Distribution® initiative, ClearTech Industries Inc. and its associated companies require, as a condition of sale, that you forward the attached Safety Data Sheet(s) to all affected employees, customers, and end-users. ClearTech will send any available supplementary handling, health, and safety information to you at your request.

References:

1) CHEMINFO
2) eChemPortal
3) TOXNET
4) Transportation of Dangerous Goods Canada
5) HSDB
6) PAN

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name Iron, sponge

Stock number: 43240
CAS Number:
7439-89-6
EC number:
231-096-4
1.2 Relevant identified uses of the substance or mixture and uses advised against.
Identified use: SU24 Scientific research and development

1.3 Details of the supplier of the safety data sheet
Manufacturer/Supplier:
Thermo Fisher (Kandel) GmbH
Zeppelinstr. 7b
76185 Karlsruhe / Germany
Tel: +49 (0) 721 84007 280
Fax: +49 (0) 721 84007 300
Email: tech@alfa.com
www.alfa.com
Informing department: Product safety Tel + +049 (0) 7275 988687-0
1.4 Emergency telephone number:
Carechem 24: +44 (0) 1235 239 670 (Multi-language emergency number)
Poison Information Center Mainz
www.giftinfo.uni-mainz.de Telephone: +49(0)6131/19240

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture
Classification according to Regulation (EC) No 1272/2008

GHS02 flame

Flam. Sol. 2 H228 Flammable solid.

GHS07

Eye Irrit. 2 H319 Causes serious eye irritation.
STOT SE 3 H335 May cause respiratory irritation.
Other hazards that do not result in classification No information known.

2.2 Label elements
Labelling according to Regulation (EC) No 1272/2008 The substance is classified and labelled according to the CLP regulation.
Hazard pictograms

GHS02 GHS07

Signal word Warning
Hazard statements
H228 Flammable solid.
H319 Causes serious eye irritation.
H335 May cause respiratory irritation.
Precautionary statements
P210 Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P261 Avoid breathing dust/fume/gas/mist/vapours/spray.
P280 Wear protective gloves / eye protection / face protection.
P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P405 Store locked up.
P501 Dispose of contents/container in accordance with local/regional/national/international regulations.
2.3 Other hazards
Results of PBT and vPvB assessment
PBT: Not applicable.
vPvB: Not applicable.

SECTION 3: Composition/information on ingredients

3.1 Substances
CAS# Designation:
7439-89-6 Iron
Concentration: ≤100%
Identification number(s):
EC number: 231-096-4

SECTION 4: First aid measures

4.1 Description of first aid measures
After inhalation
Supply fresh air. If required, provide artificial respiration. Keep patient warm. Consult doctor if symptoms persist.
Seek immediate medical advice.
After skin contact
Instantly wash with water and soap and rinse thoroughly.
Seek immediate medical advice.
After eye contact Rinse opened eye for several minutes under running water. Then consult doctor.
After swallowing Seek medical treatment.
4.2 Most important symptoms and effects, both acute and delayed Causes serious eye irritation.
4.3 Indication of any immediate medical attention and special treatment needed No further relevant information available.

SECTION 5: Firefighting measures

5.1 Extinguishing media
Suitable extinguishing agents Special powder for metal fires. Do not use water.
For safety reasons unsuitable extinguishing agents Water.

(Contd. on page 2)

Trade name *Iron, sponge*

(Contd. of page 1)

5.2 Special hazards arising from the substance or mixture
If this product is involved in a fire, the following can be released:
Iron oxides
5.3 Advice for firefighters
Protective equipment:
Wear self-contained breathing apparatus.
Wear full protective suit.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures
Wear protective equipment. Keep unprotected persons away.
Ensure adequate ventilation
Keep away from ignition sources
6.2 Environmental precautions: Do not allow product to reach sewage system or water bodies.
6.3 Methods and material for containment and cleaning up: Ensure adequate ventilation.
Prevention of secondary hazards: Keep away from ignition sources.
6.4 Reference to other sections
See Section 7 for information on safe handling
See section 8 for information on personal protection equipment.
See Section 13 for information on disposal.

SECTION 7: Handling and storage

7.1 Precautions for safe handling
Keep containers tightly sealed.
Store in cool, dry place in tightly closed containers.
Ensure good ventilation/exhaustion at the workplace.
Information about protection against explosions and fires: Protect against electrostatic charges.

7.2 Conditions for safe storage, including any incompatibilities
Storage
Requirements to be met by storerooms and containers: Store in cool location.
Information about storage in one common storage facility:
Do not store together with acids.
Store away from oxidising agents.
Further information about storage conditions:
Keep container tightly sealed.
Store in cool, dry conditions in well sealed containers.
7.3 Specific end use(s) No further relevant information available.

SECTION 8: Exposure controls/personal protection

Additional information about design of technical systems:
Properly operating chemical fume hood designed for hazardous chemicals and having an average face velocity of at least 100 feet per minute.

8.1 Control parameters
Components with critical values that require monitoring at the workplace:
The product does not contain any relevant quantities of materials with critical values that have to be monitored at the workplace.
Additional information: No data

8.2 Exposure controls
Personal protective equipment
General protective and hygienic measures
The usual precautionary measures should be adhered to in handling the chemicals.
Keep away from foodstuffs, beverages and food.
Instantly remove any soiled and impregnated garments.
Wash hands during breaks and at the end of the work.
Avoid contact with the eyes.
Avoid contact with the eyes and skin.
Maintain an ergonomically appropriate working environment.
Breathing equipment: Use breathing protection with high concentrations.
Recommended filter device for short term use:
Use a respirator with type P100 (USA) or P3 (EN 143) cartridges as a backup to engineering controls. Risk assessment should be performed to determine if air-purifying respirators are appropriate. Only use equipment tested and approved under appropriate government standards.
Protection of hands:
Check protective gloves prior to each use for their proper condition.
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer.
Material of gloves Nitrile rubber, NBR
Penetration time of glove material (in minutes) 480
Glove thickness: 0.11 mm
Eye protection:
Face protection
Safety glasses with side shields / NIOSH (US) or EN 166(EU)
Body protection: Protective work clothing.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties
General Information
Appearance:

Form:	Powder
Odour:	Not determined
Odour threshold:	Not determined.
pH-value:	Not applicable.
Change in condition	
Melting point/freezing point:	1538 °C
Initial boiling point and boiling range:	2740 °C
Sublimation temperature / start:	Not determined
Flash point:	Not determined
Inflammability (solid, gaseous)	Highly flammable.
Ignition temperature:	Not determined
Decomposition temperature:	Not determined
Self-inflammability:	Not determined.
Explosive properties:	Not determined.
Critical values for explosion:	
Lower:	Not determined
Upper:	Not determined

(Contd. on page 3)

Trade name *Iron, sponge*

(Contd. of page 3)

IMDG, IATA

Class	4.1 Flammable solids, self-reactive substances and solid desensitised explosives.
Label	4.1
Packing group **ADR, IMDG, IATA**	III
14.5 Environmental hazards:	Not applicable.
14.6 Special precautions for user	Warning: Flammable solids, self-reactive substances and solid desensitised explosives.
Kemler Number:	40
Stowage Category	A
Handling Code	H1 Keep as dry as reasonably practicable
Segregation Code	SG17 Stow "separated from" class 5.1 SG25 Stow "separated from" goods of classes 2.1 and 3. SG26 In addition: from goods of classes 2.1 and 3 when stowed on deck of a containership a minimum distance of two container spaces athwartship shall be maintained, when stowed on ro-ro ships a distance of 6 m athwartship shall be maintained.
14.7 Transport in bulk according to Annex II of Marpol and the IBC Code	Not applicable.
Transport/Additional information:	
ADR	
Excepted quantities (EQ):	E1
Limited quantities (LQ)	5 kg
Excepted quantities (EQ)	Code: E1 Maximum net quantity per inner packaging: 30 g Maximum net quantity per outer packaging: 1000 g
Transport category	3
Tunnel restriction code	E
IMDG	
Limited quantities (LQ)	5 kg
Excepted quantities (EQ)	Code: E1 Maximum net quantity per inner packaging: 30 g Maximum net quantity per outer packaging: 1000 g
UN "Model Regulation":	UN 3089 METAL POWDER, FLAMMABLE, N.O.S., 4.1, III

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture
Australian Inventory of Chemical Substances Substance is listed.
Standard for the Uniform Scheduling of Medicines and Poisons Substance is not listed.

Directive 2012/18/EU
Named dangerous substances - ANNEX I Substance is not listed.
REGULATION (EC) No 1907/2006 ANNEX XVII Conditions of restriction: 40
National regulations
Information about limitation of use:
Employment restrictions concerning young persons must be observed.
For use only by technically qualified individuals.
Classification according to VbF: Not applicable

Water hazard class: Generally not hazardous for water.
Other regulations, limitations and prohibitive regulations
ELINCS (European List of Notified Chemical Substances) Substance is not listed.
Substance of Very High Concern (SVHC) according to the REACH Regulations (EC) No. 1907/2006. Substance is not listed.
The conditions of restrictions according to Article 67 and Annex XVII of the Regulation (EC) No 1907/2006 (REACH) for the manufacturing, placing on the market and use must be observed.
Substance is not listed.
Annex XIV of the REACH Regulations (requiring Authorisation for use) Substance is not listed.
15.2 Chemical safety assessment: A Chemical Safety Assessment has not been carried out.

SECTION 16: Other information

Employers should use this information only as a supplement to other information gathered by them, and should make independent judgement of suitability of this information to ensure proper use and protect the health and safety of employees. This information is furnished without warranty, and any use of the product not in conformance with this Safety Data Sheet, or in combination with any other product or process, is the responsibility of the user.

Department issuing SDS: Global Marketing Department
Abbreviations and acronyms:
ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
IMDG: International Maritime Code for Dangerous Goods
IATA: International Air Transport Association
GHS: Globally Harmonised System of Classification and Labelling of Chemicals
EINECS: European inventory of Existing Commercial Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
VbF: Verordnung über brennbare Flüssigkeiten, Österreich (Ordinance on the storage of combustible liquids, Austria)
LC50: Lethal concentration, 50 percent
LD50: Lethal dose, 50 percent
PBT: Persistent, Bioaccumulative and Toxic
SVHC: Substances of Very High Concern
vPvB: very Persistent and very Bioaccumulative
NIOSH: National Institute for Occupational Safety
OSHA: Occupational Safety and Health Administration (USA)
TLV: Threshold Limit Value
PEL: Permissible Exposure Limit
REL: Recommended Exposure Limit
BEI: Biological Exposure Limit
Flam. Sol. 1: Flammable solids – Category 2
Eye Irrit. 2: Serious eye damage/eye irritation – Category 2
STOT SE 3: Specific target organ toxicity (single exposure) – Category 3

Trade name *Iron, sponge*

(Contd. of page 3)

IMDG, IATA

Class	4.1 Flammable solids, self-reactive substances and solid desensitised explosives.
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Packing group **ADR, IMDG, IATA**	III
14.5 Environmental hazards:	Not applicable.
14.6 Special precautions for user	Warning: Flammable solids, self-reactive substances and solid desensitised explosives.
Kemler Number:	40
Stowage Category	A
Handling Code	H1 Keep as dry as reasonably practicable
Segregation Code	SG17 Stow "separated from" class 5.1 SG25 Stow "separated from" goods of classes 2.1 and 3. SG26 In addition: from goods of classes 2.1 and 3 when stowed on deck of a containership a minimum distance of two container spaces athwartship shall be maintained, when stowed on ro-ro ships a distance of 6 m athwartship shall be maintained.
14.7 Transport in bulk according to Annex II of Marpol and the IBC Code	Not applicable.
Transport/Additional information:	
ADR	
Excepted quantities (EQ):	E1
Limited quantities (LQ)	5 kg
Excepted quantities (EQ)	Code: E1 Maximum net quantity per inner packaging: 30 g Maximum net quantity per outer packaging: 1000 g
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REGULATION (EC) No 1907/2006 ANNEX XVII Conditions of restriction: 40
National regulations
Information about limitation of use:
Employment restrictions concerning young persons must be observed.
For use only by technically qualified individuals.
Classification according to VbF: Not applicable

Water hazard class: Generally not hazardous for water.
Other regulations, limitations and prohibitive regulations
ELINCS (European List of Notified Chemical Substances) Substance is not listed.
Substance of Very High Concern (SVHC) according to the REACH Regulations (EC) No. 1907/2006. Substance is not listed.
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BEI: Biological Exposure Limit
Flam. Sol. 2: Flammable solids – Category 2
Eye Irrit. 2: Serious eye damage/eye irritation – Category 2
STOT SE 3: Specific target organ toxicity (single exposure) – Category 3

AMMONIUM NITRATE

AMN

CAUTIONARY RESPONSE INFORMATION

Common Synonyms			
Nitram	Solid pellets or flakes	White to light gray or brown	Odorless
	Sinks and mixes with water.		

Call Fire department. Keep people away.
Evacuate area in case of large discharge.
Isolate and remove discharged material.
Notify local health and pollution control agencies.
Protect water intakes.

Fire

May cause fire and explode on contact with combustibles.
CONTAINERS MAY EXPLODE IN FIRE.
POISONOUS GASES MAY BE PRODUCED WHEN HEATED.
Wear self-contained breathing apparatus.
Evacuate surrounding area.
Combat fires from protected location with unmanned hose holder or monitor nozzle.
Flood discharge area with water.
Cool exposed containers with water.
Continue cooling after fire has been extinguished.

Exposure

CALL FOR MEDICAL AID.
DUST
Irritating to eyes, nose, and throat.
If inhaled, may cause coughing or difficult breathing.
Move to fresh air.
If in eyes, hold eyelids open and flush with plenty of water.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. CORRECTIVE RESPONSE ACTIONS

Dilute and disperse
Stop discharge
Do not burn

2. CHEMICAL DESIGNATIONS

2.1 CG Compatibility Group: Currently not available; Ammonia
2.2 Formula: NH_4NO_3
2.3 IMO/UN Designation: 5.1/2067
2.4 DOT ID No.: 1942
2.5 CAS Registry No.: 6484-52-2
2.6 NAERG Guide No.: 140
2.7 Standard Industrial Trade Classification: 51481

3. HEALTH HAZARDS

3.1 Personal Protective Equipment: Wear self-contained breathing apparatus
3.2 Symptoms Following Exposure: Irritation of eyes and mucous membranes. Absorption via ingestion or inhalation causes urination and acid urine. Large amount causes systemic acidosis and metheglobinemia (abnormal hemoglobin).
3.3 Treatment of Exposure: Remove from exposure-symptoms reversible.
3.4 TLV-TWA: Not listed.
3.5 TLV-STEL: Not listed.
3.6 TLV-Ceiling: Not listed.
3.7 Toxicity by Ingestion: Currently not available
3.8 Toxicity by Inhalation: Currently not available.
3.9 Chronic Toxicity: Currently not available
3.10 Vapor (Gas) Irritant Characteristics: Not pertinent
3.11 Liquid or Solid Characteristics: None
3.12 Odor Threshold: Not pertinent
3.13 IDLH Value: Not listed.
3.14 OSHA PEL-TWA: Not listed.
3.15 OSHA PEL-STEL: Not listed.
3.16 OSHA PEL-Ceiling: Not listed.
3.17 EPA AEGL: Not listed

4. FIRE HAZARDS

4.1 Flash Point: Not flammable
4.2 Flammable Limits in Air: Not flammable
4.3 Fire Extinguishing Agents: Use flooding amounts of water in early stages of fire. When large quantities are involved in massive fires, control efforts should be confined to protecting from explosion.
4.4 Fire Extinguishing Agents Not to Be Used: Not pertinent
4.5 Special Hazards of Combustion Products: Decomposes, giving off extremely toxic oxides of nitrogen.
4.6 Behavior in Fire: May explode in fires. Supports combustion of common organic fuels.
4.7 Auto Ignition Temperature: Not flammable
4.8 Electrical Hazards: Not pertinent
4.9 Burning Rate: Not flammable
4.10 Adiabatic Flame Temperature: Not pertinent
4.11 Stoichometric Air to Fuel Ratio: Not pertinent
4.12 Flame Temperature: Not pertinent
4.13 Combustion Molar Ratio (Reactant to Product): Currently not available
4.14 Minimum Oxygen Concentration for Combustion (MOCC): Not listed

5. CHEMICAL REACTIVITY

5.1 Reactivity with Water: No reaction
5.2 Reactivity with Common Materials: No reaction
5.3 Stability During Transport: If heated strongly, decomposes, giving off toxic gases and gases which support combustion. Undergoes detonation if heated under confinement.
5.4 Neutralizing Agents for Acids and Caustics: Not pertinent
5.5 Polymerization: Not pertinent
5.6 Inhibitor of Polymerization: Not pertinent

6. WATER POLLUTION

6.1 Aquatic Toxicity: Currently not available
6.2 Waterfowl Toxicity: Currently not available
6.3 Biological Oxygen Demand (BOD): Currently not available
6.4 Food Chain Concentration Potential: None
6.5 GESAMP Hazard Profile:
Bioaccumulation: 0
Damage to living resources: 1
Human Oral hazard: 1
Human Contact hazard: 0
Reduction of amenities: 0

7. SHIPPING INFORMATION

7.1 Grades of Purity: Pure grade; fertilizer grade (33.5% nitrogen)
7.2 Storage Temperature: Currently not available
7.3 Inert Atmosphere: Currently not available
7.4 Venting: Currently not available
7.5 IMO Pollution Category: D
7.6 Ship Type: 2
7.7 Barge Hull Type: Currently not available

8. HAZARD CLASSIFICATIONS

8.1 49 CFR Category: Oxidizer
8.2 49 CFR Class: 5.1
8.3 49 CFR Package Group: III
8.4 Marine Pollutant: No
8.5 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue).....	0
Flammability (Red).....	0
Instability (Yellow).....	3
Special (White).....	OX

8.6 EPA Reportable Quantity: Not listed
8.7 EPA Pollution Category: Not listed
8.8 RCRA Waste Number: Not listed
8.9 EPA FWPCA List: Not listed

9. PHYSICAL & CHEMICAL PROPERTIES

9.1 Physical State at 15° C and 1 atm: Solid
9.2 Molecular Weight: 80.05
9.3 Boiling Point at 1 atm: Not pertinent; 230-278°F
9.4 Freezing Point: 337.8°F = 169.9°C = 443.1°K
9.5 Critical Temperature: Not pertinent
9.6 Critical Pressure: Not pertinent
9.7 Specific Gravity: 1.72 at 20°C (solid)
9.8 Liquid Surface Tension: Not pertinent
9.9 Liquid Water Interfacial Tension: Not pertinent
9.10 Vapor (Gas) Specific Gravity: Not pertinent
9.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
9.12 Latent Heat of Vaporization: Not pertinent
9.13 Heat of Combustion: Not pertinent
9.14 Heat of Decomposition: Not pertinent
9.15 Heat of Solution: Not pertinent
9.16 Heat of Polymerization: Not pertinent
9.17 Heat of Fusion: Currently not available
9.18 Limiting Value: Currently not available
9.19 Reid Vapor Pressure: Currently not available

NOTES

AMMONIUM NITRATE

AMN

9.20 SATURATED LIQUID DENSITY		9.21 LIQUID HEAT CAPACITY		9.22 LIQUID THERMAL CONDUCTIVITY		9.23 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit inch per hour-square foot-F	Temperature (degrees F)	Centipoise
	NOT PERTINENT		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT

9.24 SOLUBILITY IN WATER		9.25 SATURATED VAPOR PRESSURE		9.26 SATURATED VAPOR DENSITY		9.27 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
34	122.200		NOT PERTINENT		NOT PERTINENT		NOT PERTINENT
36	126.500						
38	130.799						
40	135.000						
42	139.299						
44	143.599						
46	147.799						
48	152.099						
50	156.400						
52	160.599						
54	164.900						
56	169.199						
58	173.400						
60	177.699						
62	182.000						
64	186.199						
66	190.500						
68	194.799						
70	199.000						
72	203.299						
74	207.599						
76	211.799						
78	216.099						
80	220.400						
82	224.599						
84	228.900						

FUEL OIL

MATERIAL SAFETY DATA SHEET

1. IDENTITY OF MATERIAL

Product Name : **Fuel Oil (FO-180 CST , FO-380 CST, LSHS)** (Producer/User : VBU, CPP,OM&S, Marketing)		Chemical Designation : **A complex Mixture of Hydrocarbons**	
Trade Name: **FO(180 CST), FO(380 CST)**		Synonyms: **Residual Fuels, Furnace Oil.**	
Formula: **A complex mixture of Hydrocarbons**	Label : Category Class **: 3**	CAS Number: **68476 – 33.5**	UN Number : **1223**
Regulated Identification: **UN no-1223**	Shipping Name Codes / Label: **Class C Flammable Liquid..**		Hazchem Code :**2PE**

2. PHYSICAL AND CHEMICAL PROPERTIES

Physical State : **Liquid**	Boiling Point in ° C. : **185 – 500^{O}C**	Vapour Pressure at 20 ° C : **< 1**---mm HG
Appearance(Colour) : **Brown to black colour**	Melting / Freezing Point in degree C: ---	Evaporation rate at 30 ° C: ----
Odour : Characteristic smell (**Diesel like)**	Vapour Density (Air-1): **3.00 – 5.00 (Heavier Than Air.)**	Solubility in water at 30 ° C: **Insoluble**
Others (Corrosivity, Etc):---	Specific Gravity (Water-1): **0.9 (Lighter Than Water.)**	pH: **Neutral.**

3. FIRE AND EXPLOSION HAZARDS DATA

Explosion / Flammability: **Flammable**	Flash Point : **66° C**	Flammability Range : 1% to 5%	Auto ignition Temperature : **263-407° C**

4. REACTIVE HAZARDS

	Impact : **Stable**	Hazardous Combustion Products): **Carbon Di-Oxide(CO_2), Carbon Monoxide(CO), Sulphur Dioxide(SO_2)**

Stability :	Static Discharge: **Yes**	(Hazardous Decomposition Products) : ---
	Reactivity : ---	(Conditions to avoid) : ---
Hazardous Polymerization:---	**May Not Occur**	(Conditions to avoid) : ---

5. HEALTH HAZARD DATA

Routes of Entry : (**Inhalation, Skin, Mucous Membranes, Eye Contact and Ingestion**)

Effects of Exposure / Symptoms: **Spontaneous Vomiting, Oil Acne.**

LD 50 (in rat) Orally or percutaneous absorption) (mg / kg body weight) : ---

LC 50 (in rat) (mg/1hour.) : ---

Permissible Exposure Limit (PEL) : ppm --- mg /cu. m **5**

Threshold Limit Value(TLV) of ACGIH (If H2S is present.) : ppm --- mg/cu. m **10**

Emergency Treatment: **Do Not Induce Vomiting If Ingested. Affected Body Parts Should Thoroughly Be Washed With Water And Soap.**

6. HAZARD SPECIFICATION

NFPA HAZARD SIGNAL	HEALTH: **2**	FLAMMABILITY: **2**	STABILITY: **0**	SPECIAL: **0**

Known Hazards

Combustible Liquid : **Yes**	Water Reactive Material: **No**	Irritant: **Yes**
Flammable Material: **Yes**	Oxidiser: **No**	Sensitiser: : **No**
Pyrophoric Material: **No**	Organic Peroxide: **No**	Carcinogen: **No**
Explosive Material: **No**	Corrosive Material: **No**	Mutagen: **No**
Unstable Material: **No**	Compressed Gas: **No**	Others (Specify): **No**

7. SAFE USAGE DATA

Ventilation	**Mechanical**
Personal Protective Equipment Required	Eyes (Specify): **Safety Goggle/Face shield.**
	Respiratory (Specify)**: Emergency Life Saving Apparatus(ELSA) / Self Contained Breathing Apparatus(SCBA).**
	Gloves (Specify) : **Asbestos / PVC**
	Clothing (specify):**Boiler Suit.**
Precautions	Handling & Storage Others (Specify) : **Store At Cool, Ventilated & Specified Area.**

8. EMERGENCY RESPONSE DATA

	Fire Extinguishing Media: **Carbon Di-Oxide (CO_2), Dry Chemical Powder(DCP), Aqueous Film Forming Foam.**
Fire	Special Procedures: **Water Spray To Be Used To Cool Containers If Exposed To Fire.**
Exposure (Skin and eye contact, inhalation, Ingestion)	First Aid Measures : **Do Not Induce Vomiting If Ingested. Affected Body Parts To Be Washed With Water And Soap. Wash Eyes Thoroughly With Water, Seek Medical Help.**
Spills	Steps to be taken: **Recover Spillage Using Absorbent Material Like Sawdust, Sand, Do Not Push In To Drainage.**
	Waste disposal method: **Recover Spillage Using Absorbent Material Like Sawdust, Sand & Land Fill.**

9. ADDITIONAL INFORMATION (DOS & DON'T)

- Incase of leaks monitor %LEL, restrict ignition sources. Stop traffic/vehicular movements and dilute vapor cloud with water spray.
- Look for wind direction.
- Approach from upwind side.
- If caught on downwind, move perpendicular to wind direction and assemble at nearest safe assembly point.
- Cordon off the area.
- Use Self Contained Breathing Apparatus Set in case of Fire.
- Contain leaking liquid on sand or earth.
- Do not Panic.
- Do not enter without knowing the wind direction.

- Do not approach leaking / affected area without proper respiratory protection.
- Do not approach from downwind direction
- Do not run.
- Do not move along or opposite to the direction of wind.
- Do not allow unauthorized personnel.

10. SOURCES USED

1. Hazardous chemicals desk reference. By – Rochar. J. Lewis.

11. MANUFACTURER / SUPPLIER DATA

Firm's Name: **Mangalore Refinery & Petrochemicals Ltd.**	Standard Packing : T**ransporation In Bulk Tanker OF 12 T,16 T, 18T Capacities, Ship, Pipelines.**
Mailing Address: **At P.O Kuthethoor, Mangalore-575030 (D.K.)**	Emergency Telephone During Transit :**(0824)2270400**
Telephone Number:**(0824)2270400**	
TeleFax. Number :**(0824)2270013**	
Contact Persons In Case of Emergency:	
Head(Operations) **TEL:** :**(0824)2270400,Ext(O)2440,(R)4440**	
Head-Marketing **TEL:** :**(0824)2270400, Ext(O)2107**	
Fire & Safety ,Control Room **TEL:** :**(0824) 2270279, 2270400,Ext-2333/3333,2555**	

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