INLAND WATERWAYS AUTHORITY OF INDIA

Ministry of Shipping, Government of India

"CAPACITY AUGMENTATION OF NATIONAL WATERWAY.1"
BETWEEN HALDIA AND ALLAHABAD

(Jal Marg Vikas Project)

ENVIRONMENTAL IMPACT ASSESSMENT REPORTS

VOLUME-3 B:
ENVIRONMENTAL MANAGEMENT FRAMEWORK FOR FUTURE INTERVENTIONS

May 2016
(Revised September 2016)

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Abbreviations	
µg/m^3	Microgram per cubic metre
A	Ampere
AAQ	Ambient Air Quality
AD	Amphibian Dredger
amsl	above men sea level
APHA	American Public Health Association
AWPCPL	Allahabad Waste Processing Company Pvt. Ltd
BCM	Billion Cubic Microns
BDU	Below Detection Unit
BDU	Best Designated Unit
BHDs	Backhoe Dredgers
BHU	Banaras Hindu University
BOD	Biochemical Oxygen Demand
BOQ	Bill of Quantity
BTKM	Billion Tonne Kilometres
BUIDCO	Bihar Urban infrastructure development Corporation Ltd.
BWE	Ballast Water Exchange
BWMP	Ballast Water Management Plan
BWP	Ballast Water Performance
CBWTF	Common Bio Medical Waste Treatment Facility
CEC	Cation Exchange Capacity
CERs	Critical Environmental Resources
CGWA	Central Ground Water Authority
CGWB	Central Ground Water Board
CIFRI	Central Inland Fisheries Research Institute
CIWTC	Central Inland Water Corporation Limited
cm	Centimetre
CNG	Compressed Natural Gas
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
Cr	Crore
CRZ	Coastal Regulation Zone
CSD	Cutter Section Dredgers
CTE	Consent to Establish
CTO	Consent to Operate
cum	cubic metre
dBs	Decibels
DEAC	District Environmental Impact Assessment Committee
DEIAA	District Environmental Impact Assessment Authority

DEM	Digital Elevation Model
DFO	District Forests Officer
DFR	Detailed Feasibility Report
DG	Diesel Generators
DGPS	Differential Global Positioning System
DO	Dissolved Oxygen
DWT	Dry Weight Tonnage
DWT	Dead Weight Tonnage
E	East
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
EMoP	Environmental Monitoring Plan
EMP	Environment Management Plan
EPC	Engineering Procurement Contractor
ESAs	Ecologically Sensitive Areas
ESC	Environment and Social Cell
ESS	Electrical Sub stations
FBP	Farakka Barrage Project
GHG	Green House Gases
GIS	Geographical Information Systems
gm	Gram
GoI	Government of India
GPS	Global Positioning System
GRB	Ganga River Basin
GW	Ground Water
ha	Hectare
HAD	Haldia Development Authority
HC	Horizontal Clearance
HDC	Haldia Dock Complex
HDPE	High Density Poly Ethylene
HFL	Highest Flood Level
hpa	Hectopascal
HPC	Name of a Consultant
hrs	Hours
HSD	Hydraulic Surface Dredger
IARI	Indian Agricultural Research Institute
IBA	Important Bird Areas
IESWM	Institute of Environmental Studies & Wetland Management
IITs	Indian Institute of Technology
IMD	India Meteorological Department
IMDG-code	International Maritime Dangerous Goods Code

IMO	International Maritime Organization
INTACH	Indian National Trust for Art and Cultural Heritage
IRS	Indian Remote Sensing Satellite
IS	Indian Standards Published by Bureau of Indian Standards
ISRO	Indian Space Research Organization
IUCN	International Union for Conservation of Nature
IWAI	Inland Waterways Authority of India
IWC	International Whaling Commission
IWT	Inland Waterway Transport
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
kgs	Kilograms
KLD	Kilolitre per Day
km	Kilometre
KMC	Kolkata Municipal Corporation
kmph	Kilometre per Hour
KoPT	Kolkatta Port Trust
KoPT	Kolkata Port Trust
KW	Kilo watt
LAD	Least Available Draft
LC	Level Crossing
Leq	Equivalent continuous sound pressure level in dB
LPG	Liquid Petroleum Gas
m	Metre
MARPOL	International Convention for the Prevention of Pollution from Ships
meq	Milli equivalent
mg/l	Milligram per litre
mg/l	Milligram per litre
□ill^3	Microgram per cubic metre
mL	Millilitre
MLD	Millions of Litres Per Day
mmhos/cm	Mili mho/ centimetre
MoEF&CC	Ministry of Environment & Forests & Climate Change
mpn/100 ml	Most Probable Number/100 millilitre
MSIHC	Manufacture Storage import of Hazardous Chemicals
MSW	Municipal Solid Waste
MSW	Municipal solid Waste
MT	Metric Tonnes
MTPA	Million Tonne Per Annum
N	North
NAAQS	National Ambient Air Quality Standards
NABL	National Accreditation Board for Testing and Calibration Laboratories

NCAER	National Council of Applied Economic Research
NGBRA	National Ganga Basin River Authority
NGO	Non-Government Organization
NH	National Highway
NMCG	National Mission for Clean Ganga
NOC	No Objection Certificate
Nox	Oxides of Nitrogen
NRCD	National River Conservation Directorate
NTPC	National Transport Policy Committee
NTU	Nephelometric Turbidity Unit
NW	National Waterways
NW	North West
ºC	Degree Celsius
PCC	Portland Cement Concrete
PCCF	Principle Chief Conservator of Forests
PIANC	World Association for Waterborne Transport Infrastructure
PM	Particulate Matter
PMC	Patna Municipal Corporation
PMU	Project Management Unit
ppb	parts per billion
ppm	parts per million
PPP	Public Private Partnership
PWD	Public Works Department
QA/QC	Quality Assurance/Quality Check
RCC	Reinforced Cement Concrete
RET	Rare Endangered and Threatened Species
RIS	River Information System
RITES	Name of Govt. Consultancy Organisation
ROB	Rail Over Bridge
RO-RO	Roll on and Roll Over
RWH	Rain Water Harvesting
S	South
SAV	Submerged Aquatic Vegetation
SC	Schedule Caste
SE	South East
SEAC	State Expert Appraisal Committee
SEIAA	State Environmental Impact Assessment Authority
SH	State Highway
SO2	Sulphur Dioxide
SPCB	State Pollution Control Board
Sq.km	Square kilometre
ST	Schedule Tribe

STP	Sewage Treatment Plant
SW	Surface Water
SWDS	Solid Waste Disposal Site
TDS	Total Dissolved Solids
TKM	Tonne Kilometres
TPD	Tonnes per Day
TPP	Thermal Power Plant
TSDF	Treatment Storage and Disposal Facilities
TSHDs	Trailer Suction Hopper Dredger
UNDP	United Nations Development Programme
UP	Uttar Pradesh
USA	United States of America
USDA	United States Department of Agriculture
USEPA	United State Environment Protection Authority
VBREC	Vikramshila Biodiversity Research and Education Centre
VC	Vertical Clearance
VMC	Varanasi Municipal Corporation
W	West
WB CZMA	West Bengal Coastal Zone Management Authority
WDSC	Whale and Dolphin Conservation Society
WHC	Water Holding Capacity
WNW	West North West
WWF	World Wide Fund for NGO

CHAPTER 1. IMPACT IDENTIFICATION FRAMEWORK FOR CIVIL INTERVENTION

1.1. Introduction

Proposed Project-Jal Marg Vikas aims at improvement of navigation in entire stretch of 1620 km of NW-1 (Haldia to Allahabad). The project envisages development of various civil interventions so as to enhance the navigational infrastructure of the waterway which includes river terminals, passenger jetties, bank protection works, navigational locks, ro-ro jetties, river information system, barge repair & maintenance facility.

Civil Intervention works development may have interface with various physical, social and biological components of the environment, i.e. water quality, aquatic and terrestrial flora & fauna, air quality, noise levels etc at all project development stages. All these environmental components will get affected due to development and operation of the terminals and a detailed environment and social impact assessment should be carried to assess all the potential impacts of the project. Further the impacts of development can be due to its location or due to the nature of activities to be performed during its development and operation phase thus both these aspects should be looked into while carrying out EIA study.

During preparation of the EIA for the NW-1, specific environmental assessments were undertaken for the major civil works interventions (the terminals at Varanasi, Sahebganj and Haldia; the augmentation of shiplock at farakka; and the maintenance dredging), and environmental management plans were prepared. However, there would be other civil works interventions in the future (such as RO-RO facilities, other multimodal terminals, and maintenance and repair facilities). Exact locations of these are yet to be finalized, and the exact designs are to be developed (although conceptual ideas and conceptual alternative locations are being discussed); and it will take possibly about 2 years to finalize these.

This Framework is prepared to give a generic idea of the possible impacts of the project (**refer Table 1.1-1.4**) for each type of such future civil intervention. The Environmental Management Framework can be utilized for preliminary identification of the impacts and carrying out the impact assessment study. Also the terms of reference to carry out the EIA studies, for each type of possible future facilities are appended to provide guidance to carry out the EIA study for each of the planned intervention. IWAI will engage independent EIA consultants to prepare EIA/EMP (parallel but sufficiently advanced to incorporate the findings of EIA into the to the process of preparation of detailed feasibility studies or detailed engineering studies) as and when these future major civil works interventions are planned.

Table 1.1 : General Impact Assessment Matrix for Terminal Facility

Activity	Major Components	Major Impacted Area	Magnitude of Impact	Duration of Impact	Type of Impact	Mitigation/Study Required
CONSTRUCTION PHASE						
Construction of berths and jetties	• Piling • Removal of bed sediments & their transportation • Operation of construction machinery • Handling of heavy machinery & equipment • Transportation of raw materials & construction debris	• Alteration of hydrology of the river • Soil erosion/bed scouring • Soil quality (depositing the bed sediments & storage of construction material) • Aquatic ecology (UG noise & loss of habitat) • Water quality (high turbidity & suspension of bed sediments) • Occupational Health & safety • Ambient & underground Noise levels • Generation of employment • Socio-economy (increased	H H M H H H H M L-M	LT LT LT ST ST ST ST ST ST	- - - - - - - + -	• Baseline study to assess the condition of anticipated components to be affected (water quality, noise levels, soil quality, river bed sediments, aquatic ecology, river morphology) • Impact analysis of affected components and suggesting mitigation measures • Identification of RET species and eco-sensitive zones in the study area and assessment of impacts on the same • Study of erosion at banks and

		pollution, traffic on internal & village road, increased accidents chances, loss of livelihood) • Air Quality	L	ST	-	provision of bank and bed protection measures • Management plan for disposal of debris and river bed sediments • Preparation of environment management plans consisting of environmental budget for the measures made, institutional mechanism for implementation of EMP & grievance readressal system
Construction of terminal building, amenity building, access & internal roads, railway sidings, boundary wall, storage yards, parking facility	• Transportation & storage of raw materials and construction debris • Removal of vegetation and tree cutting from side • Utilization of village roads for transportation of men and	• Terrestrial ecology including avifauna • Air Quality • Noise levels • Socio-economy (increased pollution, traffic on internal & village road, increased accidents chances, loss of livelihood) • Existing Infrastructure • Drainage &	L-H M M L-M L-M L-M	LT ST ST ST ST ST	- - - - - -	• Baseline study to assess the condition of anticipated components to be affected (terrestrial ecology, air quality, water quality, noise levels, soil quality, river bed sediments, aquatic ecology) • Impact analysis of affected

	materials • Debris disposal • Construction activities involving excavation, constructing structures etc. • Land acquisition and displacement of people	topography pattern • Water quality (contaminated run-off from site) • Aquatic ecology (water pollution due to contaminated run-off, washing of machinery/vehicle, discharge of sewage, spillage of chemicals or oil etc) • Generation of employment	L L L	ST ST ST	- - +	components and suggesting mitigation measures • Identification of RET species and eco-sensitive zones in the study area and assessment of impacts on the same • Preparation of environment management plans consisting of environmental budget for the measures made, institutional mechanism for implementation of EMP & grievance readressal system
Setting up construction labour camp and plant site	• Removal of vegetation • Setting up the plant • Discharge of sewage • Generation of waste • Temporary land	• Terrestrial ecology including avifauna • Socio-economy (increased pollution, traffic on internal & village road, increased accidents chances, employment	L M	LT ST	- -	• Baseline study to assess the condition of anticipated components to be affected (terrestrial ecology, air quality, water quality, noise levels, soil quality,

	acquisition	generation) • Air Quality • Noise levels • Water quality (contaminated run-off from site) • Aquatic ecology (water pollution due to contaminated run-off, bathing in river, discharge of sewage, spillage of oil etc) • Existing Infrastructure • Increase in crime in area • Alteration of drainage & topography pattern	L L L L L L L	ST ST ST ST ST ST ST	- - - - - - -	river bed sediments, aquatic ecology) • Impact analysis of affected components and suggesting mitigation measures • Identification of RET species and eco-sensitive zones in the study area and assessment of impacts on the same • Preparation of environment management plans consisting of environmental budget for the measures made, institutional mechanism for implementation of EMP & grievance readressal system • Restoration Plan for construction sites

OPERATION PHASE						
Operation of terminal- Loading, unloading, storage and transportation material	• Occupancy of physical space due to construction of jetty/berth • Dust and vehicular exhaust generation • Noise generation due to transportation and storage • Increased traffic movement for material transportation to and fro from terminal • Handling of heavy material, machinery & equipment • Generation of sewage and waste • Generation of contaminated run-off • Spillage of fuel, oil, used oil and	• Aquatic ecology • Air quality • Noise levels • Occupational health & safety • Water quality (mixing of contaminated run-off, dredging & disposal of dredged sediments) • Soil and ground water pollution due to contamination with sewage/used oil/hazardous waste • Increased traffic & accidents risks • Existing infrastructure • Employment generation • Increased vibration in area near railway siding	H H H H H H M M M L-M	LT LT LT LT LT LT LT LT LT LT	- - - - - - - - + -	• Baseline study to assess the condition of anticipated components to be affected (terrestrial ecology, air quality, water quality, noise levels, soil quality, river bed sediments, aquatic ecology) • Impact analysis of affected components and suggesting mitigation measures • Identification of RET species and eco-sensitive zones in the study area and assessment of impacts on the same • Preparation of environment management plans consisting of environmental budget for the

	stored material • Dredging at terminal location • Development of Green Belt					measures made, institutional mechanism for implementation of EMP & grievance readressal system
Berthing of barges- unloading and loading of cargo in barges	• Reduced water circulation near terminal area • Dissolution of anti-fouling paint during berthing • Discharge of sewage and waste in water • Washing and cleaning vessels	• Water quality (mixing of contaminated run-off, dredging & disposal of dredged sediments, washing water of barges, dissolution of anti-fouling paints)	H	LT	-	• Baseline data collection for water quality of river • Water Quality Management Plan
Receipt of waste from barges	• Transportation of garbage and sewage from barges to terminal facility • Treatment of the waste and sewage at terminal site	• Water quality (discharge of sewage and waste) • Soil Quality	H H	LT LT	- -	• Baseline data collection for water quality of river • Waste Management Plan

Table 1.2 : General Impact Assessment Matrix for Ro-Ro Jetties and Passenger Ferry Jetties Facility

Activity	Major Components	Major Impacted Area	Magnitude of Impact	Duration of Impact	Type of Impact	Mitigation/Study Required
Construction of berths and jetties	• Piling • Removal of bed sediments & their transportation • Operation of construction machinery • Handling of heavy machinery & equipment • Transportation of raw materials & construction debris	• Alteration of hydrology of the river • Soil erosion/bed scouring • Soil quality (depositing the bed sediments & storage of construction material) • Aquatic ecology (UG noise & loss of habitat) • Water quality (high turbidity & suspension of bed sediments) • Occupational Health & safety • Ambient & underground Noise levels • Generation of employment • Socio-economy (increased	H H M H H H H M L-M	LT LT LT ST ST ST ST ST ST	- - - - - - - + -	• Baseline study to assess the condition of anticipated components to be affected (water quality, noise levels, soil quality, river bed sediments, aquatic ecology, river morphology) • Impact analysis of affected components and suggesting mitigation measures • Identification of RET species and eco-sensitive zones in the study area and assessment of impacts on the same • Study of erosion at

		pollution, traffic on internal & village road, increased accidents chances, loss of livelihood) • Air Quality	L	ST	-	banks and provision of bank and bed protection measures • Management plan for disposal of debris and river bed sediments • Preparation of environment management plans consisting of environmental budget for the measures made, institutional mechanism for implementation of EMP & grievance readressal system
Construction of access road, small office/building, toilet	• Transportation & storage of raw materials and construction debris • Removal of vegetation and tree cutting from side • Utilization of village roads for transportation	• Terrestrial ecology including avifauna • Air Quality • Noise levels • Socio-economy (increased pollution, traffic on internal & village road, increased accidents chances, loss of livelihood) • Existing Infrastructure	L-H M M L-M	LT ST ST ST	- - - - -	• Baseline study to assess the condition of anticipated components to be affected (terrestrial ecology, air quality, water quality, noise levels, soil quality, river bed sediments, aquatic ecology) • Impact analysis of

	of men and materials • Debris disposal • Construction activities involving excavation, constructing structures etc. • Land acquisition and displacement of people	• Alteration of drainage & topography pattern • Water quality (contaminated run-off from site) • Aquatic ecology (water pollution due to contaminated run-off, washing of machinery/vehicle, discharge of sewage, spillage of chemicals or oil etc) • Generation of employment	L-M L-M L L L	ST ST ST ST ST	- - - +	affected components and suggesting mitigation measures • Identification of RET species and eco-sensitive zones in the study area and assessment of impacts on the same • Preparation of environment management plans consisting of environmental budget for the measures made, institutional mechanism for implementation of EMP & grievance readressal system
Setting up construction labour camp and plant site	• Removal of vegetation • Setting up the plant • Discharge of sewage • Generation of waste	• Air Quality • Noise levels • Terrestrial ecology including avifauna • Water quality (contaminated run-off from site) • Aquatic ecology	L L L L L	ST ST ST ST ST	- - - - -	• Baseline study to assess the condition of anticipated components to be affected (terrestrial ecology, air quality, water quality, noise

	• Temporary land acquisition	(water pollution due to contaminated run-off, washing of machinery/vehicle, discharge of sewage, spillage of chemicals or oil etc) • Socio-economy (increased pollution, traffic on internal & village road, increased accidents chances, employment generation) • Existing Infrastructure • Increase in crime in area • Alteration of drainage & topography pattern	M L L L	ST ST ST ST	- - - -	levels, soil quality, river bed sediments, aquatic ecology) • Impact analysis of affected components and suggesting mitigation measures • Identification of RET species and eco-sensitive zones in the study area and assessment of impacts on the same • Preparation of environment management plans consisting of environmental budget for the measures made, institutional mechanism for implementation of EMP & grievance readressal system • Restoration Plan for construction sites

OPERATION PHASE						
Operation of jetty- Loading, unloading of material, vehicles and men	• Occupancy of physical space due to construction of jetty/berth • Dust and vehicular exhaust generation • Noise generation due to transportation and storage • Increased traffic movement for material transportation to and fro from terminal • Handling of heavy material, machinery & equipment • Generation of sewage and waste • Generation of contaminated run-off • Spillage of fuel,	• Aquatic ecology • Air quality • Noise levels • Occupational health & safety • Water quality (mixing of contaminated run-off, dredging & disposal of dredged sediments) • Soil and ground water pollution due to contamination with sewage/used oil/hazardous waste • Increased traffic & accidents risks • Increased pressure on existing infrastructure • Generation of Employment	H H H H H H M M M	LT LT LT LT LT LT LT LT LT	- - - - - - - - +	• Baseline study to assess the condition of anticipated components to be affected (terrestrial ecology, air quality, water quality, noise levels, soil quality, river bed sediments, aquatic ecology) • Impact analysis of affected components and suggesting mitigation measures • Identification of RET species and eco-sensitive zones in the study area and assessment of impacts on the same • Preparation of environment management plans consisting of environmental

	oil, used oil and stored material • Dredging at terminal location • Development of Green Belt					budget for the measures made, institutional mechanism for implementation of EMP & grievance readressal system
Berthing of barges/ferry-unloading and loading of cargo in barges	• Reduced water circulation near terminal area • Dissolution of anti-fouling paint during berthing • Discharge of sewage and waste in water • Washing and cleaning vessels	• Water quality (mixing of contaminated run-off, dredging & disposal of dredged sediments, washing water of barges, dissolution of anti-fouling paints)	H	LT	-	• Baseline data collection for water quality of river • Water Quality Management Plan

Table 1.3 : General Impact Assessment Matrix for Maintenance Facility

Activity	Major Components	Major Impacted Area	Magnitude of Impact	Duration of Impact	Type of Impact	Mitigation/Study Required
Construction of berths, jetties, transfer bays & slipway	• Piling • Removal of bed sediments & their transportation • Operation of construction machinery • Handling of heavy machinery & equipment • Transportation of raw materials & construction debris	• Alteration of hydrology of the river • Soil erosion/bed scouring • Soil quality (depositing the bed sediments & storage of construction material) • Aquatic ecology (UG noise & loss of habitat) • Water quality (high turbidity & suspension of bed sediments) • Occupational Health & safety • Ambient & underground Noise levels • Socio-economy (increased	H H M H H H H L-M	LT LT LT ST ST ST ST ST	- - - - - - - -	• Baseline study to assess the condition of anticipated components to be affected (water quality, noise levels, soil quality, river bed sediments, aquatic ecology, river morphology) • Impact analysis of affected components and suggesting mitigation measures • Identification of RET species and eco-sensitive zones in the study area and assessment of impacts on the same • Study of erosion at banks and provision of bank and bed protection measures • Management plan for disposal of debris and river bed sediments • Preparation of environment management plans consisting of environmental budget for the measures made, institutional

		pollution, traffic on internal & village road, increased accidents chances, loss of livelihood) • Air Quality • Generation of Employment	L L	ST ST	- +	mechanism for implementation of EMP & grievance readressal system
Construction of access road, winch house, repair bays, winches & trolleys and workshops & buildings	• Transportation & storage of raw materials and construction debris • Removal of vegetation and tree cutting from side • Utilization of village roads for transportation of men and materials • Debris disposal • Construction activities involving excavation, constructing structures etc.	• Terrestrial ecology including avifauna • Air Quality • Noise levels • Existing Infrastructure • Alteration of drainage & topography pattern • Water quality (contaminated run-off from site) • Aquatic ecology (water pollution due to contaminated run-off, washing of machinery/vehicle, discharge of sewage, spillage of chemicals or oil etc) • Socio-economy (increased pollution, traffic on	L L-M L-M L L L L	LT L-M L-M ST ST ST ST	- - - - - - -	• Baseline study to assess the condition of anticipated components to be affected (terrestrial ecology, air quality, water quality, noise levels, soil quality, river bed sediments, aquatic ecology) • Impact analysis of affected components and suggesting mitigation measures • Identification of RET species and eco-sensitive zones in the study area and assessment of impacts on the same • Preparation of environment management plans consisting of environmental budget for the measures made, institutional mechanism for implementation of EMP & grievance readressal system

		internal & village road, increased accidents chances, loss of livelihood) • Generation of employment	M	ST	+	
Setting up construction labour camp and plant site	• Removal of vegetation • Setting up the plant • Discharge of sewage • Generation of waste • Temporary land acquisition	• Terrestrial ecology including avifauna • Socio-economy (increased pollution, traffic on internal & village road, increased accidents chances, employment generation) • Air Quality • Noise levels • Water quality (contaminated run-off from site) • Aquatic ecology (water pollution due to contaminated run-off, bathing in river, discharge of sewage, spillage of oil etc) • Increased pressure on existing Infrastructure • Increase in crime in	L M L L L L	LT ST ST ST ST ST	- - - - - -	• Baseline study to assess the condition of anticipated components to be affected (terrestrial ecology, air quality, water quality, noise levels, soil quality, river bed sediments, aquatic ecology) • Impact analysis of affected components and suggesting mitigation measures • Identification of RET species and eco-sensitive zones in the study area and assessment of impacts on the same • Preparation of environment management plans consisting of environmental budget for the measures made, institutional mechanism for implementation of EMP & grievance readressal system • Restoration Plan for construction sites

		area • Alteration of drainage & topography pattern	L L	ST ST	- -	
OPERATION PHASE						
Vessel maintenance	• Hazardous Materials & Chemicals use and storage • Hazardous waste generation • Removal of anti-fouling paint from vessels' hull-through scraping and scrubbing • Cleaning of vessels' exterior • Painting of Vessels • Maintenance operations • Fiberglassing • Welding and Metal fabrication	• Soil Quality • Ground water and Surface water quality • Odours and fumes • Aquatic ecology • Noise levels • Air quality • Occupational health & safety • Generation of employment	H H H H H M M M	LT LT LT LT LT LT LT LT	- - - - - - - +	• Baseline study to assess the condition of anticipated components to be affected (terrestrial ecology, air quality, water quality, noise levels, soil quality, river bed sediments, aquatic ecology) • Impact analysis of affected components and suggesting mitigation measures • Identification of RET species and eco-sensitive zones in the study area and assessment of impacts on the same • Management Plan for non hazardous and hazardous waste, air emissions, odour & noise level • Occupational health & safety plan • Preparation of environment management plans consisting of environmental budget for the measures made, institutional mechanism for implementation of EMP &

						grievance readressal system
Berthing of barges/vessel for repair	• Reduced water circulation near terminal area • Dissolution of anti-fouling paint during berthing • Discharge of sewage and waste in water • Inwater washing and cleaning vessels	• Water quality (mixing of contaminated run-off, dredging & disposal of dredged sediments, washing water of barges, dissolution of anti-fouling paints)	H	LT	-	• Baseline data collection for water quality of river • Water Quality Management Plan
Receipt of waste from barges	• Transportation of garbage and sewage from barges to terminal facility • Treatment of the waste and sewage at terminal site	• Water quality (discharge of sewage and waste) • Soil Quality	H H	LT LT	- -	• Baseline data collection for water quality of river • Waste Management Plan

Table 1.4 : General Impact Assessment Matrix For River Training Works

Activity	Major Components	Major Impacted Area	Magnitude of Impact	Duration of Impact	Type of Impact	Mitigation/Study Required
Construction of river training structures like embankments, retaining wall, water storage structures, bend correction	• Piling • Removal of bed sediments & their transportation • Operation of construction machinery • Diversion of the river water • Handling of heavy machinery & equipment • Transportation of raw materials & construction debris	• Alteration of hydrology of the river • Soil erosion/bed scouring • Soil quality (depositing the bed sediments & storage of construction material) • Aquatic ecology (UG noise & loss of habitat) • Water quality (high turbidity & suspension of bed sediments) • Occupational Health & safety • Ambient & underground Noise levels • Generation of employment	H H M H H H H M	LT LT LT ST ST ST ST ST	- - - - - - - +	• Baseline study to assess the condition of anticipated components to be affected (soil erosion, river bed erosion, water quality in river, river morphology, existence of navigation infrastructure close to the location, availability of social infrastructure like Ghats, air quality, noise level, soil quality, ground water level, soil profile) • Impact analysis of affected components and suggesting mitigation measures during construction phase and maintenance & repair phase • Identification of RET species and eco-sensitive zones in the study area and assessment of impacts on the same • Study of erosion at banks and provision of bank and bed protection measures

		• Socio-economy (increased pollution, traffic on internal & village road, increased accidents chances, loss of livelihood) • Air Quality	L-M L	ST ST	- -	• Management plan for disposal of debris and river bed sediments • Rehabilitation Plan for the construction site • Preparation of environment management plans consisting of environmental budget for the measures made, institutional mechanism for implementation of EMP & grievance readressal system
Setting up construction labour camp and plant site	• Removal of vegetation • Setting up the plant • Discharge of sewage • Generation of waste • Temporary land acquisition	• Socio-economy (increased pollution, traffic on internal & village road, increased accidents chances, employment generation) • Air Quality • Noise levels • Terrestrial ecology including avifauna • Water quality (contaminated run-off from site) • Aquatic ecology (water pollution due to contaminated run-off, washing of	M L L L L L	ST ST ST ST ST ST	- - - - -	• Baseline study to assess the condition of anticipated components to be affected (terrestrial ecology, air quality, water quality, noise levels, soil quality, river bed sediments, aquatic ecology) • Impact analysis of affected components and suggesting mitigation measures • Identification of RET species and eco-sensitive zones in the study area and assessment of impacts on the same • Preparation of environment management plans consisting of environmental budget for the measures made, institutional

		machinery/vehicle, discharge of sewage, spillage of chemicals or oil etc) • Existing Infrastructure • Increase in crime in area • Alteration of drainage & topography pattern	 L L L	 ST ST ST	 - - -	mechanism for implementation of EMP & grievance readressal system • Restoration Plan for construction sites
MAINTENANCE & REPAIR PHASE						
Maintenance & repair works	• Repair and reconstruction of the constructed structure	• Socio-economy (fishing, boating, recreational activities, ferry/barge movement) • Occupational health & safety • Soil Quality • Water quality • Aquatic ecology • Air quality • Noise levels	M M L L L L L	ST ST ST ST ST ST ST	- - - - - - -	• Supervision and monitoring to assess the condition of the constructed structures, erosion in nearby stretches of bank and bed • Impact analysis of affected components and suggesting mitigation measures • Preparation of environment management plans consisting of environmental budget for the measures made, institutional mechanism for implementation of EMP & grievance readressal system

CHAPTER 2. TERMS OF REFERENCE FOR TERMINAL FACILITY

2.1. Introduction

IWAI has proposed to develop 6 river terminals out of which 3 sites are fixed and already planned at Sahibganj, Haldia and Varanasi. Two sites are finalized and are at initial stage of planning at Kalughat and Ghazipur and one site is still to be identified and finalized. Generally, terminals have the following components:

- Terminal Administration Building
- Workers's Amenity Building
- Fuel Burner
- Security Office
- Sewage Treatment Plant
- Overhead Water Tank
- Underground Reservoir
- Pump room/reservoir for fire-fighting & DSS
- Waste collection centre
- Dump pond
- Electrical sub station
- Weigh Bridge Building
- Vehicle Parking Area
- Highmast lighting towers
- Rain water harvesting pond
- Storage sheds
- Jetties
- Berths
- Material Conveyance Systems
- Loading and unloading area and machinery
- Internal & Access Roads
- Shore Protection Works

2.2. Environmental and Social Issues of Terminal Development

River terminal development and operation will have interface with various physical, social and biological components of the environment, i.e. water quality, aquatic and terrestrial flora & fauna, air quality, noise levels etc. All these environmental components will get affected due to development and operation of the terminals and a detailed environment and social impact assessment should be carried to assess all the potential impacts of the project. Further the impacts of development can be due to its location or due to the nature of activities to be performed during its development and operation phase thus both these aspects should be looked into while carrying out EIA study. Environmental framework as given in Table 1.1 in Chapter 1 can be referred to carry out the EIA study.

2.3. Alternative Analysis

Alternative analysis study should be carried out for each of the proposed terminal covering the following

- Stratergic Analysis- With and Without Project Scenario
- Planing Analysis- Site selection, selection of layout, selection of alignment of roads/railways

- Technological Analysis- Construction material & methodology, material storage, waste treatment and dredging equipments

2.4. Scope of Work

Environmental Impact Assessment Study should broadly cover the following but should not be limited to this

- To carry out the site visits to understand the site specific environmental and social sensitivities associated with the project site
- To obtain understanding of the project, activities involved in all the stages and their interface with the environment referring to the DPR, available literature and studies of similar projects
- To carry out the environmental screening to define the impacted environment due to the project development and operation
- To define the project influence area on basis of screening excercise and considering the potential impacts of the project derived during the above excericise.
- To collect the primary and secondary data of the likely to be affected environments as identified during screening excercise to obtain their existing condition. Baseline monitoring should be conducted for a month for the following parameters
    - Air Quality-At project site and other locations in 2 kms (twice a week at each location)
    - Ground Water Quality-At project site and other locations in 2 kms (One time at each location)
    - Surface Water Quality-Near project site and other locations including any discharge point, confluence point of other stream & dredging locations (One time at each location)
    - Soil Quality-At project site and other locations in 2 kms (One time at each location)
    - River Bed Sampling- Near project site and dredging locations (One time at each location)
    - Aquatic Ecology-In river stretch (15 kms u/s & d/s), mention RET species available in that area and eco-sensitive zones within 10 km radius of the site
    - Terrestrial Ecology-In project area and 2 kms area in detail and general overview in 10 km radius. Mention RET species and eco-sensitive zones within 10 kms radius of the site
- To prepare the maps on GIS platforms of the project site, study area, drainage pattern of the site, land use, contour and socio-economy using satellite imagery, google imageries and toposheets as available and required
- To examine and understand the aggregate affects from the development of the upcoming Terminals that could affect the environmental and social dimensions of the study area w.r.t its location, nature of developments and interface with the different environments.

- To recommend specific measures, to be implemented by IWAI, as well as for other future projects, for addressing the Environmental impacts and issues over and above the mitigation and/or management measures for project-specific impacts.
- To identify the stakeholders to be affected by the project at any stage of development in consultation with the client. To draft a checklist/questionaaire of the issues to be discussed during consultations. To define the methodology of the consultation and mode of communication to the stakeholder about the consultation date and venue. Carrying out public consultations to obtain the view of the stakeholders on the project development, impacts on their life and environment due to project development and mitigation which should be taken.
- The EIA studies and reporting requirements to be undertaken under these ToR must also conform to the Government of India (GoI) and World Bank guidelines and regulations, which include, inter-alia, the EIA amendments and updated guidelines. A detailed environment legislative framework should be developed for the project which should define the applicability of the environmental legislations on the project at respective stage, clearances to be obtained and concerned authority
- EIA Study should consist of the environmental management and monitoring plan for pre-construction, construction and operation stage of the project. EMP should essentially include the institutional mechanism for implementation of the EMP, grievance readressal mechanism, EHS policy, management system and team and environmental budget for the project.

EIA Report should essentially contain the following components:

- Project general background, need of the project and sub-component, overview of the project & sub-component, Objective of the EIA study, Extent and limitation of EIA study, Contents of the EIA report, Methodology followed to carry out EIA study, Data Sources for EIA study and References
- Overview of Indian environmental legislation & administrative framework, applicable environmental legislation, international best practices & guidelines including operational policies of world bank; EHC guidelines of IFC for General industry & Ports, terminals & harbours; IMO conventions and other related conventions, Environmental standards & guidelines (national & international including PIANC)
- Settings and locations of project site, connectivity of the site, existing facilities at the site & its surroundings, project components including size & type of project; salient features of project; master planning layout; off-shore & on-shore components, construction phase activities including onshore & off-shore, operation phase activities including material handling & maintenance activities, construction material sourcing, utilities requirement & management, environmental provisions including drainage system; sewerage system; dust suppression system; green belt development; fire protection & emergency

measures & flood protection measures, implementation schedule of project, Ananlysis of alternatives

- Environment and social features of project within study area, environmental settings & features of project, site connectivity, existing sources of pollution, monitoring plan & quality assurance procedures, description of physical environment including topography; drainage pattern; land use pattern; cropping pattern; river morphology; riverbank features slope & elevation; habitations along the project site; archaeological protected areas; wastewater & waste management facilities in the area; geology; rock types; regional tectonic settings; history of volcanic activity; seismicity; information on quarries along the waterway; soil quality; meterology (wind speed & direction, relative humidity, temperature, rainfall, calm periods, cloud cover, barometric pressure, history of cyclones & tidal surges, history of floods & HFL); water resources & quality; river bed sediments; air quality; noise levels, description of biological environment including the terrestrial ecology (flora & fauna); avifauna; aquatic ecology (planktons, benthos, mangroves, marshes, fisheries); forest cover, migratory routes & eco-sensitive zones in study area; RET species in waterway (dolphins, turtles, otters, ghariyal, Gangetic sharks) with their habitat & status, description of social environment including demography; occupation/livelihood pattern; health facilities; infrastructure (transportation, industries, educational institutes); public utilities in the area (sewerage system of area, all type solid waste disposal sites in area); cultural heritage and archaeological sites; fest & festivals; tourism; spiritual & other practices associated with the waterway of locals. Maps on GIS platform should be prepared to show the study area & project site, environmental settings of project site, drainage pattern, contours, land use, connectivity and monitoring network. Primary & secondary baseline monitoring data should be presented in the reports.
- Impact identification matrix for each project activity & development stage on the above defined baseline components during the pre-construction, construction & operation stage of the project along with the impact avoidance & mitigation measures and a matrix detailing the residual impact of the project after implementation of mitigation measures. Quantification of impacts should be carried out by using modelings and calculation methods for estimating air emissions, GHG emission, maximum GLC due to transportation, noise level, sewage generation, muck generation & disposal, underground noise etc as applicable.
- Methodology & objective of the public consultation, stakeholders consulted, proof of communication and conducting consultations (attendance sheet, invitation letter/leaflets/newspaper invitation/public communication, proceedings & photographs of consultation and summary outcome of consultation with their adressal.
- Environment management plan for each of the identified project activity and affected environmental component, institutional arrangement to ensure EMP

implementation, structure of environment management plan with roles and responsibility of each member, environmental standards for operation and maintenance of terminal facility, environmental monitoring plan, reporting requirement, grievance readressal mechanism and environmental budget. EMP should cover the following components

- Measures for soil erosion protection and muck management
- Measures for management, closure and rehabilitation of sites of labour camps and plant site (batching plants, workshops and material storage sites)
- Green Belt Development Plan
- Construction Debris Management Plan
- Borrow Area Managemnet Plan
- Oil Spill Management Plan
- Occupational Health & Safety Management Plan
- Bio-diversity (RET species) Conservation & Management Plan
- Air emission Management Plan
- Noise Level Management Plan
- Water Resources and Quality Management Plan
- Accident and Risk Management
- Soil Quality Management Plan
- Sewage and Waste Management Plan
- Vessel Waste and Wastewtaer Management Plan
- EMP for vessel fueling facility (if provided)
- Monitoring Mechanism for Prevention of Disposal of Waste generated at site and vessels in the waterway

- Summary of findings EIA report and concluding remarks with recommendations made.

2.5. Consultant's Input

For the purpose of EIA study of terminal facility, following experts should be engaged

S. No.	Expert Position	Experience in Years	Expertise
1.	Team Leader/Sr. Environmental Specialist	20 yrs in field of environment and 15 yrs specific in EIA studies	M Tech Environmental Engineering/MSc. Environmental Science and allied sciences Experience in field of environmental impact assessment study of linear and area development

			projects including highways, railways, ports, container depots. Experience in field of waterways is desirable.
2.	Junior Environmental Specialist	15 Yrs of Experience in Environment and 10 Yrs specific in EIA studies	M Tech Environmental Engineering/MSc. Environmental Science and allied sciences Experience in field of environmental impact assessment study of linear and area development projects including highways, railways, ports, container depots. Experience in field of waterways is desirable
3.	Occupational Health & Safety Expert	15 Yrs of Experience in Environment and 10 Yrs specific in occupational health and management	M Tech Environmental Engineering/MSc. Environmental Science and allied sciences with qualification in field of occupational health & safety is desirable. Experience in preparation of EHS/SHE plans for linear and area development projects. Experence in field of waterways is desirable
4.	Ecology and Bio-doversity Expert	10 yrs of experience in carrying out ecology and biodeiversity studies	M.Sc. (Life Science / Ecology); Ph.D. (Life Science / Ecology)
5.	Fisheries Experts	10 yrs of experience in carrying out river water fisheries study. Experience on dolphins is desirable	M.Sc. (Ecology/Fisheries); Ph.D. (Fisheries)
6.	Sociologist	15 years of experience in carrying out socio-economic studies	M.A (Sociology/ Social Science) / Master of Social Work; Ph.D. (Sociology/ Social Science)

			Experience of conducting SIA studies and preparation of RAP
7.	GIS Expert	5 yrs experience in mapping on GIS platform	MSc in Remote Sensing and GIS
8.	Hydrologist	10 years of experience in carrying out studies for Bridge, Dam or hydro-electric power project or having experience in river morphology & modelling	B. Tech (Civil) and M. Tech (Hydrology) is desirable
9.	Solid Waste Management Specialist	10 years in managing solid waste of urban area	B.E. / B. Tech (Civil); M.Sc. (Environment) / M. Tech (Environment / P. G Diploma in Waste Management)

2.6. Timeline

Study should be completed within 4 months of the award of the work

2.7. Deliverables

- Inception report- 1 month of award of work
- Baseline Data Report-2.5 months of award of work
- Draft EIA Report-3 months of Award of work
- Standalone EMPs and Final EIA Report-4 months of Award of work

CHAPTER 3. TERMS OF REFERENCE FOR RO-RO JETIES AND PASSENGER FERRY JETTY

3.1. Introduction

Under Jal Marg Vikas projects, it is proposed to develop 5 Ro-Ro crossings at NW-1. In addition to ro-ro jetties, passenger ferry jetties will also be developed for movement of passenger ferries and promoting passenger movement and tourism in the waterway. Location for development of ro-ro jetties and passenger ferry jetties are yet not finalized. Generally, ro-ro jetties have the following components:

- Small Administration Building
- Toilet Facility
- Security Office
- Septic Tank/Soak Pit
- Water tank at building
- Fire-fighting system for building
- Rain water harvesting system
- Weigh Bridge Building
- Jetties
- Berths
- Internal & Access Roads
- Shore Protection Works

3.2. Environmental and Social Impacts Anticipated Due to Ro-Ro Jetties and Passenger Ferry Jetties

Development and operation of jetties will have interface with various physical, social and biological components of the environment, i.e. water quality, aquatic and terrestrial flora & fauna, air quality, noise levels etc. All these environmental components will get affected due to development and operation of the jetties and a detailed environment and social impact assessment should be carried to assess all the potential impacts of the project. Further the impacts of development can be due to its location or due to the nature of activities to be performed during its development and operation phase thus both these aspects should be looked into while carrying out EIA study. Environmental framework as given in Table 1.2 in Chapter 1 can be referred to carry out the EIA study.

3.3. Alternative Analysis

Alternative analysis study should be carried out for each of the proposed jetty site covering the following

- Stratergic Analysis- With and Without project Scenario
- Planing Analysis- Site selection, selection of layout, selection of alignment of roads/railways
- Technological Analysis- Construction material & methodology, material storage, waste treatment and dredging equipments

3.4. Scope of Work

Environmental Impact Assessment Study should broadly cover the following but should not be limited to this

- To carry out the site visits to understand the site specific environmental and social sensitivities associated with the project site
- To obtain understanding of the project, activities involved in all the stages and their interface with the environment referring to the DPR, available literature and studies of similar projects
- To carry out the environmental screening to define the impacted environment due to the project development and operation
- To define the project influence area on basis of screening excercise and considering the potential impacts of the project derived during the above excericise.
- To collect the primary and secondary data of the likely to be affected environments as identified during screening excercise to obtain their existing condition. Baseline monitoring should be conducted for a month for the following parameters
    - Air Quality-At project site and other locations in 2 kms (twice a week at each location)
    - Ground Water Quality-At project site and other locations in 2 kms (One time at each location)
    - Surface Water Quality-Near project site and other locations including any discharge point, confluence point of other stream & dredging locations (One time at each location)
    - Soil Quality-At project site and other locations in 2 kms (One time at each location)
    - River Bed Sampling- Near project site and dredging locations (One time at each location)
    - Aquatic Ecology-In river stretch (15 kms u/s & d/s), mention RET species available in that area and eco-sensitive zones within 10 km radius of the site
    - Terrestrial Ecology-In project area and 2 kms area in detail and general overview in 10 km radius. Mention RET species and eco-sensitive zones within 10 kms radius of the site
- To prepare the maps on GIS platforms of the project site, study area, drainage pattern of the site, land use, contour and socio-economy using satellite imagery, google imageries and toposheets as available and required
- To examine and understand the aggregate affects from the development of the upcoming jetties that could affect the environmental and social dimensions of the study area w.r.t its location, nature of developments and interface with the different environments.
- To recommend specific measures, to be implemented by IWAI, as well as for other future projects, for addressing the Environmental impacts and issues

over and above the mitigation and/or management measures for project-specific impacts.

- To identify the stakeholders to be affected by the project at any stage of development in consultation with the client. To draft a checklist/questionaaire of the issues to be discussed during consultations. To define the methodology of the consultation and mode of communication to the stakeholder about the consultation date and venue. Carrying out public consultations to obtain the view of the stakeholders on the project development, impacts on their life and environment due to project development and mitigation which should be taken.
- The EIA studies and reporting requirements to be undertaken under these ToR must also conform to the Government of India (GoI) and World Bank guidelines and regulations, which include, inter-alia, the EIA amendments and updated guidelines. A detailed environment legislative framework should be developed for the project which should define the applicability of the environmental legislations on the project at respective stage, clearances to be obtained and concerned authority
- EIA Study should consist of the environmental management and monitoring plan for pre-construction, construction and operation stage of the project. EMP should essentially include the institutional mechanism for implementation of the EMP, grievance readressal mechanism, EHS policy, management system and team and environmental budget for the project.

EIA Report should essentially contain the following components:

- Project general background, need of the project and sub-component, overview of the project & sub-component, Objective of the EIA study, Extent and limitation of EIA study, Contents of the EIA report, Methodology followed to carry out EIA study, Data Sources for EIA study and References
- Overview of Indian environmental legislation & administrative framework, applicable environmental legislation, international best practices & guidelines including operational policies of world bank; EHC guidelines of IFC for General industry & Ports, terminals & harbours; IMO conventions and other related conventions, Environmental standards & guidelines (national & international including PIANC)
- Settings and locations of project site, connectivity of the site, existing facilities at the site & its surroundings, project components including size & type of project; salient features of project; master planning layout; off-shore & on-shore components, construction phase activities including onshore & off-shore, operation phase activities including material handling & maintenance activities, construction material sourcing, utilities requirement & management, environmental provisions including drainage system; sewerage system; dust suppression system; green belt development; fire protection & emergency measures & flood protection measures, implementation schedule of project, Ananlysis of alternatives

- Environment and social features of project within study area, environmental settings & features of project, site connectivity, existing sources of pollution, monitoring plan & quality assurance procedures, description of physical environment including topography; drainage pattern; land use pattern; cropping pattern; river morphology; riverbank features slope & elevation; habitations along the project site; archaeological protected areas; wastewater & waste management facilities in the area; geology; rock types; regional tectonic settings; history of volcanic activity; seismicity; information on quarries along the waterway; soil quality; meterology (wind speed & direction, relative humidity, temperature, rainfall, calm periods, cloud cover, barometric pressure, history of cyclones & tidal surges, history of floods & HFL); water resources & quality; river bed sediments; air quality; noise levels, description of biological environment including the terrestrial ecology (flora & fauna); avifauna; aquatic ecology (planktons, benthos, mangroves, marshes, fisheries); forest cover, migratory routes & eco-sensitive zones in study area; RET species in waterway (dolphins, turtles, otters, ghariyal, Gangetic sharks) with their habitat & status, description of social environment including demography; occupation/livelihood pattern; health facilities; infrastructure (transportation, industries, educational institutes); public utilities in the area (sewerage system of area, all type solid waste disposal sites in area); cultural heritage and archaeological sites; fest & festivals; tourism; spiritual & other practices associated with the waterway of locals. Maps on GIS platform should be prepared to show the study area & project site, environmental settings of project site, drainage pattern, contours, land use, connectivity and monitoring network. Primary & secondary baseline monitoring data should be presented in the reports.
- Impact identification matrix for each project activity & development stage on the above defined baseline components during the pre-construction, construction & operation stage of the project along with the impact mitigation & avoidance measures and a matrix detailing the residual impact of the project after implementation of mitigation measures. Quantification of impacts should be carried out by using modelings and calculation methods for estimating air emissions, GHG emission, maximum GLC due to transportation, noise level, sewage generation, muck generation & disposal, underground noise etc as applicable.
- Methodology & objective of the public consultation, stakeholders consulted, proof of communication and conducting consultations (attendance sheet, invitation letter/leaflets/newspaper invitation/public communication, proceedings & photographs of consultation and summary outcome of consultation with their adressal.
- Environment management plan for each of the identified project activity and affected environmental component, institutional arrangement to ensure EMP implementation, structure of environment management plan with roles and responsibility of each member, environmental standards for operation and

maintenance of jetty, environmental monitoring plan, reporting requirement, grievance readressal mechanism and environmental budget. EMP should cover the following components

- Measures for soil erosion protection and muck management
- Measures for management, closure and rehabilitation of sites of labour camps and plant site (batching plants, workshops and material storage sites)
- Green Belt Development Plan
- Construction Debris Management Plan
- Borrow Area Managemnet Plan
- Oil Spill Management Plan
- Occupational Health & Safety Management Plan
- Bio-diversity (RET species) Conservation & Management Plan
- Air emission Management Plan
- Noise Level Management Plan
- Water Resources and Quality Management Plan
- Accident and Risk Management
- Soil Quality Management Plan
- Sewage and Waste Management Plan

- Summary of findings EIA report and concluding remarks with recommendations made.

3.5. Consultant's Input

For the purpose of EIA study of jetties, following experts should be engaged

S. No.	Expert Position	Experience in Years	Expertise
1.	Team Leader/Sr. Environmental Specialist	20 yrs in field of environment and 15 yrs specific in EIA studies	M Tech Environmental Engineering/MSc. Environmental Science and allied sciences Experience in field of environmental impact assessment study of linear and area development projects including highways, railways, ports, container depots. Experience in field of waterways is desirable.
2.	Junior Environmental Specialist	15 Yrs of Experience in Environment and 10 Yrs	M Tech Environmental Engineering/MSc.

		specific in EIA studies	Environmental Science and allied sciences Experience in field of environmental impact assessment study of linear and area development projects including highways, railways, ports, container depots. Experience in field of waterways is desirable
3.	Occupational Health & Safety Expert	15 Yrs of Experience in Environment and 10 Yrs specific in occupational health and management	M Tech Environmental Engineering/MSc. Environmental Science and allied sciences with qualification in field of occupational health & safety is desirable. Experience in preparation of EHS/SHE plans for linear and area development projects. Experence in field of waterways is desirable
4.	Ecology and Bio-doversity Expert	10 yrs of experience in carrying out ecology and biodeiversity studies	M.Sc. (Life Science / Ecology); Ph.D. (Life Science / Ecology)
5.	Fisheries Experts	10 yrs of experience in carrying out river water fisheries study. Experience on dolphins is desirable	M.Sc. (Ecology/Fisheries); Ph.D. (Fisheries)
6.	Sociologist	15 years of experience in carrying out socio-economic studies	M.A (Sociology/ Social Science) / Master of Social Work; Ph.D. (Sociology/ Social Science) Experience of conducting SIA studies and preparation of RAP
7.	GIS Expert	5 yrs experience in mapping on GIS platform	MSc in Remote Sensing and GIS

8.	Hydrologist	10 years of experience in carrying out studies for Bridge, Dam or hydro-electric power project or having experience in river morphology & modelling	B. Tech (Civil) and M. Tech (Hydrology) is desirable
9.	Solid Waste Management Specialist	10 years in managing solid waste of urban area	B.E. / B. Tech (Civil); M.Sc. (Environment) / M. Tech (Environment / P. G Diploma in Waste Management)

3.6. Timeline

Study should be completed within 4 months of the award of the work

3.7. Deliverables

- Inception report- 1 month of award of work
- Baseline Data Report-2.5 months of award of work
- Draft EIA Report-3 months of Award of work
- Standalone EMPs and Final EIA Report-4 months of Award of work

CHAPTER 4. TERMS OF REFERENCE FOR BARGE MAINTENANCE AND REPAIR FACILITY

4.1. Introduction

Under Jal Marg Vikas projects, it is proposed to develop barge repair and maintenance facility. Locations for development of barge repair and maintenance facility are yet not finalized. Generally, barge repair and maintenance facility have the following components:

- **Slipway**: It is a ramp, which helps in moving the barge/ship to and fro from water to land. Slipway will be provided in deeper water conditions so as design vessels can be taken in docking conditions.
- **Winch House:** It should be provided in straight-line to main slipway. It is generally a single room like structure and should have adequate space for winch and electrical equipment
- **Repair bay for large & small vessels**: Repair bay for vessels should be inclined so as the vessels can slide towards the river on its own after repair under control of winch.
- **Transfer bays**: To transfer small vessels between slipway and repair bay
- **Winches and trolleys:** Winches should be provided at winch house and at transfer bay. Trolleys should be provided to receive the vessels on main slipway.
- **Workshops and buildings** with all basic utilities like water, electricity, storm water management system and waste management system

4.2. Environmental and Social Impacts Anticipated Due to Development and Operation of Barge Repair & Maintenance facility

Maintenace and repair facilities for barges involve handling, storage and management of various hazardous chemicals and waste. Also there are occupational health and safety risks are involved at these facilities due to nature of works and machinery involved. High VOC emission and odour are also expected from such sites due to storage of paints & other chemicals and painting facility. Large quantity of washingwater will be generated from these sites for which an efficient effluent treatment system should be provided. Overall development of maintenance facility will have interface with various physical, social and biological components of the environment, i.e. soil quality, water quality, aquatic and terrestrial flora & fauna, air quality, noise levels, waste management facilities etc. All these environmental components will get affected due to development and operation of the maintenance facilities and a detailed environment and social impact assessment should be carried to assess all the potential impacts of the project.

Further the impacts of development can be due to its location or due to the nature of activities to be performed during its development and operation phase thus both these aspects should be looked into while carrying out EIA study. Environmental framework as given in Table 1.3 in Chapter 1 can be referred to carry out the EIA study.

4.3. Alternative Analysis

Alternative analysis study should be carried out for each of the proposed barge maintenance and repair facility site covering the following

- Stratergic Analysis- With and Without Project Scenario
- Planing Analysis- Site selection, selection of layout, selection of alignment of roads/railways.
- Technological Analysis- Construction material & methodology, material storage, waste treatment and dredging equipments

4.4. Scope of Work

Environmental Impact Assessment Study should broadly cover the following but should not be limited to this

- To carry out the site visits to understand the site specific environmental and social sensitivities associated with the project site
- To obtain understanding of the project, activities involved in all the stages and their interface with the environment referring to the DPR, available literature and studies of similar projects
- To carry out the environmental screening to define the impacted environment due to the project development and operation
- To define the project influence area on basis of screening excercise and considering the potential impacts of the project derived during the above excericise.
- To collect the primary and secondary data of the likely to be affected environments as identified during screening excercise to obtain their existing condition. Baseline monitoring should be conducted for a month for the following parameters
    - Air Quality-At project site and other locations in 2 kms (twice a week at each location)
    - Ground Water Quality-At project site and other locations in 2 kms (One time at each location)
    - Surface Water Quality-Near project site and other locations including any discharge point, confluence point of other stream & dredging locations (One time at each location)
    - Soil Quality-At project site and other locations in 2 kms (One time at each location)
    - River Bed Sampling- Near project site and dredging locations (One time at each location)
    - Aquatic Ecology-In river stretch (15 kms u/s & d/s), mention RET species available in that area and eco-sensitive zones within 10 km radius of the site
    - Terrestrial Ecology-In project area and 2 kms area in detail and general overview in 10 km radius. Mention RET species and eco-sensitive zones within 10 kms radius of the site

  - Socio-Economy- Analysis of all the habitations and sensitive habitats located within 2 kms of the project site, availability of nearest fire-fighting facility to the site, connectivity of the site to the highway.
- To prepare the maps on GIS platforms of the project site, study area, drainage pattern of the site, land use, contour and socio-economy using satellite imagery, google imageries and toposheets as available and required
- To examine and understand the aggregate affects from the development of the maintenance facility that could affect the environmental and social dimensions of the study area w.r.t its location, nature of developments and interface with the different environments.
- To recommend specific measures, to be implemented by IWAI, as well as for other future projects, for addressing the Environmental impacts and issues over and above the mitigation and/or management measures for project-specific impacts.
- To identify the stakeholders to be affected by the project at any stage of development in consultation with the client. To draft a checklist/questionaaire of the issues to be discussed during consultations. To define the methodology of the consultation and mode of communication to the stakeholder about the consultation date and venue. Carrying out public consultations to obtain the view of the stakeholders on the project development, impacts on their life and environment due to project development and mitigation which should be taken.
- The EIA studies and reporting requirements to be undertaken under these ToR must also conform to the Government of India (GoI) and World Bank guidelines and regulations, which include, inter-alia, the EIA amendments and updated guidelines. A detailed environment legislative framework should be developed for the project which should define the applicability of the environmental legislations on the project at respective stage, clearances to be obtained and concerned authority
- EIA Study should consist of the environmental management and monitoring plan for pre-construction, construction and operation stage of the project. EMP should essentially include the institutional mechanism for implementation of the EMP, grievance readressal mechanism, EHS policy, management system and team and environmental budget for the project.

EIA Report should essentially contain the following components:

- Project general background, need of the project and sub-component, overview of the project & sub-component, Objective of the EIA study, Extent and limitation of EIA study, Contents of the EIA report, Methodology followed to carry out EIA study, Data Sources for EIA study and References
- Overview of Indian environmental legislation & administrative framework, applicable environmental legislation, international best practices & guidelines including operational policies of world bank; EHC guidelines of IFC for General industry & Ports, terminals & harbours; IMO conventions and other related

conventions, Environmental standards & guidelines (national & international including PIANC)

- Settings and locations of project site, connectivity of the site, existing facilities at the site & its surroundings, project components including size & type of project; salient features of project; master planning layout; off-shore & on-shore components, construction phase activities including onshore & off-shore, operation phase activities including material handling & maintenance activities, construction material sourcing, utilities requirement & management, environmental provisions including drainage system; sewerage system; dust suppression system; green belt development; fire protection & emergency measures & flood protection measures, implementation schedule of project, Ananlysis of alternatives
- Environment and social features of project within study area, environmental settings & features of project, site connectivity, existing sources of pollution, monitoring plan & quality assurance procedures, description of physical environment including topography; drainage pattern; land use pattern; cropping pattern; river morphology; riverbank features slope & elevation; habitations along the project site; archaeological protected areas; wastewater & waste management facilities in the area; geology; rock types; regional tectonic settings; history of volcanic activity; seismicity; information on quarries along the waterway; soil quality; meterology (wind speed & direction, relative humidity, temperature, rainfall, calm periods, cloud cover, barometric pressure, history of cyclones & tidal surges, history of floods & HFL); water resources & quality; river bed sediments; air quality; noise levels, description of biological environment including the terrestrial ecology (flora & fauna); avifauna; aquatic ecology (planktons, benthos, mangroves, marshes, fisheries); forest cover, migratory routes & eco-sensitive zones in study area; RET species in waterway (dolphins, turtles, otters, ghariyal, Gangetic sharks) with their habitat & status, description of social environment including demography; occupation/livelihood pattern; health facilities; infrastructure (transportation, industries, educational institutes); public utilities in the area (sewerage system of area, all type solid waste disposal sites in area); cultural heritage and archaeological sites; fest & festivals; tourism; spiritual & other practices associated with the waterway of locals. Maps on GIS platform should be prepared to show the study area & project site, environmental settings of project site, drainage pattern, contours, land use, connectivity and monitoring network. Primary & secondary baseline monitoring data should be presented in the reports.
- Impact identification matrix for each project activity & development stage on the above defined baseline components during the pre-construction, construction & operation stage of the project along with the impact mitigation & avoidance measures and a matrix detailing the residual impact of the project after implementation of mitigation measures. Quantification of impacts should be carried out by using modelings and calculation methods for estimating air

emissions, GHG emission, maximum GLC due to transportation, noise level, sewage generation, muck generation & disposal, underground noise etc as applicable.

- Methodology & objective of the public consultation, stakeholders consulted, proof of communication and conducting consultations (attendance sheet, invitation letter/leaflets/newspaper invitation/public communication, proceedings & photographs of consultation and summary outcome of consultation with their adressal.
- Environment management plan for each of the identified project activity and affected environmental component, institutional arrangement to ensure EMP implementation, structure of environment management plan with roles and responsibility of each member, environmental standards for operation and maintenance of barge repair & maintenance facility, environmental monitoring plan, reporting requirement, grievance readressal mechanism and environmental budget. EMP should cover the following components
    - Measures for soil erosion protection and muck management
    - Measures for management, closure and rehabilitation of sites of labour camps and plant site (batching plants, workshops and material storage sites)
    - Green Belt Development Plan
    - Construction Debris Management Plan
    - Borrow Area Managemnet Plan
    - Oil Spill Management Plan
    - Occupational Health & Safety Management Plan
    - Bio-diversity (RET species) Conservation & Management Plan
    - Air emission Management Plan
    - Noise Level Management Plan
    - Water Resources and Quality Management Plan
    - Accident and Risk Management
    - Soil Quality Management Plan
    - Effluent/Sewage and Waste Management Plan for Non hazardous and Hazardous liquid & solid waste
    - Monitoring Mechanism for Prevention of Disposal of Waste generated at site and vessels in the waterway
- Summary of findings EIA report and concluding remarks with recommendations made.

4.5. Consultant's Input

For the purpose of EIA study of barge repair & maintenance facility, following experts should be engaged

S. No.	Expert Position	Experience in Years	Expertise
1.	Team Leader/Sr. Environmental Specialist	20 yrs in field of environment and 15 yrs specific in EIA studies	M Tech Environmental Engineering/MSc. Environmental Science and allied sciences Experience in field of environmental impact assessment study of linear and area development projects including highways, railways, ports, container depots. Experience in field of waterways is desirable.
2.	Junior Environmental Specialist	15 Yrs of Experience in Environment and 10 Yrs specific in EIA studies	M Tech Environmental Engineering/MSc. Environmental Science and allied sciences Experience in field of environmental impact assessment study of linear and area development projects including highways, railways, ports, container depots. Experience in field of waterways is desirable
3.	Occupational Health & Safety Expert	15 Yrs of Experience in Environment and 10 Yrs specific in occupational health and management	M Tech Environmental Engineering/MSc. Environmental Science and allied sciences with qualification in field of occupational health & safety is desirable. Experience in preparation of EHS/SHE plans for linear and area development projects. Experence in field of waterways is desirable
4.	Ecology and Bio-doversity Expert	10 yrs of experience in carrying out ecology and biodeiversity studies	M.Sc. (Life Science / Ecology); Ph.D. (Life Science / Ecology)

5.	Fisheries Experts	10 yrs of experience in carrying out river water fisheries study. Experience on dolphins is desirable	M.Sc. (Ecology/Fisheries); Ph.D. (Fisheries)
6.	Sociologist	15 years of experience in carrying out socio-economic studies	M.A (Sociology/ Social Science) / Master of Social Work; Ph.D. (Sociology/ Social Science) Experience of conducting SIA studies and preparation of RAP
7.	GIS Expert	5 yrs experience in mapping on GIS platform	MSc in Remote Sensing and GIS
8.	Hydrologist	10 years of experience in carrying out studies for Bridge, Dam or hydro-electric power project or having experience in river morphology & modelling	B. Tech (Civil) and M. Tech (Hydrology) is desirable
9.	Solid Waste Management Specialist	10 years in managing solid waste of urban area	B.E. / B. Tech (Civil); M.Sc. (Environment) / M. Tech (Environment / P. G Diploma in Waste Management)

4.6. Timeline

Study should be completed within 4 months of the award of the work

4.7. Deliverables

- Inception report- 1 month of award of work
- Baseline Data Report-2.5 months of award of work
- Draft EIA Report-3 months of Award of work
- Standalone EMPs and Final EIA Report-4 months of Award of work

CHAPTER 5. TERMS OF REFERENCE FOR RIVER TRAINING (BANK PROTECTION) WORKS IN FUTURE

5.1. Introduction

Erosion of banks is natural phenomenon in the alluvial rivers. However, erosion is aggravated due to construction of any structure like bridge, terminal and jetty on the river and also due to ripple action of the waves due to barge movement in narrow stretches of the waterway. Under Jal Marg Vikas projects, it is proposed to carry out the river training works to prevent the erosion of the banks, control and guide the river. River training works includes the following

- Bank protection works
- Bend correction
- Closure of secondary channels
- Construction of water storage structures
- Embankments development & improvement

It is proposed to carry out bank protection works of total 48.168 kms in the areas where erosion is observed and where civil interventions are planned to be carried out and details of the same are given at **Table 5.1**. Bank protection additionally also be carried out at other interventions are yet to be finalised.

Table 5.1 : Bank Protection Works as per Current Planning

S. No.	Location	App. Length (km)
1.	Varanasi	0.35
2.	Sahibganj	1.1
3.	Farakka Navigation Lock	0.75
4.	Three new terminal	2.5
5.	Farakka Feeder Canal	9.438
6.	Farakka to Tribeni	27.43
7.	Barge Repair and maintenance facility	2
8.	Existing Terminals & Jetties	4.6

Bends are navigational hazard which may require straitening to minimize the hazard. Crucial bends likely to be considered for straightening are Bend near Mirzapur, bend near Patauli & Agradwip, bend near Sanudragrah, bend near Chumariagacha, bend near Digibaraj and sharp bend just u/s of Farakka navigation lock. Finalization of correction of bends will be taken up at later stage of project development. Issues related to environment should be considered prior carrying out river training works.

5.2. Environmental and Social Impacts Anticipated Due to River Training Works

Maintenace and repair facilities for barges involve handling, storage and management of various hazardous chemicals and waste. Also there are occupational health and safety risks are involved at these facilities due to nature of works and machinery involved. High VOC emission and odour are also expected from such sites due to storage of paints &

other chemicals and painting facility. High washingwater will be generated from these sites for which an efficient effluent treatment system should be provided. Overall development of maintenance facility will have interface with various physical, social and biological components of the environment, i.e. soil quality, water quality, aquatic and terrestrial flora & fauna, air quality, noise levels, waste management facilities etc. All these environmental components will get affected due to development, maintenance & repair of the maintenance facilities and a detailed environment and social impact assessment should be carried to assess all the potential impacts of the project.

Further the impacts of development can be due to its location or due to the nature of activities to be performed during its development and operation phase thus both these aspects should be looked into while carrying out EIA study. Environmental framework as given in Table 1.4 in Chapter 1 can be referred to carry out the EIA study.

5.3. Alternative Analysis

Alternative analysis study should be carried out for each of the proposed river training work covering the following

- Stratergic Analysis- With and Without Project Scenario
- Technological Analysis- Construction material & methodology, material storage, waste treatment and dredging equipments

5.4. Scope of Work

Environmental Impact Assessment Study should broadly cover the following but should not be limited to this

- To carry out the site visits to understand the site specific environmental and social sensitivities associated with the project site
- To obtain understanding of the project, need of the project, construction methodology, activities involved during construction phase and their interface with the environment referring to the DPR, available literature and studies of similar projects
- To carry out the environmental screening to define the impacted environment due to the project development and maintenance & repair
- To define the project influence area on basis of screening excercise and considering the potential impacts of the project derived during the above excericise.
- To collect the primary and secondary data of the likely to be affected environments as identified during screening excercise to obtain their existing condition. Baseline monitoring should be conducted for a month for the following parameters
    - Air Quality-At project site and other locations in 2 kms (twice a week at each location)
    - Surface Water Quality-Near project site (One time at each location)
    - Soil Quality-At project site (One time at each location)

- River Bed Sampling- Near project site (One time at each location)
- Aquatic Ecology-In river stretch (15 kms u/s & d/s), mention RET species available in that area and eco-sensitive zones within 10 km radius of the site
- Terrestrial Ecology-In project area and general overview in 10 km radius. Mention RET species and eco-sensitive zones within 10 kms radius of the site
- River Bank Condition in project site

- To prepare the maps on GIS platforms of the project site, study area, drainage pattern of the site, land use and contour using satellite imagery, google imageries and toposheets as available and required
- To examine and understand the aggregate affects from the development of the river training works that could affect the environmental and social dimensions of the study area w.r.t its location, nature of developments and interface with the different environments.
- To recommend specific measures, to be implemented by IWAI, as well as for other future projects, for addressing the Environmental impacts and issues over and above the mitigation and/or management measures for project-specific impacts.
- To identify the stakeholders to be affected by the project at any stage of development in consultation with the client. To draft a checklist/questionaaire of the issues to be discussed during consultations. To define the methodology of the consultation and mode of communication to the stakeholder about the consultation date and venue. Carrying out public consultations to obtain the view of the stakeholders on the project development, impacts on their life and environment due to project development and mitigation which should be taken.
- The EIA studies and reporting requirements to be undertaken under these ToR must also conform to the Government of India (GoI) and World Bank guidelines and regulations, which include, inter-alia, the EIA amendments and updated guidelines. A detailed environment legislative framework should be developed for the project which should define the applicability of the environmental legislations on the project at respective stage, clearances to be obtained and concerned authority
- EIA Study should consist of the environmental management and monitoring plan for pre-construction, construction and maintenance & repair stage of the project. EMP should essentially include the institutional mechanism for implementation of the EMP, grievance readressal mechanism, EHS policy, management system and team and environmental budget for the project.

EIA Report should essentially contain the following components:

- Project general background, need of the project and sub-component, overview of the project & sub-component, Objective of the EIA study, Extent and limitation of

EIA study, Contents of the EIA report, Methodology followed to carry out EIA study, Data Sources for EIA study and References

- Overview of Indian environmental legislation & administrative framework, applicable environmental legislation, international best practices & guidelines including operational policies of world bank; EHC guidelines of IFC for General industry, Environmental standards & guidelines (national & international including PIANC)
- Settings and locations of project site, connectivity of the site, existing facilities at the site & its surroundings, project components including length of bank protection works and features of other river training works; salient features of project; master planning layout; off-shore & on-shore components, construction phase activities including onshore & off-shore, operation phase activities including material handling & maintenance activities, construction material sourcing, utilities requirement & management for project construction, Ananlysis of alternatives
- Environment and social features of project within study area, environmental settings & features of project, site connectivity, existing sources of pollution, monitoring plan & quality assurance procedures, description of physical environment including topography; drainage pattern; land use pattern; river morphology; riverbank features slope & elevation; habitations along the project site; archaeological protected areas; geology; seismicity; soil quality; meterology (wind speed & direction, relative humidity, temperature, rainfall, calm periods, cloud cover, barometric pressure, history of cyclones & tidal surges, history of floods & HFL); water resources & quality; river bed sediments; air quality; noise levels, description of biological environment including the terrestrial ecology (flora & fauna); avifauna; aquatic ecology (planktons, benthos, mangroves, marshes, fisheries); forest cover, migratory routes & eco-sensitive zones in study area; RET species in waterway (dolphins, turtles, otters, ghariyal, Gangetic sharks) with their habitat & status, description of social environment including demography; occupation/livelihood pattern; health facilities; infrastructure (transportation, industries, educational institutes); cultural heritage and archaeological sites; fest & festivals; tourism; spiritual & other practices associated with the waterway of locals. Maps on GIS platform should be prepared to show the study area & project site, environmental settings of project site, drainage pattern, contours, land use, connectivity and monitoring network. Primary & secondary baseline monitoring data should be presented in the reports.
- Impact identification matrix for each project activity & development stage on the above defined baseline components during the pre-construction, construction and maintenance & repair stage of the project along with the impact mitigation & avoidance measures and a matrix detailing the residual impact of the project after implementation of mitigation measures. Quantification of impacts should be carried out by using modelings and calculation methods for estimating air

emissions, GHG emission, maximum GLC due to transportation, noise level, sewage generation, muck generation & disposal, underground noise etc as applicable.

- Methodology & objective of the public consultation, stakeholders consulted, proof of communication and conducting consultations (attendance sheet, invitation letter/leaflets/newspaper invitation/public communication, proceedings & photographs of consultation and summary outcome of consultation with their adressal.
- Environment management plan for each of the identified project activity and affected environmental component, institutional arrangement to ensure EMP implementation, structure of environment management plan with roles and responsibility of each member, environmental monitoring plan, reporting requirement, grievance readressal mechanism and environmental budget. EMP should cover the following components
    - Measures for soil erosion protection and muck management
    - Measures for management, closure and rehabilitation of sites of labour camps and plant site (batching plants, workshops and material storage sites)
    - Construction Debris Management Plan
    - Borrow Area Managemnet Plan (if applicable)
    - Occupational Health & Safety Management Plan
    - Bio-diversity (RET species) Conservation & Management Plan
    - Air emission Management Plan
    - Noise Level Management Plan
    - Water Resources and Quality Management Plan
    - Accident and Risk Management
    - Soil Quality Management Plan
    - Monitoring Mechanism for Checking bank erosion and condition of the river training works
- Summary of findings EIA report and concluding remarks with recommendations made.

5.5. Consultant's Input

For the purpose of EIA study of river training works, following experts should be engaged

S. No.	Expert Position	Experience in Years	Expertise
1.	Team Leader/Sr. Environmental Specialist	20 yrs in field of environment and 15 yrs specific in EIA studies	M Tech Environmental Engineering/MSc. Environmental Science and allied sciences

			Experience in field of environmental impact assessment study of linear and area development projects including highways, railways, ports, container depots. Experience in field of waterways is desirable.
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3.	Occupational Health & Safety Expert	15 Yrs of Experience in Environment and 10 Yrs specific in occupational health and management	M Tech Environmental Engineering/MSc. Environmental Science and allied sciences with qualification in field of occupational health & safety is desirable. Experience in preparation of EHS/SHE plans for linear and area development projects. Experence in field of waterways is desirable
4.	Ecology and Bio-doversity Expert	10 yrs of experience in carrying out ecology and biodeiversity studies	M.Sc. (Life Science / Ecology); Ph.D. (Life Science / Ecology)
5.	Fisheries Experts	10 yrs of experience in carrying out river water fisheries study. Experience on dolphins is desirable	M.Sc. (Ecology/Fisheries); Ph.D. (Fisheries)

6.	Sociologist	15 years of experience in carrying out socio-economic studies	M.A (Sociology/ Social Science) / Master of Social Work; Ph.D. (Sociology/ Social Science) Experience of conducting SIA studies and preparation of RAP
7.	GIS Expert	5 yrs experience in mapping on GIS platform	MSc in Remote Sensing and GIS
8.	Hydrologist	10 years of experience in carrying out studies for Bridge, Dam or hydro-electric power project or having experience in river morphology & modelling	B. Tech (Civil) and M. Tech (Hydrology) is desirable
9.	Solid Waste Management Specialist	10 years in managing solid waste of urban area	B.E. / B. Tech (Civil); M.Sc. (Environment) / M. Tech (Environment / P. G Diploma in Waste Management)

5.6. Timeline

Study should be completed within 4 months of the award of the work

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