FINAL DETAILED PROJECT REPORT (DPR) OF NATIONAL WATERWAY NO. 44

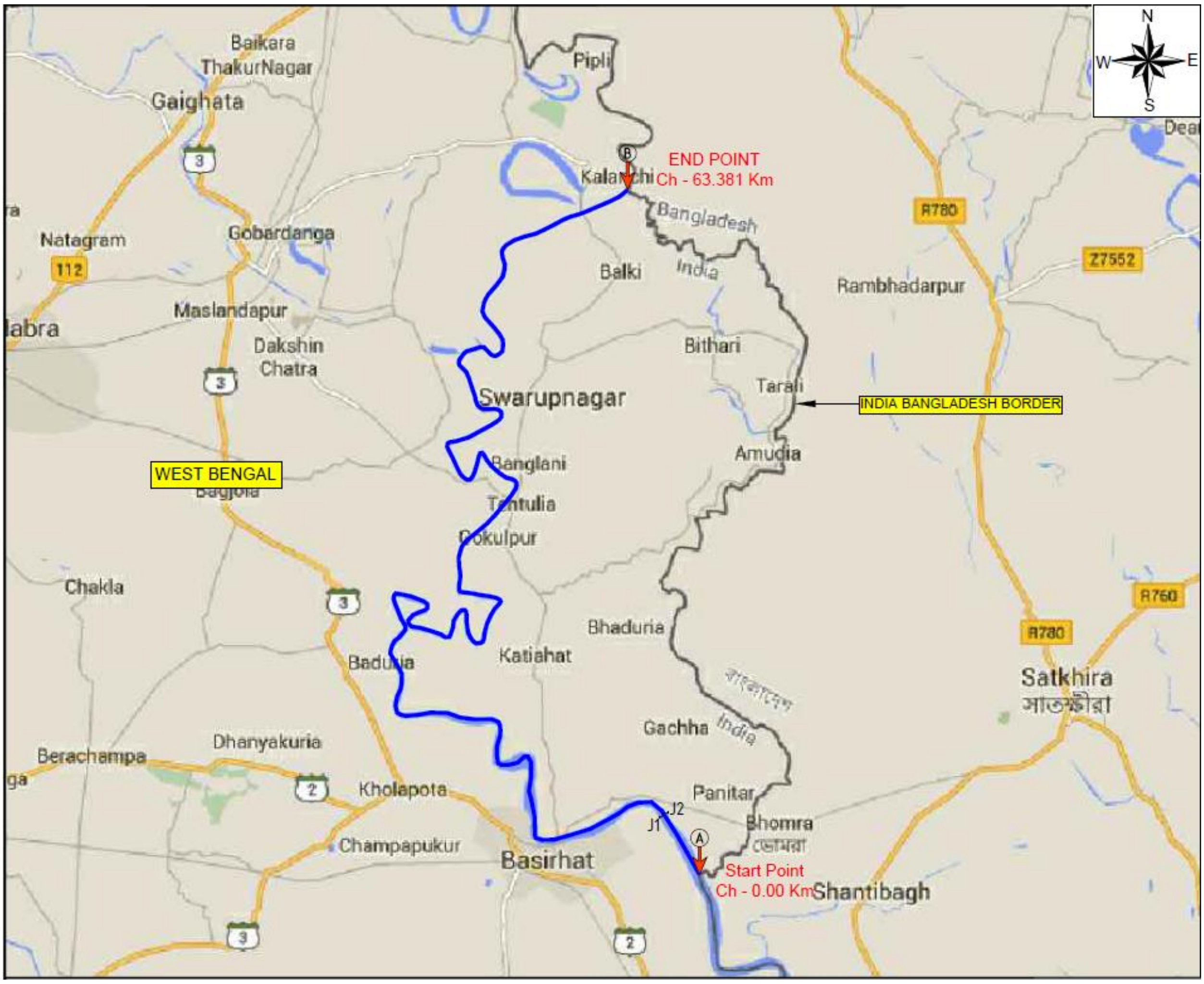
RIVER: ICHAMATI (STATE OF WEST BENGAL)

BANSJHARI MALLIKPUR TO KALANCHI (63.381 KMS)

(Volume – I: Main Report)

(Volume – II: Drawings)

Submission Date: 27/09/2019



Inland Waterways Authority of India

FINAL DETAILED PROJECT REPORT

REVISION - 4

September 2019

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BANSJHARI MALLIKPUR TO KALANCHI (63.381 KMS)
(Volume – I: Main Report)
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Submission Date: 27/09/2019

Project: Consultancy Services for preparation of Two Stage Detailed Project Report (DPR) of Cluster 1 National Waterways

Owner: IWAI, Ministry of Shipping

Consultant: Egis India Consulting Engineers

<table>
<tr><td colspan="3">Authors:
Mr. Ashish Khullar, M.Tech, Hydraulics (IIT, Roorkee)
Mr. Dipankar Majumdar, Master's in Env. Management (IISWBM, Kolkata)
Mr. Monu Sharma, B Tech, Mechanical (UPTU)
Mr. Rahul Kumar, B Tech, Civil (TMU,U.P)
Mr. Divyanshu Upadhyay, M Tech, Structure (CEPT, Gujarat)</td><td colspan="3">Project No:
PT/EIPTIWB003

Report No:
PT/EIPTIWB003/2017/Stage-2/DPR/004
<hr>Approved by:
Dr. Jitendra K. Panigrahi (Project Manager)
PhD.[DRDO]
Harbour & Coastal Engineering Expert</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4</td><td>For Approval</td><td>Sep 2019</td><td>Team</td><td>A Khullar</td><td>JK Panigrahi</td></tr>
<tr><td>3</td><td>For Approval</td><td>June 2019</td><td>Team</td><td>A Khullar</td><td>JK Panigrahi</td></tr>
<tr><td>2</td><td>For Approval</td><td>Dec 2018</td><td>Team</td><td>A Khullar</td><td>JK Panigrahi</td></tr>
<tr><td>1</td><td>For Approval</td><td>July 2018</td><td>Team</td><td>A Khullar</td><td>JK Panigrahi</td></tr>
<tr><td>0</td><td>For Acceptance</td><td>Dec 2017</td><td>Team</td><td>A Khullar</td><td>JK Panigrahi</td></tr>
<tr><td>Revision</td><td>Description</td><td>Date</td><td>Prepared By</td><td>Checked By</td><td>Approved By</td></tr>
<tr><td colspan="6">Document Title: Final DPR of Ichamati Waterway NW 44.
Volume-I Main Report
Volume-II Drawings</td></tr>
<tr><td colspan="3">Distribution : IWAI</td><td colspan="3">Classification: Restricted</td></tr>
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ACKNOWLEDGEMENT

Egis India Consulting Engineers Pvt Ltd (EIPL) expresses their gratitude to ***Dr. Amita Prasad, IAS, Chairperson,*** *for spending their valuable time and guidance for completing this "Final Detailed Project Report (DPR) of National Waterway 44, Ichamati Waterway". EIPL would also like to thank* ***Shri Pravir Pandey, Vice Chairman IA&AS, Shri Alok Ranjan, Member (Finance) ICAS, Shri S.K. Gangwar, Member (Technical)*** *for their valuable support during the execution of project.*

EIPL wishes to express their gratitude to ***Captain Ashish Arya, Hydrographic Chief, IWAI*** *for his guidance and inspiration for this project. EIPL would also like to thank* ***Sh. Rajiv Singhal, S.H.S., IWAI*** *for their invaluable support and suggestions provided throughout the project duration. EIPL is pleased to place on record their sincere thanks to other staff and officers of IWAI for their excellent support and co-operation throughout the project duration.*

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IWAI	Inland Waterways Authority of India
IWT	Inland Water Transportation
MOS	Ministry of Shipping
NW	National Waterway
DPR	Detailed Project Report
WW	Waterway
AtoN	Aid to Navigation
VC	Vertical Clearance
HC	Horizontal Clearance
CD	Chart Datum
SD	Sounding Datum
MSL	Mean Sea Level
DGPS	Differential Global Positioning System
RTK	Real Time Kinematic
GPS	Global Positioning System
SBES	Single Beam Echo Sounder
TS	Total Station
CRP	Common Reference Point
SBAS	Satellite-based augmentation systems
DGLL	Directorate General of Light House & Light ships
UTM	Universal Transverse Mercator
WGS	World Geodetic System
MT	Metric Ton
GNSS	Global Navigation Satellite System
BM	Bench Mark
TBM	Temporary Bench Mark
HAD	Haldia Development Authority
WBSTC	West Bengal Surface Transport Corporation Ltd.
WBTIDC	West Bengal Transport Infrastructre Development Corporation Ltd.
HNJPSS	Hooghly Nadi Jalpath Paribahan Samabai Samity Ltd.
IMO	International Maritime Organisation
VHF	Very High Frequency
RIS	River Information System

SALIENT FEATURES OF ICHAMATI WATERWAY (NW 44)

Sr. No.	Particulars	Details							
A.	**GENERAL**								
1.	***Location***								
a)	Cluster	1							
b)	State(s)	West Bengal							
c)	Co-ordinates & Name of Place	**Start**				**End**			
	Place	Bansjhari Mallikpur				Kalanchi			
	Latitude	22°39'6.71"N				22°53'53.79"N			
	Longitude	88°55'33.35"E				88°53'53.94"E			
B.	**TECHNICAL**								
1.	***Waterway***								
a)	National Waterway Number	44							
b)	Class	III							
c)	Type (Tidal/Non-Tidal)	Tidal							
	Length (Km.)	**Total**		**Tidal**			**Non-Tidal**		
		63.381 Km		63.381 Km			0 Km		
d)	Sounding Datum								
	Description/Basis	Sounding Datum was transferred at all the newly established BM's using Sagar Road values. Standard method was adopted for transfer of datum for tidal reaches areas as per Admiralty Manual.							
	Value w.r.t MSL (m)	0 – 10 Km	10.1 – 20.0 Km	20.1 – 30.0 Km	30.1 – 40.0 Km	40.1 – 50.0 Km	50.1 – 60.0 Km	60.1 – 60.381 Km	
		-2.252	-2.254	0.207	0.207	1.627	1.531	1.948	
e)	LAD Status (w.r.t. SD)								
		Sub - Stretch 1	**Sub - Stretch 2**	**Sub - Stretch 3**	**Sub - Stretch 4**	**Sub - Stretch 5**	**Sub - Stretch 6**	**Sub - Stretch 7**	**Total (Km)**
	Stretch Km (From......To......)	**0-10**	**10-20**	**20-30**	**30-40**	**40-50**	**50-60**	**60-63.381**	

Sr. No.	Particulars	Details							
	Length with LAD < 1.2 m	6.868	10	10	10	8.129	6.214	2.008	53.219
	With LAD from 1.2-1.4 m	1.115	0	0	0	1.584	0.885	0.401	3.985
	With LAD from 1.5-1.7 m	0.284	0	0	0	0.102	0.292	0.121	0.799
	With LAD from 1.8-2.0 m	0.282	0	0	0	0.185	1.398	0.058	1.923
	With LAD > 2.0 m	1.451	0	0	0	0	1.211	0.793	3.455
f)	Target Depth of Proposed Fairway (m)	1.7m below SD level for proposed Class –III waterway + 0.5m clearance.							
g)	Conservancy Works Required for proposed waterway stretch of 3.0 Km								

	Type of Work	**0 – 3 Km**	**3 – 10 Km**	**10 – 63.381 Km**	**Total (Km)**
	Dredging Required (M. Cum.)	0.233	Nil	Nil	0.233
	Bandalling	Nil	Nil	Nil	Nil
	Barrages & Locks	Nil	Nil	Nil	Nil
	River Training (Km.)	Nil	Nil	Nil	Nil
	Bank Protection (Km.)	Nil	Nil	Nil	Nil
h)	Existing Cross Structures along the proposed waterway stretch				

	Name of Structure	**Type**	**Nos.**	**Range of Horizontal Clearance**	**Range of Vertical Clearance w.r.t. HFL/MHWS**
	Dams/Barrages/Weirs/Aqueducts etc.	Nil	Nil	Nil	Nil
	Bridges	Nil	Nil	Nil	Nil
	HT/Tele-communication lines	Nil	Nil	Nil	Nil
	Pipelines, underwater cables, etc.	Nil	Nil	Nil	Nil

2.	***Traffic***	
a)	Present IWT Operations (type of services)	Passenger Ferry
b)	Major industries in the hinterland (i.e. within 25 km. on either side)	Not Available.
c)	Connectivity of major industries with Rail/Road network	Not applicable

Sr. No.	Particulars	Details				
	(Distances/Nearest Railway Stations etc.)					
d)	Commodities	**In-bound**		**Out-bound**		
		Not Available		Not Available		
e)	Existing and Future Potential					
	Name of Commodity	**Existing**	**5 years**	**10 years**	**15 years**	**20 years**
	Passengers (nos./day)	4000	4595	5073	5601	6184
	RO-RO Cargo traffic from Basirhat to Indo-Bangladesh border (Lakh MT/Year)	0	3.0 – 10.0	10.0	10.0	10.0
3.	***Terminals/Jetties***					
a)	Terminal/Jetty - 1					
	Location	(Right Bank/Itinda Jetty/North 24 Parganas district)				
	Type/Services	Passenger Ferry				
	Existing Infrastructure/Facilities	Wooden jetty and passenger shed. No terminal structure or basic amenities for passengers are available.				
	Proposed Infrastructure/Facilities	Gangway, Pontoon Platform, Parking, Passenger waiting and ticketing area, Office complex				
	Approach	Itinda Road				
	Area (sq.m.)	**Govt.**		**Private**		
		2,185.00				
b)	Terminal/Jetty – 2					
	Location (Bank/city/district)	(Left Bank/ Basirhat Jetty/North 24 Parganas district)				
	Type/Services	Passenger Ferry and RO-RO				
	Existing Infrastructure/Facilities	Wooden jetty and passenger shed. No terminal structure or basic amenities for passengers are available.				
	Proposed Infrastructure/Facilities	Gangway, Pontoon Platform, Parking, Passenger waiting and ticketing area, Office complex (facilities required for RO-RO operations shall be developed and maintained by M/s River Waterlink Pvt. Ltd.				
	Approach	Basirhat jetty road				

Sr. No.	Particulars	Details		
	Area (sq.m.)	**Govt.**		**Private**
		2,185.00		
4.	***Design Vessel***	(For RO-RO operations M/s River Waterlink Pvt. Ltd. will use its own barges.)		
a)	Type	Steel ferry vessel		
b)	No. & Size	2 No. (62.4L x 4.5B)		
c)	Loaded Draft	1.5 m		
d)	Capacity	150 passengers		
5.	***Navigation Aids***			
a)	Type	Marking buoys		
b)	Nos.	20		
c)	Communication facilities	RIS – 1 station		
C.	**FINANCIAL**			
1.	***Project Cost***			
	Cost	***Capital Cost*** (INR Lakhs)		***O&M Cost*** (INR Lakhs)
	a) Fairway Development	466.20		46.62
	b) Terminal Structure	1,183.87		175.36
	c) Vessels	183.996		86.16
	Total Cost including Vessel	**2342.386**		**549.315**
	Total Cost without Vessel	**2158.39**		**463.155**
2.	***User Charges***	INR 10 per person per trip one way		
3.	***Financial Internal Rate of Return (%)***	**Option 1** Total Capital Cost + Total O&M cost	**Option 2** Option 1 - Vessel Capital & O&M cost	**Option 3** Vessel Capital Cost + Vessel O&M Cost
		0.24	4.27	107.59
4.	***Economic Internal Rate of Return (%)***	**Option 1** Total Capital Cost + Total O&M cost	**Option 2** Option 1 - Vessel Capital & O&M cost	**Option 3** Vessel Capital Cost + Vessel O&M Cost
		5.10	9.06	189.93

EXECUTIVE SUMMARY

1.0 INTRODUCTION

Inland Waterways Authority of India appointed M/s Egis India for providing Consultancy Services for preparation of Two Stage Detailed Project Report (DPR) of Cluster 1 National Waterways. Ichamati waterway is one of the 4 rivers clubbed in Cluster 1.

This final detailed project report of 63.381 km stretch of Ichamati waterway is prepared on the basis of recommendations from feasibility report, detailed survey & investigations, preliminary engineering and design and suggestions from IWAI.

2.0 WATERWAY/DETAILED HYDROGRAPHIC SURVEY

The 63.381 Km stretch of Ichamati National waterway proposed for DPR study lies from Bansjhari Mallikpur at Lat 22°39'6.71"N, Long 88°55'33.35"E to Kalanchi at Lat 22°53'53.79"N, Long 88°53'53.94"E. Whole stretch of Ichamati waterway is having tidal influence with a maximum tidal variation of 4.013 m to a minimum tidal variation of 0.39 m.

River width in the waterway stretch varies from 400 m to 300 m. Maximum and minimum reduced depth of the waterway with respect to sounding datum is 8.4m and -3.36m respectively, for proposed waterway Class III. Average flow velocity in the waterway varies from 0.8 m/sec to 0.5 m/sec.

3.0 FAIRWAY DEVELOPMENT

Ichamati waterway is proposed to be developed in following stretches:

a) **Fairway stretch 1** from Basirhat to Indo-Bangladesh Border – The proposed fairway provides connectivity for RO-RO operations to Bangladesh. The total length of proposed fairway is about 3.0 Km along the river.
b) **Fairway stretch 2** from Itinda ghat to Basirhat ghat - The proposed fairway connects the passenger jetties proposed at both banks of Itinda and Basirhat ghat across the river. The total length of proposed fairway is about 300 m.

Dredging is proposed for obtaining desired depth of 2.2 m below sounding datum including 1.7m depth as per Class-III waterway classification. The total capital and O&M cost of fairway development works out to INR 466.20 Lacs and INR 46.62 Lacs respectively.

4.0 TRAFFIC STUDY

On the basis of detailed traffic survey and study done during DPR stage, it is concluded that locally operated passenger ferry service is currently operational near Itinda and Basirhat ghat for river crossing. Vehicular traffic use the Ichamati road bridge located about 4 Km upstream of Basirhat ghat. Existing passenger traffic as observed during field survey is about 4000 person per day.

In addition to passenger ferry services, Ichamati waterway also has potential for RO-RO operations. M/s River Waterlink Pvt. Ltd., a trader company proposed to use Ichamati waterway for transporting cargo from Basirhat Ghat to Indo-Bangladesh border. The company also proposed to bear all expenses for design and construction of RO-RO jetty at Basirhat and have their own RO-RO barges for the same. The initial guaranteed cargo traffic proposed for RO-RO operations is 3.0 Lakh MT/year which will be rapidly increased to about 10.0 Lakh MT/year as claimed by M/s River Waterlink Pvt. Ltd through IWAI letter no. IWAI/PR/46NW/2016/1B, dated 22nd January 2019.

5.0 TERMINALS

Design, development and maintenance of all infrastructure facilities required for RO-RO operations shall be borne M/s River Waterlink Pvt. Ltd. as detailed above.

For passenger ferry services, floating pontoons with Gangway and necessary terminal structure is envisaged to be developed on both the banks (Itinada and Basirhat) of Ichamati waterway at Chainage 3.0 Km.

The total cost of terminals structures works out on the basis of preliminary engineering design is provided as below:

Sl. No.	Item	Amount in Lacs (INR)
1.0	Capital cost for Terminals	1,183.87
2.0	O&M cost for Terminals	175.36

6.0 PRELIMINARY ENGINEERING DESIGNS

Preliminary engineering design is done for terminal structures and necessary infrastructure required for waterway development. Following basic facilities are provided for both the passenger ferry terminal structures:

- Floating Pontoon
- Gangway
- Approach Platform
- Parking Facilities
- Terminal Building

Relevant Indian and International codes are used for preliminary design of all structures.

7.0 VESSEL DESIGN

Steel ferry vessels developed by West Bengal Transport Infrastructure Development Corporation (WBTIDC), with carrying capacity of 150 passengers are proposed to be operated in Ichamati waterway for passenger ferry services. The procurement and O&M cost of 2 vessels works out to INR 183.996 Lacs and INR 86.16 Lacs respectively.

For RO-RO operations M/s River Waterlink Pvt. Ltd. will use their in-house barges.

8.0 NAVIGATION & COMMUNICATION SYSTEM

Marking buoys are proposed along the channel alignment. Capital and maintenance cost for the same is estimated to INR 363.30 Lacs and INR 183.82 Lacs respectively.

9.0 ENVIRONMENTAL & SOCIAL ASPECTS

The major objective of this study is to establish present environmental condition along the Ichamati River through available data /information supported by field studies to evaluate the impacts on relevant environmental attributes due to the construction & operation of the proposed project; to recommend adequate mitigation measures to minimize / reduce adverse impacts and to prepare an Environmental Management Plan (EMP) for timely implementation of the mitigation measures to make the project environmentally sound and sustainable. The study basically includes:

- Establishment of the present environmental scenario
- Study of the specific activities related to the project
- Evaluation of the probable environmental impacts
- Recommendations of necessary environmental control measures.
- Preparation of Environmental Management Plan

The study stretch passes through North 24 Parganas District of West Bengal State. North 24 Parganas is a district in southern West Bengal, of eastern India. North 24 Parganas extends from latitude 22º11'6" north to 23º15'2" north and from longitude 88º20' east to 89º5' east. The physiography of the region is that of a typical alluvial plain with gentle ups and downs. The terrain is essentially composed of Soft River borne sediments deposited under fluviatile environment. The general slope is from north west to south east. As the area is situated very near to the out fall, the dominant slope of the land is towards south with average elevation varying from 3.5 m to 2.5 m above MSL. The project falls under the seismic zone II as defined by the Indian Standard (IS) 2002 seismic zoning classification system, i.e. a zone of relative stability. The average annual rainfall is 1579mm. The temperature ranges between 41°C in May (Max) to 10°C in January (Min) and Relative Humidity ranges between 50% in March & 90% in July.

Assessments of impact on environment including social considerations are done in the DPR. The total environmental estimated cost for the project is INR 129.295 Lacs

10.0 INSTITUTIONAL REQUIREMENTS

The proposed development of passenger ferry services in Ichamati waterway at Itinda and Basirhat Ghats shall be developed and maintained by a separate Project Management Unit (PMU) under the jurisdiction of Director, Inland Waterways Authority of India, Kolkata. The total cost for Institutional set up works out to INR 39.0/- Lacs and annual O&M cost works out to INR 34.0/- Lacs.

11.0 PROJECT COSTING

The basis of cost estimates worked out as per following:

a) Standard Schedule of Rates 2015-16 of PWD, Govt. of West Bengal.
b) “Unified Schedule of Rates” prepared by Irrigation and Waterways department, Government of West Bengal.
c) The consultants experience on various projects sites proximity to the project area.
d) Local enquiries at the time of conducting surveys.
e) Market surveys and enquires
f) Judgement based on Consultant’s Experience

Ichamati waterway is proposed to be developed for passenger ferry services at Itinda & Basirhat ghats and for RO-RO operations from Basirhat ghat to Indo-Bangladesh Border. The development cost for waterway comprises of:

a) Cost for fairway development comprising dredging and navigation & communication system
b) Cost of floating pontoons, gangway and terminal buildings
c) Vessel Cost
d) Cost of Aids to Navigations
e) EMP cost.

The total capital cost for development of waterway, construction of terminals, and procurement of vessels including other expenses works out to INR 2342.39/- Lacs. Annual operation and maintenance cost of Ichamati waterway including O&M expenses for terminal/ jetty structures works out to INR 549.32/- Lacs.

12.0 IMPLEMENTATION SCHEDULE

The project is scheduled to be completed in 24 months from the start date of construction.

13.0 ECONOMIC & FINANCIAL ANALYSIS

An attempt has been made to estimate the possible revenue available from this service. Although this has been calculated in a thorough and logical manner the study is based on many assumptions and it should therefore be taken as a guide to the magnitude of possible revenue.

The techno-economic model has been run with the following assumption as stated below:

a) Passenger Ferry services from Basirhat to Itinda Jetty - 2 passenger ferry vessels of 150 pax capacity operating 7:00 AM to 7:00 PM at every 30 minute interval from each jetty.
b) RO-RO cargo operations from Basirhat to Indo-Bangladesh Border – assuming 2 vessels of 2000 DWT will be operated daily by M/s River Waterlink Pvt. Ltd.

A downtime of about 2 months is assumed, which could be occurred due to weather, operational or other factors. Hence, it is assumed that the full service is operating for 300 days annually.

From the detailed financial and economic analysis, it is recommended that project shall be implemented in two packages as below:

Package – 1 : Construction, Operation & Maintenance of fairway and jetties

Package – 2 : Procurement, operation & maintenance of Ferry Vessel

The calculated FIRR and EIRR for varying fare is shown as below:

Sr. No.	Fare (INR)	FIRR (%)			EIRR (%)		
	(per trip one way)	Option-1	Option-2	Option-3	Option-1	Option-2	Option-3
1	3.00	Not Calculable	Not Calculable	27.53	Not Calculable	Not Calculable	95.13
2	5.00	Not Calculable	Not Calculable	47.72	Not Calculable	-7.80	122.20
3	6.75	Not Calculable	-6.36	67.22	-5.41	1.00	145.67
4	8.00	-7.01	-1.21	81.95	-0.29	4.61	162.16
5	10.00	0.24	4.27	107.59	5.10	9.06	189.93
6	12.50	5.28	8.67	137.66	9.41	12.97	221.54
Not Calculable		All/majorly negative cash-flows					

From the above table, it can be concluded that with the existing tariff, the proposed IWT operation along Ichamati waterway is not financially viable.

However, in case the tariff is increased to INR 10.00 per trip, the passenger ferry services becomes financially viable.

For RO-RO operations from Basirhat to Indo-Bangladesh border, a private company operating in Indo-Bangladesh trade has shown interest for investing on development, operation and maintenance of terminal and vessels. The company is ready to use their own RO-RO barges for the services and to provide operation and maintenance services also. Company has also acquired 6.0 Hectare of land on long term rental basis at Basirhat. On the basis of above information and DPR studies, it is concluded that the proposal of M/s River Waterlink Pvt. Ltd. can be recommended to approving authorities for execution.

1.0 INTRODUCTION

Inland Waterways Authority of India (IWAI), an undertaking of Ministry of Shipping, Government of India intends to develop 106 new National Waterways in addition to the exiting 5 National waterways. The National waterways are proposed to be developed as a composite and integrated water transport system with the existing rail and road infrastructure across the country.

In view of this, IWAI invited online bids for "Consultancy Services for preparation of Two Stage Detailed Project Report of the 106 National Waterways in a set of eight clusters. Each waterway is to be explored for the potential of year round commercial navigation during Stage-1 (Feasibility Studies) of the project. The second stage comprises of preparation of techno-commercial detailed project report of the river/stretches approved by IWAI for stage -2 studies. Egis India Consulting Engineers Pvt. Ltd (EICEPL) was awarded the work for two stage DPR studies of two out of eight clusters respectively. Ichamati River was clubbed under Cluster -1 for the two stage DPR studies.

This final detailed project report of 63.381 km stretch of Ichamati waterway is prepared on the basis of recommendations from feasibility report, detailed survey & investigations, preliminary engineering and design and suggestions from IWAI. The report is prepared in accordance with detailed ToR as per the agreement **(Refer Annexure 1)**.

1.1 PROJECT BACKGROUND AND SUMMARY OF PREVIOUS STUDY

Ichamati Waterway is declared as National Waterway-44 as per "The National Waterway Act, 2016", No. 17 of 2016, published in the Gazette of India, Part – II- Section 1 no. 18, New Delhi, Saturday, March 26/2016/Chaitra 6, 1938 (Saka), by Ministry of Law and Justice (Legislative Department).

As per the Gazette notification, following section of the river is declared as National Waterway and recommended for Feasibility studies by IWAI:

Length	Co-ordinate at Start	Start Location	Co-ordinate at End	End Location
63.381 Km	22°39'6.71"N 88°55'33.35"E	Bansjhari Mallikpur	22°53'53.79"N 88°53'53.94"E	Kalanchi

Following conclusions were made in the feasibility study for 63.381 km stretch of Ichamati waterway:

- The waterway is a tidal river having year round navigational.
- The horizontal and vertical clearance of existing cross-structures is in the range of 30m to 10m and 10m to 6m respectively.
- Taking in to account the water availability, LAD of >2.0 m is available for 12.60 km length of the waterway, 1.5 m to 2.0 m is available for 4.59 km length, 1.0 to 1.50 m is available for 6.99 km and <1.0 m of LAD is available for 39.82 km of the waterway stretch. All LAD are with respect to Chart Datum.
- Taking advantage of tidal window of 2.5m, the LAD of 1.0 m will have more under keel clearance of minimum 1.2 m.
- Considering the availability of numerous minor and major industries and connectivity with rail and road network with 5km reach across the bank , the river has huge economic potential for development as a Waterway
- Also the connectivity of Ichamati waterway with Raimangal Waterway and thereby with Sunderbans Waterways creates an added advantage for triggering new traffic.

All the above conclusions were made on the basis of findings during the feasibility study stage. Detailed survey and investigations are done including preliminary engineering studies as per the scope of work defined in the ToR to validate above conclusions and to identify the development works required for making a techno-economically viable IWT in Ichamati WW.

Based on the above conclusions/observations done during feasibility studies i.e. first stage of the studies, IWAI recommended following stretch of Ichamati river for second stage of the studies i.e. for detailed project report.

Length	Co-ordinate at Start	Start Location	Co-ordinate at End	End Location
63.381 Km	22°39'6.71"N 88°55'33.35"E	Bansjhari Mallikpur	22°53'53.79"N 88°53'53.94"E	Kalanchi

1.2 PROJECT LOCATION / DETAILS OF STUDY AREA

Complete 63.381 Km stretch of Ichamati waterway is located in North 24 Parganas district of West Bengal. As observed during the feasibility studies, complete stretch of waterway is having tidal influence. Locally operated jetties/ferry ghats are also available at Itinda and Basirhat ghats (Chainage 3.0 Km) and all along the river stretch of 63.381 Km. Locally operated boats are used for the ferry services which uses river banks for embarking and disembarking of passengers except Itinda and basirhat ghat. At Itinda and Basirhat wooden jetty is located for the same.

Ichamati waterway project location as per DPR is shown in **Figure 1**. The detailed layout plan of waterway and terminal structures are provided in Drawings PT/EIPTIWB003/2017/DPR/0001 to 0003 attached as **Volume-II**.

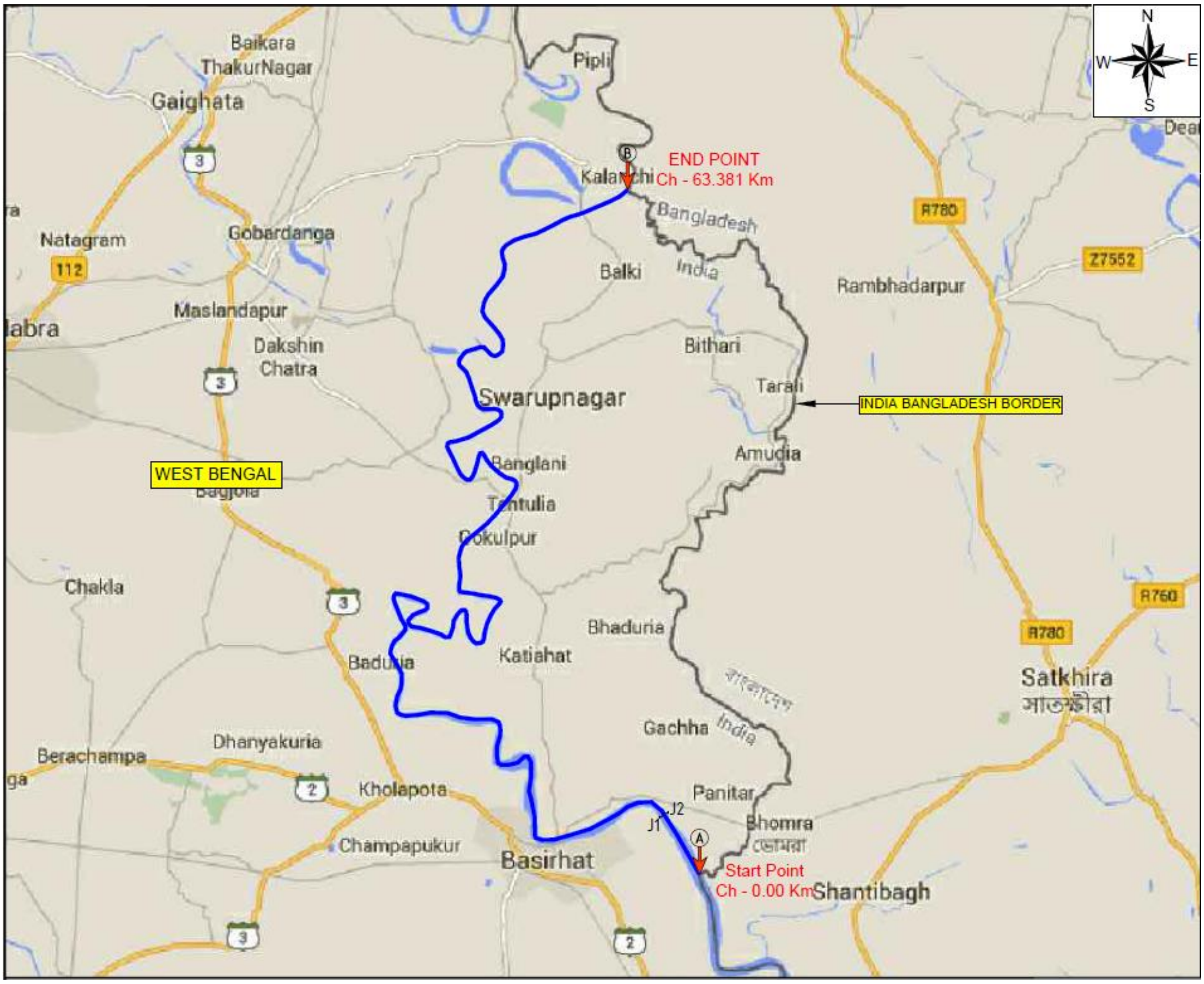

Figure 1: Ichamati National Waterway Project Location

1.3 BRIEF SCOPE OF WORK AND COMPLIANCE STATEMENT

The brief scope of work for the project comprises of:

a) Hydrographic and Hydomorphological Survey and Investigations

i. Installation of bench mark pillars
ii. Installation of water level gauges and observations as per TOR
iii. Bathymetric & Topographic Survey
iv. Current velocity and discharge measurements
v. Collection of water & bottom samples and analysis as per TOR
vi. Collection of Topographical features.
vii. Survey chart preparation

b) Traffic Survey
c) Geotechnical investigations
d) Environmental & social impact assessment
e) Analysis of collected data and preliminary engineering design
f) Scheduling and costing
g) Economic & Financial analysis for assessment of techno economic feasibility
h) Conclusion and recommendations.

The scope of work mentioned above, under Hydrographic and hydromorphological survey was covered in the Hydrographic Survey Charts and Report, submitted as part of first deliverable under Stage-II of the project. The compliance statement of Detailed project report covering the remaining scope of work as per TOR is provided as below:

Sr. No.	Section – 6 Terms of Reference Clause No. 1.2	Covered under Chapter No./ Title
1.0	Assessment of Hydrographic Survey Report	Chapter 2: Waterway/Detailed Hydrographic Survey
2.0	Traffic Survey	Chapter 4: Traffic Study
3.0	Geotechnical investigations	Chapter 5: Terminals & Volume –IV: Geotechnical Investigation Report
4.0	Environmental & Social impact assessment	Chapter 9: Environmental and Social Aspects
5.0	Analysis of collected data and preliminary engineering design	Chapter 6: Preliminary engineering Designs
6.0	Scheduling and costing	Chapter 11: Project Costing Chapter 12: Implementation Schedule

Sr. No.	Section – 6 Terms of Reference Clause No. 1.2	Covered under Chapter No./ Title
7.0	Economic & Financial analysis for assessment of techno economic feasibility	Chapter 13: Economic and Financial Analysis
8.0	Conclusion and recommendations.	Chapter 14: Conclusion and Recommendations

The above scope of works shall be executed as per the framework shown below;

Stage-2:
Field Survey & Investigations

- Benchmark Establishment
- Hydrographic survey & Topographic details
- Water level (Guage Measurement)
- Current & Discharge Measurement
- Water & Soil samples
- Traffic Surveys
- Geotechnical Surveys

Stage-2:
Project Studies

- Analysis of Hydrographic survey data & existing infrastructure
- Traffic studies, Vessel analysis & dredging
- Proposed location for terminals/ports loading and unloading terminals
- Environmental Impact studies
- Fairway design, Navigational Aids and communication facilities
- River training, shore/bank protection measures
- Location requiriong detailed geotechnical investigations
- Preliminary design of proposed facilities & infrastructure, alternatives
- BOQ and Cost Estimation
- Financial & Economic analysis

1.4 BRIEF METHODOLOGY & APPROACH

The stretch of waterway, recommended for DPR studies is surveyed and studied in detail for techno-economic development of IWT along the proposed stretch.

Detailed hydrographic, hydro morphological survey and investigations, traffic, environment and social survey is done out along the stretch. The data collected from survey is further analysed in detail for design of waterway, estimating of dredging quantity and finalising location and type of jetties/terminals required along the waterway. On the basis of DPR level design and drawings, cost estimate, financial and economic evaluation is done. The techno-economic viability of IWT development along the proposed stretch is assessed and concluded in the report.

A detailed DPR methodology and the expected outcome in fulfilling the assignment are presented as below:

1.4.1 Classification of Waterways

For safe plying of self- propelled vessels up to 2000 tonne Dead Weight Tonnage (DWT) and tug-barge formation in push tow units of carrying capacity up to 8000 tonne, National waterways can be classified in the following categories as suggested by IWAI:

Table 1: Classification of National Waterway -Rivers

Class of Waterway	Depth (m)	Bottom Width (m)	Bend Radius (m)	Vertical Clearance (m)	Horizontal Clearance Between Piers (m)	Self propelled vessel Carrying Capacity
CLASS-I	1.2	30	300	4	30	100 tonne Dead Weight Tonnage (approx. size 32m overall length, 5m moulded breadth and 1.0m loaded draft or one tug and two barges combination of 200 tonne Dead Weight Tonnage (approx. size 80m overall length, 5m moulded breadth and 1.0m loaded draft).
CLASS-II	1.4	40	500	5	40	300 tonne Dead Weight Tonnage (approx. size 45m overall length, 8m moulded

Class of Waterway	Depth (m)	Bottom Width (m)	Bend Radius (m)	Vertical Clearance (m)	Horizontal Clearance Between Piers (m)	Self propelled vessel Carrying Capacity
						breadth and 1.2m loaded draft or one tug and two barges combination of 600 tonne Dead Weight Tonnage (approx. size 110m overall length, 8m moulded breadth and 1.2m loaded draft).
CLASS-III	1.7	50	700	6	50	500 tonne Dead Weight Tonnage (approx. size 58m overall length, 9m moulded breadth and 1.5m loaded draft or one tug and two barges combination of 1000 tonne Dead Weight Tonnage (approx. size 141m overall length, 9m moulded breadth and 1.5m loaded draft).
CLASS-IV	2.0	50	800	8	50	1000 tonne Dead Weight Tonnage (approx. size 70m overall length, 12m moulded breadth and 1.8m loaded draft or one tug and two barges combination of 2000 tonne Dead Weight Tonnage (approx. size 170m overall length, 12m moulded breadth and 1.8m loaded draft).
CLASS-V	2.0	80	800	8	80	1000 tonne Dead Weight Tonnage (approx. size 70m overall length, 12m moulded breadth and 1.8m loaded draft or one tug and two barges combination of 4000 tonne Dead Weight Tonnage (approx. size 170m overall length, 24m moulded breadth and 1.8m loaded draft).
CLASS-VI	2.75	80	900	10	80	2000 tonne Dead Weight Tonnage (approx. size 86m overall length, 14m moulded

Class of Waterway	Depth (m)	Bottom Width (m)	Bend Radius (m)	Vertical Clearance (m)	Horizontal Clearance Between Piers (m)	Self propelled vessel Carrying Capacity
						breadth and 2.5m loaded draft or one tug and two barges combination of 4000 tonne Dead Weight Tonnage (approx. size 210m overall length, 14m moulded breadth and 2.5m loaded draft).
CLASS-VII	2.75	100	900	10	100	2000 tonne Dead Weight Tonnage (approx. size 86m overall length, 14m moulded breadth and 2.5m loaded draft or one tug and two barges combination of 8000 tonne Dead Weight Tonnage (approx. size 210m overall length, 28m moulded breadth and 2.5m loaded draft or with higher dims).

In addition to the above, IWAI also given guidelines regarding vertical clearances with respect to transmission lines for National waterways as below:

Type of Transmission Lines	Vertical Clearance
Low voltage transmission lines including telephone lines	16.5
High voltage transmission lines, not exceeding 110 kilo volt	19.0
High voltage transmission lines, exceeding 110 kilo volt	19.0
	+1 centimetres extra for each additional 1 kilovolt

Also:

a) Waterway side slopes should be kept as 1(V): 5(H);

b) Minimum depth of channel should normally be available for about 330 days of the year;

c) Vertical clearance at cross structure over the waterway should be available at least in central 75% portion of each of the spans in entire width of the waterway;

d) For rivers, vertical clearance should be kept over Navigational High Flood Level (NHFL), which is the highest flood level at a frequency of 5% in any year over a period of last twenty years.

1.4.2 Measures to Improve the Depth

The basic parameters considered for the fairway design are:

- Depth
- Width
- Side slopes
- Bends

As explained above, as the classification of waterways in India is based on the experience gained in various waterways, the characteristic features of the design waterways based on studies carried out by IWAI are furnished below and the same shall be followed.

Fairway Design

The fairway depth should be good enough to ensure steerability of the vessel and to prevent bottom feel. To meet this requirement, the minimum depth that is needed in a channel would commonly be the sum of the draught (draft) of the vessel and other tolerance factors. The tolerance factors to be considered are listed as:

- Factor of keel clearance to avoid touching of the vessel to the ground and minimum free water below the keel for maintaining control on manoeuvring,
- Wave tolerance for the heaving and pitching of the vessel due to wave motion,
- Squat, increase of draft due to ship motion,
- Tolerance for siltation and dredging,
- Increase of draught due to trim and heaving due to unequal loading and steering manoeuvre respectively, and
- Tolerance for the change of draught during the transition from salt water to fresh water.

The keel clearance factor is the prime concern of the all tolerance factors considered. As per the standards laid down by German Code of practice (EAU 80), a 0.3 m layer of water column below the keel of the loaded ship is sufficient for free manoeuvrability of the vessel.

IWAI's experience in inland waterways in India and sub-continent (Bangladesh and Myanmar) shows that the under keel clearance for free manoeuvrability of the vessel varies between 0.2 and 0.5 m depending upon the soil characteristics of the channel bed and other parameters.

Width of a Channel

The total width of a navigation waterway (W) in general is expressed in terms of a beam of a vessel (B). The design width for the proposed two-way navigation can be obtained as:

W = BM + BM1 + C + 2C1

Where: W = Navigation channel width for two-way navigation.

BM = Maneuvering zone for the design vessel which takes into account the directional stability of vessel.

BM1 = Maneuvering zone for the upcoming vessel which takes into account the directional stability of vessel.

C = Width of separating zone.

C1 = Width of the security area, between the maneuvering zone and the channel side which is accounted for environmental and human factors including bank suction.

Values recommended by various authorities for the above equation vary within wide limits. Some of the recommended values are presented here:

BM = 1.3 B to 3.0 B
BM = BM1
C = 0.5 B to 1.0 B
C1 = 0.3 B to 1.5 B
Where, B = Beam of a design vessel.

Based on the experience and recommendations of experts on Inland Waterways, the factors considered for the present design are:

BM = 1.8 B
BM = BM1
C = 0.5 B
C1 = 0.5 B

The designed channel width = 1.8B+1.8B+0.5B+2x0.5B for two way navigation at draft level = 5.1B. The bottom width of the channel for two-way navigation for the design vessel can generally be considered as 5 x B.

Slopes

The selection of slope is in accordance with the soil characteristics of the bed and banks, width of the waterway etc. The adopted channel slope shall be 1:5

Width Allowance at Bends

In bends, the width of the fairway should be more than the width of the canal that is designed for a straight reach to allow for a drift of the vessel in a curved portion of the waterway. It means that the vessel occupies a greater width in bends than in a straight stretch of the waterway. The drift of the vessel depends on the radius of the bend, the speed of the vessel, wind forces, the flow pattern and the loading of the vessel. The drift angle is larger for vessels traveling in the downstream than the upstream direction. The drift angle is inversely proportional to the bend radius 'R', that is, the larger the radius the smaller the value of drift angle. Unloaded ships normally subjected to more drift and consequently take up a greater width in bends than loaded ships and therefore the proposed allowance at the keel level of the unloaded ships is larger than the loaded ships.

Dredging of Navigational Channel

The dredging quantities for the above design channel shall be worked out based on the bathymetric surveys carried out. The system and different type of navigation marks shall be proposed in the DPR are given as follows:

- Lateral marks, to mark the left and right sides of the navigation route to be followed by navigator;

- Bifurcation marks, to mark the middle ground between the navigation channel, bifurcated channel and isolated dangers in the middle of the navigational channel;
- Shore marks;
- Bank wise marks, to indicate the channel at point where it approaches a bank;
- Crossing marks, to indicated crossing and alignment of the channel from one bank to another;
- Marks of prohibited areas, to indicate no permission of entry;
- Sound signal marks, to indicate use of horning or other sound signals;
- Marks for traffic control, to control up bound or down bound vessel in one way or sequence passage or to prohibit navigation;
- Marks on bridges, to indicate the passage through bridges;
- Depth indicator marks, to indicate shallow areas ahead in the navigation channel;
- Width indicator marks, to indicate the narrow stretches ahead in the navigational channel;
- River training marks, to indicate the ongoing river training works in the river to the navigators.

1.4.3 Identification of IWT Terminals

Site selection is the most important as it decides the investment for establishing the terminal facilities. Hence, proper consideration has to be given to select the most optimum location which will minimise the capital investment and other recurring cost during operation. The selection of suitable site shall be carried out with the view of following considerations:

- Water availability near the terminal land throughout the year especially during lean season;
- Stable river channel with sufficient depth;
- Favourable hydraulic conditions for berthing and cargo handling;
- Availability of terminal land for infrastructure, cargo storage and handling;
- Traffic potential and cargo characteristics; and
- Navigational safety.

The proposed IWT Terminals shall be planned with the following infrastructure facilities for operation:

i) Steel Gangway resting on a floating pontoon. The detailed engineering & design of gangway arrangement shall be carried out during the construction stage. The preliminary layout drawing shall be proposed in the DPR;
ii) Administration Building and Bank protection arrangement;
iii) Covered Storage Shed/Transit Shed;
iv) Open storage area;

v) Security Shed;

vi) Forklift Trucks, Pay loaders & Dumper tracks; and

vii) Weigh Bridge, Watch and ward, Compound wall, Firefighting arrangement, Electrical & PH Facilities including DG.

The terminal shall be proposed with suitable mooring facilities, firefighting water line, water supply pipeline, power line for shore connection to barges, fenders etc. Preliminary planning and master plan shall be prepared in the DPR stage as per the relevant IS codes. It is envisaged and proposed that to the extent possible, all shore/river bank based buildings / godown are prefabricated, pre-engineered type conforming to the best standards in vogue in logistic / supply chain industry.

Other Alternatives to Improve for Navigation

Based on our earlier study for Ganga River between the reach from Allahabad to Ghazipur, there are many methods available to improve river navigation. Bandalling work – it has to follow closely falling stage of river, closing minor channels and diverting river flow in single channel to increase depth in the navigable channel in mainly due done by bandalling. In some reaches this method becomes successful but some river stretches remain shallow and need other training measures including dredging. Channelization of river and Construction of barrages at suitable locations, creating ponding conditions with required depth and navigational locks for ships and vessel movement shall be studied. The examination of various options/measures to improve the water depth shall be studied. The most suitable method for development shall be identified with consideration on the likely morphological, sediment transport, and dredging aspects of different options. This task is expected to be fed back into from the financial and economic analysis providing refinement to the proposed development until a recommended solution is reached. The most appropriate type of river development including drudging option along the river shall be identified and likely impacts of these developments on river flow depths as well as sedimentation and morphology shall be investigated. This analysis will constitute an iterative process in which problems relating to LAD will be addressed to find more successful solutions where necessary. This will however, not be an open-ended process as the assessment of techno-economic feasibility updation only requires an indication of the likely costs of building and maintaining the structures which are shown to support achievement of LAD as intended.

1.4.4 Concept Design and Cost Estimates

Preliminary Design shall be performed for all the structures /developmental works proposed as per the above analysis and mathematical model studies carried out conforming to relevant IS Codes. Design drawings shall be prepared and submitted based on the preliminary design. Bill of quantities and cost estimates shall be prepared for all the proposed structures / developmental works. Based on the cargo potential and other considerations necessary for locating an IWT terminal, extent of land required for setting up of IWT terminals and other suitable locations shall be identified. Preliminary topographic survey shall be carried out and layout plan for all suggested locations shall be prepared clearly indicating all facilities e.g. jetty, approach to jetty, bank protection, covered and open storage, roads, office, sentry hut, boundary wall, bank protection, bunkering facility, water facility, turning circle for IWT vessels location of depth contours of 2m and 2.5m in the river near the terminal sites. Preliminary engineering design and drawings for setting up of terminals with related facilities including mechanical loading/ unloading at the proposed sites shall be prepared. Also inter modal cargo transfer facilities required at these terminals shall be indicated.

1.4.5 Financial and Economic Analysis

Financial and economic analysis through FIRR and EIRR of the project including SWOT analysis shall be carried out for the project. For the Financial Internal Rate of Return shall be computed as follows:

- Costs shall be calculated as total capital investment for the Project components, net rate of interest charges during construction and operations & maintenance costs for the Project;
- Income flows shall be calculated based on gross revenues of projected goods to be transported through private operators with permissible assumptions such as project life etc.;
- Economic Internal Rate of Return shall be computed taking into account the following factors;
- The assumed life of the project as per norms;
- Costs shall be calculated as Government contribution and other sources. A standard conversion factor shall be used to reduce financial costs to economic costs;
- Benefits shall be estimated as Government revenues, calculated as net profit share, royalties and tax;
- Social Benefits like fuel saving, reduction in environment pollution and carbon emission, accident reduction, decongestion of rail and roads, etc.

The financial viability and sustainability of this project depend upon the adaptation to the prevailing context in which they operate. In working out the Financial Viability and sustainability, the following factors shall be considered.

- budgeting and cost accounting systems,
- resource mobilization for capital investments,

- cost recovery and operational financing,
- cost reduction and control.

The Profitability projections and financial analysis for each of the project components shall be worked out in detail and presented in the report. The financial statements shall be prepared on the basis of the suitable assumptions. The cost benefit analysis for the proposed project shall be calculated. IRR and preliminary expenses shall be suitably considered and estimated. Break-even analysis shall be performed and presented in the report.

2.0 WATERWAY / DETAILED HYDROGRAPHIC SURVEY

2.1 HYDROGRAPHIC SURVEY

As detailed above, the National Waterway stretch of Ichamati river under DPR study is from Bansjhari Mallikpur at Lat 22°39'6.71"N, Long 88°55'33.35"E to Kalanchi at Lat 22°53'53.79"N, Long 88°53'53.94"E. The total length of this stretch is about 63.381 Km. The scope of the work to conduct hydrographic and topographic survey of this stretch of Ichamati waterway comprises of:

- Undertake bathymetric and topographic survey of proposed waterway
- Establishing horizontal and vertical control stations.
- Construction of benchmark pillars and establishing its reduced level w.r.to Mean Sea Level.
- Transfer of sounding Datum.
- Setting up and deployment of water level gauges.
- Current velocity and discharge measurements.
- Collection and analysis of water and bottom samples.
- Collection of topographic features including existing cross structures.
- Preparation of inventory of industries in the project influence area (PIA).
- Analysis of survey data, including assessment of water availability for navigation.
- Preparation of survey charts and report.
- Geotechnical Investigations at proposed new Jetty/ Terminal locations.

2.1.1 Waterway in General and Hydro-Morphological Characteristics

Ichamati River is a trans-boundary river which flows through India and Bangladesh and also forms the boundary between the two countries. The river is facing the problem of siltation leading to thin flow of water in the dry season and floods in the rainy season. Experts are handling the situation and remedial matters are being discussed between the governments of India and Bangladesh. Ichamati River flows in three parts: (1) The longer part flows from the Mathabhanga River, a distributary of the Padma, and after flowing for 208 kilometres joins the Kalindi River near Hasnabad in North 24 Parganas and Debhata in Satkhira District (2) Once the main river west of Dhaka and (3) Ichamati of Dinajpur. According to a number of hydrologists, the three Ichamati Rivers, in the past, were a single channel. The second river marked above originates south of Jafarganj opposite to the mouth of the Hoorsagar and runs towards Joginighat in Munshiganj. Joginighat is situated at the confluence of the Jamuna and the Ichamati.

The proposed 63.381 Km stretch of Ichamati waterway is located in the North 24 Parganas district of West Bengal. Whole stretch of Ichamati waterway is having tidal influence with a maximum tidal variation of 4.013 m to a minimum tidal variation of 0.39 m.

River width in the waterway stretch varies from 400 m to 30 m. Maximum and minimum reduced depth of the waterway with respect to sounding datum is 8.4m and -3.36m respectively, for proposed waterway Class III. Average flow velocity in the waterway varies from 0.8 m/sec to 0.5 m/sec. Reduced depth at every 1 Km intervals for full stretch of the river are provided in **Annexure 2**.

2.1.2 Existing Hydrological / Topographical Reference levels

There was no GTS Station available near the survey area. As per IWAI guidelines, a 4 hour observation was carried out simultaneously at RM -06 and IM-01 and thereafter simultaneous 4 hour observation were carried out at IM-02, IM -03, IM-04, IM-05, IM-06 & IM-07 BM's and data was logged in rinex format which was post processed in Auspos and Spectra software and value of BMs w.r.t. MSL were obtained.

Also sounding datum was transferred from Sagar Roads at IM-01, IM-03, IM-05 and IM-07. SD for IM 02 was transferred from IM-01, IM-04 from IM-03, and IM-06 from IM-05. The 63.381 Km stretch of Ichamati waterway was divided into 10 km stretches for ease of applying Tidal level corrections to the collected bathymetric data. The values of BM's w.r.t sounding datum were established by using few hour observation methods in accordance with Admiralty Manual of Hydrographic Surveying Vol 2. Seven (07) number of BM's pillars (naming IM-01, IM-02, IM -03, IM-04, IM-05, IM-06 & IM-07) were constructed and erected along the river from Bansjhari Mallikpur to Kalanchi.

The Final accepted WGS 84 coordinates and details of Benchmarks established during the conduct of survey are provided in **Table 2**.

Table 2: Description of Bench Marks

BM	Location	Chainage	Latitude (N)	Longitude (E)	Easting (m)	Northing (m)	Height above SD (m)	SD w.r.t MSL	Height above MSL (m)
IM-01	Itinda ghat	2.97	22°40'26.64"	88°54'38.51"	696304	2508702	7.504	-2.252	5.252
IM-02	Tapachar	9.84	22°40'30.30"	88°51'25.43"	690791	2508745	6.196	-2.254	3.942

BM	Location	Chainage	Latitude (N)	Longitude (E)	Easting (m)	Northing (m)	Height above SD (m)	SD w.r.t MSL	Height above MSL (m)
IM -03	Fatullapur	19.53	22°42'52.52"	88°48'34.31"	685853.1	2513059	4.918	0.207	5.125
IM -04	Mediya	31.41	22°44'08.67"	88°50'19.03"	688812.5	2515438	5.305	0.207	5.512
IM -05	Tentulia	39.94	22°47'10.16"	88°51'06.94"	690109.6	2521038	4.542	1.627	6.169
IM -06	Gopalpur	48.7	22°49'07.17"	88°50'53.94"	689693.7	2524633	3.054	1.531	4.585
IM -07	Tarunipur	61.81	22°53'24.54"	88°52'47.43"	692829	2532590	1.774	1.948	3.722

2.1.3 Sounding Datum and Reduction details

Sounding Datum was transferred at all the newly established BM's using values obtained from Sagar Roads. Standard method was adopted for transfer of datum for tidal reach areas as per Admiralty Manual. Details of Sounding Datum (SD) and reduction details are provided in **Table 3** as below:

Table 3: Details of Sounding Datum

Sl. No	Location of Bench Mark / tide gauges	Chainage (Km)	Stretch for corrected soundings and topo levels (Km)	Established Sounding Datum w.r.t. MSL (m) at col. A. (+ve indicates above MSL, -ve indicates below MSL)	Sounding Datum of Tide Gauge w.r.t. MSL (m)	Correction in WL data for Bathymetric survey (m)	Topo level data to be converted as depth for volume calculation wrt SD (m)
	A	B	C	D	E	F = (E- WL data in MSL)	G = ((E- topo levels in MSL)
1	Itinda ghat	2.97	0.0 to 10.0	-2.252	-2.252	Tide Applied	2.252
2	Tapachar	9.84	10.1 to 20.0	-2.254	-2.254		2.254

Sl. No	Location of Bench Mark / tide gauges	Chainage (Km)	Stretch for corrected soundings and topo levels (Km)	Established Sounding Datum w.r.t. MSL (m) at col. A. (+ve indicates above MSL, -ve indicates below MSL)	Sounding Datum of Tide Gauge w.r.t. MSL (m)	Correction in WL data for Bathymetric survey (m)	Topo level data to be converted as depth for volume calculation wrt SD (m)
	A	B	C	D	E	F = (E- WL data in MSL)	G = ((E- topo levels in MSL)
3	Fatullapur	19.53	20.1 to 30.0	0.207	0.207	w.r.t SD	0.207
4	Mediya	31.41	30.1 to 40.1	0.207	0.207		0.207
5	Tentulia	39.94	40.1 to 50.0	1.627	1.627		1.627
6	Gopalpur	48.70	50.1 to 60.0	1.531	1.531		1.531
7	Tarunipur	61.81	60.1 to 63.381	1.948	1.948		1.948

2.2 EXISTING CROSS STRUCTURES

2.2.1 Bridges

There are total three completed road bridges and one under construction road bridge in the entire survey stretch of Ichamati River. The details of the existing Bridges and crossings over waterways are provided in **Table 4** below.

Table 4: Details of Bridges

Sr. No.	Structure Name and for road / rail	Chainage (km)	Type of Structure (RCC / Iron / Wooden)	Location	Position (Lat/Long)		Position (UTM)			Width (m)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	Vertical clearance w.r.t. HFL / MHWS (m)	Remarks (complete / under-construction), in use or not, condition
					Left Bank	Right Bank	Left Bank	Right Bank	Length					
1	Itinda Bridge	7.41	RCC	Itinda (Bbashirhaat)	22°39'58.62" 88°52'23.40"	22°39'50.02" 88°52'25.90"	692458.22, 2507791.85	692532.61, 2507527.21	288.02	10.31	7	38.45	0.99	Complete
2	Bongaon bridge	21.91	RCC	Bongaon	22°44'6.55" 88°48'19.94"	22°44'2.35" 88°48'31.01	685415.13, 2515331.21	685732.51, 2515205.72	354.12	13.11	Under construction	Under construction	Under construction	Under construction
3	Tentulia bridge	40.05	RCC	Tentulia	22°47'16.79" 88°51'4.98"	22°47'12.85" 88°51'10.86"	690051.20, 2521241.88	690220.72, 2521122.78	211.30	11.23	4	43.40	1.73	Complete
4	Kalanchi Bridge	63.0	Iron	Kalanchi	22°53'52.3627"N,7 6°53'47.0677"E	22°53'48.2331"N 076°53'49.8011"E	2533467.86, 694517.5827	2533341.831, 694597.1204	150 m	4	2	44	3.54	Complete

Note: - The value of MHWS and Mean Sea Level was taken from KPT Tide book for the Standard Port i.e Sagar Roads and same was applied at the site. From field observation Bridge clearance over MSL was obtained and subtracted from the MHWS of the standard port. Thus vertical clearance over MHWS level in those locations was obtained.

2.2.2 Electric Lines / Communication Lines

One (1) no. of high tension line is located along the waterway. The detail of this high tension line is provided **Table 5** in below.

Table 5: Detail of High Tension Lines

Sr. No.	Type of Line	Chainage (KM)	Location	Position (Lat/Long)				Position (UT M)				No. of Piers	Horizontal clearance (clear distance Between piers) (m)	Vertical clearance w.r.t. MHWS (m)	Remarks (complete/ under-construction)
				Left Bank		Right Bank		Left Bank		Right Bank					
1	TRANFORMER	7.41	Itinda	22°39'58.68"	88°52'23.96"	22°39'50.69"	88°52'26.45"	2481224.794	2507793.00	692548.00	2507548.00	4	258.97	4.16	Complete

2.2.3 Pipe Lines / Cables

No cross-structures, pipe lines, underwater cables are located along the entire stretch of waterway.

2.2.4 Dams / Barrages / Locks / Weirs / Anicuts / Aqueducts

No dams, barrage, weir or any other cross structure are located along the entire stretch of waterway.

2.3 BENDS

Few sharp bends are located along the waterway at as detailed below:

Sl. No.	Start Chainage (Km)	End Chainage (Km)	Radius of Curvature (m)
1	3.169	4.38	878.4879
2	8.158	9.03	499.9265

Sl. No.	Start Chainage (Km)	End Chainage (Km)	Radius of Curvature (m)
3	11.360	12.46	444.6012
4	13.065	13.86	345.5895
5	14.704	15.38	348.6368
6	19.014	19.41	273.2141
7	20.343	21.26	994.3599
8	21.696	22.13	431.6537
9	22.927	23.22	207.9574
10	24.230	24.80	249.2338
11	25.866	26.18	130.8188
12	26.823	27.42	230.5941
13	28.884	29.06	111.3852
14	30.234	30.51	125.153
15	31.931	32.11	132.0846
16	34.000	34.25	117.5966
17	35.809	36.00	111.447
18	41.143	41.30	90.0757
19	43.110	43.26	67.2431
20	44.349	44.62	179.382
21	46.107	46.33	137.1459
22	48.776	49.00	102.1316
23	49.759	49.95	156.0727
24	51.759	52.09	241.8854
25	53.123	53.21	119.12
26	53.827	53.97	222.1517
27	55.613	56.29	566.2156
28	58.400	58.85	528.9532

However, as the proposed fairway on Ichamati for IWT is proposed to connect both river banks at Itinda and Basirhat ghat. Hence, the fairway alignment is nearly a straight line

2.4 VELOCITY AND DISCHARGE DETAILS

Current meter observation was carried out at each location at required depths using virtual ware Current meter. The observations were carried out at the deepest route of the channels. Discharge calculations are from the observed data. The current meter and discharge details are provided in **Table 6**.

Table 6: Current Meter and Discharge Details

Stretch No.	Chainage (Km)	Position				Observed Depth (m)	Velocity (m/sec.)			Average Velocity (m/sec.)	Area (sq. m.)	Discharge (cu. m)
		Latitude	Longitude	Easting (m)	Northing (m)		Surface	0.5 D	0.8 D			
1	3	22°40'28.36"N	88°54'39.07"E	696319.06	2508754.93	5.3	0.865	0.841	0.801	0.8	205.7	164.56
2	10	22°40'41.7"N	88° 51' 31.1"E	690949.16	2509099.98	5.2	0.802	0.793	0.777	0.8	866.54	693.23
3	19.5	22°42'51.2"N	88°48'32.5"E	685803.27	2513018.77	2.6	0.715	0.723	0.700	0.7	345.12	241.58
4	31.5	22°44'8.44"N	88°50'18.4"E	688796.44	2515430.79	2.2	0.687	0.623	0.601	0.6	26.70	16.02

Stretch No.	Chainage (Km)	Position				Observed Depth (m)	Velocity (m/sec.)			Average Velocity (m/sec.)	Area (sq. m.)	Discharge (cu. m)
		Latitude	Longitude	Easting (m)	Northing (m)		Surface	0.5 D	0.8 D			
5	41	22°47'11.22"N	88° 51'4.52"E	690040.04	2521069.54	2.2	0.680	0.654	0.622	0.7	52.10	36.47
6	48.5	22°49'8.8"N	88°50'4.4"E	689706.92	2524683.54	2.3	0.541	0.511	0.503	0.5	45.12	22.56
7	62.5	22° 53' 24.8"N	88° 52' 50.3"E	692912.409	2532600.430	2.2	0.578	0.525	0.517	0.5	48.03	24.01

2.5 WATERWAY DESCRIPTION

The total 63.381 Km stretch of Ichamati Waterway under DPR study, can be broadly divided in to Six (6) stretches in accordance with the river gradient.

Table 7 below provides the details of sub-stretches of Ichamati waterway.

Table 7: Sub-Stretches of Ichamati Waterway

Sub-Stretch No.	Location		Chainage	
	From	To	From	To
1	Bansjhari Mallikpur	Par Naihati	0 Km	10 Km
2	Par Naihati	Arsula	10 Km	20 Km
3	Arsula	Anarpur	20 Km	30 Km
4	Anarpur	Tentulia	30 Km	40 Km

Sub-Stretch No.	Location		Chainage	
	From	To	From	To
5	Tentulia	Khardda Singa	40 Km	50 Km
6	Khardda Singa	Kalanchi	50 Km	63.381 Km

Detail descriptions of each sub-stretch are provided in below sections.

2.5.1 Sub Stretch 1: From Bansjhari Mallikpur to Par Naihati (Chainage 0 Km to 10 Km)

Bathymetric and Topographic Survey was carried out for Sub-Stretch 1 (Chainage 0 Km to 10 km) of Ichamati river. The starting Chainage of waterway is very close to the India – Bangladesh border and it moves upstream. This sub-stretch of waterway is fairly wide in the initial stages at about 450 m but it gradually reduces to about 150m as we move upstream towards Par Naihati. Also, the river bank is protected at some sections in this sub-stretch. There are also many brick factories on both the banks in this sub-stretch. Ferry services run from Itinda Ghat jetty and have a load of about 4000 person per day.

Following are the observations made during survey of Sub-stretch 1: From Bansjhari Mallikpur to Par Naihati (Chainage 0 Km to 10 Km)

- A RCC road bridge exists at Itinda and electric cables also cross over at this stretch at chainage and there are no other overhead obstructions/crossovers in this section.
- No Prominent dams & Barrage available in this stretch.
- The tidal range is about 4m in this stretch from Chainage 0.0Km to 10Km.
- There is no hindrance or encroachment in this stretch.

Figure 2: Google Image showing Sub-Stretch -1 of Ichamati Waterway

Figure 2 above shows the alignment of Sub-stretch 1 (Ch. 0.0 Km to 10.0 Km) of Ichamati Waterway. The quantity of dredging required for Class II, III and IV type of WW, for this stretch is provided in **Table 8**. **Figure 3** shows the observed and reduced bed profile of sub-stretch 1.

Table 8: Dredging Quantity (cum) for Sub-Stretch 1

Class	Chainage (km)		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)
II	0	10	Not Applicable (Tidal Zone)				-1.99	8.7	9017	419762.6
III	0	10					-1.99	8.7	9403	674184.2
IV	0	10					-2.01	8.85	9488	847230.2

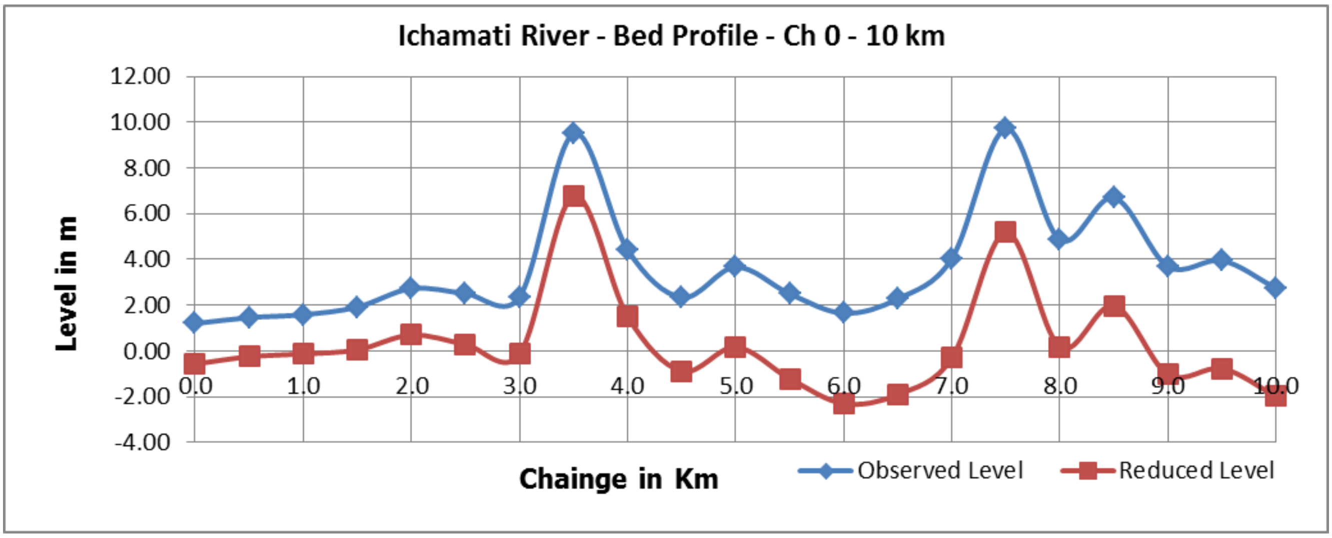

Figure 3: Bed Profile of Waterway Sub-Stretch 1 (Chainage 0Km – 10Km)

	
Itinda Road Bridge	**HT Line Crossing at Itinda**

Figure 4: Photographs of Sub-Stretch 1

2.5.2 Sub Stretch 2: From Par Naihati to Arsula (Chainage 10 Km to 20 Km)

Both Bathymetric and Topographic Survey was carried out for this sub-stretch 2 (Chainage 10 Km to 20 Km) of the Ichamati waterway. There is a shallow patch of approximately 500 m length near Chaura, where bathymetric survey was not possible during normal flow conditions, however, navigation is possible during high tide near to the river right bank. There are many brick factories on both the banks in this sub-stretch 2. Fishing and rice farming are main source of livelihood & the fields in this area are dependent on the rainfall. This stretch is much narrower as compared to sub stretch 1 and average width is about 300m with some portion of the river bank as protected.

Following are the observations made during survey of Sub-stretch 2: From Tutabedria to Anantpur (Chainage 10 Km to 20 Km):

- There are no overhead obstructions/crossovers or hindrance or encroachment in this stretch.
- There are no cross-structures like dams, barrage, weirs etc. available in this stretch.

The tidal range is 2.5 m in this stretch from Chainage 10.0Km to 20Km

Figure 5 below shows the alignment of Sub-stretch 2 (Ch. 10.0 Km to 20.0 Km) of Waterway.

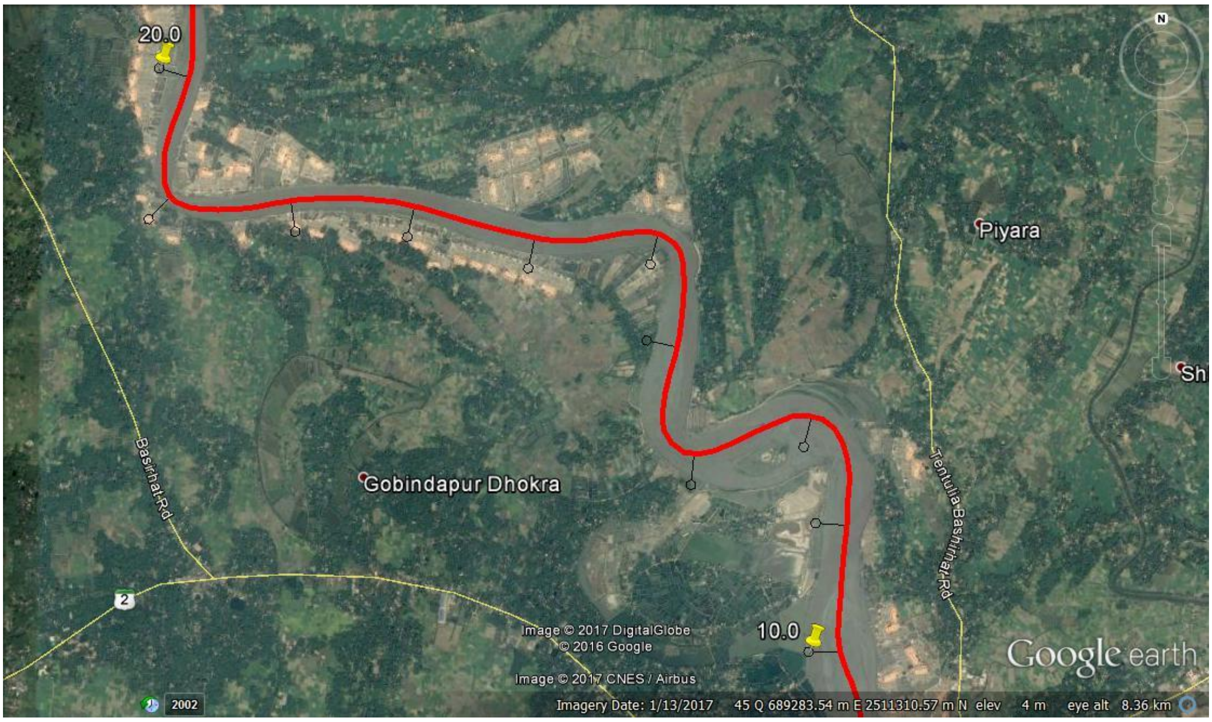

Figure 5: Google Image showing Sub-Stretch -2 of Waterway

The quantity of dredging required for Class II, III and IV type of WW for this stretch is provided in **Table 9**. **Figure 6** shows the observed and reduced bed profile of sub-stretch 2.

Table 9: Dredging Quantity (cum) for Sub-Stretch 2

Class	Chainage (km)		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)
II	10	20	Not Applicable (Tidal Zone)				-3.34	1.41	10000	1697807
III	10	20					-3.35	1.41	10000	2290603
IV	10	20					-3.44	1.41	10000	2559080

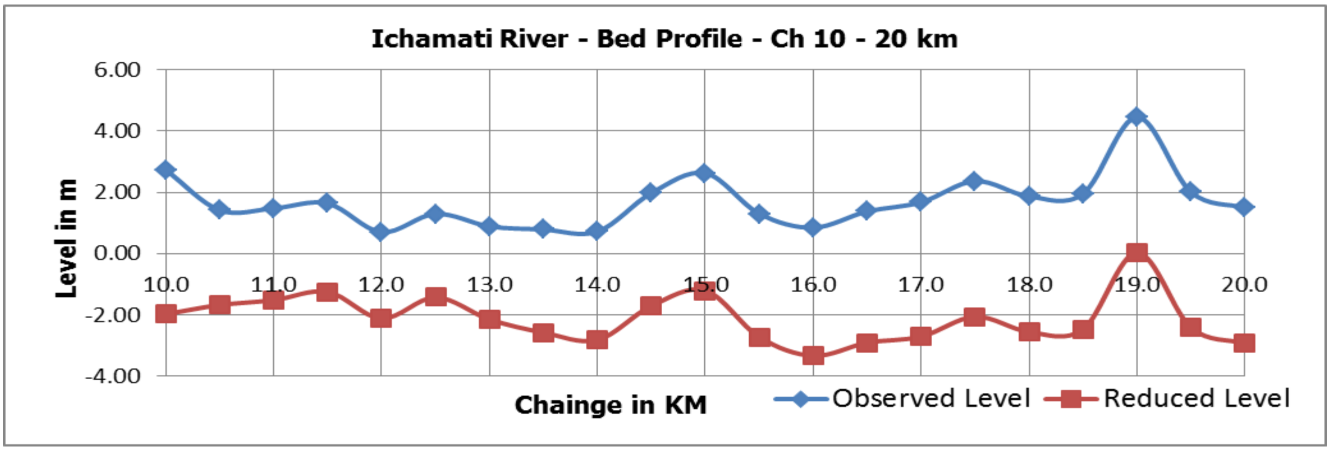

Figure 6: Bed Profile of Waterway Sub-stretch 2 (Chainage 10Km – 20Km)

	
Unprotected River Bank	**Dense Mangroves**

Figure 7: Photographs of Sub-stretch 2

2.5.3 Sub Stretch 3: From Arsula to Anarpur (Chainage 20 Km to 30 Km)

Bathymetric and Topographic Survey was carried out for this sub-stretch 3 (Chainage 20 Km to 30 Km) of Ichamati river. The water depth is less as compare to stretch 2. River banks are partially protected. Soil erosion found at some areas. There are also many brick factories on both the banks. Fishing and rice farming are main source of livelihood & the fields in the area are dependent on the rainfall .This stretch is narrow at about 80-100 m width with sharp curves in the river flow at Kankrasuti and some portion of the river bank is protected. Following are the observations made during survey of Sub-stretch 3: From Arsula to Anarpur (Chainage 20 Km to 30 Km):

- A RCC road bridge is under construction at Bongaon and there are no other overhead obstructions/crossovers or hindrance or encroachment in this stretch.
- There are no cross-structures like dams, barrage, weirs etc. available in this stretch.
- The tidal range is 2.32 m in this stretch from Chainage 20Km to 30Km.
- There are no ferry jetties available in this stretch however fishermen use the natural slope of the ground for landing the boats.

Figure 8 above shows the alignment of sub-stretch 3 (Ch. 20.0 Km to 30.0 Km) of Waterway. The quantity of dredging required for Class II, III and IV type of WW, for this stretch is provided in **Table 10**.

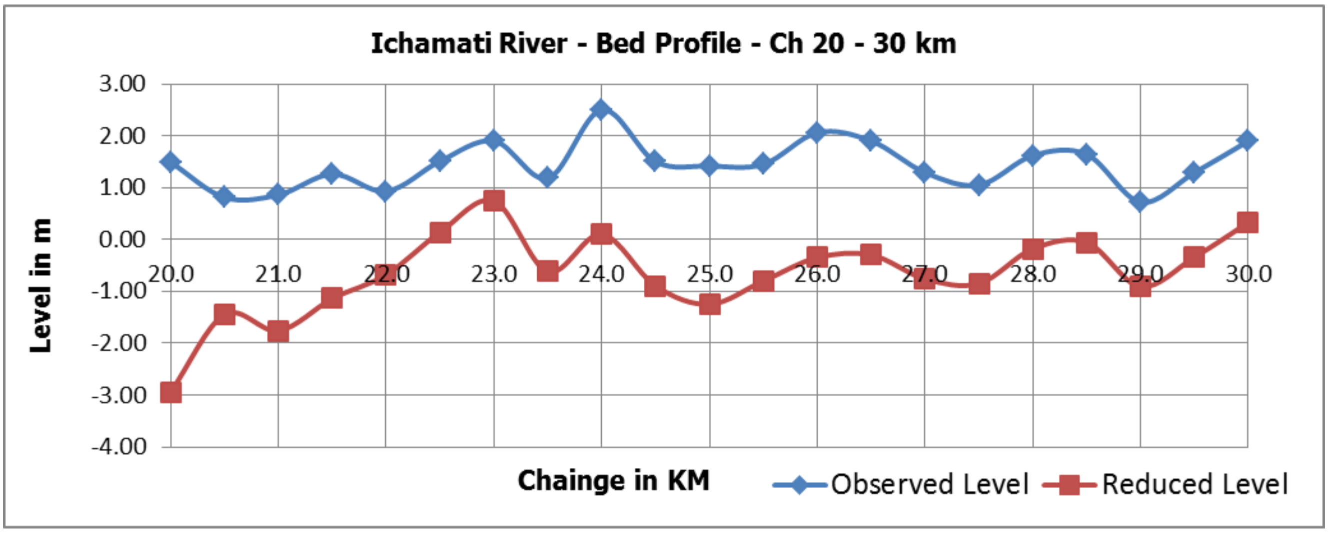

Figure 9 shows the observed and reduced bed profile of sub-stretch 3.

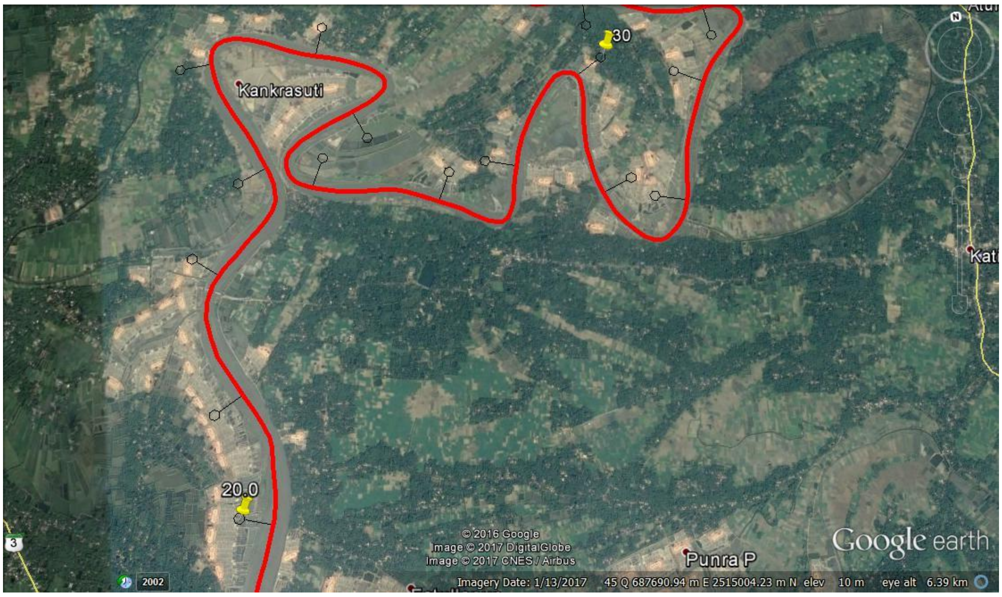

Figure 8: Google Image showing Sub-Stretch -3 of Waterway

Table 10: Dredging Quantity (cum) for Sub-Stretch 3

Class	Chainage (km)		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)
II	20	30	Not Applicable (Tidal Zone)				-2.72	0.87	10000	1088047
III	20	30					-2.82	0.87	10000	1524191
IV	20	30					-2.93	0.87	10000	1748574

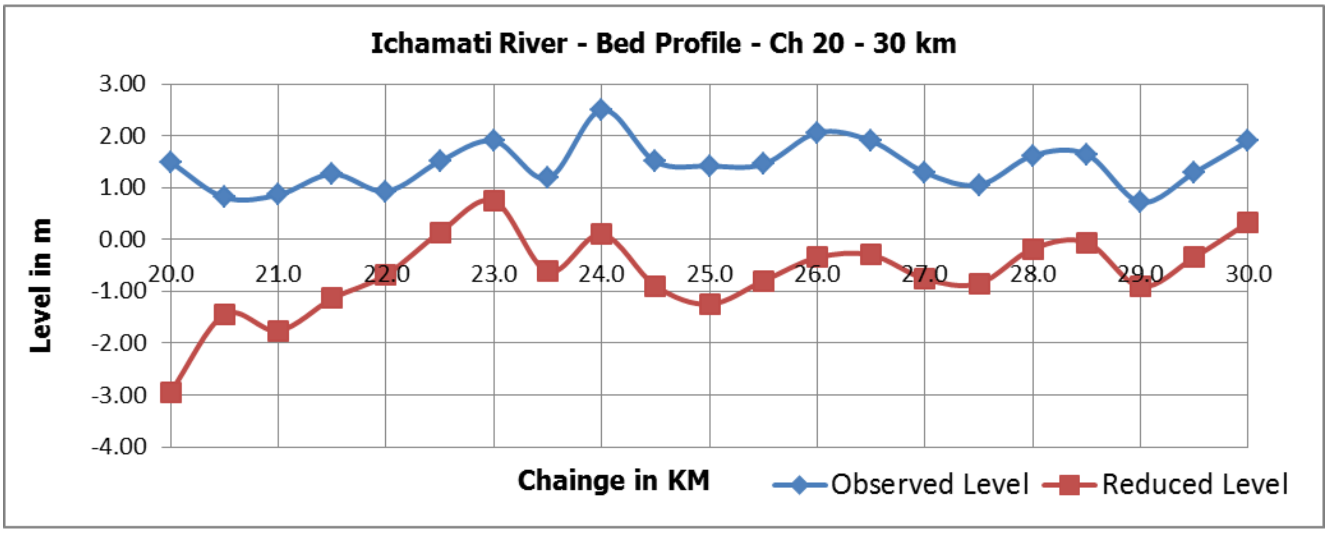

Figure 9: Bed Profile of Waterway Sub-stretch 3 (Chainage 20Km – 30Km)

	
Under Construction bridge at Bongaon	**Soil Erosion**

Figure 10: Photograph along Sub-Stretch 3

2.5.4 Sub Stretch 4: From Anarpur to Tentulia (Chainage 30 Km to 40 Km)

Bathymetric and Topographic Survey was carried out for this sub stretch 4 of Ichamati River from Chainage 30 Km to 40 Km. There is shoal of approximately 8Km in this stretch. The area is sparsely populated.

The stretch is considerably narrow at about 60-80 m with large portion of the river bank being unprotected.

Following are the observations made during survey of Sub-stretch 4: From Anarpur to Tentulia (Chainage 30 Km to 40 Km):

- There are no other overhead obstructions/crossovers or hindrance or encroachment in this stretch.
- There are no cross-structures like dams, barrage, weirs etc. available in this stretch.
- The tidal range is 0.5 m in this stretch from Chainage 30 Km to 40 Km.
- A ferry ghat exists at Media and small boats ply from there however fishermen use the natural slope of the ground for landing the boats.

Figure 11 above shows the alignment of sub-stretch 4 (Ch. 30.0 Km to 40.0 Km) of Waterway. The quantity of dredging required for Class II, III and IV type of WW, for this stretch is provided in **Table 11**. Figure 12shows the observed and reduced bed profile of sub-stretch 4.

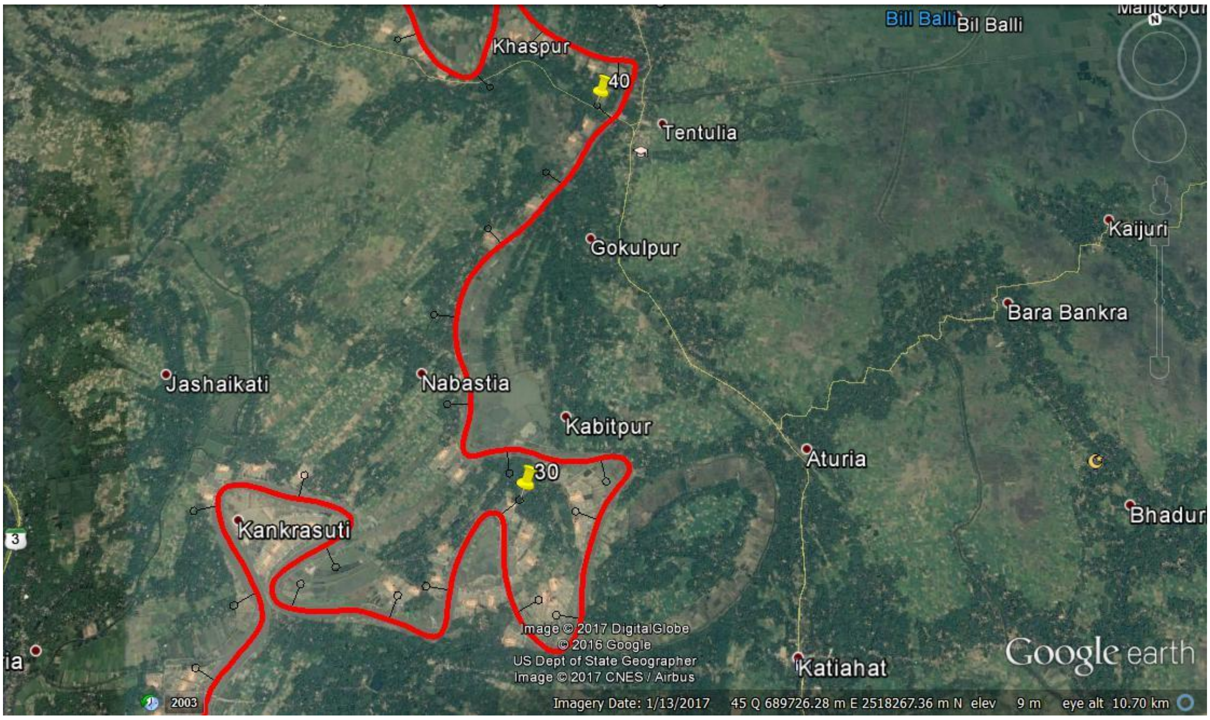

Figure 11: Google Image showing Sub-Stretch -4 of Waterway

Table 11: Dredging Quantity (cum) for Sub-Stretch 4

Class	Chainage (km)		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)
II	30	40	Not Applicable (Tidal Zone)				-2.43	1.45	10000	836514.7
III	30	40					-2.43	1.45	10000	1204362
IV	30	40					-2.44	1.45	10000	1411757

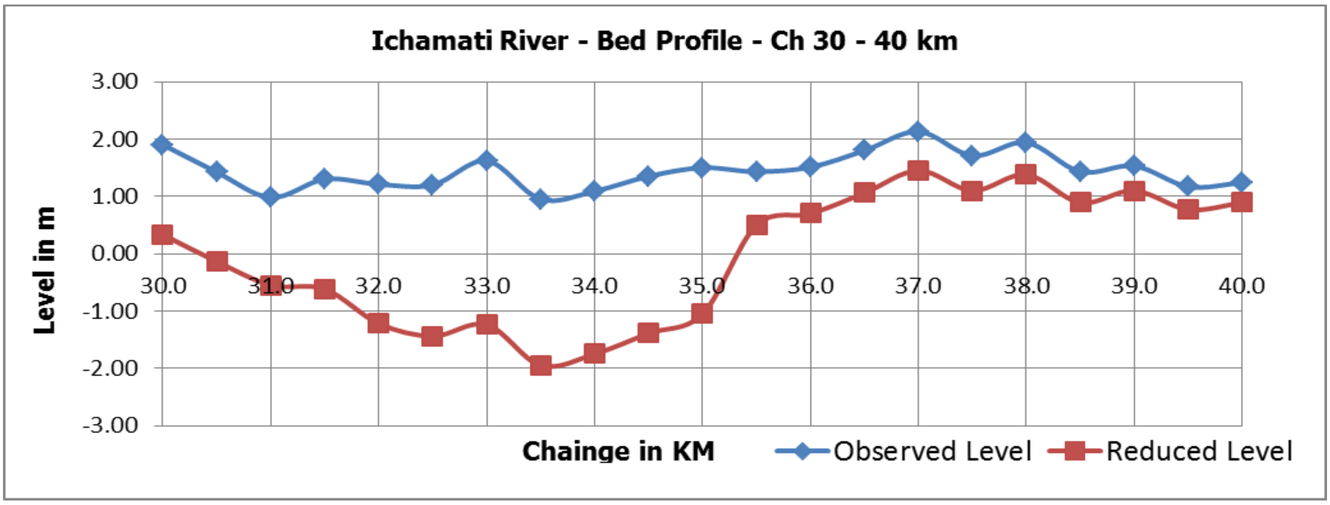

Figure 12: Bed Profile of Waterway Sub-stretch 4 (Chainage 30Km – 40Km)

Brick Kiln

Soil Erosion

Figure 13: Photograph along Sub-Stretch 4

2.5.5 Sub Stretch 5: From Tentulia to Kharddа Singa (Chainage 40 Km to 50 Km)

Bathymetric and Topographic Survey was carried out for this sub stretch 5 of Ichamati River from Chainage 40 Km to 50 Km. There are a few brick kilns located on both the banks of this sub-stretch. Fishing and rice farming are main source of livelihood & the fields in the area are dependent on the rainfall. This stretch is considerably narrow at about 60-80 m with some portion of the river bank as protected. The water depth in this sub-stretch is less as compare to sub-stretch 4 and dredging was seen at a few locations.

Following are the observations made during survey of Sub-stretch 4: From Tentulia to Khardda Singa (Chainage 40 Km to 50 Km):

- A RCC road bridge exists at Tentulia at Chainage 40.5 and there are no other overhead obstructions/crossovers or hindrance or encroachment in this stretch.
- There are no cross-structures like dams, barrage, weirs etc. available in this stretch.
- The tidal range is 1.2 m in this stretch from Chainage 40 Km to 50 Km.
- There are no ferry jetties available in this stretch however fishermen use the natural slope of the ground for landing the boats.

Figure 14 above shows the alignment of sub-stretch 5 (Ch. 40.0 Km to 50.0 Km) of Waterway. The quantity of dredging required for Class II, III and IV type of WW, for this stretch is provided in **Table 12**. **Figure 15** shows the observed and reduced bed profile of sub-stretch 5.

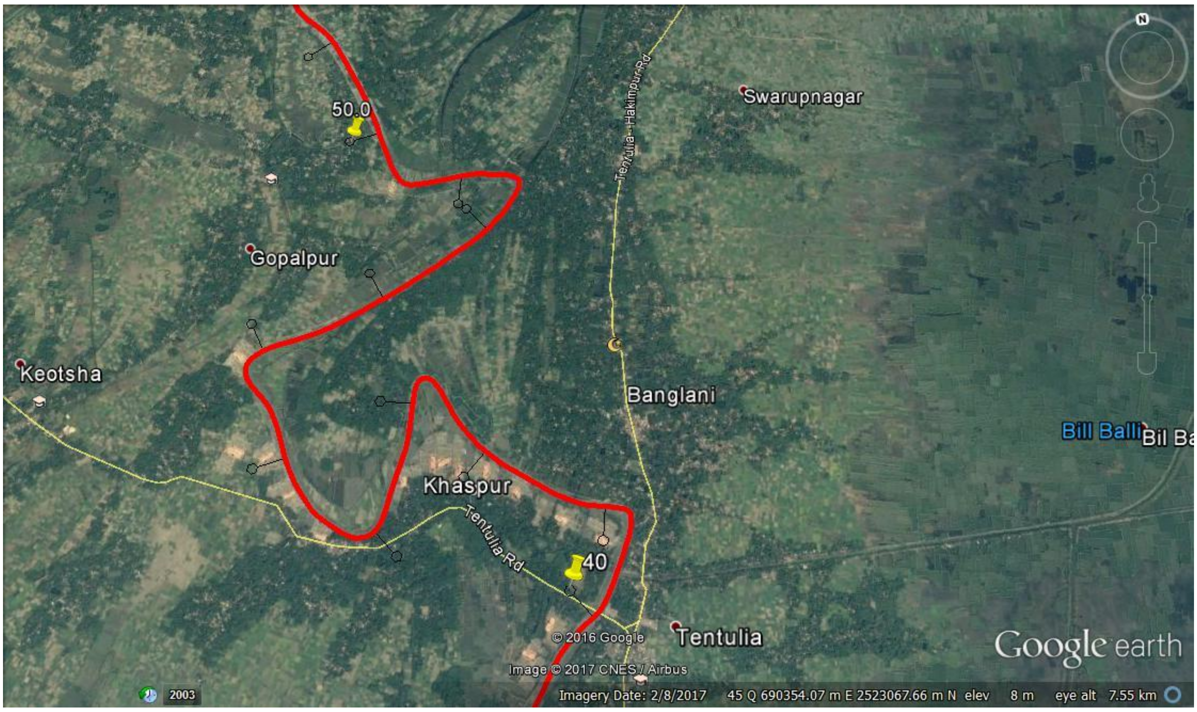

Figure 14: Google Image showing Sub-Stretch -5 of Waterway

Table 12: Dredging Quantity (cum) for Sub-Stretch 5

Class	Chainage (km)		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)
II	40	50	Not Applicable (Tidal Zone)				-0.81	1.84	10000	328033.2
III	40	50					-0.82	1.84	10000	585372
IV	40	50					-0.83	1.89	10000	770428.5

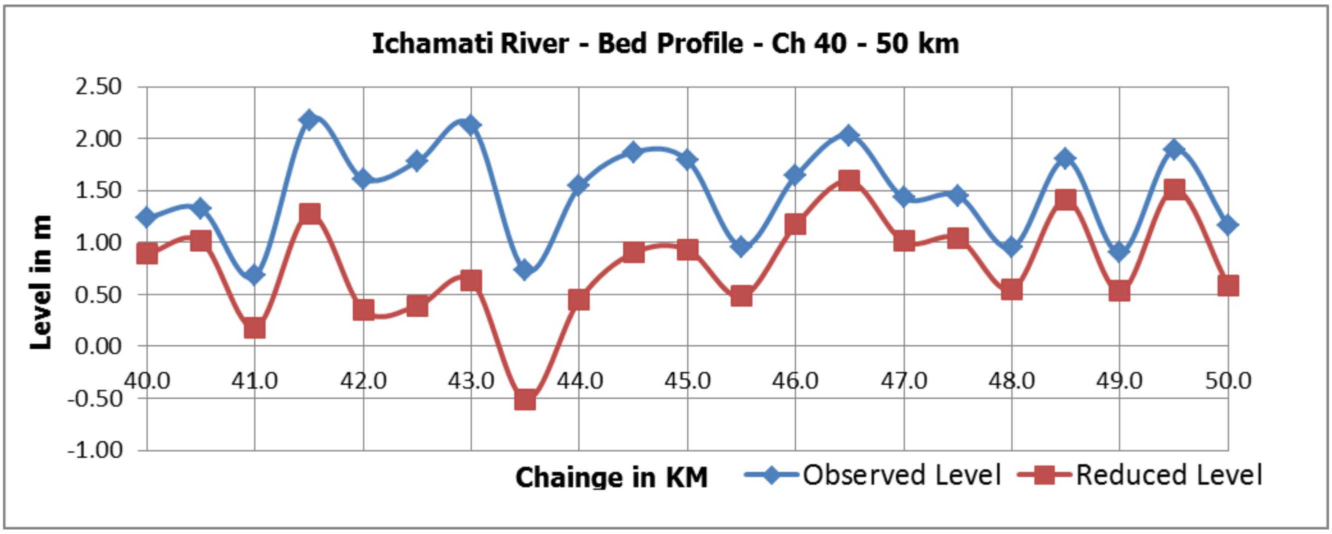

Figure 15: Bed Profile of Waterway Sub-stretch 5 (Chainage 40Km – 50Km)

	
Narrow River Stretch	**Dredging in progress**

Figure 16: Photograph along Sub-Stretch 5

2.5.6 Sub Stretch 6: From Khardda Singa to Kalanchi (Chainage 50 Km to 63.381 Km)

Bathymetric and Topographic Survey was carried out for this sub stretch 6 of Ichamati River from Chainage 50 Km to 63.381 Km. There are also many brick kilns located on both the banks of this sub-stretch. Fishing and rice farming are main source of livelihood & the fields in the area are dependent on the rainfall.

This stretch is narrow at about 60-80 m with some portion of the river bank as protected.

There is one road bridge located across the river at chainage 63.0 Km near Kalanchi. The area is close to the India – Bangladesh border and is moderately populated.

Following are the observations made during survey of Sub-stretch 6: From Khardda Singa to Kalanchi (Chainage 50 Km to 63.381 Km):

- There are no overhead obstructions/crossovers or hindrance or encroachment in this stretch.
- There are no cross-structures like dams, barrage, weirs etc. available in this stretch.
- The tidal range is 1.0 m in this stretch from Chainage 50 Km to 63.381 Km.
- There are no ferry jetties available however fishermen use the natural slope of the ground for landing the boats

Figure 17 above shows the alignment of sub-stretch 3 (Ch. 20.0 Km to 30.0 Km) of Waterway. The quantity of dredging required for Class II, III and IV type of WW, for this stretch is provided in **Table 13. Figure 18** shows the observed and reduced bed profile of sub-stretch 3.

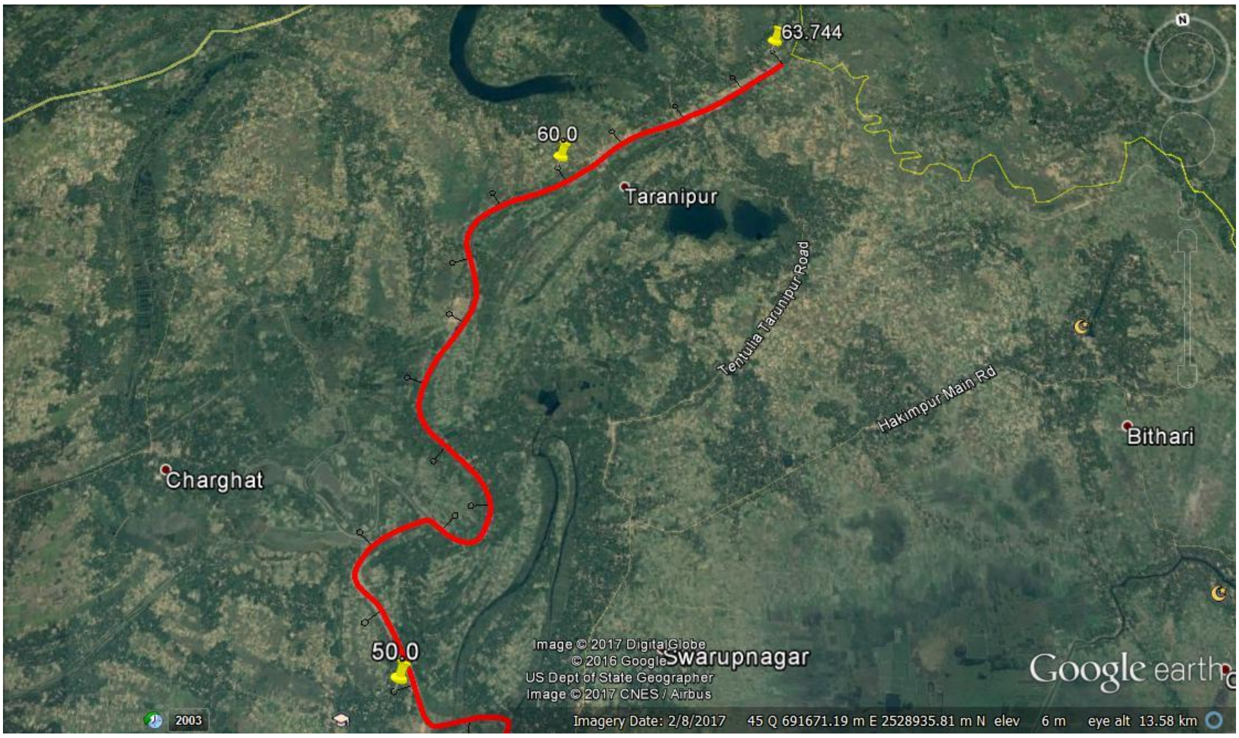

Figure 17: Google Image showing Sub-Stretch -6 of Waterway

Table 13: Dredging Quantity (cum) for Sub-Stretch 6

Class	Chainage (km)		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)
II	50	63.381	Not Applicable (Tidal Zone)				-0.51	2.32	12515	383500.7
III	50	63.381					-0.51	2.32	13132	663520.5
IV	50	63.381					-0.5	2.33	13659	887407.8

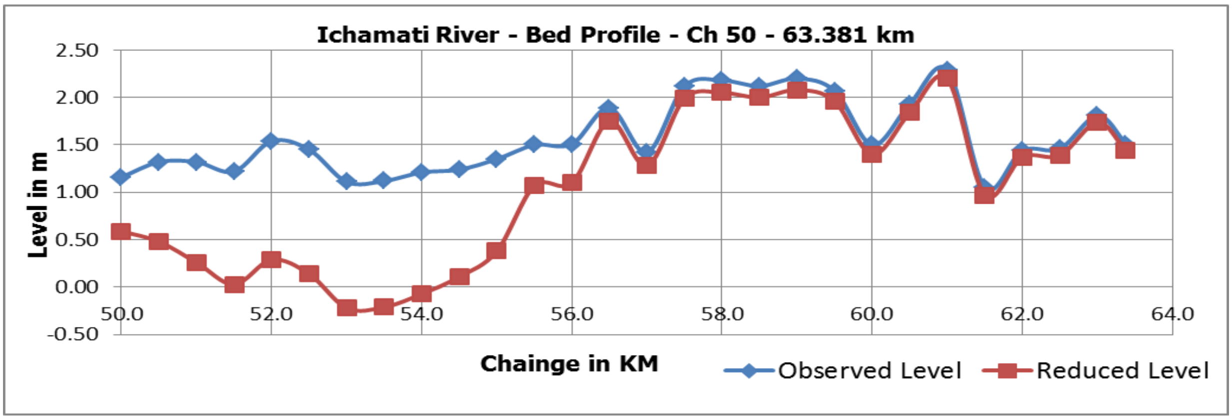

Figure 18: Bed Profile of Waterway Sub-stretch 6 (Chainage 50Km – 63.381Km)

Fishing by locals

Brick Kiln

Figure 19: Photograph along Sub-Stretch 6

2.6 SOIL AND WATER SAMPLES ANALYSIS AND RESULTS

Waterway bed soil and water samples were collected using Vanveen Grab & Niskin type water sampler at respective locations. One sample were collected at each location in the river stretches. The location and depth of the collected samples are appended in **Table 14.**

Table 14: Soil & Water Sample Locations

Sample No	Chainage (Km)	Latitude	Longitude	Easting (m)	Northing (m)	Soil Sampling Depth (m)	Water Sampling at 0.5D Depth (m)
1	3	22°40'28.358	088°54'39.066	696319.06	2508754.93	5	2.5
2	10	22°40’41.788	088°51’31.131	690949.16	2509099.98	4.8	2.4
3	19.5	22°42’51.234	088°48’32.554	685803.27	2513018.77	2.1	1.05
4	31.5	22°44’08.440	088°50’18.474	688796.44	2515430.79	2.4	1.2
5	41	22°47’12.134	088°51’05.617	690070.87	2521098.02	3.1	1.55
6	48.5	22°49’09.5143	088°50’55.2378	689729.67	2524704.97	3.6	1.8
7	62.5	22°53’23.8314	088°52’49.405	692885.44	2532569.12	3.7	1.85

The collected soil & water samples were analyzed for the following properties:-

Soil Samples

- Grain size
- Specific gravity
- PH Value
- Cu, Cc
- Clay Silt percentage

Water samples

- Sediment Concentration

Test result of samples is provided in **Table 15**.

Table 15: Soil and Water Sample Test Results

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CERTIFICATE OF ANALYSIS ON SOIL & WATER SAMPLES

Table No. : 6

Project : Laboratory Analysis of Soil & Water Samples | River : Ichamati | Job No. : 6154 H

Sample Reference					Test Results on SOIL SAMPLES								Test Results on WATER SAMPLES
					Particle Size Analysis								Sediment Concentration Test
					By Sieve Analysis		By Hydrometer Analysis						
Serial No.	Sample Ref. No.	Name of Sample	Chainage	Observed Depth (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Specific Gravity	pH Value	Cohesive Strength of Uniformity (Cu)	Cohesive Strength of Curvature (Cc)	Total Solid (mg/lit)
1	IM-01	Soil	3.00	5.00	0	2	39	59	2.60	8.57	6.00	1.50	-
2	IM-02	Soil	10.00	4.80	0	5	47	48	2.61	8.12	6.00	1.50	-
3	IM-03	Soil	19.50	2.10	0	9	53	38	2.63	8.86	6.00	1.50	-
4	IM-04	Soil	31.50	2.40	0	9	41	50	2.65	8.49	6.00	1.50	-
5	IM-05	Soil	41.00	3.10	0	5	49	46	2.62	8.83	6.00	1.50	-
6	IM-06	Soil	48.50	3.60	0	9	49	42	2.64	8.93	6.00	1.50	-
7	IM-07	Soil	62.50	3.70	0	8	41	51	2.64	8.77	6.00	1.50	-
8	IM-01	Water	3.00	5.00	-	-	-	-	-	-	-	-	18758
9	IM-02	Water	10.00	4.80	-	-	-	-	-	-	-	-	18730
10	IM-03	Water	19.50	2.10	-	-	-	-	-	-	-	-	17516
11	IM-04	Water	31.50	2.40	-	-	-	-	-	-	-	-	15923
12	IM-05	Water	41.00	3.10	-	-	-	-	-	-	-	-	13942
13	IM-06	Water	48.50	3.60	-	-	-	-	-	-	-	-	13014
14	IM-07	Water	62.50	3.70	-	-	-	-	-	-	-	-	11474

for DRILLTECH CONSULTANT

3.0 FAIRWAY DEVELOPMENT

In most of the countries where inland navigation is developed, such as in Europe, China, Russia etc., the waterways have been classified in different classes depending on their physical characteristics and development potential in future. Generally, with larger waterway dimensions bigger IWT vessels can operate resulting in lower shipping cost per tonne of cargo as compared to the shipping cost of smaller vessels. One of the important factors contributing to lower shipping cost by operation of bigger vessels is the improvement in power to load ratio, i.e. capacity of cargo carrying per unit of engine power. Hence, every waterway should be developed to larger dimensions (depth and width of navigation channel) subject to the physical characteristics of the waterway. However, for developing a waterway to larger dimensions (in other wards waterway of higher class) additional investment would be required. Therefore, there would be an optimum waterway class for a particular waterway whereby total cost to the system (i.e., increase in cost due to development work vis-a-vis reduction in shipping cost) is minimum. This optimum solution is required for each waterway and for this purpose classification of waterways would facilitate planning for the optimum class of the waterway and its development.

3.1 PROPOSED CLASS / TYPE OF WATERWAY

IWAI gives a classification of waterways on the basis of width and depth of rivers/canals, radius of bends, vertical clearance, horizontal clearance between bridge piers and self-propelled vessel carrying capacity of vessels. On the basis of these criteria's, classification of waterways was done by IWAI as detailed in Paragraph **1.4.1** and **Table 1**.

On the basis of inputs from bathymetric and traffic survey as detailed in chapter 2 and 4, it is proposed to develop fairway stretch as below:

c) **Fairway stretch 1** from Basirhat to Indo-Bangladesh Border – The proposed fairway provides connectivity for RO-RO operations to Bangladesh. The total length of proposed fairway is about 3.0 Km along the river.
d) **Fairway stretch 2** from Itinda ghat to Basirhat ghat - The proposed fairway connects the passenger jetties proposed at both banks of Itinda and Basirhat ghat across the river. The total length of proposed fairway is about 300 m.

From the detailed hydrographic survey, following observations are made on the proposed fairway:

a) No dams, barrage and any other cross-structure is located along the proposed fairway stretch.
b) Reduced depth of waterway varies from 2.4 m to 0.1 m w.r.t sounding datum along the proposed fairway stretch of about 300 m.
c) Reduced depth of waterway varies from 8.7 m to -0.52 m w.r.t sounding datum along the proposed fairway stretch of 3.0 Km.
d) Tidal variation is about 4.0 m.
e) Width of waterway varies from 400m to 300m along the proposed fairway stretch of 3.0 Km.

Figure 20 shows the alignment of proposed fairway stretch 1 along the river, connecting Indo-Bangladesh Border with Basirhat Jetty and fairway stretch 2 across the river connecting cross banks of the river namely Basirhat jetty and Itinda Jetty.

Figure 20: Proposed alignment of Fairway Stretch 1 and 2

On the basis of above inputs, and type of proposed vessel for estimated traffic as discussed in subsequent chapters, the fairway is classified as Class – III. All the development works, like dredging shall be proposed considering the fairway as Class-III waterway.

3.2 DETAILS OF SHOALS

Due consideration was given for shoals identified during the survey. Considering the alignment of proposed navigation channel with the river flow direction and unstable channel bed, it is foreseen that the channel bed of proposed waterway alignment is at risk of continuous silting. In view of this, it is recommended to consider whole waterway stretch of 3.0Km for dredging.

3.3 PROPOSED CONSERVANCY ACTIVITIES

Dredging is proposed under conservancy works for the proposed fairway stretch.

3.3.1 Dredging

A defined waterway is required to make throughout the year navigation in the IWT stretch of Ichamati waterway possible. Design improvement measures and increase of channel depth by dredging is required for the fairway development. Thereby, regular maintenance of fairway depth by maintenance dredging is required in the navigable route.

<u>Fairway Dimensions</u>

As per IWAI guidelines, fairway dimensions for river classified as Class-III waterway should have required dimensions of 50m bottom width; 1.7m depth and side slop of 5:1 as shown in **Figure 21**. The dredging quantity estimated on the basis of bathymetric survey is provided as below.

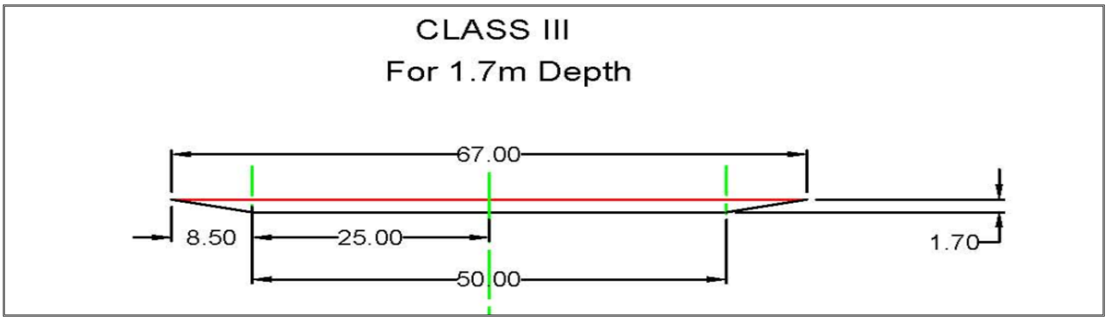

Figure 21: Fairway Dimension Class III

a) For Fairway stretch 1 of 3.0 Km along the river the dredging quantity for Class III waterway is provided as below:

Chainage (Km)		Reduced w.r.t. Sounding Datum				
From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulative Dredging Qty. (cum)
0	1	-0.52	0.56	1000	110010.4	110010.41
1	2	0	1.69	1000	48632.03	158642.44
2	3	0.36	2.6	1000	43703.41	202345.85

b) For Fairway stretch 2 of about 300 m along the river the dredging quantity for Class III waterway is provided as below:

Length of channel to be dredged (L) = 250 m
Reduced depth w.r.t Sounding datum = 0.1 m
Required draft = 1.70 m +0.5 = 2.20 m
Hence, dredge depth of the channel = 2.20 – 0.1 = 2.10 m
Area of channel to be dredged (A) = 0.5*(50m+67m) x 2.10m = 122.85 sqm
Dredging Quantity (Q) = (A) x (L) = 122.85 x 250
= 30,712.5 cum

Hence total quantity of the dredged material works out to 2,33,058.35 cum (= 2,02,345.85 cum +30,712.5 cum) ~ 2,33,100 cum.

Disposal of Dredging Material

The 2,33,100 cum of dredged material is proposed to be dumped on low lying areas located on both sides of the river bank near the terminal area. The dredge material should be dumped providing gabion walls. The gabion walls should be adequately provided to prevent the dredged material to fall back in the waterway as shown in **Figure 22**.

Figure 22: Photograph showing arrangement of Gabion Wall along River Bank

Selection of dredging equipment

There are various types of dredgers available in the market viz., suction dredger, bucket dredger, grab dredger, backhoe / dipper dredger, water injection dredger, pneumatic dredger etc. While most of these dredgers are ideally suit for sea conditions to dredge harbour and approach channels, the selection of a dredger for inland waterway is rather critical due to various mobility factors, seasonal variation of water levels (floods/dry season) and shallow depths.

Selection of dredging equipment

The dredging is usually carried out with a cutter-suction dredger or with a trailing suction hopper dredger. There are various types of dredgers available in the market viz., suction dredger, bucket dredger, grab dredger, backhoe / dipper dredger, water injection dredger, pneumatic dredger etc. While most of these dredgers are ideally suited for sea conditions to dredge harbour and approach channels, the selection of a dredger for inland waterway is rather critical due to various mobility factors, seasonal variation of water levels (floods/dry season) and shallow depths.

The cutter suction dredgers having conventional centrifugal pumps or modern jet pumps will be more effective to dredge out the material. In a cutter-suction dredger or CSD, the suction tube has a cutter head at the suction inlet, to loosen the bed and transport it to the suction mouth. The cutter can also be used for hard consolidated type of bed. The dredged soil is usually sucked up by a wear resistant centrifugal pump and discharged through a pipe line or to barge.

Alternately the modern amphibious cutter suction dredger is also suitable for the waterway. The amphibious dredger can be road transportable, able to unload itself from the truck/lorry and can dredge rivers/canals having depths of 2.0 to 3.0 m. These dredgers can walk into the river and even in dry portions of the river during lean period. The dredgers can also be disassembled for transportation to other locations. These dredgers are indigenously available in India. Specifications of typical dredging equipment suitable to the waterway are indicated below:

- Length overall 20 m
- Width 4.1 m
- Dredging depth 6m
- Suction pipe 325 mm
- Discharge pipe 300 mm
- Installed capacity 350 kw
- Cutter power 50 kw
- H.P 500 BHP
- Draft 1 m
- Rated output with 500 m pipe line 200 cu m / hour

The low draft amphibious dredgers with bucket arrangement to remove the material are also ideally suitable. Specifications of typical amphibious bucket dredger are given below:

- Length overall 9.5 m
- Beam 2.5 m
- Dredging depth 2.75 m over stern

• Draft	0.5 m
• Weight	7.5 MT
• BHP	63 BHP
• Reach	7 m
• Bucket capacity	200 litres.

In the case of bucket dredger, hopper tugs/barges are required to transport the material to disposal grounds. The type of dredging effort (either floating or mobile shore based) will, however, depend on the detailed investigations on the availability of indigenous equipment, disposal area, and environmental impact.

3.3.2 River Training

No river training works is required in the proposed navigable waterway stretch.

3.4 BANK PROTECTION / EMBANKMENT STRENGTHENING

The river bank in the proposed fairway stretch is fairly stable with mild slope. No bank protection works is envisaged in the proposed fairway stretch. However, as RO-RO operations are recommended at Basirhat terminal location, stone pitching work for about 200 m is recommended for safeguarding the river bank from wave actions caused by vessel movement.

3.5 NAVIGATION MARKINGS / NAVIGATION AIDS

Navigation markings/aids, proposed for safe navigation along the proposed fairway stretch are discussed in detail in Chapter 8.

3.6 MODIFICATION REQUIREMENT IN EXISTING BRIDGES / CABLES / DAMS / BARRAGES / LOCKS / WEIRS / ANICUTS / AQUEDUCTS

No Bridges / Cables / Dams / Barrages / Locks / Weirs / Anicuts / Aqueducts are located or proposed along the navigation channel.

3.7 PROPOSED DAMS / BARRAGES / LOCKS / WEIRS TO IMPROVE DEPTH

No dam/ barrage/ locks/ weirs is proposed to improve depth.

3.8 LAND ACQUISITION

No additional land is required to be acquired for fairway development.

3.9 FAIRWAY COSTING

The cost estimate for fairway development of IWT system including O&M of the system has been worked out. The cost estimates for development of the system are considered as Capital cost while for operation of the system is termed as maintenance or operating cost (O & M cost). The fairway development cost is estimated for navigation channel proposed in Ichamati waterway.

3.9.1 BASIS OF COST

The basis of cost estimates worked out as per following:

a) Standard Schedule of Rates 2015-2016 of PWD, Govt. of West Bengal considered for various works;
b) Market surveys and enquires
c) Judgement based on Consultant's Experience

3.9.2 Capital Cost

Dredging is required for fairway development of Ichamati waterway. The cost of initial dredging is as below:

Dredging cost @ INR 200/cum for 2,33,100 cum = INR 4,66,20,000/- (**INR 466.20 Lacs**)

3.9.3 O&M Cost

Operation and Maintenance of fairway comprises of dredging cost only. Actual quantity of dredging required during operation stage can be worked out from model studies only. For DPR studies, it is assumed that 10% of dredging is required annually for smooth and safe navigation. Hence O&M cost works out as:

Dredging cost @ INR 200/cum for 10% of 2,33,100 cum = INR 46,62,000.0/- **(INR 46.62 Lacs).**

4.0 TRAFFIC STUDY

4.1 GENERAL

North 24 Parganas is a district in southern West Bengal, of eastern India. North 24 Parganas extends in the tropical zone from latitude 22º11'6" North to 23º15'2" North and from longitude 88º20' East to 89º5' East. It is bordered to Nadia by north, to Bangladesh (Khulna Division) by north and east, to South 24 Parganas and Kolkata by south and to Kolkata, Howrah and Hoogly by west. Barasat is the district headquarters of North 24 Parganas. North 24 Parganas is West Bengal's most populous district and (following the splitting of the Thane district of Maharashtra in 2014) the most populated district in the whole of India. It is also the tenth-largest district in the State by area

4.2 INFLUENCE AREA / HINTERLAND

Ichamati River is one of the main rivers of West Bengal State. Ichamati River is a trans-boundary river which flows through India and Bangladesh and also forms the boundary between the two countries. The river is facing the problem of siltation leading to thin flow of water in the dry season and floods in the rainy season. Experts are handling the situation and remedial matters are being discussed between the governments of India and Bangladesh. Ichamati River flows in three parts: (1) The longer part flows from the Mathabhanga River, a distributary of the Padma, and after flowing for 208 kilometres joins the Kalindi River near Hasnabad in North 24 Parganas and Debhata in Satkhira District (2) Once the main river west of Dhaka and (3) Ichamati of Dinajpur. According to a number of hydrologists, the three Ichamati Rivers, in the past, were a single channel. The second river marked above originates south of Jafarganj opposite to the mouth of the Hoorsagar and runs towards Joginighat in Munshiganj. Joginighat is situated at the confluence of the Jamuna and the Ichamati.

The Project Influence Area (PIA), considering existing and projected traffic for passenger ferry services, comprises of the following CD blocks and districts. Total influence area/hinterland extending on either side of waterway is provided in **Table 16**.

Table 16: Project Influence Area/ Hinterland

State	District	Area (Km^2)	C.D. Block	Area (Km^2)	Total Hinterland area (Km^2)
West Bengal	North 24 Parganas	4,094	Itinda	1.33	1.33

4.2.1 Population of Hinterland area

Population of hinterland area for proposed IWT in Ichamati waterway is provided in **Table 17** below:

Table 17: Population of Hinterland[1]

State	District	Population (Nos.)	C.D. Block	Population (Nos.)	Total Hinterland Population (Nos)
West Bengal	North 24 Parganas	1,00,09,781	Itinda	8,679	8,679

4.2.2 Existing and proposed Industries

Large number of locally operated brick kilns is located all along the river stretch on both sides of banks. The brick kilns operated along Ichamati river banks mostly uses fuel wood, saw dust, rice husks and agricultural residues along with coal for firing their kilns. All these are locally arranged and transported through roads by owners directly to their kilns. Also, no major industry or any other commercial establishment is located/proposed in the hinterland area..

4.3 COMMODITY COMPOSITION / CATEGORIZATION

Agriculture and allied sectors are the main-stay of the economy in districts comprising hinterland area. It provides both direct and indirect employment to the majority of the workforce. Agriculture is the main source of livelihood of the population supplemented by livestock rearing, fishery and horticulture. The district lack mineral resources and so also major and medium industries. Hence, the rural population of the district mainly depends on agriculture, fishery and other activities allied to agriculture for their livelihood.

4.4 PRIVATE PARTICIPATION - RO-RO OPERATIONS FOR DRY BULK CARGO TO BANGLADESH

According to letter from IWAI no, IWAI/PR/46NW/2016/1B, dated 22nd January 2019 shown in **Figure 23**, an exporter firm M/s River Waterlink Pvt. Ltd of West Bengal operating along Indo-Bangladesh Border has proposed to provide RO-RO operations to Bangladesh. The details provided by company are as below:

[1] District Census Handbook, 2011

a) M/s River Waterlink Pvt. Ltd. is transporting bulk cargo (coal, limestone and stone aggregates) to Bangladesh from last 25 years through roads.
b) The company proposes to transfer the existing cargo to IWT route through Ichamati waterway in RO-RO barges.
c) Required land for RO-RO operations is acquired by the company in Indian side. For Bangladesh side, required land is acquired by its counter-part.
d) Company has their own RO-RO barges for these operations.
e) All costs and time for construction of RO-RO jetty will be borne by the company.
f) In the Indian side, the proposed location of Jetty is similar to the one proposed by Egis in Final DPR (R2) (Ref: Page 75, Para 5.2 of Volume 1).
g) Total length of required waterway in Indian side is about 3.00 Km (from Basirhat) out of 4.20 Km.
h) The company also guarantees movement of bare minimum of 3.0 Lacs MT per annum of cargo, which can be increased rapidly to 10.0 Lacs MT per annum.

In order to appraise above proposal by M/s River Waterlink Pvt Ltd and as directed by IWAI through letter no. IWAI/Hy./Ichamati River/NW-44/DPR/2017-18, dated 08.08.2019, consultant visited Ichamati Waterway Basirhat location on 10th Sep 2019. List of officials present during site visit are as follows:

a) IWAI - Mr. G.J, Reddy
b) M/s River Waterlink Pvt Ltd - Mr. Yash Jalan and Mr. Mahesh Bhaturia
c) Basirhat Land Owner - Mr. Rajesh Sana
d) M/s Egis India Consulting Engineers Pvt. Ltd. - Ashish Khullar and Divyanshu Upadhyay.

The purpose of site visit was to evaluate RO-RO proposal made by/s River Waterlink Pvt Ltd. in terms of the following criteria's:

a) Land for RO-RO Terminal
    i. Ownership status
    ii. Availability of area for development of required infrastructure
    iii. Condition of river bank
b) Connectivity
    i. Availability and condition of approach road
    ii. Requirement of any upgradation or strengthening of existing roads
c) Impact on existing ferry services

Photographs of the site visit showing present conditions of the land, river bank and approach road are provided as below:

Entry gate to the proposed land for RO-RO terminal

Proposed area for RO-RO terminal

	
Condition of River Bank along proposed RO-RO terminal	
	
Approach road to the proposed RO-RO terminal	River view from proposed RO-RO terminal bank

Following details have been gathered from site visit and with discussion with M/s River Waterlink Pvt Ltd.

- M/s River Waterlink Pvt Ltd has acquired land on rent for a lease of 30 years
- Total land available for RO-RO terminal development is 6 Hectare
- Available parking capacity in the proposed land is 500 Trucks (10 Wheeler)
- Total riverfront stretch available is 200m
- River banks is mostly stable, however further strengthening is required for Ro-Ro operations
- Proposed land is well connected with bitumen motor able road
- It is proposed to operate RO-RO services for 24 hours.
- The proposed land for RO-RO terminal is connected on one side with existing ferry ghat.

- The ferry ghat at Basirhat is at government land.
- Operation and maintenance of the ferry services and amenity building is on contractual basis.

From the information and data collected at site and on the basis of discussions with M/s River Waterlink Pvt Ltd and owner of proposed land for RO-RO terminal, it is concluded that the proposal made by M/s River Waterlink Pvt Ltd can be recommended to approving authorities.

Considering the benefits from above proposal, RO-RO operations for transporting bulk cargo in 3.00 Km stretch of Ichamati River is considered in this DPR.

As such initial dry bulk cargo traffic of 3.0 Lacs MT per annum is considered in the DPR study from start date of operations. It is also assumed that the guaranteed traffic of 10.0 Lacs MT per annum of traffic will be attained in next 5 years.

भारतीय अन्तर्देशीय जलमार्ग प्राधिकरण
(पोत परिवहन मंत्रालय, भारत सरकार)
मुख्यालय : ए–13, सैक्टर–1, नौएडा–201 301, (उ० प्र०)
INLAND WATERWAYS AUTHORITY OF INDIA
(Ministry of Shipping, Govt. of India)
Head Office : A-13, Sector-1, Noida-201 301 (U.P.)
Website : www.iwai.gov.in | www.iwai.nic.in
Tel. : +91-120-2544036, 2543972, 2527667, 2448101 Fax : +91-120-2544009, 2544041, 2543973, 2521764

No. IWAI/PR/46NW/2016/1B

January 22, 2019

To,
M/s EGIS SRE JV Consulting Engineers Pvt. Ltd.
Plot No. 66, Sector-32,
Gurgaon, Haryana - 122 001
Email – egis-india@egis-india.com,
(Kind Attn.: Mr. J.K. Panigrahi)

Sub: - Usage of Ichamati river (NW-44) for Ro-Ro operations to Bangladesh.
Ref: - (1) This office agreement no. IWAI/PR/43NW/2015/1A dated 19.08.2016
(2) This office supplementary agreement no. IWAI/PR/46NW/2016/1B dated 21.12.2016.

Sir,

Refer enclosed lr. no. RWPL/18-19/IWAI/KOL/023 dated 07.01.2019 received from River Waterlink Pvt. Ltd., Cuttack on the cited subject, wherein the firm has inform that Ichamati river (NW-44) is having potential for Ro-Ro operations to Bangladesh.

It is requested to study the proposal and offer necessary comments w.r.t. the DPR of Ichamati river (NW-44).

Yours faithfully,
22/01/19
(Rajiv Singhal)
Sr. Hydrographic Surveyor

Encl.: As stated.

RIVER WATERLINK PVT. LTD.

Regd Off: Aditya Complex, Chauliaganj, Cuttack- 753 003 I CIN: U61100OR2000PTC006370
Head Off: 11, Clive Row, 1st Floor, Room No: F, Kolkata- 700 001 I www.riverwaterlink.com
Email: support@riverwaterlink.com I Ph: +91 33-4600-2483

RWPL/18-19/IWAI/HO/023

7th January, 2019

To
The Member (Technical)
Inland Waterways Authority of India
(Ministry of Shipping, Govt. Of India)
A-13, Sector-1
Noida – 201301
Uttar Pradesh

SUBJECT: <u>FORWARDING LETTER – USAGE OF NW-44 FOR RO-RO OPERATIONS TO BANGLADESH</u>

Dear Sir

Please find enclosed your copy of letter addressed to *Shri. L.K. Rajak, The Director, Kolkata Regional Office, Inland Waterways Authority of India (Ministry of Shipping, Govt. Of India)*

Dated: 07.01.2019
Ref: RWPL/18-19/IWAI/KOL/023
Subject: USAGE OF NW-44 FOR RO-RO OPERATIONS TO BANGLADESH

Thanking you.

Best Regards

Yash Jalan
Director
Email: yash@riverwaterlink.com
Phone: +91 97489-18888

1. A. see & discuss.
2. Also get it in the DPR which is being prepared by EGIS.
17/1
17/1

CE (Tech)

Page 1 of 1

RIVER WATERLINK PVT. LTD.

Regd Off: Aditya Complex, Chauliaganj, Cuttack- 753 003 I CIN: U61100OR2000PTC006370
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RWPL/18-19/IWAI/HO/023

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Director
Email: yash@riverwaterlink.com
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Page 1 of 1

RIVER WATERLINK PVT. LTD.
Regd Off: Aditya Complex, Chauliaganj, Cuttack- 753 003 I CIN: U61100OR2000PTC006370
Head Off: 11, Clive Row, 1st Floor, Room No: F, Kolkata- 700 001 I www.riverwaterlink.com
Email: support@riverwaterlink.com I Ph: +91 33-4600-2483

RWPL/18-19/IWAI/KOL/023

7th January, 2019

To
The Director
Inland Waterways Authority of India
(Ministry of Shipping, Govt. Of India)
Kolkata Regional Office
P-78, Garden Reach Road
Kolkata – 700043
West Bengal

Kind Attention: Shri. L.K. Rajak

SUBJECT: USAGE OF NW-44 FOR RO-RO OPERATIONS TO BANGLADESH

We are a group of companies having presence across various parts of India. For the last 25 years we have been exporting goods like coal, limestone and stone aggregates to Bangladesh under different name and style for which we have our own sources of mines in the North-Eastern part of India. Previously during the 90s' under the name of M/s Rock International, we were one of the leading exporters of stone Boulders & Aggregates from the Jharkhand belt for the prestigious Jamuna Bridge project of Bangladesh. Further between the year 2002 & 2007 we successfully supplied huge quantities of river boulders to the N.F. Railways for their Bogibeel Bridge Project site near Dhemaji on the North bank of River Brahmaputra, achieving a figure of more than 2 Lac Cubic Meter.

Further, seeing the past records of performance and achievement and in respect to our credentials gained over the years we were also invited to supply stone for Padma Bridge project in Bangladesh, but due to extreme congestion at the West Bengal road borders and unavailability of railway rakes we declined the offer as we could foresee the bottle necks of the movement which would not let us achieve 100% efficiency and would reflect upon our performance standards. Further in 2015 our Advisor, Mr. Mahesh Kumar Jalan initiated & introduced stone by the means of mother vessels to Bangladesh using the sea route from different countries including China. Presently we are working under the above name & style.

We are exporting coal, limestone and stone aggregates to Bangladesh through various land borders across the Eastern belt of India catering to our strong counterparts in Bangladesh since the past 25 years. One of such borders is the Ghojadanga, India & Bhomra, Bangladesh border: We have huge quantity requirements to cater to from this particular border. We have a depot established at a nearing area from where we transport our material via Ghojadanga L.C. Station by trucks. There is immense congestion on this border and each

Page 1 of 3

truck is getting detained at the border for more than 20 days *(copy of photographs attached)*, which is withholding us from supplying and fulfilling the demand and huge quantity requirements of Bangladesh. The reasons for pro-longed detention are restriction on the number of trucks entering each day and preferences / priority given to other edible & perishable commodities.

After several site visits to the nearing areas and on discussion with your good self, we understand that the Ichamati River that flows by the town of Basirhat is marked under National Waterways – 44 (NW-44). Further, this river flows down having a floating river border dividing the two mentioned countries.

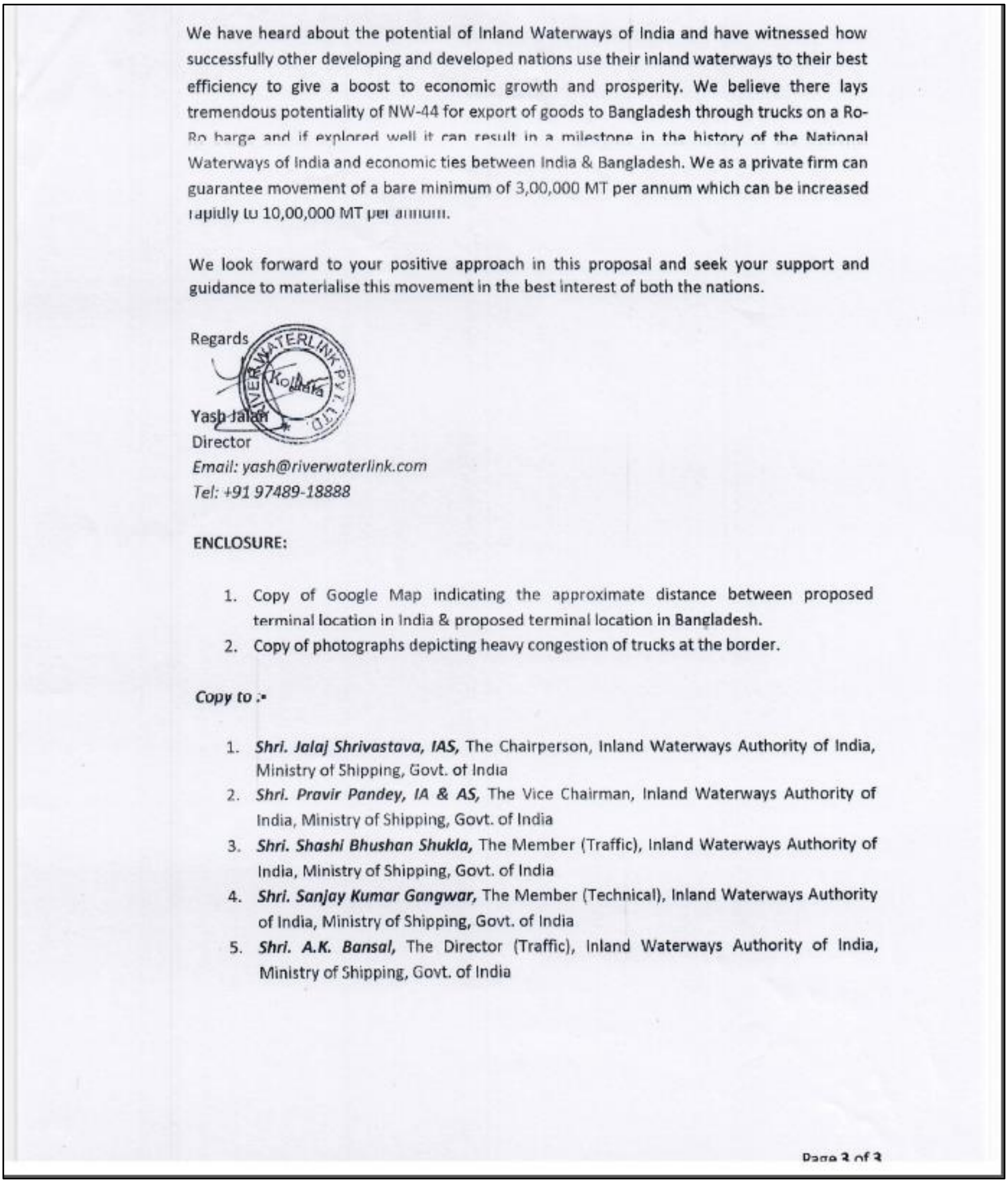
We have already identified and acquired suitable land area(s) for loading and a Ro-Ro barge in the Indian side without interfering with the channel of this river. Our counter-part in Bangladesh is also very interested to take up this project and has already acquired suitable land area(s) for this operation on the Bangladeshi side. The approximate distance between proposed terminal location in India & proposed terminal location in Bangladesh is only **4.20 kilometres** *(copy of Google Map attached)*. Further, after conducting a local survey with the fishermen and boat operators of that region, we found the LAD of the river channel to be 2-2.5 metres at all times. We have also identified suitable Ro-Ro barge (Indian Flag) for this operation which belongs to our group company involved in barging operations along the NW-1 region. We seek the following permissions and support from you:

1. Permission for construction of Ro-Ro jetty along the river banks of NW-44. All costs and time towards such construction will be borne by our company.
2. Permission to ply our barge on the given route and incorporation of this river route under the Indo-Bangla Protocol routes for transportation of stone aggregates and other commodities by the trucks through a Ro-Ro vessel (No bulk handling will be required).
3. Permission of customs clearances at the proposed site.

We guarantee the following benefits that will be achieved if the above can be successfully implemented by the government of the two nations / countries:

1. Movement of bare minimum 3,00,000 MT per annum to start with a tremendous potential of growth to more than 10,00,000 MT per annum only from one border area.
2. De-congestion of Ghojadanga & Bhomra L.C. Station.
3. Bringing NW-44 into good commercial use for transportation of cargo.
4. Increase in quantity movement of material will reflect the efficiency of National Waterways of India which is a prime and dream project of our *Honourable Prime Minister and the Ministry of Shipping, Govt. of India.*
5. Increasing volumes will lead towards cost efficiency and working effectiveness.
6. Increase in exports will lead to inflow of foreign exchange in US Dollars for our country.

Page 2 of 3



We have heard about the potential of Inland Waterways of India and have witnessed how successfully other developing and developed nations use their inland waterways to their best efficiency to give a boost to economic growth and prosperity. We believe there lays tremendous potentiality of NW-44 for export of goods to Bangladesh through trucks on a Ro-Ro barge and if explored well it can result in a milestone in the history of the National Waterways of India and economic ties between India & Bangladesh. We as a private firm can guarantee movement of a bare minimum of 3,00,000 MT per annum which can be increased rapidly to 10,00,000 MT per annum.

We look forward to your positive approach in this proposal and seek your support and guidance to materialise this movement in the best interest of both the nations.

Regards

Yash Jalan
Director
Email: yash@riverwaterlink.com
Tel: +91 97489-18888

ENCLOSURE:

1. Copy of Google Map indicating the approximate distance between proposed terminal location in India & proposed terminal location in Bangladesh.
2. Copy of photographs depicting heavy congestion of trucks at the border.

Copy to :-

1. ***Shri. Jalaj Shrivastava, IAS,*** The Chairperson, Inland Waterways Authority of India, Ministry of Shipping, Govt. of India
2. ***Shri. Pravir Pandey, IA & AS,*** The Vice Chairman, Inland Waterways Authority of India, Ministry of Shipping, Govt. of India
3. ***Shri. Shashi Bhushan Shukla,*** The Member (Traffic), Inland Waterways Authority of India, Ministry of Shipping, Govt. of India
4. ***Shri. Sanjay Kumar Gangwar,*** The Member (Technical), Inland Waterways Authority of India, Ministry of Shipping, Govt. of India
5. ***Shri. A.K. Bansal,*** The Director (Traffic), Inland Waterways Authority of India, Ministry of Shipping, Govt. of India

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Figure 23: IWAI letter no. IWAI/PR/46NW/2016/1B, dated 22nd January 2019 regarding RO-RO Operations to Bangladesh

4.5 PASSENGER FERRY SERVICES

Transportation is an important sector of growth in this region along the waterway. Local ferry services are operational at Itinda and Basirhat Ghat (Chainage 3.0 Km). As observed during traffic survey, the ferry services are used to transport passengers, two-wheelers and light cargo from one bank to other using country boats. Daily about 4000 persons use this ferry service to cross river at Itinda and Basirhat Ghat. The fare of existing ferry services are about INR 3/- per person per trip, INR 20/- per bike per trip and INR 10/- per cycle per trip. Ferry services are operational from 4:00 am to 10:30 pm daily.

The ferry services are locally operated and lack the basic infrastructure for berthing/mooring of vessels, passenger waiting area including other basic amenities.

	
JETTY ENTRY	**JETTY STRUCTURE**

Figure 24: Ferry Service in Ichamati River

4.6 TOURISM TRAFFIC

No tourism traffic is available along the study stretch of Ichamati waterway.

4.7 GROWTH TREND FOR PASSENGER TRAFFIC

The population growth of hinterland districts is about 12.04%. About 2% of growth trend for passenger traffic is considered on the basis of discussions done with local boat operators during site visit. The growth trend for traffic at proposed passenger ferry service at Itinda and Basirhat Ghat for 20 years (from 2020 to 2040) is shown in **Figure 25**.

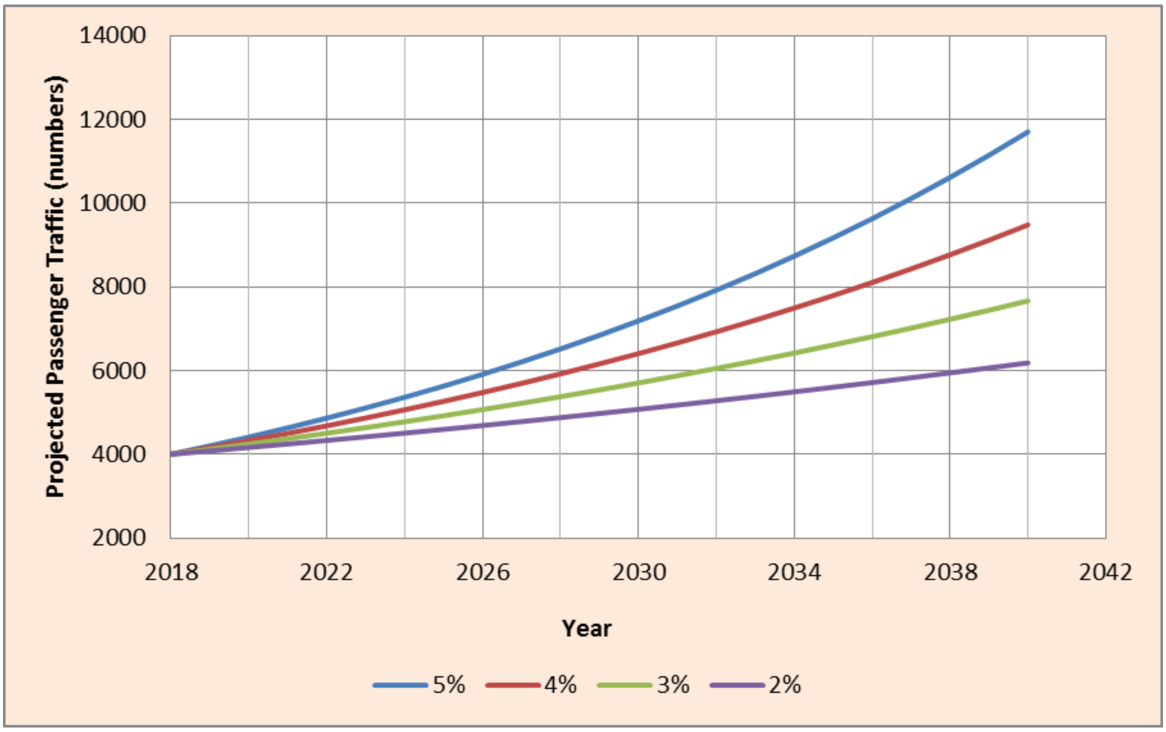


Figure 25: Projected Passenger Traffic at Itinda and Basirhat Ghat

As 2% growth rate for passenger traffic is considered for design of terminal infrastructure. Thus the proposed terminal infrastructure is planned for about 6000 passenger per day at this stage. Future expansion area is also proposed to cater the additional passengers projected in the design life.

4.8 CONCLUSION

On the basis of above traffic study following conclusions are made:

a) Private participation model proposed for RO-RO operations from Basirhat to Indo-Bangladesh order is feasible.
b) All costs and time for construction/operation and maintenance of RO-RO terminal/jetty will be borne by the M/s River Waterlink Pvt.
c) Existing ferry services can also be operated from RO-RO proposed jetty.
d) M/s River Waterlink Pvt Ltd will deploy own vessels for RO-RO operations.
e) Waterway needs to be developed by IWAI for 24 hour operations.

In view of the above conclusions, detailed DPR studies regarding development of Ichamati waterway in the 3.5 Km stretch of river from Basirhat to Indo-Bangladesh border is done in the subsequent chapters.

5.0 TERMINALS

The terminal planning and design includes selection of suitable sites in the vicinity of traffic potential considering all the relevant technical variables such as choosing the type of berthing facility and providing of waiting and parking areas and other ancillary facilities required for efficient terminal operation. Based on the projected traffic, the selection of various facilities is planned. The cost estimate including capital and operating costs is planned for each of the proposed system considering the design. These above aspects are briefly explained in the following subsequent sections.

5.1 GENERAL REVIEW

Presently local ferry services are already running at Itinda, Basirhat & Tarangunia locations along the Ichamati River. At Itinda Ghat jetty traffic of about 4000 person per day is being handled. Even though there is no proper terminal at these locations and along the waterway for safely embarking/ disembarking of passengers and loading/unloading of cargo. Locals from nearby villages cross the river for work, marketing or to meet the relatives. The details of existing ferry services are provided as below:

Passenger Ferry Services		Passengers using Jetty per day
From	To	
Basirhat	Itinda	Approx. 4000
Itinda	Basirhat	Approx. 3500
Tarangunia	Tarangunia (Fatullapur)	> 800

5.2 IDENTIFICATION AND SITE LOCATION

Site selection is most important as it decides the investment for establishing the terminal facilities. Hence proper consideration has been given to select the most optimum location which will minimise the capital investment and other recurring cost during operation. The selection of suitable site was carried out with the view of following considerations:

- Water availability near the terminal land throughout the year especially during lean season,
- Stable river channel with sufficient depth,
- Favourable hydraulic conditions for berthing,
- Availability of land for terminal infrastructure,

- Traffic potential, and
- Navigational safety.

On the basis of detailed bathymetric and traffic survey done during DPR studies on the 63.381 Km stretch of Ichamati waterway from Bansjhari Mallikpur at Lat 22°39'6.71"N, Long 88°55'33.35"E to Kalanchi at Lat 22°53'53.79"N, Long 88°53'53.94"E, following location is identified for development and construction of terminals:

Sl. No	Name	Type	Latitude	Longitude
1.	Itinda Ghat	Passenger Ferry Terminal	22°40'30.95"N	88°54'46.27"E
2.	Basirhat Ghat	RO-RO/Passenger Ferry Terminal	22°40'29.13"N	88°54'37.49"E

5.3 TERMINAL LAYOUT / MASTER PLANNING INCLUDING PHASES OF DEVELOPMENT

Terminal facilities need to be developed according to an adequate Master Plan providing development concept and framework indicating the phased developmental solutions to meet the ultimate requirements. The Master Plan will include solutions for the actual planning periods as well as point out possibilities for further expansions in the more distant future. Normally, a master plan is developed for a time horizon of 20-25 years as any prediction of cargo throughput and the matching development requirements, in terms of terminal operational needs. Beyond this period may not be very accurate. Hence a master plan need to allow development in stages to meet the demands as they come and grow and also be flexible to incorporate mid-course modifications and to be responsive to emerging scenarios as time goes on. At this stage, based on the traffic, land and water front availability following concept layout were presented for the proposed passenger terminals.

IWT terminal layout for passenger ferry services is proposed for base year 2017-18 traffic data collected during DPR study. Scope for future development for 20 years project design life is considered in the terminal layouts.

The following simple basic assumptions were considered for the purpose of IWT terminal planning:

a) Terminal facilities are planned for the initial passenger traffic projected for base year 2017-18 and shall be expanded in the subsequent development phase for 20 year design life.

b) Based on the water level data analysis, the designed master plan has been considered available for berth operation of 300 days per year.

c) Average time required for to and fro movement from berthing time and other formalities is considered as 30 minutes per ferry.

d) Passenger capacities provided at the terminals facility will be adequate to smooth operation during disruption of traffic.

e) The storm water drain proposed at the terminals periphery shall discharge into the river.

The terminals facilities proposed for this project shall include the following:

At Basirhat (RO-RO/Passenger Ferry Terminal):

- Berthing and parking facilities for RO-RO barges
- Landside parking facilities for about 500 trucks.
- Floating Pontoon platform for ferry vessels berthing
- Parking facilities for ferries
- Terminal operation building comprising
    - Ticketing area for RO_RO and ferry services
    - Waiting area
    - Customs office
    - Toilets & other utility area
- Other ancillary Facilities

At Itinda (Passenger Ferry Terminal):

- Floating Pontoon platform for ferry vessels berthing
- Passenger ticket, waiting and parking area
- Toilets & other utility area
- Other ancillary Facilities

As detailed in Chapter 4 – Traffic Study, Land for development of RO-RO terminal at Basirhat is already acquired by M/s River Waterlink Pvt. Ltd and all facilities required for RO-RO operations to export dry bulk cargo to Bangladesh will also be developed and maintained by M/s River Waterlink Pvt. Ltd. As part of DPR studies, the preliminary engineering design and drawings of the RO-RO and passenger ferry terminals for both the locations are provided in this DPR.

5.3.1 RO-RO Terminal

A. MARINE FACILITIES

1. LAYOUT

The terminals at proposed locations have been designed to facilitate the efficient operation of both Roll-On, Roll-Off (RO-RO) and passenger ferries. A single ferry berth is provided at each site capable of handling all types of ferry vessels, but principally the combined RO-RO and passenger vessels which are expected to be the first vessels to use the terminals. An approach jetty is provided linking the berths to the shore allowing vehicular and pedestrian transfer between the shore terminal and the ferries. The layouts and designs that are shown in this and following chapters take account of the consultants' accumulated experience and in particular draw on the recommendations given in international design manuals and review of works carried out at other similar terminals.

The ferry berths are intended for use by vessels operating on regular ferry services to other terminals along the waterway and further afield, but the designs do not preclude use by other vessels should that be appropriate. However, in order to minimise their initial capital cost attributable to the ferry service, separate berths sharing the approach jetty with the ferry traffic may be provided for use by other shipping lines.

2. RO-RO BERTH

Where possible the RO-RO berths are positioned in sufficiently deep water to allow RO-RO vessels to have safe access to and from navigation channels at all states of the tide.

The berths are aligned at an optimum orientation to resist the prevailing sea generated loading conditions. The most significant in this respect will be current flow because this would be present, albeit at different velocities, for most of the time. It will also be necessary to consider storm wave attack. Since the berths are being constructed in the river, the effect of storm waves will be considerably less as compared to open sea conditions.

The terminal provides a berth for a single RO-RO vessel either alongside a jetty structure or against discrete berthing dolphins. In all case fenders are being provided to enable berthing to take place in most conditions without damaging either the vessel or the berth. Bollards are being provided along the length of the berth for the vessel to tie up and remain safely during loading and unloading operations. The layout of the berth is planned to suit the operational requirements of a wide range of ferry types. However, the requirements of ferry operators vary considerably and the RO-RO facilities are designed to suit the needs of specific vessels where these have already been identified.

3. LINKSPAN

A link is necessary between the ferry and the fixed shore installation. In essence this is a bridge supported at one end on the fixed jetty structure and at the other on the ferry or some other structure allowing the level to vary with tide and ferry configuration. It is required to provide for a single lane of traffic and be capable of carrying the heaviest vehicles which are expected to use the ferry. The slope of the link will vary according to the state of the tide and the vessel configuration, and the length of the bridge is chosen so that the gradient under normal conditions does not exceed 1:10. A steeper slope will occur under rarely occurring extreme low water conditions and will generally be acceptable, but it is possible that operations could be suspended for short periods.

In practice, the ferry is not capable of supporting the weight of the bridge and the traffic on- it, and the seaward end of the bridge must therefore be supported by other means. Typically the bridge may float on a pontoon or inbuilt buoyancy, or be supported from a fixed gantry with some means of adjusting the level. The bridge itself will be steel to reduce weight and may take any form, but will usually be a truss or box girder.

Fixed support at the seaward end will result in the lightest bridge structure, but this will be at the expense of a complex hoist system for controlling the level of the bridge. In general such a system is only justified in the most intensively used facilities serving vessels without stern ramps, and we have therefore chosen a buoyant system of support. Such a system will require much less maintenance. Such a system has the additional advantage that there is considerable degree of natural level control, and the consequence of any mechanical or electrical failure is much less critical. It is possible to provide support either in the form of a separate pontoon, on which the outer end of the bridge rests, or provide buoyancy tanks within an enlarged structure at the outer end of the bridge itself: We have opted for this latter solution as being the most economic, the weight of the bridge with tank being significantly less than the combined weights of pontoon and simple bridge. The enlarged tank section, which will coincide with the wider section of the bridge needed to serve the ferry will also contain a system of pumps which will be used to control and adjust the level of the bridge to suit individual ferries and tide levels.

For the bridge structure itself, we have selected a box girder design. This is now a standard form of construction, resulting in a light and economical structure. It is particularly suited to the marine environment in that the clean lines allow for easy maintenance. The box girder form allows the width of the bridge to vary, allowing the ship end of the link to be wider, providing access across the full width of the ferry; it is designed to support a short ramp from the ship. The buoyancy tank, which is an integral part of the structure, will be of similar construction and will contain a machinery room housing the pumping system.

The inner end of the bridge is supported by a hinge system mounted on a part of the jetty structure. This hinge will allow principally for the rise and fall of the linkspan in response to tidal changes, but will also allow horizontal movement to the extent permitted by the restraining structures at the ship end. A buffer system between the linkspan and the hinge will absorb impact forces from ship contact. Design of the supports and bearings of the linkspan will be carried out to achieve robust fixity and degrees of freedom where necessary; - good inspection and maintenance will be necessary in use.

The same design is used at Noorpur, Gadiara and Geonkhali simplifying spares and maintenance; if necessary, linkspans could be interchanged. The ramp will require a power supply for level adjustment and a backup supply is provided; however the ramp itself is not at risk in the event of power failure.

4. APPROACH JETTY

The berth is connected to the shore terminal by an approach jetty. The total width of jetty is kept as 10.0 m which also consists of 1.5m wide pedestrian access/walkway and 1.0m wide strip for services such as electrical cables, water pipelines and telephone lines etc. This approach provides access to the RO-RO berth as well as any other berth constructed at the jetty head.

5. UTILISATION

It is intended that a regular service can be operated on a timetable without undue restriction by tidal conditions. Although the prevailing weather conditions are such that vessels will be able to operate for most of the year in the waterway stretch, it must be recognised that there will be some weather related downtime at all of the terminals. It would simply not be economic to construct the infrastructure to enable operation in all weather or tidal conditions. In the event of the most severe river/weather conditions, operations would cease in the terminal and storm control measures would have to be taken to ensure survivability of the structures.

The RO-RO berth has been designed to be as versatile as possible, permitting use by a wide range of vessels although the detailed design is based on specific vessel. This will provide the opportunity for the operation of as many ferry services as possible. In common with most modern ferry terminals the berths will be designed to serve vessels with their own stern ramps. This covers the vast majority of RO-RO vessels currently in operation and will include provision for berthing of single and double door RO-RO vessels. It will not be possible to accommodate vessels without stern ramps without major modifications.

All roadways are designed to support road going trucks, buses and terminal trailer units. Suitable turning areas are provided for vehicles close to the berth with sufficient road space for vehicles to embark and disembark from the vessels. There will also be a setting down and picking up area for passenger buses alongside but clear of the main carriageway.

6. SAFETY

The berths and approach jetties are provided with appropriate safety equipment including lifesaving equipment, ladders and safety rails. The roads will be marked in lanes as appropriate and signs will be installed to direct traffic.

Navigation lights are located on the berth to mark its position and suitable ships to shore communications are provided for operational control of vessels at each terminal.

Pedestrian walkways are segregated from vehicle carriageways between the passenger shelter on the jetty and the ferries. The walkway along the jetty is marked by a kerb; this walkway is for general use by the public, and it is the intention that all foot passengers will use the walkway, to and from the ferry. Safety parapets or hand railings are provided along the edge of all roadways.

A detailed set of procedures will be prepared for the safe operation of the link between the ferry and the shore.

At all terminals, a fendering system will be incorporated to cater for both normal berthing impacts and abnormal accidental ship impact.

7. SERVICES

There will be a small operations, maintenance and storage room within the terminal building. This room will contain equipment necessary for operation of the link as well as spare parts and emergency equipment.

The electricity supply to the berth will be sufficient for power requirements of the operating equipment as well as flood lighting at the berth and lighting of the approach jetty and a standby generator will be installed in the terminal complex providing sufficient power for basic lighting and operation of the jetty and linkspan infrastructure. There will be a water supply piped to the berth to enable servicing of the vessel, cleaning and other incidental use. A telephone connection will be installed for direct communication with the shore terminal.

Facilities for reception of wastes from the ferries will be installed adjacent to the berth. A fuel supply will also be installed close to the berth to enable fuelling of vessels from storage tanks on shore.

B. SHORE FACILITIES

The various facilities to be developed on the shore may be grouped in three major sections:

1. Building facilities;
2. Infrastructure (service) facilities;
3. Customs and BSF Office

1. BUILDING FACILITIES;

The following facilities are proposed in the terminal building:

i) Ticketing cabin/window
ii) Waiting area/ Rest rooms
iii) Central administration block and canteen;
iv) Electrical sub-station and switch yard
v) Service buildings such as: workshop, fire station, telephone exchange, emergency medical centre, etc;
vi) Drivers'/terminal staff room
vii) Other buildings related to functional need of the onshore facilities such as: security cabins, compound wall etc.

2. INFRASTRUCTURE (SERVICE) FACILITIES

These are support requirements for buildings with a high functional priority and they are listed below.

i) Roads and parking facilities;
ii) Water supply system;
iii) Storm water disposal system;
iv) Sewage disposal system;
v) Electricity, including emergency power system;
vi) Fuel storage and supply system (not at every terminal);
vii) Telecommunication system including wireless network and PA system;
viii) Fire protection arrangements

Certain basic services such as power, water supply, etc. which are sourced from the public supply outside the terminal may need upgrading to satisfy the additional demand imposed by the terminal.

3. Customs and Security Office

As the RO-RO services are proposed for cross-border trade between India and Bangladesh, Customs and security office is also proposed. However, it is recommended that the government owned existing terminal building shall be used for these facilities.

5.3.2 Passenger Ferry Terminal

A. RIVER SIDE FACILITIES

1. LAYOUT

The passenger terminal at proposed locations is designed to facilitate the efficient operation of passenger ferries. A single floating pontoon platform is provided for berthing of ferries at each site capable of handling all types of proposed ferry vessels. A gangway & approach platform is provided linking the berthing pontoon to the shore allowing pedestrian transfer between the shore terminal and the ferries.

The ferry platform are intended for use by vessels operating on regular ferry services to other terminals along the waterway and further afield, but the designs do not preclude use by other vessels should that be appropriate.

2. GANGWAY

A Gangway is passageway through which to enter or leave. It is an articulating bridge or ramp, such as from land to a dock/platform or a ship.

The gangway is envisaged at proposed terminal to embark and disembark of passengers and small vehicles form the terminal to the vessel. The gangway proposed shall be of 16 m length and 2.2 m wide for the placement of the hoses and the man movement. The gangway shall be designed considering OSHA and other relevant standards. The gangway shall be built according to the rules and regulations of Indian Register of Shipping.

A number of factors have to be considered for the proper design:

- Environmental impact„
- Wind loads
- Tidal Fluctuations and traffic
- Present and future vessels to be served

Periodic maintenance shall be performing to ensure safe operation of the gangway. Gangway shall be designed using only the best materials and components, together with intelligent design and to reduce maintenance.

Gangway shall be constructed with shore side pivot and fixed to landing pontoon with hooks and pin allowing vertical motion during tidal fluctuations.

The installation of gangway shall be with Roller arrangement on pontoon and on yoke foundation on the bank/Approach platform.

Steel used for construction of gangway shall confirm to IS 226 – 1975 or IS 2062 – 1984. All electrodes are to confirm to relevant Indian Standard and IRS Rules. The gangway shall be of all welded construction. The skilled welders and updated technology shall be utilised for undertaking construction of gangway.

All the internal and external surface of gangway shall be thoroughly cleaned and painted to prevent corrosion. Minimum Two coats of anti-corrosive paints shall be done following one coat of zinc chromate primer.

3. <u>PONTOON</u>

A pontoon also known as a floating platform uses floats or shallow-draft boats to support a continuous deck for pedestrian and vehicle travel. The buoyancy of the supports limits the maximum load they can carry. The level of the pontoon will vary as per the tide variations. Floating pontoon shall provide the support to the other end of the approach bridge and also provide berthing to the passenger ferries. The pontoon is to be stationed at proposed terminal locations along river. The pontoon will be moored at site via sets of catenary and anchors. The pontoon shall be suitably chained anchored to the river bed for the horizontal & vertical stability.

The main particulars of the pontoons are:

Type of Pontoon Box type steel all welded

- Length = 20.0 m
- Breadth = 10.0 m
- Moulded Depth = 1.6 m
- Draft = 0.7 m

Classification, Regulation and Certificates

The pontoon shall be designed and built in accordance with the requirements of the rules and regulations of:

a) IRS (Indian Register of Shipping) or any Classification Society who is member of International Association of Classification Society (IACS)

b) The Inland Vessel Act 1917 and as amended in 2007.

The Pontoon shall be built under the inspection of the above mentioned Classification Society and to be classified as a pontoon suitable for inland waterways.

Trim and Stability

The Pontoon shall comply with IMO's stability requirements. The Pontoons shall not have any trim by fore in any of the operating loading conditions.

Hull Structure

The pontoon is to be shaped with rounded corners and swims ends. The hull is to be divided into three watertight subdivisions.

Scantlings

The steel to be used is to be of IS 2062 Grade B or equivalent and classification society shall carry out necessary testing of the samples of steel as required by class. The welding is to be of excellent quality and using high quality electrodes. The hull scantlings are to be not less than given below:

Plating

- Bottom Plating 8mm
- Side plating 6mm
- End bulkheads 6mm
- Internal bulkhead 6mm
- Deck plating 6mm chequered plats
- Tank boundaries 6mm

Profiles

- Bottom longitudinal 1A 75x75x8
- Side shell stiffeners 1A 65x65x6
- Deck longitudinal 1A 65x65x6
- Bulk head stiffeners 1A 65x65x6/ 1A 100x100x10

The Pontoons shall be built with shipbuilding quality steel of IS-2062 Grade "B" or equivalent with all welded construction. Necessary hull preservation and painting to be carried out as per shipbuilding practice. The hull shall have the following layout from forward to aft:

In general the hull shall be built of steel from keel to main deck according the transverse/ longitudinal framing system. Scantlings of all structural members shall be as per IRS requirements. Approved shipbuilding quality material is to be used throughout the construction. Sharp corners are to be avoided. Good continuity of structural members in basic hull structure should be maintained.

Flanging of plates and brackets, in general, shall not be allowed. For bolts only drilling is allowed. Before the steel plates and rolled sections are used for construction, rust and mill-scale must be removed by means of sand/grit-blasting. Immediately after the steel sand/grit-blasting, one coat of rich shop primer with a thickness of minimum 25 microns is to be applied as a temporary protection.

Bulkhead

All watertight bulkheads shall be plated horizontally. Vertical stiffening shall be provided with the stiffeners spaced as per frame spacing.

Hull Opening, watertight doors and hatches

All hull openings wherever provided shall be in accordance with IRS rules. Watertight doors and hatches are to be provided where necessary and shall comply with the rule requirements.

All manhole and hatches are to be 600 x standard size. Hatches are to have a coaming of at least 450 mm and all manholes are to be provided with water right covers bolted on to 1A 100x 100xS profiles welded around the opening. The bolts have to be of at least M16 size.

One drain plug below every tank is to be provided

Hull Outfit and Deck Equipment

Anchor and Mooring Arrangement

The pontoon deployed on the river is to encounter current of maximum 2m/sec during flood. Therefore suitable mooring arrangements along with anchors are to be provided for sustaining the above conditions. The winches, anchor chain, mooring ropes, shackles etc. shall be as per the IRS class requirement. The requirement of mooring at shore with appropriate arrangement through steel wire rope of adequate dia shall also be provided.

Anchor Winches

Electrically operated anchor winch to be installed on both sides of required size shall be provided. Winch also suitable for manual operation. The anchor winch to have one chain pulley/sprocket and one warping head. Lined brakes and couplings to be provided for independent operation of the pulley and the warping head.

Dock Machinery

Necessary windlass to be provided for the handling of anchors of 600 kg each. 2 numbers hand operated davits of 1.5 ton SWL each to be provided conforming to IS 5386 (1969).

Ladders

One wooden ladder to be provided for embarking/ disembarking from the Pontoon.

Bollards

Adequate double bollards to be provided on the main deck distributed on the port and starboard side for effective mooring. The bollards placed in heavy foundations with a height of about 200 mm. Total height of the bollards 500 mm. Deck construction in way of bollards shall be reinforced with increased plating thickness and extra stiffeners.

Fenders

Steel fenders of 300 mm dia (6 mm thick) are to be provided on either sides for 95 percent of the length of pontoon. Tyre fenders of sufficient size are also to be provided on both sides in such a manner that the spacing between them does not exceed 1250 mm. Lugs of not less than 16 mm to tie up these tyres are to be welded to the sides.

Accommodation

One cabin on deck suitable for two people for watch & ward and for keeping consumables, stores, etc. Placement of cabin shall be such that the working area is kept clear.

General arrangement and dimension plan of Pontoon is provided in Annexure -5 Drawings.

4. APPROCAH PLATFORM

At all proposed terminals an approach platform shall be constructed (onshore) which shall connect the terminal building to the approach bridge and thus to the pontoon platform as shown in drawings provided in Volume-II.

It is intended that a regular service can be operated on a timetable without undue restriction by tidal conditions. Although the prevailing weather conditions are such that vessels will be able to operate for most of the year in the waterway stretch, it must be recognised that there will be some weather related downtime at all of the terminals. It would simply not be economic to construct the infrastructure to enable operation in all weather or tidal conditions. In the event of the most severe river/weather conditions, operations would cease at all terminals and storm control measures would have to be taken to ensure survivability of the structures.

5. SAFETY

The Pontoon, Gangway and approach platform are provided with appropriate safety equipment including lifesaving equipment, ladders and safety rails. The passenger's walkway will be marked in lanes as appropriate and signs will be installed to direct.

Navigation lights shall be placed at suitable locations for operation of the terminal in low lights.

A detailed set of procedures will be prepared for the safe operation of the link between the ferry and the shore.

At both terminals, a fendering system on pontoon will be incorporated to cater for both normal berthing impacts and abnormal accidental ferry impact.

Facilities for reception of wastes from the ferries will be installed adjacent to the berth. A fuel supply will also be installed close to the berth to enable fuelling of ferries from storage tanks on shore.

B. SHORE FACILITIES

The various facilities to be developed on the shore may be grouped in three major sections:

1. Building facilities;
2. Infrastructure (service) facilities;

1. BUILDING FACILITIES;

The following buildings are provided at each terminal:

i) Passenger terminal building (with embarking and disembarking facilities);
ii) Ticketing cabin/window
iii) Waiting area/ Rest rooms
iv) Terminal staff room

2. INFRASTRUCTURE (SERVICE) FACILITIES

These are support requirements for buildings with a high functional priority and they are listed below.

i) Roads and parking facilities;
ii) Water supply system;
iii) Storm water disposal system;
iv) Sewage disposal system;
v) Electricity, including emergency power system;
vi) Fuel storage and supply system (for ferries);
vii) Telecommunication system including wireless network and PA system;
viii) Fire protection arrangements

Certain basic services such as power, water supply, etc. which are sourced from the public supply outside the terminal may need upgrading to satisfy the additional demand imposed by the terminal.

5.4 LAND DETAILS

As detailed earlier, M/s River Waterlink Pvt. Ltd. acquired 6.0 hectare of land on left side of existing ferry ghat on Basirhat side of the river for RO_RO terminal operations. Existing ferry services at both Basirhat and Itinda are operational on Govt. land. No additional land is required to be acquired for terminal construction.

5.5 GEOTECHNICAL INVESTIGATIONS

For preliminary engineering design, the data about soil characteristics is collected from the local sources based on the basis of structure constructed near by. On the basis of visual inspection as observed during site visit the top layer of the area (around 2.5 m depth) is covered with fine river sand. During project execution, detail geotechnical investigation may be done for detail engineering.

5.5.1 Regional Geology

The district of North 24 Parganas of West Bengal, India, lies in the southern part of the Bengal Basin. The basin is actually a peri-cratonic basin and comprises of Ganga-Brahmaputra delta in the southern part. It had broken from the Gondowana land along the margin of the Indian plate and then moved northerly in the early Cretaceous (125Myr ago) period. The collision of the Indian plate and European plate began in the early Eocene (40–41 Myrs ago) period and resulted in the formation of the Himalayas. Due to this, the two sediments from the Ganga and the Brahmaputra Basin got merged subsequently. Relatively recent folding and uplifting (Quaternary epoch) of the Brahmaputra sediments close to the intraplate boundary have redirected the course of the Brahmaputra to its present configuration.

The Ganga-Brahmaputra delta thickens towards the south and has three stratigraphic sequences–the proto - Ganges delta, the transitional delta and the modern delta (created 11Myrs ago) with a successive sequence of sand, sandy mud, silt and mud which were deposited under a major eustatic sea level about 11 Myrs ago. The modern delta has been formed primarily from alluvial sediments transported by the rivers originating from the Chotanagpur Uplands in the west e.g. the Mayurakshi, the Ajoy, the Damodar etc. and subsequently by the rivers flowing from the Himalayan foredeep basin from the north e.g. the Ganges, the Padma, the Bhagirathi, the Brahmaputra etc. when a gap named as the Garo -Rajmahal gap, was created due to tectonic movements. Arsenic contaminated groundwater occurs in the modern deltaic sediments.

In the present study area, the main water bearing formations are Quaternary formations which chiefly comprises of Recent and Pleistocene alluvial deposits and aquifer materials comprising of sand of varying grades and gravels. Thus ground water occurs within water table and in semi confined to confined conditions.

5.5.2 Physical Condition and Drainage

The drainage capabilities of the canals, rivers etc. located in the district have been reduced due to unplanned manmade activities and some ecological changes like silting of the rivers etc. So, the flood/heavy water logging has been common occurrence every year in the most parts of the aforesaid sub-divisions. Similarly, Cyclone and High tide has been commonly found in the riverine belts of Basirhat sub-division.

5.6 TERMINAL INFRASTRUCTURE INCLUDING EQUIPMENT

IWT Terminals proposed to be constructed with the following infrastructure facilities for operations.

a) Floating Pontoon
b) Gangway,
c) Approach platform,

d) Operation cum Administration Building including custom office,

e) Parking area.

As per the scope of work mentioned in ToR preliminary engineering design is done in the DPR. The detailed engineering & design of terminals shall be carried out during the construction stage. The preliminary layout shown in **Volume-II** drawing is proposed for the DPR purposes only.

All facilities required for RO-RO operations to Bangladesh will be designed, developed and operated by M/S River Waterlink Pvt. Ltd. However, tentative layout and detailing for RO-RO terminal, on the basis of data provided by M/s River Waterlink Pvt. Ltd. is provided in the DPR.

Also, major facilities provided at proposed terminals for safe and efficient terminal operation for passenger services are discussed in detail as below:

5.6.1 Terminal Building

The following terminal buildings are proposed for the IWT terminal:

1. <u>Terminal Operation cum Administration Building</u>

It will be single building housing the following:

- Administration wing of the terminal including documentation
- Terminal operations wing

It is assessed that the terminal operation cum administration building shall be of size 20m X 27m (including exit corridor) and will have a total floor area of 540 sqm.

2. <u>Security Office</u>

This will be a single storied building/office for security personnel at the entrance of terminal premises of size 4.5m X 5m.

3. <u>Electrical Sub-station</u>

The electrical panel cum control room of suitable size 5m X 4m shall be located inside admin building preferably at the ground floor.

4. Overhead water tank

The overhead water tank above terminal building to cater need of the daily water demand required for terminal staff and passengers. The minimum capacity of the overhead tank shall be 60 m^3 or the two days requirement whichever is higher.

5.6.2 Boundary Wall / Fencing

It is proposed to provide boundary wall of 2.4 m height using brick masonry with barbed wire fencing. The boundary wall shall be provided along the periphery of the terminal area.

5.6.3 Sewerage System

Sewerage system for the IWT has been proposed considering the requirement of the proposed terminal vis-à-vis the development control regulation. An independent system has been proposed for the terminal considering the new CRZ regulation.

SYSTEM PROPOSAL

With the above, proposed sewerage system for the terminal area has been prepared. Features of the system are as below:

- A fab based package STP of 12 KLD or 12 cum/day are proposed for the sewage generated from the terminal building, etc. However capacity of 12 KLD is draft only and may vary during detailed engineering as per the requirements of the system.
- Sewage from the independent building unit to STP will be conveyed through underground conduit;
- Conveyance of flow will be through gravity only;
- Inspection chamber of each building unit will collect the sewage of that unit. Thereafter the same will be conveyed to the nearest sewage collection pit/ manhole connected to the main sewer line of STP. Manhole will be proposed when the length of individual sewer line is more than 30m;
- The treated effluent from STP will be collected in a treated effluent tank. The same will then be utilized for gardening and in case of any surplus that will be discharged to the drainage network along the access road outside the western side of terminal boundary;

- The sludge coming out from the treatment plant will be taken to centrifuge and converted into sludge cake, which may be used as manure.

5.6.4 Firefighting System

For terminal building, Electrical room and other building Dry type fire extinguishers will be provided. Beside above, a continuous back up support will be provided by fire tenders round the clock are envisaged for the firefighting system.

The complete firefighting system shall be designed as per standard guidelines & codes. The system provided shall cater to the terminal area. However, for future developments, separate dedicated firefighting system may be required based in the future requirements.

Portable Fire Extinguishers (PFE)

Portable Fire extinguishers (PFE) are small hand held appliances that are used to put out fires in the very early stage of their inception. There are different types of extinguishers in use and their classification is based on the types of fires on which they are effective. Hence an understanding of the types of fire is very essential in selecting the appropriate type of extinguisher for use in a particular location.

Quantity

As per TAC (Tariff Advisory Committee) at least two extinguishers are to be provided in every area/ room. The appliances are to be so distributed over the entire floor such that a person has to travel not more than 15 metres to reach the nearest appliance.

As per TAC Guidelines - For any property, basic protection shall be appliances suitable for class A fires, since class A fires are of universal character.

Where class B fires are anticipated, a suitable number of appliances as determined above shall be replaced with appliances suitable for B class fires.

As a thumb rule the requirements specified above would mean approximately 2 extinguishers for every 600 m^2 of floor area or part thereof which would however be slightly less in case of light hazard occupancies having larger than 600 m2 floor area in a single fire compartment.

In rooms containing only electrical equipment such as electrical transformers, switch gears, motors or other electrical apparatus, not less than 2 KG Dry Powder or carbon Dioxide type extinguishers are to be provided within 15 metres of the apparatus.

In rooms containing motors and/or other electric equipment along with other machineries or facilities one 5 Kg. DCP or Carbon Dioxide extinguisher is to be installed within 15 metres of the equipment in addition to the requirements that were earlier specified.

<u>Location</u>

Generally Portable Fire Extinguishers (PFE) are to be placed (wall mounted) as near as possible to exits or staircase landings by also taking into consideration (wherever possible) the normal routes of escape of persons. Placing PFE in such positions will enable these to be seen by persons following the natural impulse to get out of danger.

Standards further prescribe that PFE's be so located that the top of the extinguisher is located at a height of 1.5 metres from the finished floor level or that the bottom of the extinguisher is located at a height of 1 metre from the finished floor level.

Based upon the above the Selection of Fire Extinguishers shall be as follows

A. For Terminal Operation cum Administrative Building

a. Ground Floor:

Type of Fire Extinguishers Selected : 2 X 5kg, CO_2 (Type ABC) inside office Area
(ii) 1 X 5kg, DCP (Dry Chemical powder) Type C inside Electrical panel /Control room

B. Car/Vehicle Parking Area

Type of Fire Extinguishers Selected : 2 X 5kg, DCP (Dry Chemical powder) Type C

5.7 BERTHING STRUCTURE (FLOATING PONTOON)

The berthing structure for Ferry terminal proposed for Ichamati waterway on both the river banks at Itinda and Basirhat Ghats should have:

- Berthing facility for ferries,
- Facilities boarding/de-boarding of passengers,
- Land based facilities for passenger's movement, ticketing, waiting, etc.
- Scope for future development.

In order to work out the pontoon requirements to meet the projected requirement, it is necessary to define the following governing parameters:

- Ferry Size
- Passenger traffic
- Number of operational days per year
- Number of ferry trips per day
- Effective working hours per day
- Time required for peripheral/other activities

All the proposed facility shall connect terminal area to pontoon platform as shown in Layout drawing.

5.8 TERMINAL COSTING

Cost for development of RO-RO Jetty, land acquisition and other necessary amenities required for RO-RO operations will be borne by M/s River Waterlink Pvt. Ltd. as stated earlier. The cost estimate for proposed development of passenger ferry services at the banks of Itinda and Basirhat Ghat, including O&M of the system has been worked out. The cost estimates for development of the system are considered as Capital cost while for operation of the system is termed as maintenance or operating cost (O & M cost).

5.8.1 Capital Cost

Capital cost for proposed ferry terminal is provided in **Table 18** respectively.

Table 18: Capital Cost for Ferry Terminal

Sl. No.	Facilities	Unit	Quantity	Unit Rate (INR)	Cost (INR Lakh)
1	Gangway	no.	1	17,50,000	17.50

Sl. No.	Facilities	Unit	Quantity	Unit Rate (INR)	Cost (INR Lakh)
2	Pontoon platform with all required accessories	No.	1	50,00,000	50.00
3	Passenger Arrival Area/ Bus Car Drop Off Area Outside terminal building (11.5m X 27 m)	m^2	311	40,000	124.40
4	Approach Platform (3m X 7 m)	m^2	21	75,000	15.75
5	Control Room Equipment's including navigation control equipment's	No.	LSM	50,000	0.50
6	Telecomm. Room Equipment's	lot	LSM	1,00,000	1.00
7	Operating Building (20m X27m) (single storey) (excluding Passenger arrival area)	m^2	540	40,000	216.00
8	Ticket vending Machine & installation cost	No.	1	4,00,000	4.00
9	Automatic Fare collection gates (4 X 2 at Entry gates + 4X1 at Exit Gate)	No.	2	3,00,000	6.00
10	Passengers Arrival Area facility (example ramp, railings, guideways, waiting sheds etc.)	lot	LSM	5,00,000	5.00
11	Visitors parking Area (15m X 10 m)	m^2	150	18,000	27.00
12	Passengers Waiting Chairs	No.	50	2,500	1.25
13	Substation	No.	1	10,00,000	10.00
14	Fire Fighting System (dry type)	lot	LSM	2,50,000	2.50
15	Electrical, Water& Utility	lot	LSM	12,50,000	12.50
16	Security Office (4.5m X 5m)	m^2	22.5	18,000	4.05
17	Sewerage Treatment System	No.	1	25,00,000	25.00
				Total	**522.45**
18	Cost of Detail Engineering	4%			20.90
19	Construction supervision	6%			31.35

Sl. No.	Facilities	Unit	Quantity	Unit Rate (INR)	Cost (INR Lakh)
				Total	**574.70**
20	Contingency		3%		**17.24**
	Total Capital Cost for one Terminal in INR Lacs				**591.94**
	Total Capital Cost for two Terminals in INR Lacs				**1,183.87**

5.8.2 O&M Cost

Operation and Maintenance cost to be incurred for running terminal facilities for ferry terminals are provided as below.

a) Manning

The efficient IWT operation requires a substantial number of staff. These include:-

- The Management comprising the Terminal Manager, Operating Superintendent and their deputies;
- The operating staff comprising Terminal Manager, traffic marshals etc;
- The Accounts Department comprising the Financial Manager and clerical assistants;
- Security Staff comprising the Security Chief and security officers
- Maintenance Engineering Staff comprising the maintenance engineer, his deputy, mechanical, electrical and civil engineers, foremen, fitters, welders, electricians, plumbers, joiners, painters, riggers and their mates and labourers;
- Administration staff comprising administrators, personnel, property managers, their assistants, secretaries and cleaning staff.

The total number of staff required to operate both the terminals on a single shift basis (excluding staff required for RO-RO operations) is estimated as provided in **Table 19.**

Table 19: Manpower Requirement for IWT Terminal Operation

Sl. No	Staff	Numbers
1	Management	1
2	Operating Staff	6
3	Accounts Staff	4
4	Security Staff	8
5	Maintenance Engineering Staff	4
6	Administration Staff	4
7	Misc. Staff for Field Works	4
	Total	**31**

Table 20: Manpower Cost per annum

Sl. No.	Location	No./Shift	No. of Shift required	Total no. of Personnel required	Rate (INR)	Cost (INR) in Lacs
1	Terminal Manager	1	1	1	10,00,000	10.00
2	Terminal Operational staff	6	1	6	5,00,000	30.00
3	Security Office	4	2	8	3,00,000	24.00
4	Accounts	4	1	4	5,00,000	20.00
5	Control Room	4	1	4	4,00,000	16.00
6	Plumper & Electrician	2	2	4	4,00,000	16.00
7	Misc. for Field Works	4	1	4	3,00,000	12.00
	Total			**31**		**128.00**

From the above table, the total annual manpower cost required for running the passenger ferry services at Itinda and Basirhat Ghat works out to **INR 128.00 Lacs annually**.

b) Utilities and Services

The annual cost of providing water, electricity and other services is considered as about 1.0% of the capital cost. Thus, the annual cost for providing Utilities and Services works out as **INR 11.84 Lacs.**

c) Maintenance

To ensure that the terminals are kept in an efficient and safe condition, it will be necessary to ensure that money is set aside for annual maintenance. In the first four years of operation, maintenance costs are comparatively low but would then build up as structures and equipment begin to be affected by wear and tear.

In the first four years, the maintenance staff might consist only of fitters, electricians and plumbers together with their mates all under the control of a general trades foreman. Their duties would be to deal with breakdowns in the mechanical and electrical equipment as well as the water supply system. In the fourth year, it would be advisable to provide a fully equipped workshop where equipment can be repaired and serviced. The workshops would provide storage space for spare parts and would provide a base for all maintenance staff.

The annual cost of maintaining terminal structures including all civil, mechanical and electrical components is considered to be about 3% of the capital cost. Thus, the annual maintenance cost for all the terminals from fifth year onwards works out as **INR 35.52 Lacs.**

The total O&M cost of proposed terminals are provided in terminal **Table 21** below

Table 21: Annual O&M cost of terminals

Sl. No	Item	Cost (INR) Lacs
1.	Manpower	128.00
2.	Utilities and Services	11.84
3.	Maintenance	35.52
Total annual O&M cost		**175.36**

6.0 PRELIMINARY ENGINEERING DESIGNS

The main objective of preliminary engineering is to ascertain quantitatively the feasibility of engineering works. Preliminary engineering is carried out to arrive at the preliminary sizing of all major facilities required at the terminal and waterway for safe navigation. The preliminary sizing, design and engineering of the facilities are presented in following sections.

6.1 RIVER TRAINING (INCLUDING BARRAGES AND LOCKS, IF PROPOSED)

As stated in the earlier sections, no river training works in the form of barrages, weirs or locks is required for the waterway.

6.2 BANK PROTECTION

As stated in the earlier sections, bank protection works is required for along the proposed RO-Ro terminal structure. Suitable stone pitching works is recommended for a length of about 200.00 m along the Basirhat bank of river.

6.3 NAVIGATION AIDS

The total navigation operation, ranging from arrival to departure, can be subdivided in to the following operations,

- Navigation through the waterway for 24 hours RO-RO opertaions.
- Arrival at Jetty
- Preparation for berthing, including possible turning of the ship and pre-berthing procedures
- Berthing including mooring, etc. to the berth structure
- Loading and unloading operation while at berth
- Departure from the Jetty

Navigation aids for the waterway and terminals are required to ensure safe and efficient navigation of ships navigating through the waterway and berthing/un-berthing at terminals.

These aids as listed below are proposed to be installed on land or in water for guidance to all vessels for safe and regulated navigation in channels, basin, berths and docks. The various types of navigational aids proposed for RO-RO and passenger ferry operations on Ichamati waterway is provided in detail in Chapter 8.

6.4 RO-RO AND PASSENGER FERRY TERMINAL

Preliminary engineering design required for DPR level costing and analysis for jetty, terminal structures and access infrastructure is done and provided as below for ferry terminals.

Following codes and standards are used for preliminary design of structures.

Civil Works:

- IS 4651 (Part 1-5): Codes of Practice for Planning and Design of Ports and Harbors
- IS 456 - 2000: Code of Practice for Plain and Reinforced Concrete
- IS 800 – 1984: Code of Practice for General Construction of Steel
- IS 2911: Code of Practice for Design and Construction of Pile Foundations
- IS 1893 – 2002 (Part 1): Criteria for Earthquake resistant design of Structures
- IS 9527 (Part 3): Code of Practice for Design and Construction of Port and Harbor Structures
- IS 875 (Part 3): Code of Practice for Design Loads for Building and Structures-Wind Load
- IRC-6: Standard Specifications and code of Practice for Road Bridges, Section 2 Loads and Stresses

Where applicable the following International Standards are referred

- BS 6349 Maritime Structures
- BS 8110 & 5400 Reinforced Concrete Structures
- BS 449 & API-RP 2A-WSD Offshore Platforms-Working Stress Design
- BS 5950 Structural Steel Work
- BS 8004 & 8000 Foundations
- MJ Tomlinson: Pile Design and Construction Practice, Fourth edition
- Joseph E Bowles: Foundation Analysis and Design, Fifth edition.

The objective of this section is to present design of marine & land side facilities required for development of RO-RO and passenger ferry terminal. The following are the main facilities required for operation of the terminal:

- Approach Jetty
- Link Span Bridge
- Parking Facilities

- Terminal Building

A. STRUCTURAL SYSTEM

The overall Layout showing location of facilities is shown in drawings provided in Volume II of this DPR.

The approach jetty is an open piled structure, 35 m long and 10 m wide with a deck elevation of +6.20 m CD. The pile spacing of 0.75 m dia pile is 5.0m in longitudinal direction and 4 m in transverse direction. Beams of 1.0m wide and 1.2m deep in both directions connect the piles. The deck slab, which accommodates the deck furniture, is 0.35 m thick. To accommodate the effects of berthing, arch fenders are proposed and the same is provided on fender wall of 0.35 m thick on either side of berth. Bollards are provided for safe mooring operations.

The link span bridge is a steel platform hinged on the jetty and free on the other end. The free end rests on a hydraulic system which enables vertical movement of link span bridge according to the water levels for safe terminal Operation

Truck parking facilities are provided on land. 6.0 hectare of land is available for the same. M/s River Waterlink Pvt. Ltd. has acquired the land and will develop it for RO-RO operations with its own time and cost.

A terminal building is provided with all facilities like ticketing room, waiting area, operations control centre, pantry and toilets.

B. CONSTRUCTION METHOD

The construction method proposed for jetty is as described below:

<u>PILING</u>

1) Drive steel liner up to refusal.
2) Bore inside the liner up to the founding level.
3) Lower Reinforcement cage and concrete the pile up to bottom of Pile muff.
4) Place sacrificial precast pile muff over the piles and concrete the annular space between the pile and pile muff.

ERECTION & CONCRETE WORK

1) After the in-situ concrete attains strength, place the precast pile cap U beams over the Pile muffs. Note that the Precast U beams are designed as part of permanent structure.
2) Concrete inside the U beam upto the soffit level of bottom slab.
3) After the in-situ concrete attains strength place precast planks and precast Fender wall panel over the U beams.
4) Cast the in-situ portion of the bottom slab.
5) On completion of concrete works fixtures like fenders, bollards, pipes and cable support system shall be installed
6) All equipment, pipes, cables, light poles shall be installed at the end.

C. DESIGN CRITERIA

LOADING DATA

The principal loads considered for design of various components are listed as below:

1) Dead Load
2) Live Load
3) Wind Load
4) Wave Load
5) Current Load
6) Berthing Load
7) Mooring Load
8) Seismic Loads
9) Temperature and Shrinkage Effects

The values of intensities of the above loads that have been considered in design are detailed in the following sections.

1) Dead Load:

The following unit weights are used in design

Reinforced Cement Concrete	2.5 T/m^3

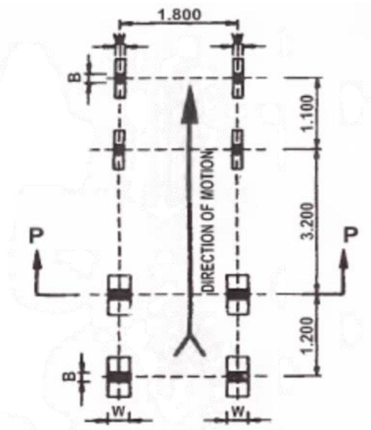
Structural Steel	7.85 T/ m^3
Density of sea Water, considered for tidal river	1.025 T/ m^3

2) Live Load:

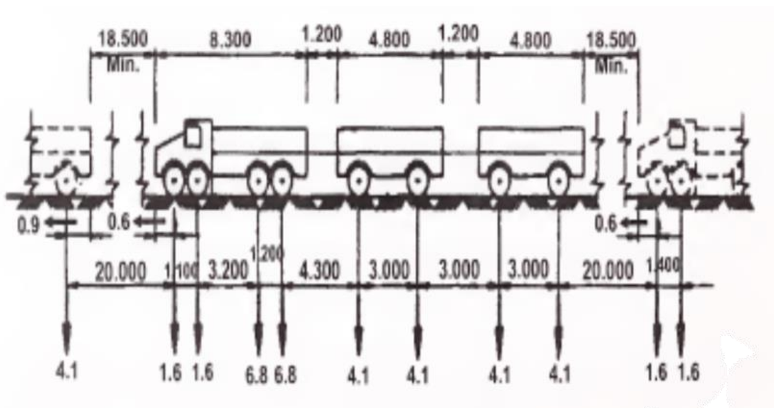
Live load on the jetty and approach structure is as per relevant Indian standards and the same is given below.

Load	**Intensity**
UDL – Jetty	25 kN/m^2
UDL – Terminal Building	5 kN/m^2

In addition to the above load the jetty and approach is also checked for Class B truck load as per IRC: 6-2014. The details of the same are presented below for ready reference



Driving Vehicle: Plan



Class B Train of Vehicles

3) Wind Load:

The basic Wind Speed in the region are as given below:

Operational Wind speed	24 m/s
Extreme Wind Speed	47 m/s

Based on the above parameters, the calculated wind pressures are as follows

Calculated Wind Pressure-Normal Condition	0.339 kN/m^2

Calculated Wind Pressure-Extreme Condition	1.3 kN/m^2

4) Wave Load:

Based on observed wave conditions, the effects of wave are found to be insignificant and hence not considered in design.

5) Current Load:

Design current velocity considered for calculation of current load is as given below:

Condition	**Velocity**
Operational	0.5 m/s
Extreme	1.5 m/s

Based on the above parameters, the calculated current force are as follows

Condition	**Load**
Operational	0.089 kN/m
Extreme	0.699 kN/m

6) Berthing Load:

The details of proposed ship are summarized below:

Length o.A.	70.0 m
Breadth moulded	14.50 m
Breadth main deck	15.54 m
Depth Main Deck	2.80 m
Draught max.	1.70 m
Lightweight estimate	710 t
Payload at Tmax	757 t
Air draft in operation	max 9.50 m

Based on parameters in design basis, Berthing load is calculated and the same is furnished below for ready reference.

Berthing Energy – Operational Condition	10.9 kNm
Berthing Energy – Extreme Condition	22 kNm
Recommended fender	Cylindrical 500 x 250
Fender Reaction – Operational Condition	136 kN
Fender Reaction – Extreme Condition	226 kN
Spacing of fender	10 m

7) Mooring Load:

Mooring load is calculated for the following conditions:

- Normal condition- Wind Speed at 18m/s & Current speed at 0.5m/s
- Extreme Condition- For full Capacity of Bollard (Recommended bollard Capacity is 50MT)

Based on parameters in design basis, mooring load is calculated and the same is furnished below for ready reference

Mooring Load – Operational Condition	56 kN
Mooring Load – Extreme Condition	431 kNm
Recommended Bollard	Pipe Bollard
Bollard Capacity	50 T

8) Seismic Load:

The site falls in Zone 3 as per seismic map of India presented in IS 1893 (Part I) – 2002. Design horizontal seismic coefficient is evaluated as per provisions mentioned in code for the following parameters

Zone Factor	0.16
Importance Factor	1.5
Response Reduction Factor	3

9) Temperature and Shrinkage Effects

The maximum and minimum temperature in site location is 41° and 7.2° respectively as per IS -875 part 5. Hence the mean temperature is 24.1°. Temperature during construction is considered mean temperature +/- 10°. Shrinkage strain in reinforced concrete elements is taken as 0.0002 as per IRC 6: 2010. Effects of shrinkage are also converted into equivalent temperature

LOAD COMBINATIONS

The structure will be analysed as per load combinations presented in IS 4651 (Part IV) – 2014 for ultimate limit state and serviceability limit state.

SL.No	Loading	Partial Load factor					
		Serviceability Limit State			Ultimate Limit State		
		Short Term	Long Term	Normal	Extreme/ Survival	Temporary	Reverse
1	Dead Load (DL)	1.0	1.0	1.5	1.2	1.2	0.9
2	Live Load –Dynamic (DyL)	1.1	0.5	1.5	1.2	1.2	0.9
3	Live Load –Static (LL)	1.0	0.5	1.5	1.2	1.2	0.9
4	Earth Pressure (EP)	1.0	1.0	1.2	1.0	1.0	1.0
5	Hydrostatic Force (HyF)	1.0	-	1.0	1.0	1.0	1.0
6	Wave & Current Force (WL-CL)	1.0	-	1..2	1.0	1.0	1.0
7	Berthing Force (BF)	1.0	-	1.5	1.0	-	1.5
8	Mooring Force (MF)	1.0	-	1.5	-	-	1.5
9	Working Wind Force (WWiF)	1.0	-	1.0	-	-	
10	Extreme Wind Force (EWiF)	-	-	-	1.2	-	1.5
11	Shrinkage	-	1.0	-	-	-	-
12	Creep	-	1.0	-	-	-	-
13	Temperature Load (TempL)	-	1.0	-	-	-	-
14	Seismic Load (SL)	1.0	-	-	1.2	-	1.5
15	Tsunami Load (TL)	-	-	-	1.2	-	-
16	Secondary Stress (SS)	1.0	-	-	-	-	-

SERVICEABILITY CRITERIA

1) Deflection Limit

Deflection of Pile at Pile cut-off level shall be L/350 under operating condition and L/250 under extreme condition, where L is the length of the pile from pile fixity to cut-off level.

2) Crack width Limit

Crack width in structural elements shall be maintained as per IS 4651 (Part IV) – 2014. The same has been reproduced here for ready reference.

Sl. No:	Exposure Zone	Maximum Crack width	
		Sustained	Transient
1	Atmospheric Zone (Above Splash Zone)	0.2 mm	0.3 mm
2	Splash Zone (Between CD & MHWS)	0.1 mm	0.2 mm
3	Continuous sea water immersion Zone (Below Splash Zone	0.2 mm	0.3 mm
4	Below Seabed Level	0.3 mm	0.3 mm

MATERIAL PROPERTIES

All reinforced cement concrete works shall be carried out with M40 grade concrete and reinforcement steel shall be of Fe500 grade. Clear cover to reinforcement shall be as per IS 4651 (Part IV) – 2014 which is as shown below.

Sl. No:	Exposure Zone	Clear Cover
1	Atmospheric Zone (Above Splash Zone)	50 mm
2	Splash Zone (Between CD & MHWS)	75 mm
3	Continuous sea water immersion Zone (Below Splash Zone upto sea	75 mm
4	Below Seabed Level	75 mm

DESIGN LIFE

The jetty and associated structure shall be designed for the following design life

Sl. No:	Structural Element	Design life
1	RCC Pile and deck superstructure	50 Years
2	Fender	8 Years

DESIGN METHODOLOGY

The structure shall be idealized in STAAD Pro with all mentioned loads and design criteria to analyse and design the structural elements. Fixity method shall be adopted in modelling of piles. All design is based on IS 456-2000 and IS 2911 (Part 1/Section 2) – 2010.

D. METHOD OF ANALYSIS

The following software have been used in design

- STAAD Pro V8i

STRUCTURAL STAAD MODEL

3-dimensional STAAD model has been idealized for each of the structure envisaged. Piles and beams have been modelled as beam elements while deck slab is idealized as plate elements. Length of the pile has been assessed based on sea bed level as presented in available data. The following figures give an in-sight of the modelling undertaken for analysis.

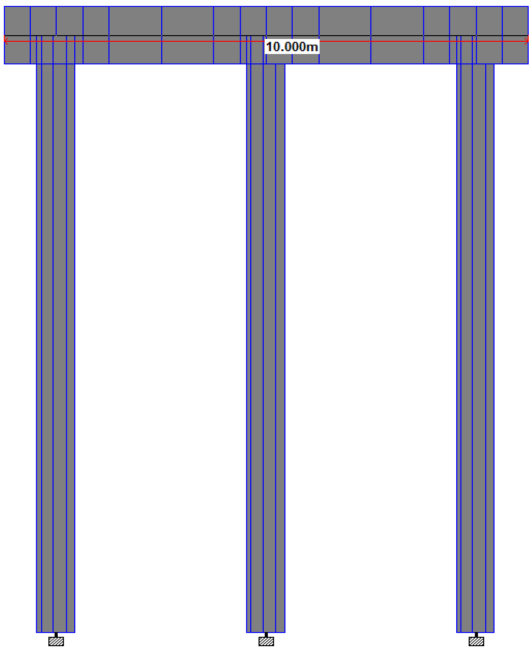


Figure 26: 2D View of STAAD Model – Approach Jetty

P-Δ analysis is carried out on the idealized model to include secondary effects. All possible loads and load combinations as per IS4651 (Part 4): 2014 is considered and applied in a logical way to analyse the structure to determine the design forces.

Limit State Design Method is used for design of structural components. All possible limit states are checked which includes serviceability and collapse limit states.

Design of piles

Design of longitudinal and helical reinforcement of pile is done as per IS: 456-2000 & SP 16. Piles are checked for all possible severe combination of resultant forces and design for governing forces.

Development length (Refer IS: 456-2000, Cl. 26.2.1)

Development length,	L_d	$= \Phi\ \sigma_s / 4\ \tau_{bd}$
Bond stress,	τ_{bd}	= 1.9 MPa

60% increase in bond stress for deformed bars (Refer IS: 456-2000, Cl. 26.2.1.1)

Hence, Design Bond Stress		= 3.04 MPa
Stress in bar,	$\sigma s = 0.87\ f_y$	= 435 MPa
	L_d	$= 35.8\ \Phi$
	Say	$= 36\ \Phi$

6.5 CONSTRUCTION SCHEDULE

The time schedule for construction activities of the project is considered as two (2) years. The proposed project schedule is provided in **Figure 27.**

Sl. No.	Activities	1st Year	2nd Year
1	Approval of DPR and Project Financial Closure		
2	Environmental, Forest and CRZ clearances		
3	Fairway development		
a)	Procurement of Hardware and other equipment's		
b)	Capital Dredging		
4	Procurement and installation of Aids to Navigation		
5	Setting up of IWT terminals		
a)	Land Development		
b)	Construction of terminal building, landside facilities		
6	Upgrading existing road to terminals		

Figure 27: Construction Schedule

7.0 VESSEL DESIGN

The major principal parameters governing Inland Waterway Fleet designs are:

- Terminal facilities and obstructions enroute,
- Waterway characteristic like river course, depth of water, radius of bends, current/velocities of water etc.,
- Navigational aspects and improvements to navigation,
- Cargo characteristic like type of cargo, quantum of cargo and distance of transportation,
- The vessel dimension like length, beam, moulded depth, minimum and maximum draft,
- Haulage distance
- Physical constrains like clearance under bridges, navigation locks size etc., and
- Capital, operation and maintenance cost.

7.1 GENERAL REVIEW

India has a long history of river based water transport. Among operators, the government owned CIWTC (Central Inland Water Transport Corporation) is the largest owner of vessels and barges. However, CIWTC is now a part of GRSE and executes orders for Indian Navy only. Private operators have a substantial fleet, but have not been investing in new vessels in the last decade. In fact, there has been scrapping vessels of late, and all operators may require some help in reviving them and investing in new vessels.

7.2 DESIGN BASIS

The type and size of vessels proposed to be operated in Ichamati waterway is designed on the basis of following factors:

a) Cargo Characteristics
b) Cargo Factors
c) Waterway and Other Features
d) Operational Factors

7.2.1 Cargo Characteristics

The cargo consists of passengers including small cargo like bikes, cycles and agricultural goods. The volume of total cargo originating and terminating from different terminal is shown in Traffic Studies chapter.

7.2.2 Waterway and Other Features

The field investigations done in the total stretch of the river bring out the following characteristic of the waterway which shall influence selection of the vessel for transportation.

- No bridge is located along the proposed fairway.
- Fairway is proposed for river crossing.
- Shoals located along the waterway.
- Current velocities.

Hence, the waterway condition during lean season would dictate the selected vessel to have shallow draft to ensure navigation all around the year.

7.2.3 Operational Factors

The following factors are generally considered as operational factors in the process of study on vessels for IWT.

- Speed of vessel under varying hydraulic condition,
- Relation between speed, propulsive power and energy consumption,
- Rate of embarkment and dis-embarkment of passengers.
- Number of unworkable days per year, and
- Susceptibility of vessel to damage and crew efficiency.

7.3 PROPOSED VESSEL SIZE AND SPECIFICATIONS

For RO-RO operations, M/s River Waterlink Pvt. Ltd. will provide their RO-RO barges. Passenger ferry services proposed to connect both banks of Itinda and Basirhat ghat will have draft of about 0.1 to 2.4 m w.r.t sounding datum, as per the bathymetric survey. However, dredging is proposed to develop the fairway as per waterway classification for Class-III.

Transport department of Government of West Bengal is operating regular ferry services in the state, to provide, clean, safe and faster mode of transport system. The list of various ferry service operators and number of water crafts for the ferry trips operating by Government of West Bengal (excluding private operators) in the Hooghly River are provided in **Figure 28**.

List of various Ferry Service Operators and number of water crafts for the ferry trips :

1. WBSTC Ltd. *(A Govt. of West Bengal undertaking).*
2. HNJPSS (Hooghly Nadi Jalapath Paribahan Samabay Samity Limited).
3. Ghatal Steam Navigation Company (private operator).
4. Indo Swiss Waterways Company (private operator).

Name of operator	Number of steel vessel with capacity of passengers
WBSTC Ltd.	16 steel vessels of capacity for 400 passengers 2 steel vessels of capacity for 250 passengers 2 Steel vessels of capacity for 150 passengers
HNJPSS	14 steel vessels of capacity for 400 passengers 6 steel vessels of capacity for 250 passengers 4 steel vessels of capacity for 150 passengers 10 wooden vessels of capacity for 100 passengers
Ghatal Steam Navigation Company	1 steel body vessel of capacity for 150 passengers 1 wooden vessel of capacity for 100 passengers
Indo Swiss Waterways Company	2 steel vessels of capacity for 150 passengers

Note – It has been decided that the jetties at Bandhaghat in Howrah and Ahiritala in Kolkata will be renovated by Kolkata Port Trust. Ghatal Steam Navigation Company & Indo Swiss Waterways Company are operating the ferry service at these ferry ghats on contact basis from the Kolkata Port Trust. Kolkata Port Trust has been informed

Figure 28: Ferry Services in the river Hooghly between Kolkata and Howrah[2]

West Bengal Transport Infrastructure Development Corporation (WBTIDC), (A govt. of West Bengal Undertaking) is constructing steel ferry vessels of capacity 150 passengers as per I.V Act for operating in the state. Some of its existing vessels with 150 passenger capacity are as follows[3]:

a) M. V. Shrishti (HAD) – Plying between Raichak – Kukrahati
b) M. V. Brishti (WBSTC) – Plying between Howrah – Kolkata

[2] http://transport.wb.gov.in/transport-services/ferry-services/passenger-ferry-services/

[3] http://transport.wb.gov.in/infrastructure/jetties/constructionrenovation-of-jetties/

c) M. V. Krishti (WBSTC) – Plying between Belur – Dakshineswar

d) M. V. Drishti (HNJPSS) – Plying between Bauria – Budge Budge

For proposed passenger ferry services in Ichamati waterway passenger ferry vessels built in house by WBTIDC are proposed. We have only considered conventional vessels at this stage to keep the start-up risk to a minimum.

For RO-RO Operations M/s River Waterlink Pvt. Ltd. will use its own barges, hence no design and costing is done for vessels to be used for Ro-Ro operations.

7.4 TURNAROUND TIME

Turnaround time for ships is defined as the length of time between arriving at a point and being ready to depart from that point. It is used in this sense for the loading, unloading, re-fuelling, and re-arming of vessels.

Turnaround time varies with type of vessel, efficiency of jetties and available cargo handling facilities on the jetties. Turnaround time for passenger ferry vessel is discussed in detail in following paragraphs.

The time taken by Passenger ferry vessel for loading and unloading of passengers, re-fuelling and re-arming is considered as 30 minutes.

7.5 NUMBER OF VESSEL REQUIRED

Number of vessel required to ply on route is estimated and provided in **Table 22** as below.

Table 22: Estimate of No. of vessel required for Passenger Ferry Service

Sl. No.	Description	Value
A	Speed of vessel considered	6 Knot
B	Average distance between terminals along navigational channel	300 m
C	Travel Time required to cover 300 m both ways	05 minutes
D	Embarking and Dis-embarking time considered (@10min/terminal)	20 minutes
E	Trip duration (sl. no. C + sl. no. D)	30 minutes

Sl. No.	Description	Value
F	Capacity of passenger ferry per trip as per proposed vessel specification	150
G	Total no. of passenger's currently using the terminal per day	4000
H	Design passenger capacity for terminals per day	6000
I	Required no. of trips per day (sl. no. H/ sl. no. F)	40 trips
J	Considering operating hours for ferry services, per day	12 hours
K	No. of trips allowed during 12 hours operational time per day (sl. no. J / sl. no. E)	24 trips (approx)
L	Number of Ferry vessel required (sl. no. I/ sl. no. K)	1.67 ~ 2 (i.e 1 for each jetty)

7.6 VESSEL COSTING

The cost of operating a ferry is made up from a number of component parts. We have made an assessment of these costs considering fixed costs charged on a time basis and running costs charged on a distance basis.

7.6.1 Capital Cost

The cost to purchase the vessels, whether they are new or second hand, represents a significant commitment for the ferry operating company. For passenger ferry services, vessels need to be procured.

For the purpose of estimating a capital cost for vessels proposed to be operated in Ichamati waterway, manufacturing cost of vessels quoted in their websites are taken as a reference as shown in table below :

Table 23: Capital Cost of Vessels

Sl. No.	Description	No. of Vessel	Rate per Vessel (INR Lacs)	Total Cost (INR Lacs)
2.	Passenger Ferry Vessel	2	91.998[4]	183.996

7.6.2 O&M Cost

The O&M cost of vessels are estimated as below:

a) Officers and Crew Costs

Two crews have been allocated for each vessel to enable continuous operation of vessels for 12 hours. Each crew comprise of 4 staff members for running/operating of vessel and on-board safety and security. One Electrical & one mechanical engineer shall common for both vessels. Total nos. of crew members proposed is tentatively as below:

Sl. no.	Type of Crew	Number	Tentative Annual Rate (INR)	Annual Cost (INR)
1.	Pilot	2	5,00,000/-	10,00,000/-
2.	Electrical Engineer	1	5,00,000/-	4,00,000/-
3.	Mechanical Engineer	1	5,00,000/-	4,00,000/-
4.	Life Guards	6	3,00,000/-	18,00,000/-
Total		**10**		**36,00,000/-**

Hence, for two vessels total 10 crew members are required. The annual cost of crew works out to be INR 36,00,000/- (**INR 36.00 Lacs** annually)

b) Consumables and Repair/Maintenance Cost

Consumables such as oil and lubricants are generally used at a predictable rate and we have adopted a figure of INR 0.02 lacs per day derived for a vessel similar to those considered in this study. Similarly we have adopted a figure of INR 0.02 lacs per day for maintenance and repair of

[4] http://transport.wb.gov.in/infrastructure/jetties/constructionrenovation-of-jetties/

the vessels to cover the regular maintenance programme. Annual consumables and repair/maintenance cost works out to **INR 12.00 Lacs**.

c) Fuel Cost

Fuel expenses for running two (2) passenger ferry vessels in the proposed fairway is estimated as below:

Number of days of operation in a year = 300 days
Number of trips in a day = 24 trips
Mobility time per trip = 10 minutes
Approximate rate of fuel per litre = 75 INR per litre
Vessel running cost per annum = 300 days x (10/60) Hrs x 24 trips x {0.1 litre per hour x 2 Engines x 106 Bhp} x INR 75 per litre x 2 Vessel
= INR 38,16,000 per annum
= **(INR 38.16 Lacs)**

Table 24: Annual O&M cost of Vessels

Sl. No	Item	Annual Cost (INR) Lacs
1.	Officer and Crew Costs	36.00
2.	Consumables and Repair/Maintenance Cost	12.00
3.	Fuel Cost	38.16
	Total	**86.16**

8.0 NAVIGATION AND COMMUNICATION SYSTEM

In SOLAS-V/13 ("Safety of navigation" IMO, 1974), IMO established that each State shall provide the aids to navigation appropriate to the level of traffic and the degree of risk. International Association of Lighthouse Authorities (IALA) defines aids to navigation as systems external to the ship capable of helping determine its position and course, warning about dangers and obstacles and indicating the best route to follow.

As defined by IMO, the absolute horizontal accuracy of aids to navigation regarding vessel position on inland waterways should be 10 metres, with a probability of 95%. The accuracy of nautical charts is also very important. The national authority responsible for their publication must work in coordination with the body responsible for aids to navigation. In the particular case of restricted waters, the nautical chart scale is 1:10 000, requiring an accuracy of 10 m (IALA-AISM, 2014).

Aids to navigation include visual aids (lighthouses, beacons, buoys and leading lines), electronic navigation (AIS, DGPS, VTMS etc.), a pilotage service and traffic organisation boats.

The objectives of e-navigation are: to facilitate the safe navigation of vessels with regard to hydrographical, meteorological and navigation information, facilitate maritime traffic management, facilitate communication and provide opportunities to improve the efficiency of transport and logistics. E-navigation is a concept that incorporates systems and services.

8.1 GENERAL REQUIREMENTS

The information system for navigation and communication aims to improve the navigational capability and safety in the inland waterways, key points of River Information System are:

- The information system will help to track the real time position of ships plying on the inland waterways
- The system will also provide real time weather reports and help in building communication among the vessels
- Under the project, radars and sensors will be installed in boats and river ports
- The information will be sent via Very High Frequency (VHF) wireless communication between the operators and the user

For safe navigation of the ships throught the waterway, sate of the art navigation and communication system are to be provided in the waterway stretch. These services should be supported by currently available technical systems like:

- Mobile radio communication systems for inland navigation (VHF radio)
- Ship and shore based radar
- Mobile data communication systems
- Global navigation satellite system (GNSS)
- Internet
- Electronic chart and display and information system for inland navigation (Inland ECDIS)
- Automatic identification system for inland navigation (Inland AIS)
- Ship reporting systems.

8.1.1 VHF / HF

One of the main characteristics of the River Information Service is efficient and reliable flow of information. It can be effectively achieved in real time through VHF communication, which is of key importance in maritime navigation and has been implemented to meet the requirements of inland waterway shipping services.

VHF communication is in use in inland navigation to ensure safe flow of information among vessels and services coordinating SAR operations within the RIS operation range.

The RIS operating centre is proposed to be located in one of the terminal building. Within a usable floor area of 200 sq. m, a room shall be arranged for the maintenance of constant radio watch by three system operators who can control the system modules. The foreground item of the equipment's will be a display consisting of six LCD screens.

It will display a view of the AIS and views from CCTV cameras, which, combined, support real time view of the situation on the waterway. The RIS Centre shall also provide electronic charts for the purposes of the Inland ECDIS, transmits Notices to Skippers (NtS), receives ERI messages and ensures system users reliable VHF radio communication. Signals received by VHF radio stations are transmitted directly to the RIS Operating Centre via a relay network.

8.1.2 DGPS

The Differential Global Positioning System (DGPS) is an enhancement to GPS that improves accuracy to under 3 metres, by means of a ground-based network of reference stations. It is proposed that all vessels should be equipped with latest DGPS equipment's to track the time positional accuracy of vessels.

A DGPS station is located at Swaroopganj (Lat 23^0 24' 46.29"d, Long 88^0 23' 17.17") with an effective radial coverage of about 125 km. As Ichamati waterway is about 100 Km (radial distance) from Swaroopganj station, no DGPS station is proposed for Ichamati waterway.

8.1.3 RIS / AIS / Radar / VTMS

An objective is the description of intention. The objective may also be called the goal or aim. RIS have three main objectives:

1) Transport should be *safe*:

- Minimise injuries
- Minimise fatalities
- Minimise voyage incidents

2) Transport should be *efficient*:

- Maximise throughput or effective capacity of waterways
- Maximise the carrying capacity of vessels (length, width, draught and height)
- Reduce travel time
- Reduce workload of RIS users
- Reduce transport costs
- Reduce fuel consumption
- Provide efficient and economical link between transport modes
- Provide efficient harbours and terminals

3) Transport should be *environmentally friendly*:

- Reduce environmental hazard

- Reduce polluting emissions and spills due to accidents, illegal actions or normal operations

These objectives should be met under the constraints that all RIS are supplied in a manner that is reliable, cost efficient and legally sound.

For Ichamati waterway, one RIS station is proposed to be set up near proposed Basirhat RO-RO jetty .

8.2 EXISTING SYSTEM

From the 63.381 Km length of Ichamati waterway, fairway is proposed for a stretch of about 3.2 Km m only from Basirhat Jetty to Indo-Bangladesh border. Presently, passenger ferry services are operational across the river to from Basirhat to Itinda Jetty. The ferry services are operated by locals on yearly contract basis and No safety, aids to navigation and communication system exists currently along the Ichamati waterway.

8.3 ADDITIONAL REQUIREMENT

In addition to existing passenger ferry services, RO-RO service is also proposed in Ichamati waterway for transporting trucks from Basirhat jetty to Indo-Bangladesh border. As discussed with M/s River Waterlink Pvt. Ltd. it is desired that the RO-RO services shall be operational for 24 hours. In view of this, aids for night navigation are also proposed for the waterway.

State-of-art navigation and communication system is required in Ichamati waterway. The details of River information systems and its applicability and relations to different services in navigation are provided in **Figure 29** as below.

SYSTEM	SERVICE													
		Traffic information		Traffic management				Information for transport logistics						
	Fairway information	Tactical	Strategic	Vessel traffic services	Navigational support	Lock and bridge management	Calamity abatement support	Voyage planning	Transport management	Inter-modal port and terminal management	Fleet and cargo management	Information for law enforcement	Statistics	Waterway charges and harbour dues
Visual aids to navigation	x													
Radar reflecting aids to navigation	x			x										
Light signals	x			x		x								
Mobile phone (voice and data)	x				x	x	x	x	x	x	x	x		x
GNSS for vessel positioning		x	x				x	x	x	x				
VHF radio	x	x	x	x	x	x	x	x		x		x		
Internet	x				x		x	x	x	x	x			x
Vessel based radar	x	x					x							
Shore based radar		x		x		x	x							
Shore based CCTV cameras		x		x		x								
Electronic navigational chart	x	x		x		x	x	x						
Vessel tracking and tracing system		x	x	x		x	x	x	x	x	x	x		x
Ship reporting system			x				x	x	x	x	x	x	x	x

Figure 29: Relation between Services and RI Systems

8.4 COSTING

The following criteria have been adopted for estimating the quantity and cost of navigational aids, proposed for Ichamati waterway.

i) Quantity of the equipment/s has been decided depending on the distance of the river to be covered.

ii) To operate the system, proper certified operators are to be deployed at site along with the security guards.

iii) CAMC for minimum three years has been considered after one year warranty from the date of commissioning.

Capital cost of purchase & installation is INR 363.30 Lakhs and O&M cost works out to 183.82 Lakhs.

8.4.1 Capital Cost

Table 25: Capital Cost for Aids to Navigation and Communication

Sr. No.	Equipment	Qty	Unit Price (INR)	Total (INR Lacs)
A	**RIS System**			
1	AIS Base Station	1	30,00,000.00	30.00
2	RADAR	1	50,00,000.00	50.00
3	Meteo Sensor	1	7,00,000.00	7.00
4	ATG	1	9,00,000.00	9.00
5	VHF	1	5,00,000.00	5.00
6	DG Set 10 KVA	1	7,00,000.00	7.00
7	UPS	1	5,00,000.00	5.00
8	RIS Software	1	35,00,000.00	35.00
9	RIS Hardware	1	1,00,00,000.00	100.00
10	Installation Testing & Commissioning	1	20,00,000.00	20.00
11	Porta cabin	1	12,00,000.00	12.00
12	Trestle Tower	1	10,00,000.00	10.00
	Total cost of one RIS system			290.00
B	Marine Lantern/Buoys	20	2,00,000	40.00
	Total Cost in Lacs			**330.00**
C	3% Contingencies and 7% Supervision charges on Base cost			33.00
D	**Total Navigation & Communication Cost in Lacs**			**363.30**

8.4.2 O&M Cost

The operation and maintenance cost works out to as below:

Table 26: O&M Cost for Aids to Navigation and Communication

Sr. No.	Manpower	Qty	Unit Price (INR)	Total (INR Lacs)
1	Engineer 1 * Site 1 * Months 12 per year	12	35,000.00	4.20

Sr. No.	Manpower	Qty	Unit Price (INR)	Total (INR Lacs)
	Operator 3 * Site 1 * Months 12 per year	36	20,000.00	7.20
	Security 3 * Site 1 * Months 12 per year	36	15,000.00	5.40
2	Second Year			17.98
3	Third Year			19.23
4	Fourth Year			20.58
			Total	**74.59**
	CAMC for 4 Years			
1	1st Year	1	33,00,000.00	33.00
2	2nd Year	1	36,30,000.00	36.30
3	3rd Year	1	39,93,000.00	39.93
			Total	**109.23**
	Overall O&M Cost in INR Lacs			**183.82**

9.0 ENVIRONMENTAL AND SOCIAL ASPECTS

9.1 OBJECTIVE OF ENVIRONMENTAL AND SOCIAL STUDIES

Inland Waterway Authority of India (IWAI), Ministry of Shipping, Government of India intends to explore the potential of additional waterways across the country for year round commercial navigation, and recommending the possibility of Composite and Integrated development of National waterways to achieve navigation and to develop water transport facilities across India.

Among many rivers, the section of Ichamati River from 0.000 Km to 63.381 Km falling in North 24 Parganas District of West Bengal State is also considered for waterway and declared as National Waterway No. 44 (NW-44).

Ichamati River is a trans-boundary river which flows through India and Bangladesh and also forms the boundary between the two countries. The river is facing the problem of siltation leading to thin flow of water in the dry season and floods in the rainy season. Experts are handling the situation and remedial matters are being discussed between the governments of India and Bangladesh. Ichamati River flows in three parts: (1) The longer part flows from the Mathabhanga River, a distributary of the Padma, and after flowing for 208 kilometres joins the Kalindi River near Hasnabad in North 24 Parganas and Debhata in Satkhira District (2) Once the main river west of Dhaka and (3) Ichamati of Dinajpur. According to a number of hydrologists, the three Ichamati Rivers, in the past, were a single channel. The second river marked above originates south of Jafarganj opposite to the mouth of the Hoorsagar and runs towards Joginighat in Munshiganj. Joginighat is situated at the confluence of the Jamuna and the Ichamati. The total catchments area of the Ichamati river system is 3384 sq. Km, out of which 2320 sq. Km are in West Bengal, India and rest 1064 sq. Km. falls in Bangladesh.

The major objective of this study is to establish present environmental condition along the project corridor through available data /information supported by field studies to evaluate the impacts on relevant environmental attributes due to the construction & operation of the proposed project; to recommend adequate mitigation measures to minimize / reduce adverse impacts and to prepare an Environmental Management Plan (EMP) for timely implementation of the mitigation measures to make the project environmentally sound and sustainable. The study basically includes:

- Establishment of the present environmental and social scenario
- Study of the specific activities related to the project
- Evaluation of the probable environmental and social impacts
- Recommendations of necessary environmental control measures.

- Preparation of Environmental Management Plan
- To identify the requirement of various regulatory clearances, NoCs

9.2 ENVIRONMENTAL SETTING IN THE PROJECT AREA

9.2.1 Physiographic

The study stretch passes through North 24 Parganas District of West Bengal State. North 24 Parganas is a district in southern West Bengal, of eastern India. North 24 Parganas extends from latitude 22º11'6" north to 23º15'2" north and from longitude 88º20' east to 89º5' east. It is bordered to Nadia by north, to Bangladesh (Khulna Division) by north and east, to South 24 Parganas and Kolkata by south and to Kolkata, Howrah and Hoogly by west. Barasat is the district headquarters of North 24 Parganas. North 24 Parganas is West Bengal's most populous district. It is also the tenth-largest district in the State by area.

The district, North 24-parganas, has been divided geographically into three parts,

(a) Vast reverine belt in the Southern part of Basirhat Sub-Division. (Sundarban area),

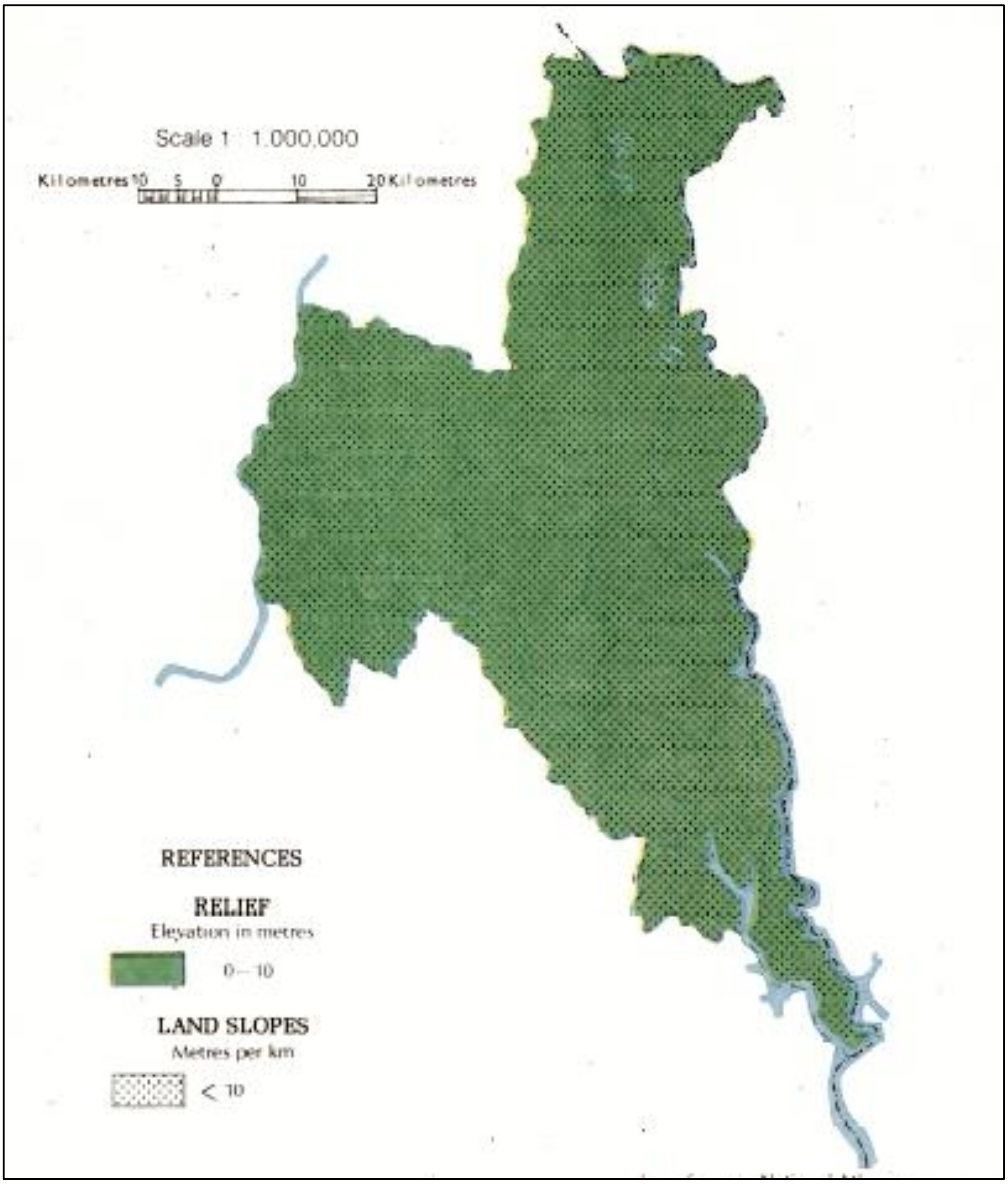
(b) The industrial and urbanized zone of Bidhannagar and Barrackpore Sub-division

(c) Vast cultivating plain land in the Bongaon Sub-division and adjoining part of Barrackpore, Barasat & Northern part of Basirhat Sub-Divisions.

The study stretch passes through North 24 Parganas District in the state of West Bengal. The physiography of the region is that of a typical alluvial plain with gentle ups and downs. The terrain is essentially composed of Soft River borne sediments deposited under fluviatile environment. The general slope is from north west to south east. As the area is situated very near to the out fall, the dominant slope of the land is towards south with average elevation varying from 3.5 m to 2.5 m above MSL. The region is criss-crossed by a network of small streams and rivulets with out falls either at river Hooghly or Haldi. Since these rivers are connected to the sea, the channels suffer daily fluctuations in water level due to tidal influence. Hence, estuarine conditions prevail here with problems of salinity and coastal hazards especially along the banks and river fronts.

The district lies within the Ganges-Brahmaputra delta. The river Ganges flows along the western border of the district. The main rivers of the district of North 24-Parganas are Ichhamati, Kalindi, Raimangal, Dansa, Borokalagachi, Benti, Haribhanga, Gourchrar, Bidyadhari, Hooghly, etc. Ichhamati is the longest among these rivers. It enters the district through Bagdah block in the north of the district from Nadia and flows south through Bangaon, Swarupnagar, Baduria, Bashirhat-I, Hasnabad and Hingalganj. This river flows into river Kalindi and Kalindi in turn flows into Raimangal. It indicates the borderline between India and Bangladesh during its course of flow from Bashirhat to Hingalganj. River Hooghly lies between Hooghly and North 24-Parganas district. Besides, Sunderban deltas make many rivers flow in this region due to high tidal water entering from Bay of Bengal.

Relief and Slope Map of North 24 Parganas District are furnished in **Figure 30.**



Source : NATMO

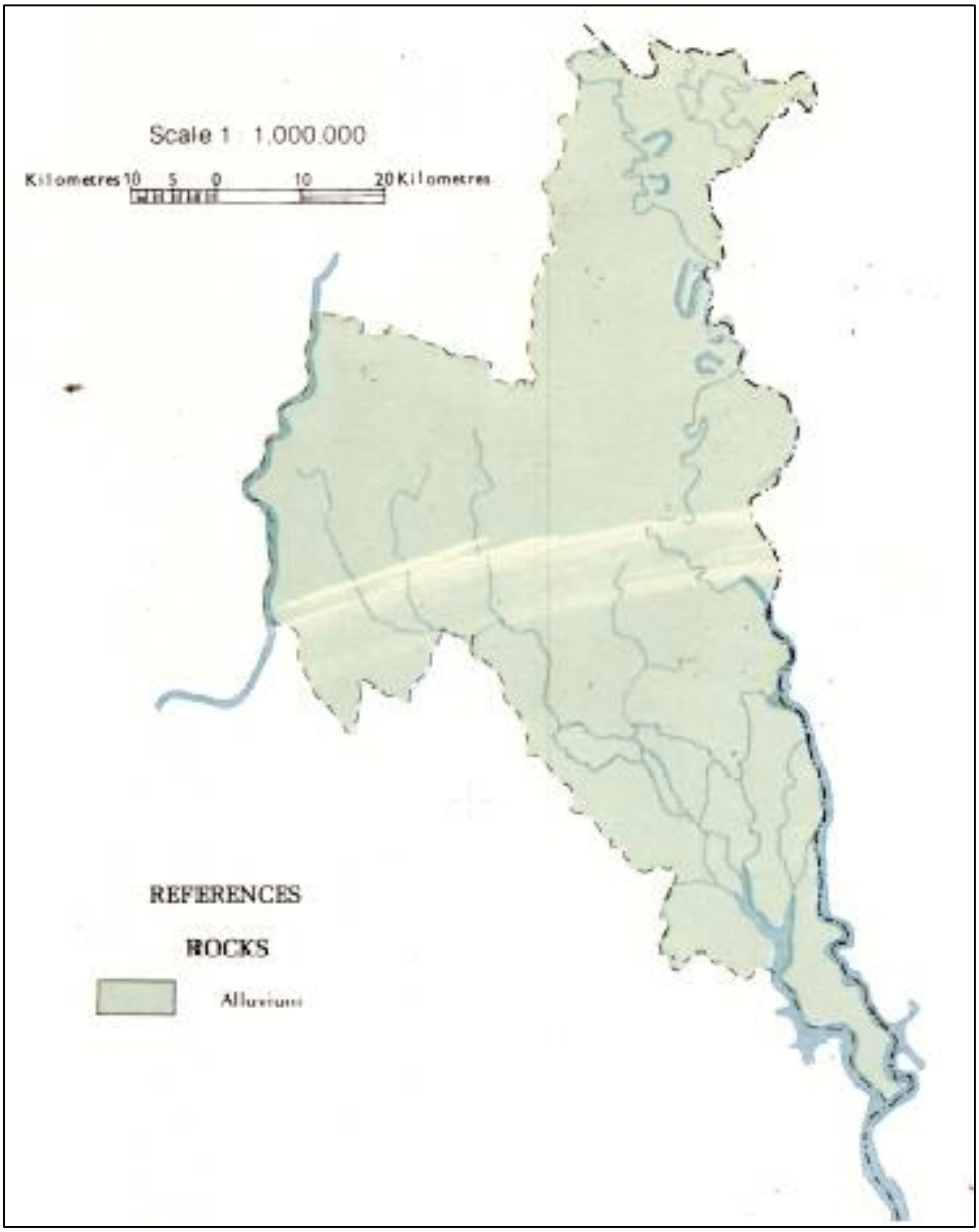
Figure 30: Relief and Slope Map of North 24 Parganas District

9.2.2 Geology and Seismicity

Geology:

The district lies within the Ganges-Brahmaputra delta. The river Ganges flows along the western border of the district. There are many other rivers, which include the Ichhamati, Jamuna, and Bidyadhari. The entire landmass of Sundarbans is of very recent in origin and is the result of extensive fluvial-marine deposits of the river Ganges and Bay of Bengal. This stretch of coastal landmass exhibits varied geomorphologic features like sandstones, beach ridge, intertidal sandy flats, tidal shoals etc. These structures are evolved out of dynamic and varied interactions of marine agencies like waves, tides and littoral currents combined with fluvial components. The silt, clay and sand particles have been deposited layer by layer by the river Ganges and its tributaries in the sea board. These rapid delta formations have resulted in uneven thickness and width of the horizons in the estuarine mouths by facing the Bay of Bengal. Lithological logs of the boreholes of Sundarbans include thick clay blanket (15.24 m to 76.20 m) at the topand is underlain by the presence of very coarse sediment containing medium to small gravels of rock fragments and quartz of Quaternary age.

The Rock and Mineral Map of North 24 Parganas District is presented in **Figure 31**.

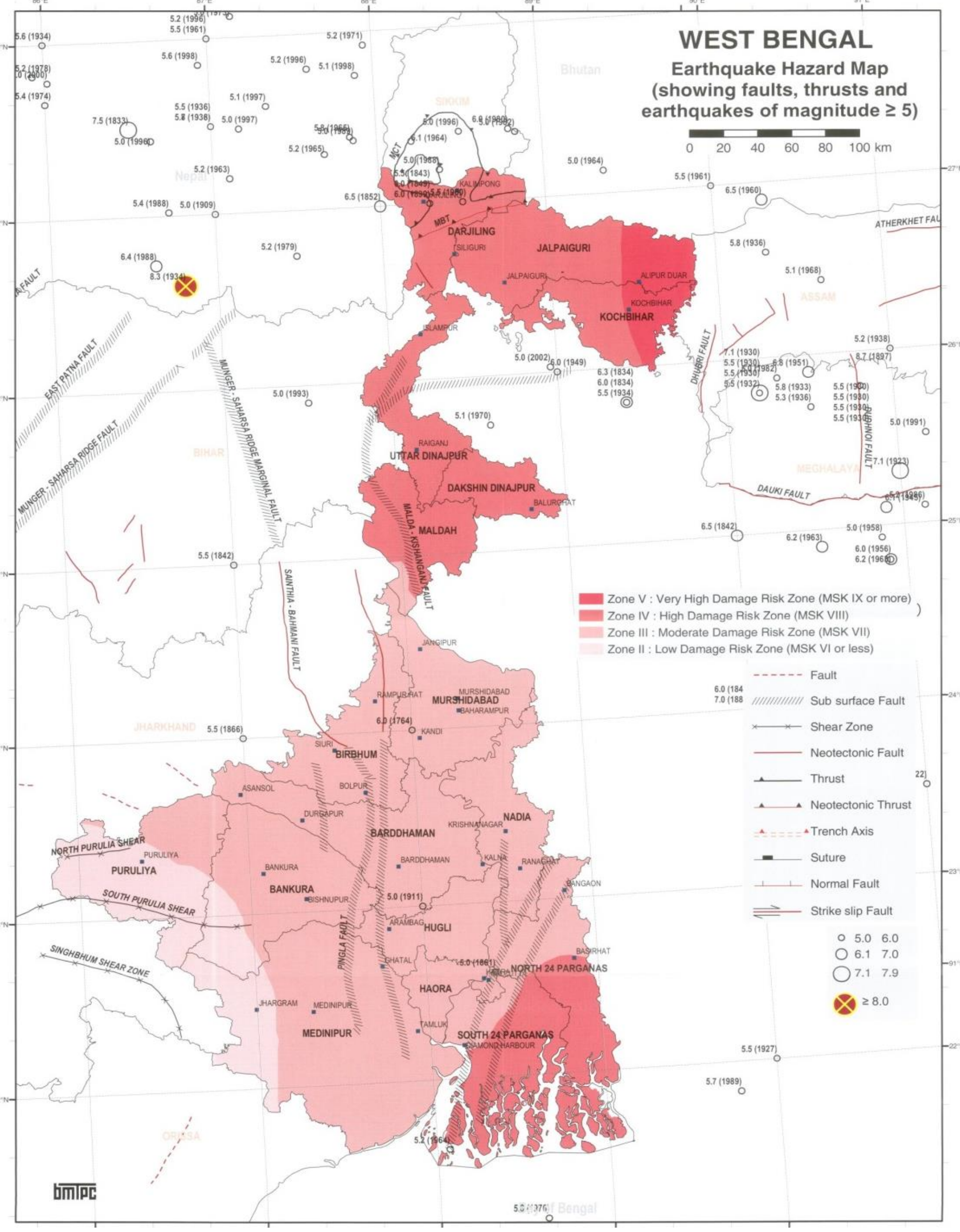


Source : NATMO

Figure 31: Rock and Mineral Map of North 24 Parganas District

Seismicity:

As defined by the Indian Standard (IS) 2002 seismic zoning classification system, the seismicity is measured on a scale from II to V where zone II is most stable and Zone V is considered to be least stable. According to West Bengal Disaster Management Department (WBDMD) western sections of the northern districts of Jalpaiguri and Kooch Bihar lie in Zone V. The remaining parts of these two districts, along with the districts of Darjeeling, Uttar Dinajpur, Dakshin Dinajpur, Maldah, 24 North Parganas and 24 South Parganas lie in Zone IV. The rest of the state along with the city of Kolkata lies in Zone III. The project stretch lies in Earthquake high damage risk zone-IV. The Eartquake zoning map of West Bengal state is shownin **Figure 32**.



Source : West Bengal Disaster Management Department

Figure 32: Earthquake Zoning map of India

9.2.3 Climate

The district North 24 Parganas is characterized by humid, subtropical climate. It receives adequate rainfall from South-West Monsoon, which sets in the later half of June and continues upto middle of

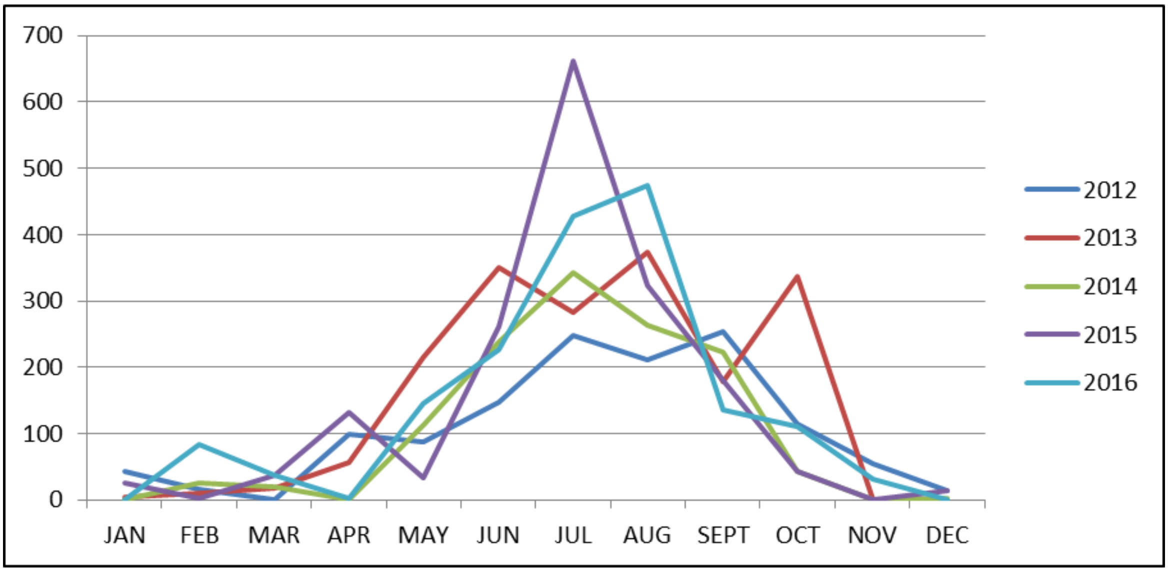
October. Premonsoon torrential downpour received during March-May. The average annual rainfall is 1579mm. The temperature ranges between 41 °C in May (Max) to 10°C in January (Min) and Relative Humidity ranges between 50% in March & 90% in July.

The pattern of Rainfall in North 24 Parganas District is furnished in below table and figure.

Table 27: Rainfall Pattern of North 24 Parganas District

Year	Month wise Rainfall Pattern (mm)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
2012	43.3	15.6	0	98.5	87.2	147.6	248.7	211.8	254.2	115.2	55.5	14
2013	4.3	10.1	18.2	57.6	214.9	350.3	282.5	373.7	178.8	337.4	0	0
2014	0	25.3	19.9	0	112.6	237.9	343.4	262.6	222.8	42.7	0	2.5
2015	26.3	1.8	36.7	131.2	33.2	261.9	662.1	324.1	180.2	42.5	0	15
2016	0.7	84.4	37.8	2.5	146	225.8	427.1	473.4	135	111.3	30.7	0

Source: India Meteorological Department



Source: India Meteorological Department

Figure 33: Rainfall Pattern of North 24 Parganas District

The observatory of Indian Meteorology Department is located in Dumdum (Kolkata). Based on observations from 1971 to 2000 the temperature profile of the project area is furnished in below table. April is the warmest month of the year. The maximum temperature in April averages 35.5 °C. The lowest average temperatures in the year occur in January, when it is around 12.9 °C (minimum).

Table 28: Daily (Mean) Maximum and Minimum temperature by month in the Project Area (1971-2000)

Month	Temperature in ° C (Mean)	
	Daily Maximum	Daily Minimum
January	25.8	12.9
February	28.7	16.2
March	33.3	21.0
April	35.5	24.5
May	35.4	25.6
June	34.0	26.3
July	32.6	26.0
August	32.3	26.1
September	32.5	25.7
October	32.2	23.8
November	29.9	19.1
December	26.7	13.8

Source: India Meteorological Department

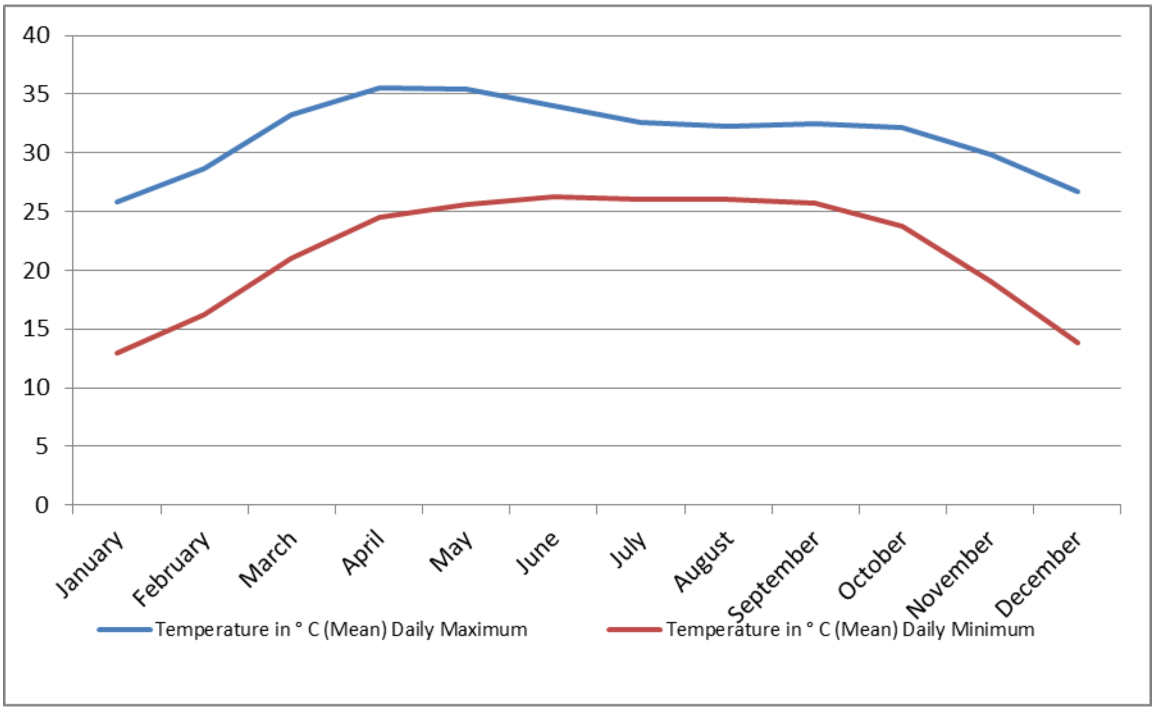
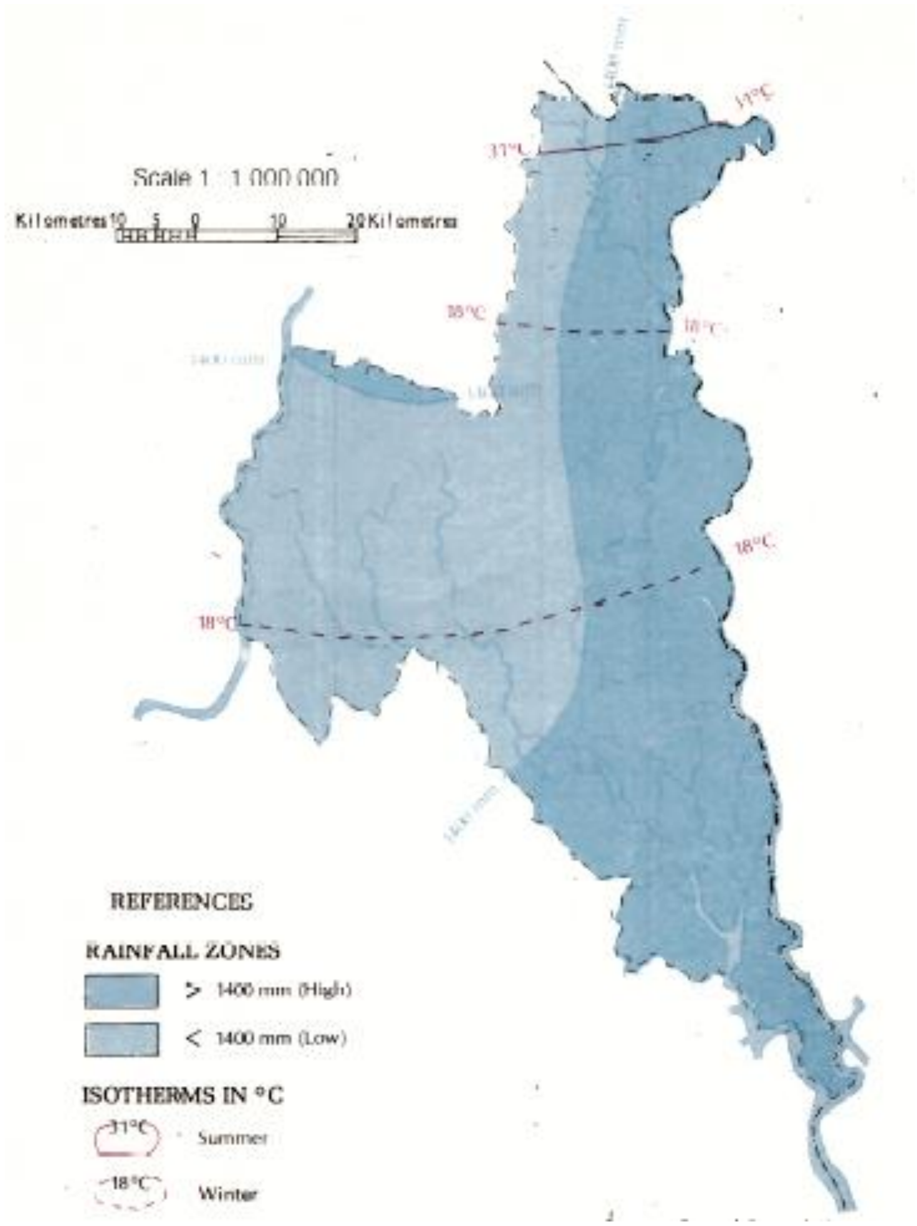


Figure 34: Temperature Graph

The **Figure 35** showing climatic condition of North 24 Parganas district is furnished below.



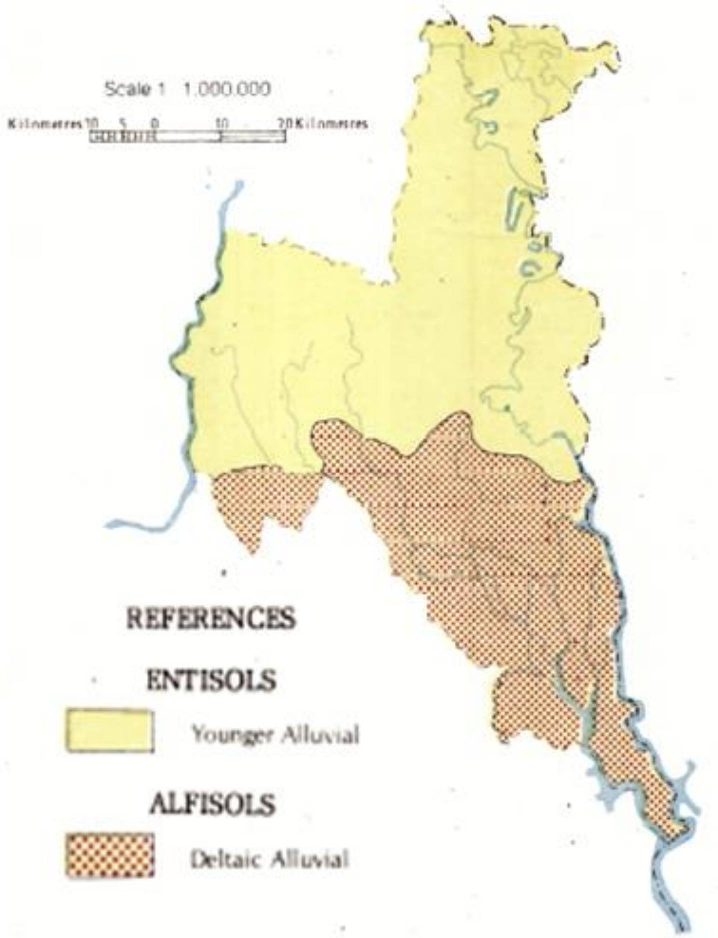
Source : NATMO

Figure 35: Climatic condition of North 24 Parganas District

9.2.4 Soils

North 24 Parganas district is underlain by Quaternary sediments consisting of clay, silt and various grades of sand gravel and pebble. No hard rock geological formation is found here. Lithological log indicates the presence of a clay bed at the top of the geological succession with thickness varying from 10- 40 m. Alternate clay and sand bed exists further in the downward direction. A group of granular aquifer is found between 250-650 m below ground level. These layers are being tapped as groundwater sources. The unconsolidated alluvial sediments of Quaternary age have over laid the older deposits of Tertiary age as noticed in this pile of alluvium. The top most sediment, belonging to recent alluvium which contains mostly of clay. The type of soil varies widely from Sandy, alluvial to clay loam. As the district falls within the Gangetic delta, the soil of the district is very favourable for cultivation. Shallow black and brown soils are also found. The presence of good number of rivers, creeks, khals etc. also favours the cropping pattern of the district. The soil of northern part of the district is sandy, in the central middle part it is sandy with clay loam and in southern side it is clay loam. The physiography of the district is mostly plain. Most of the soils derived from alluvial deposits are azonal with little or no profile development. Clay loam is the predominating type. Clays with or without muck soils occur in swamps and alluvial lakes. These soils have been formed from deposits brought by tidal currents. The active delta still growing southwards is a system of innumerable tidal rivers, canals and creeks, saline soils, swamps and marshes. A part of this active delta contains forests. Known as Sunderbans, this part of the active delta region is under reserve forests. Quite a large part of Sunderbans has been brought under cultivation. Even then the area of Sunderbans spread over 24 Parganas (north and south) is 0.42 million hectares (1629 sq. km.). Sunderbans is a mangrove forest. All the mangroves protect the shore from erosion and aid in accumulation of deposit of peat and mud.

The soil map of the district is given in below Figure.



Source : NATMO

Figure 36: Soil Map of North 24 Parganas District

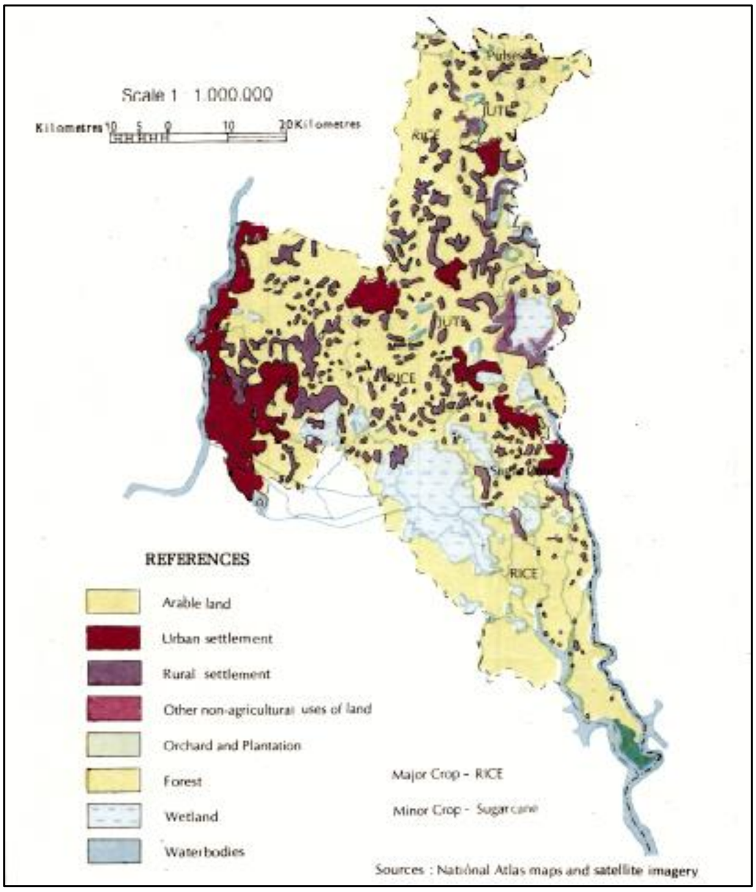
9.2.5 Land Use Pattern

The land use along the project waterway is predominantly agricultural land. There are a number of brick kilns located along the waterway. Land use pattern of the project influenced district is presented in below table.

Table 29: Land use Pattern of the project district (Area in '000 ha.)

Year	Reporting area	Area under non agricultural use	Barren & un-agriculturable land	Permanent Pastures & other grazing lands	Land under misc. tree groves not included in net area sown	Culturable waste land	Fallow other than current fallow	Current fallow	Net area sown
2006-07	386.52	119.7	0	0	4.44	0	0	2.4	259.98
2007-08	386.53	121.92	0	0	3.39	0.17	0	1.82	259.23
2008-09	386.52	122.37	0	0	4.85	0	0	1.89	257.41
2009-10	386.52	123.23	0.06	0	4.48	0	0	39.12	219.63
2010-2011	386.52	124.78	0	0	4.81	0	0	33.91	223.02

Source: District Statistical Hand Book, North Twenty Four Parganas, 2010-11)



Source : NATMO

Figure 37: Land Use Map of North 24 Parganas District

9.2.6 Ambient Air Quality

During the reconnaissance survey, it was the found that the Air quality along the study area of Ichamati River was free from dust. However, it was also confirmed from the local people that there is no problem caused due to Air pollution. Also there is no major industrial development along the waterway stretch except some good numbers brick klins.

9.2.7 Ambient Noise Levels

During the reconnaissance survey, it was the found Noise is not big issues in the surrounding areas of Ichamati River. There are not any noises generating sources in the nearby areas.

9.2.8 Susceptibility to Natural Hazards

West Bengal is vulnerable to multiple disasters. Due to its sub-tropical littoral location, the state is prone to tropical cyclones, storm surges and tsunamis. In past, this district was hit by natural hazards in many occasions. The hazards include Cyclone, Storm Surge, Flood, Earthquake etc. of medium to large intensities. Susceptibility to various kinds of Natural Hazards are elaborated in the following sections-

- **Susceptibility to floods**

19.16% of the population lives in flood-prone areas. Most flood-prone Blocks are Hingalganj, Hasnabad, Sandeshkhali- I/II, Minakhan, Horoa, Baduria, Swarupnagar, Bagdah, Bongaon, Gaighata, Deganga, Habra-I/II. There are 18 rivers running through the district and as it is situated at the downstream of these rivers. Embankments of all the rivers are made of Soil and the river beds are getting high day by day due to Siltation. All inhabitants are situated in the area comparatively at the lower level than the water level of river, so they face a water logging in almost every year due to heavy rainfall. In the year 2015 rainfall has occurred in 2491.50 mm. Due to heavy rainfall and breach of embankment maximum area of this district was water logged. As a result huge nos. of houses are damaged, agricultural crop, fishery, and other infrastructure like roads, tube wells & schools etc. are also damaged.

Source : West Bengal Disaster Management Department

Figure 38: Flood Prone Zones of West Bengal

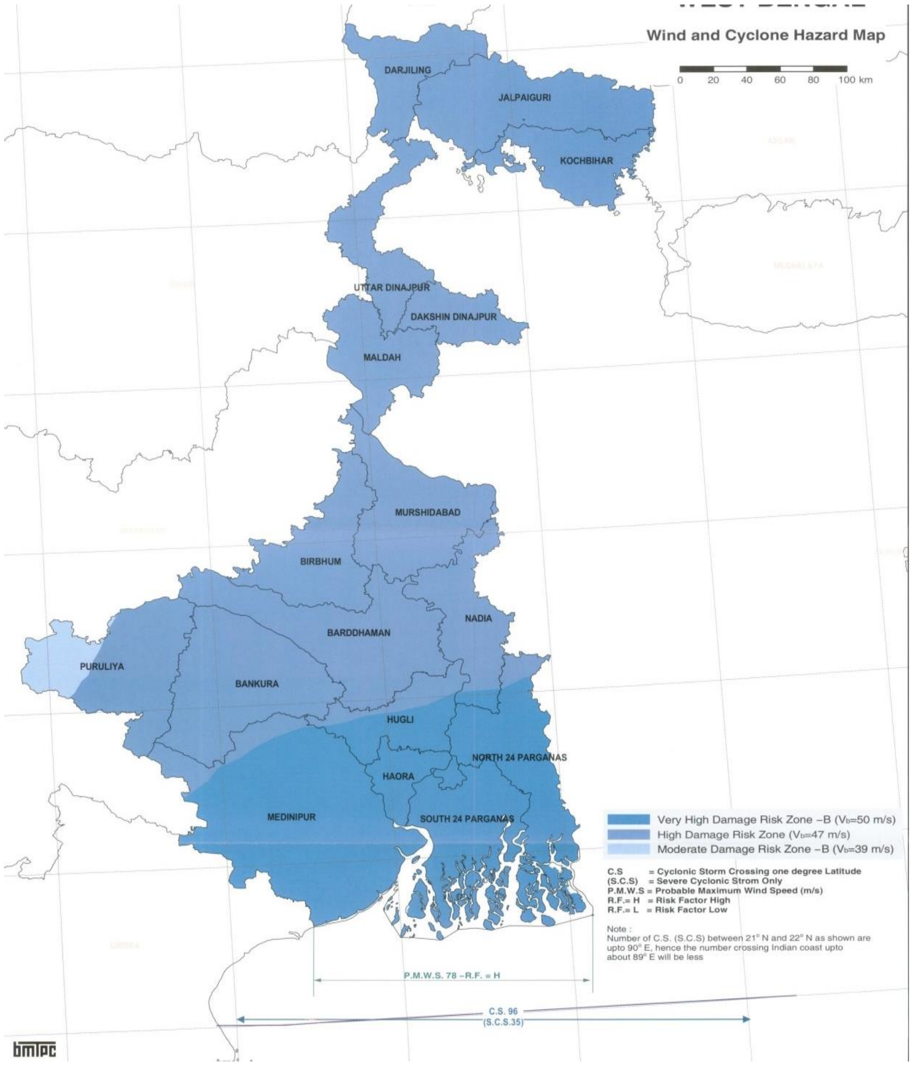
- **Susceptibility to Earth Quake**

73 % of the total area comes under High Damage Risk Zone (Zone IV) and 27 % of the total area comes under Moderate Damage Risk Zone (Zone III). Part of Bangaon, Barasat and Barrackpore Sub

divisions come under Zone IV. Entire Basirhat Subdivision containing the entire Sundarbans area under this district is highly vulnerable to Earth Quake and Tsunami.

- **Susceptibility to Wind and Cyclones**

Cyclone and High tide has been commonly found in the reverine belts of Basirhat sub-division. Strangely, several focal areas of Gaighata Block of Bongaon sub-division had been found to be hit by tornado several times in the past. The East Coast of India is one of the six most cyclone-prone areas in the world. One of the Cyclone AILA which hit coastal West Bengal on 25 May, 2009 is described as one of the worst storms to hit the state in many years. Over 5.1 million people have been affected in 16 districts of West Bengal. Over 500,000 houses were damaged either fully or partially. The storm was especially devastating for farmers who were preparing to harvest rice and other crops. According to media sources, the Sundarbans national reserve forest was worst-hit, as many as three million people lived in the forests. All the coastal districts are vulnerable to cyclones.



Source : West Bengal Disaster Management Department

Figure 39: Wind and Cyclone Map of West Bengal

- **Susceptibility to Drought**

Draught is Occasional in North 24 Parganas. The district recently experienced draught in 2010 owing to less rainfall (857 mm) in Monsoon Season against normal rainfall (1579 mm). Probability of Draught is increasing with increasing water Scarcity.

- **Susceptibility to Tornadoes**

Tornado hits at Gaighata Block in the year 1983, 2001 under Bongaon Sub-Div. Tornado hits at Asoknagar – Kalyangar Municipality, Habra-I Block Deganga Block in the year 2015 (29.7.15)

9.2.9 Estuary and Coastal Zone

Estuaries form a transition zone between riverine and maritime environments. They are subject to both to marine influences—such as tides, waves, and the influx of saline water—and to riverine influences—such as flows of fresh water and sediment. The inflows of both sea water and fresh water provide high levels of nutrients both in the water column and in sediment, making estuaries among the most productive natural habitats in the world.

The section of waterway starts from Bansjhari Mallikpur at Lat 22°39'6.71"N, Long 88°55'33.35"E and ends at Kalanchi at Lat 22°53'53.79"N, Long 88°53'53.94"E. The start point is nearest to Dampier-Hodges Line and located at a distance of 4.5 km north from the Dampier-Hodges Line. It is an imaginary line, passing through 24 Parganas South and North districts, which roughly indicates the northern-most limits of estuarine zone affected by tidal fluctuations. However, tidal influence is observed in the stretch of waterway. According to Dept. of Environment, GoWB, proper delineation of CRZ area is yet to be finalized.

9.2.10 Archaeological and Heritage Locations

Chandraketugarh is an archaeological site located beside the Bidyadhari river, about 12 km west of proposed waterway near the township of Berachampa. The history of Chandraketugarh dates back to almost the 3rd century BC, during the pre-Mauryan era. Artefacts suggest that the site was continuously inhabited and flourished through the Shunga-Kushana period.

Sunderban Biosphere Reserve, a World Heritage Site and International Biosphere Reserve declared by UNESCO is located at 4.5 Km south from the end point of the waterway.

9.2.11 Flora and Fauna

According to Forest Survey of India Report, 2015 the total forest cover of Nouth 24 parganas district is 724 Km2 which is about 17.68 % of the district’s total geographical area (4094 Km2).

Out of 724 Km2, 13 Km2 falls under very dense forest area category; whereas Moderately Dense Forest and Open Forest area covers 185 Km2 and 526 Km2 areas respectively. The comparative statement showing forest cover of North 24 Parganas District and West Bengal state is presented in below table. It is observed from the table that district's Forest Cover percentage in respect to total geographical area is little less than state's overall coverage.

Table 30: Forest Cover of North 24 Parganas District and West Bengal State

District / State	Forest Cover in Sq. Km					
	Geographical Area (GA)	Very Dense Forest	Moderately Dense Forest	Open Forest	Total	Percentage of GA
North 24 Parganas	4094	13	185	526	724	17.68
West Bengal	88752	2948	4172	9708	16828	18.96

Source : Forest Survey of India, 2015

As confirmed by concerned forest department, there is no forest patches along the proposed waterway stretch.

The floral environment in the study area is quite similar with Gangetice West Bengal. Identified flora in the area are *Mangifera indica* (Mango), *Syzygium cumini* (Jaam), *Phoenix sylvestris* (Date Plam), *Musa sapientum* (Banana), *Carica papaya* (Papya), *Psidium guajava* (Guava), *Artocarpus heterophyllus* (Jackfruit), common shrubs and herbs like *Abutilon indicum* (Potari), *Achyranthes aspera* (Latjira), *Adhatoda vasica* (Basak), *Ageratum conyzoides* (Uchunti), *Amaranthus viridis* (Kata Note), *Amorphophallus paeoniifolius* (Oal/Gandira), *Andrographis paniculata* (Kalmegh), *Bambusa bambos* (Bamboo), *Blumea lacera* (Kukurmuta), *Bryophyllum pinnatum* (Patharkuchi), *Calotropis gigantean* (Akanda), *Catharanthus roseus* (Nayantara), *Centella asiatica* (Thankuni), *Cestrum diurnum* (Day jasmine), *Clerodendrum infortunatum* (Ghentu), *Clitoria ternatea* (Aparajita), *Coccinia grandis* (Telakucha), *Commelina benghalensis* (Bengal Day flower/Kanchira), *Cynodon dactylon* (Doobghas),*Datura metel* (Dhutura), *Dentella repens* (Creeping Dentella), *Dryopteris filixmas* (Fern), *Euphorbia neriifolia* (Mansa), *Grangea maderaspatana* (Namuti), *Grewia hirsuta* (Kukurbicha), *Hibiscus rosa sinensis* (Joba), *Leucas aspera* (Swet Dron/ Ghal),*Mimosa pudica* (Lajjabati),*Musa paradisiaca* (Kachkola), *Nerium oleander* (Raktakarabi),*Ocimum basilicum* (Bantulsi), *Ocimum sanctum* (Tulshi), *Parthenium hysterophorus* (Parthenium), *Solanum surattense* (Kanta Begun), *Tragia involucrata* (Bichuti), *Vitex negundo* (Nishinda).

Climbers trees are *Abrus precatorius* (Gunch), *Asparagus racemosus* (Shatamuli), *Bougainvillea spectabilis* (Baganbilas), *Gymnema sylvestre* (Gurmar/ Chhotadudhilata), *Ichnocarpus frutescens* (Kalidudhi), *Luffa aegyptiaca* (Purulgach), *Paederiascandens* (Gandal), *Tinospora cordifolia* (Nimgilo/ Gulancha).

In the study area common mammals, birds, reptiles and amphibians area recorded. This is similar with gangetic West Bengal. Notable common mammals are *Canis aureus* (Fox), *Presbytis entellus* (Common Langur), *Rattus rattus* (House rat), *Mus musculus* (House Mouse), *Bandicota bengalensis* (Indian mole rat), *Suncus murinus* (Indian Shrew), *Felis domesticus* (Domestic Cat), *Rousettus Leschenaulti* (Fruit bat), *Pipistrellus coromandra* (Chamchika), *Canis lupus familiaris* (Indian Street Dog), *Herpestes edwardsii* (Indian grey Mongoose), *Funambulus palmarum* (Three stripped squirrel), *Funambulus pennantii* (Five-striped palmsquirrel) etc.

Common birds are *Corvus splendens* (House Crow), *Eudynamys scolopacea* (Koel), *Columba livia* (Pegion), *Passer domesticus indicus* (Sparrow),*Psittacula krameri* (Parrot), *Acridotheres tristis* (Myna), *Athene brama* (Spotted owl), *Alcedo atthis* (Common Kingfisher), *Bubulcus ibis* (Cattle Egret), *Ardeola grayii* (Pond Heron), *Streptopelia orientalis* (Oriental turtle dove), *Spilopelia chinensis* (Spotted Dove), *Arachnothera longirostra* (Little spiderhunter), *Ardea purpurea* (Purple heron), *Egretta garzetta* (Little egret), *Coracias benghalensis* (Indian roller), *Orthotomus sutorius* (Common tailorbird), *Halcyon smyrnensis* (White-throated kingfisher), *Haliastur indus* (Brahminy kite), *Nycticorax nycticorax* (Night Heron), *Lanius cristatus* (Brown shrike).

Numbers of reptiles are recorded, those are *Hemidactylus flaviviridis* (House gecko), *Typhlops acutus* (Blind snake), *Xenochrophis piscator* (Checkered keelback), *Enhydris enhydris* (Rainbow water snake), *Naja naj* (Cobra),Common retiles like *Ptyas mucosa* (indian rat snake), *Vipera russelii* (Russells vipers), *Dendrelaphis tristis* (Bronz Back Trees snake), *Bungarus caeruleus* (Indian Krait), *Amphiesma stolatum* (Streeped Kill back)etc.

In the study area common amphibians noted are Rana tigrina (*Indian bull frog*), Bufo melanostictus (Common Indian toad), *Hyla sp.* (Tree Frog), *Euphlyctis hexadactylus* (Indian green frog) etc.

Part of Sundarban Biosphere Reserve and Sundarban National Park area is annexed to the District of North 24-Parganas which are in the South-East portion of the district. It covers 6 (six) Blocks viz Sandeshkhali-I, Sandeshkhali-II, Hingalganj, Haroa, Minakhan and Hasnabad. Sundarbans area harbours many endangered/rare/vulnerable species like *Panthera tigris* (Royal Bengal Tiger), *Prionailurus viverrinus (*Fishing Cat*), Neomeris phocaenoides (*Finless Porpoise*), Platanista gangetica (*Gangetic Dolphin*), Orcaella brevirostris* (Irawady Dolphin*), Lutrogale perspicillata (*Smooth coated otter*).*

*Sighting of dolphin is rare along Ichamati River. Though there is no forest land along the bank of the waterway, however some sporadic growth of mangrove and mangrove associated vegetaion like Ceriops sp (*Goran*), Heritiera fomes (*Sundari*), Avicennia sp (*Baen*), Porteresia coarctata (*Dhani Grass*), Barringtonia sp (*Hijal*) are present*.

9.2.12 National Parks, Forests, Wildlife Sanctuaries and Reserves

National Parks, Wildlife sanctuaries, Biosphere Reserve play a vital role in protecting the wildlife of a particular area and providing them their natural habitat.

Part of Sundarbans Biosphere Reserve and Sundarban National Park area is annexed to the District of North 24-Parganas which are in the South-East portion of the district. Which covers 6 (six) Blocks viz Sandeshkhali-I, Sandeshkhali-II, Hingalganj, Haroa, Minakhan and Hasnabad. These blocks are surrounded by tidal rivers such as the Ichhamati, Bidyadhari, Kulti, Dansa, Raymangal etc. besides being crisscrossed by numerous creeks and channels. Sundarbans have been declared a National Park, a Biosphere Reserve by Indian Government and World Heritage Site and “An International Biosphere Reserve” by UNESCO during the 1980s and special measures were taken to reduce further deforestation and human induced destruction of forest. The Sundarbans Biosphere Reserve is located at a distance of 4.5 Km from the end point of Waterway section. The Map of Sundarbans Biosphere Reserve is provided in **Figure 40**.

Figure 40: Map of Sundarban Biosphere Reserve

Besides Sundarban, the other notified Protected Area (under Willdlife Act, 1972) in the district is situated in Bongaon Sub-division and is known as Bibhutibhusan Wildlife Sanctuary (formerly

Parmadan Forest). The details of various protected areas in West Bengal covered under purview of Wildlife Act, 1972 is given in **Figure 41.**

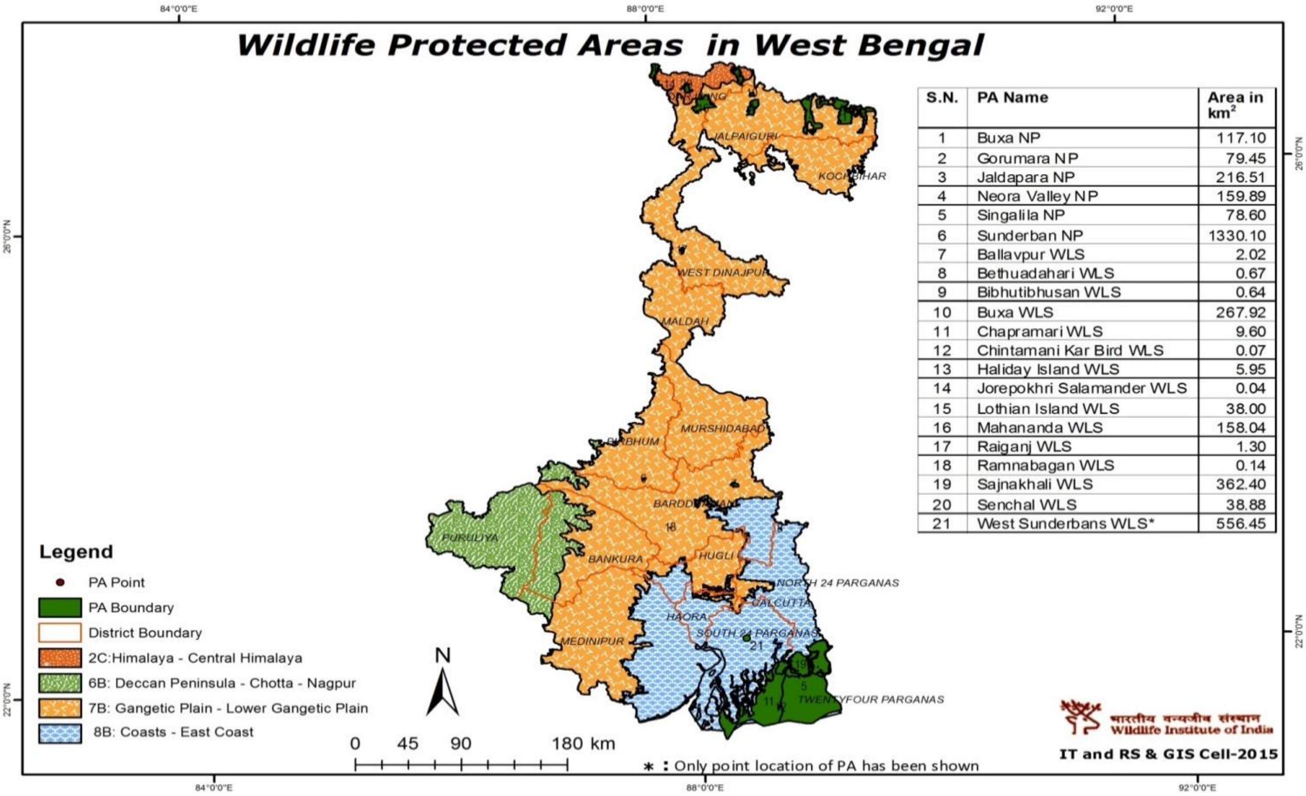


Figure 41: Wildlife Protected Area of West Bengal

9.2.13 Socio Economic Profile

Social Profile

The distribution of population in rural and urban area in the district as per 2011 census shows that majority of the population i.e. 57.3% live in urban areas. The percentage of rural population, on the other hand, is gradually decreasing from 57.1 in 1951 Census to 42.7 in 2011 Census.The total population of the district is 1,00,09,781 (Males- 5,119,389. Female - 4,890,392). The literary rate and sex ratio being 84.06% and 955 respectively, the percentage of SC and ST was 21.67 and 2.64 in the district. The district comprises of 27 municipalities along with 78 Census Towns and 1,527 villages. The demographic profile of the project district is presented in below table.

Table 31: Demographic Profile of North 24 Parganas District

Total Population	Male Population	Female Population	Literary Rate (%)	Sex Ratio	SC (%)	ST (%)
1,00,09,781	5,119,389	4,890,392	84.06	955	21.67	2.64

Source : Census of India, 2011

Major settlements/village located along the section of Ichamati River has been listed in the following table along with population details as per Census of India Data, 2011.

Table 32: Major settlements/village along the project stretch of Ichamati River

S. No.	Village/ Town name	Population (nos.)
1	Bansjhari Mallikpur	3447
2	Itinda	8679
3	Dhaltitha	3047
4	Merudandi	4730
5	Basirhat	171613
6	Sangrampur	7233
7	Par Naihati	574
8	Amarkati	590
9	Chaura	2594
10	Purba Bibipur	361
11	Bajitpur	2018
12	Magurati Shrirampur	2080
13	Fatullapur	4589
14	Baduria	285319
15	Gopalpur	15,967
16	Gobindapur	2,077
17	Mirzapur	7,733
18	Raghunathpur	1,288
19	Kalanchi	1153

Source : Census of India, 2011

Economic Profile

Agriculture: Abundance of fertile lands supported by handful rainfall had made the district an agricultural paradise. Total area used for production of Total Food Grains in the district is 239.1 thousand hectares during 2010-11. Oil seeds are grown in 45.6 thousand hectares of land and fibers are grown in 50.6 thousand hectares of land.

Irrigation: As already stated, economy of the district depends on agriculture andtherefore irrigation plays a major role. Water is drained into the field through various canals. The presence of abundant rivers, creeks etc. help the cultivators a lot.

Animal Husbandry: The district has plenty of live stocks. As per District Statistical Hand Book, North Twenty Four Parganas, 2010-11 data of Aminal Husbandary shown up to 2007. There were total cattle population accounts for 948260, total Buffalo population accounts for 38071, total live-stock population is 2055617, total poultry 7936844 in the District.

Fishery: Because of abundant rivers, creeks, khals (manmade water channels) and bils, a fishery of the district has flourished. Many people earn their livelihood by catching fishes. Fishes are not only distributed among various parts of the state but also are exported to the other parts of the country.

Industry: Industrial development in the district of North Twenty Four Parganas is noteworthy. It is one of the top most districts in the state in terms of industrialization. Industries like cotton handloom, leather tanning, manufacturing of cutlery, brass and bell-metal industries, pottery, embroidery and lace works (chikan) etc. flourished in the district during the last century. Later large scale industries like jute manufacturing, engineering, rubber, textile, paper, chemical, etc. have been established. Cotton handloom textile industries and jute manufacturing industries plays an important role in the district's economy. Due to its geographical advantages, the riverside of Hooghly was developed as a centre of jute manufacturing mills by the British Government. The major jute mills of India are situated here. Cotton handloom textile industry centers are located mainly at Baduria, Barasat, Taki and Basirhat though there are other centers also. Huge qualities of handloom products are being exported from the district. There are several power loom centres found in the district. There are many large scale industries in the district also. The most notable of them is the Andrew Yule Company Ltd. which was established in 1863 with Japanese collaboration. Other important large scale industries are Chloride Industries Ltd. At Shyamnagar, India Foils Ltd. at Kamarhati, India Paper Pulp at Naihati, Titagarh Paper Mills Ltd., The Locomotive Carriages and Wagon Workshop at Kanchrapara, Kalyani Spinning Mills Ltd., West Bengal Ceramic Development Corporation, Sree Saraswati Press Ltd. etc.

The Information Technology hub of Kolkata is situated in this district, which is the centre of some of the reputed IT/ITES Indian and multinational companies. Around 1.2 Lakh people are employed in Sector V and Sector III at Salt Lake City. The area is administered by Naba Diganta Industrial Township Authority (NDITA).

Trade and Commerce: Due to improved industrialization as well as growth ofagricultural products along with fisheries, the district have a good trade and commerce setup. International trade towards Bangladesh is made through the international boarder of Bongaon. The most important export items are engineering, chemical, jute, cereals, vegetables, poultry, bamboo etc. On the other hand coal, petroleum products, sugar etc.are imported in the district.

Transport: Transport and communication in the district is quite developed. Without adequate transport facilities, industries and agriculture could not be as developed as it is in this district. Summary of the length of roads maintained by different Government bodies(as per 2011 census); P.W.D road is 1391.00 km, Zilla Parishad road is 670 km, Gram Panchayat & Panchayat Samity road is 6711.48 km & road under Prime Minister's Gramin Sarak Yojana is 91.20 km. A good number of vehicles are registered with the Regional Transport Authority. There are numerous non-registered vehicles as hand pulled rickshaw, batteryoperated e-rickshaw etc. which is also used for human as well as material transport.

The district has good railway connectivity also. It falls under the Sealdah Division of the Eastern Railways. Four important section viz. (1) Sealdah-Dankuni, (2) Sealdah- Ranaghat, (3) Sealdah-Bongaon, and (4) Sealdah-Barasat-Hasnabad connects different parts of the district.The only international airport of entire Eastern India is located at Dum Dum named The Netaji Subhash Chandra Bose International Airport.

9.3 POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS OF THE PROJECT

Environmental Assessment helps in identifying the likely impacts due to project activities for all stages of the project viz, design, and construction and operation stage on the physical, biological and social environment.

The three major activities involved in the project development which may have impacts on environment at different stages are construction and operation of civil interventions, dredging and operation of barges. These activities may impact different environmental components at different stages of project life cycle. The details are as follows:

9.3.1 Impacts during Construction Phase

A. IMPACTS DUE TO EXCESS SOIL/ DREDGING MATERIAL/ WASTE

The excess soil and muck generated from various construction activities, waste from construction vehicles, fuel lubricants, machinery & maintenance equipment needs to be properly disposed, so as to avoid adverse impacts. The impacts however, shall be marginal. The solid waste generated due to various construction activities should be disposed off at designated disposal ground.

Dredging of about 2,33,100 cum m is required for RO-RO and passenger ferry operations as estimated in Chapter 3.0.. Dredging may changes the water quality, river bed topography and benthos. These activities must not occur at sites used for drinking water and fish spawning.

Mitigation Measures:

The 2,33,100 cum of dredged material is proposed to be dumped on low lying areas located on both sides of the river bank near the terminal area. The dredge material should be dumped providing gabion walls..

B. IMPACTS ON LAND

The impact associated with the land environment during design and construction phases area are as follows:

- Loss of land / land acquisition : No land will be acquired for upgradation of existing jetties and construction of terminal at the following locations
    - Basirhat (Coordinate : 22°40'29.13"N; 88°54'37.49"E) :
    - Itinda (Coordinate : 22°40'30.95"N; 88°54'46.27"E
- Change in topography
- Change in land use
- Deterioration of soil quality due to spillage of fuel, disposal of muck and any other construction material.

Mitigation Measures:

- ✓ Excavation and filling tasks should be carried out simultaneously so as to minimize the soil erosion. Unusable debris material should be suitably disposed off at designated site with prior approval from concerned authority
- ✓ Compaction of soil should be undertaken by controlled sprinkling the water to minimize the surface runoff and erosion.
- ✓ Agricultural land should be avoided for setting up construction camps, plant site or any other construction purpose
- ✓ Water sprinkling to be carried out for dust suppress
- ✓ Dredging soil should be properly utilized and may be proposed for flood protection measures around the terminal area.

C. IMPACTS ON SOIL

The site clearance process includes excavation and vegetation clearance for jetties and terminals, which ultimately induces loss of top soil. Since, the vegetation clearance shall be confined to the minimum area; the area affected would be very less. The activities associated with the site preparation and excavation plus movement of vehicles and equipments can disturb the surrounding lands.

Contamination of Soil: Contamination of soil is primarily due to construction and allied activities. The sites where construction vehicles are parked and serviced are likely to be contaminated because of leakage or spillage of fuel and lubricants. Refuse and solid waste from labour camps can also contaminate the soil. Contamination of soil during construction might be a major long-term residual negative impact. Unwarranted disposal of construction spoil and debris will add to soil contamination. This contamination is likely to be carried over to the River in case of dumping being done near River locations. However, by following mitigation measures such as maintenance of vehicles and machines and fuel refilling carried out in a confined area contamination of soil can be avoided to a great extent. The provision for oil interception chamber is suggested in EMP for treating the waste water generated from vehicle washing, refilling and maintenance areas. Fuel storage and refilling sites should be kept away from cross drainage structures and important water bodies. All spoils shall be disposed off as desired and the site shall be fully cleaned before handing over. These measures are expected to minimise the impact on soil contamination.

Compaction of Soil: Compaction of soil is anticipated due to the movement of construction vehicles and heavy machines. Thus regulation of movement of heavy equipments and vehicles shall be essential to prevent this.

Mitigation Measures:

- ✓ Rehabilitate all sites during construction including construction camps, stockpile area, temporary access and hauling routes, as soon as possible after the disturbance has ceased.
- ✓ Contractor to exercise strict care in the disposal of construction waste, with proof of disposal at an approved site provided after offloading each waste load and this logged/registered.
- ✓ Waste containing contaminated water to dispose off site at an approved disposal site in consultation with State Pollution Control Board.
- ✓ Dispose of waste from the oil interceptors only through suitable waste-handling contractor and request for safe disposal certificates.
- ✓ The movement of construction vehicles and equipments will be restricted to only designated route.
- ✓ Mix cement, concrete and chemicals on a concrete plinth and contain spillages or overflows into the soil.
- ✓ Vehicle maintenance are not allowed on site.
- ✓ If oil spills occur, disposing contaminated soil at a disposal site in consultation with State Pollution Control Board.
- ✓ Stockpiling of subsoil and overburden in all construction and lay down areas.

D. <u>IMPACTS ON AIR</u>

The air quality parameter is the most common environmental feature, which is being affected by any infrastructure projects at different stages i.e. during constructional as well as operational phase. The major indicators of Ambient Air Quality relevant to the project are the concentration of Particulate matters of size less than 10μ (PM10), Particulate matters of size less than 2.5μ (PM2.5), Sulphur dioxide (SO2), Nitrogen oxides (NOx), Carbon monoxide (CO) in the atmosphere.

Sensitive receptors and nearby habitation area may be affected temporarily by increased of traffic due to movement of construction vehicles and transportation of material. Fugitive dust can also impact on air quality due to various construction activities. Exhaust fumes from construction machinery, and potential smoke from cooking fires of labour camp, burning of waste and cleared vegetation also affect the air quality. The improper sanitation at worker camps and waste disposal usually lead to odour problem. The problems related to the deterioration of air quality, however, will temporal in nature till the construction period only.

Shrub Vegetation existing at proposed terminal site will be removed. Bare & loose soil after removal will be exposed to wind and will add on to the concentration of ambient dust levels.

Mitigation Measures:

- ✓ All the Construction vehicles and machineries will be regularly maintained to conform to the emission standards stipulated under Environment (Protection) Rules, 1986.
- ✓ All the DG sets will conform to the emission standards as stipulated under Environment (Protection) Rules, 1986.
- ✓ Undertaking monitoring of air pollution levels in potential problem areas.
- ✓ Avoid dust generating construction activities during strong winds.
- ✓ Cover soil loads in transit.
- ✓ Cover stockpiles of soil or apply suitable dust palliative such as water or commercial dust suppressants.
- ✓ Regularly service vehicles off-site in order to limit gaseous emissions.
- ✓ No open fires permitted on site
- ✓ Place portable toilets on-site and maintain on a daily basis.
- ✓ Water will be sprayed in construction area and other excavation areas for suppressing fugitive dust.
- ✓ Transportation material should be Water sprinkled and covered with tarpaulin.
- ✓ Dust emission from stock piles of excavated material will be controlled either by covering the stockpiled materials or water spraying over it.
- ✓ Special attention will be given when working near educational institutions and health centers and settlement areas.
- ✓ As soon as construction is over all the surplus earth will be utilized properly and all loose earth will be removed from the site.
- ✓ Plantation of trees having adequate canopy should be implemented.

E. IMPACTS ON AMBIENT NOISE AND VIBRATION

The proposed construction activities are expected to increase the noise levels mainly due to plying of construction vehicles, pumping machines, use of portable generators, mechanical machinery etc. These activities will occur round the clock and the noise pollution thus created may affect human habitations, particularly during the night time. Increase of noise level at night may cause discomforts to population in the vicinity of the site in case construction activity is extended into the night hours.

Sensitive receptors and nearby habitation may be affected temporarily by increased traffic due to movement of heavy construction vehicle and equipments, which may generate high levels of noise.

Vibrations resulting from bulk earthworks, micro-tunneling and compaction may create significant disturbances to nearby area.

Mitigation Measures:

- ✓ All noise generating equipments and construction camps will be installed sufficiently away from settlement and sensitive areas.
- ✓ Restrict construction activities to reasonable working hours where near sensitive receptors.
- ✓ Keep adjacent landowners informed of unusually noisy activities planned.
- ✓ The main stationary noise producing sources such as generator sets shall be provided with noise shields around them. The noise shields can either be a brick masonry structure or any other physical barrier which is effective in adequate attenuation of noise levels.
- ✓ The plants and equipment used for construction will strictly conform to CPCB noise standards and ensures that machinery in a good state of maintenance
- ✓ Vehicles and equipments used will be fitted with silencer and maintained accordingly.
- ✓ Noise to be monitored as per monitoring plan and if the noise level at any time found to be higher than immediate measure to reduce noise in that area will be ensured.
- ✓ An awareness programme may be organized for drivers and equipment operators to make them aware of the consequences of noise and to act properly at site.

F. <u>IMPACTS ON ECOLOGY AND BIODIVERSITY</u>

The proposed development is along the Ichamati River. No major impact on ecology is anticipated since existing jetties will be developed only. However, dredging is proposed between jetty locations. About 300 m length of dredging will take place. Some shrubs may also get affected due to construction of terminal. Likely impact on population of phytoplankton, zooplankton, benthic communities and fishes are envisaged due to dredging, but temporary in nature.

Mitigation Measures:

- ✓ Permission will be obtained from Competent Authority for the cutting/felling of trees prior to start of civil works if tree felling is absolutely unavoidable.
- ✓ Ensure any landscaping to be undertaken will be done with locally indigenous species and low maintenance requirements.
- ✓ Dredging should be avoided during breeding season of aquatic fauna.
- ✓ Construction workers should be strictly instructed not to harm any unknown/rarely seen fauna if encountered
- ✓ The generated muck due dredging should not be disposed off in the waterway
- ✓ Construction vehicles should run along specified access to avoid accidents to cattle

G. IMPACTS ON RIVER WATER

The impact on water arises due to the following:

- Discharge of sewage and wastewaters from construction sites and camps to surface waters
- Re-suspension of sediments contaminated with heavy metals during the construction of the terminal.
- Risk of accidental spillages of oils, fuels, and other materials
- Siltation due to surface runoff
- Improper handling and stacking of construction material

Mitigation Measures:

- ✓ The site surface should be engineered and shaped in such a way that rapid and efficient evacuation of runoff is achieved.
- ✓ Provide containment areas for potential pollutants at construction camps, refueling, depots, asphalt plants and concrete batching plants.
- ✓ Implement waste management practices.
- ✓ Control and manage transport, storage, handling and disposal of hazardous substances.
- ✓ Use of tarpaulin sheets during transportation of construction material. Proper stacking of material
- ✓ Use of Silt fencing during construction
- ✓ Stockpiling of subsoil and overburden in all construction and lay down areas

H. IMPACTS DUE TO LABOUR CAMP

Construction workers are neglected group in the country. Unless the workers are provided proper amenities to live at the construction site the environmental issues of project cannot be properly met. Location of the Construction camp also has certain impacts on surrounding environment if not properly managed.

At labour and construction camps lot of wastes are likely to be generated. These wastes are refuge from the plants, and equipments, waste water and other domestic waste. These wastes are solid as well as liquid waste mainly refuse water and kitchen waste. The disposal of such waste material to the surrounding land can potentially damage the land and would generate health risk to not only surrounding area but within the premises itself. Improper drainages system within the premises also creates insanitation condition thereby enhancing health risk.

Maximum labour to be employed in the project shall come from nearby areas. Some labour is expected to be migrated from other areas and is likely to put some stress on account of the following:

- ✓ Generation of sewage from labour colony.
- ✓ Generation of solid waste from labour colony.

Mitigation Measures:

- ✓ The Construction/labour camps will be established only on approved area.
- ✓ The worker's/labour camp will be located away from water bodies, schools and residential areas. The camp will be constructed with proper accommodation facilities.
- ✓ The workers camp will be provided with drinking water supply system so that local water sources are not disturbed.
- ✓ The camp should be provided with fuel for cooking like kerosene and /or LPG to avoid any cutting of trees for fuel wood.
- ✓ Camp will be provided with proper sanitation facilities, separate toilets and bathrooms for female and male workers, septic tanks with soak pits of sufficient size, dust bins etc.
- ✓ Waste water from domestic uses and solid wastes will be disposed of without violating environmental norms. The measures will be site specific.
- ✓ The labour camps will be provided with crèche, first aid facilities, etc as required under Factory Act.

- ✓ After completion of construction, the contractor will dismantle the camp and restore it to the original condition of the area before handing over the site to the land owner.

I. SOCIAL IMPACTS

- **Impacts on Socio-economic environment**

No land will be acquired for the upgradation of the existing jetties and construction of terminal at Bashirhat and Itinda.

- **Impacts on the Regional Economy**

There would be benefits to the local and regional economy through the direct demand for construction goods and services associated with construction activities.

- **Health and Safety**

One of the potential impacts of the proposed project will be on the air quality due to the dust generated during construction. The amount of dust generation will depend upon the level of digging and the prevailing weather conditions. Based on past experience, the air pollution due to entrainment of fugitive emission is marginal in nature and is observed up to a distance of 100 to 200 m from the point of entrainment. Thus, it is expected to lead to marginal impact on ambient air quality. No major health related issues due to air pollution during construction phase of the proposed project are anticipated.

Construction related activities may lead to injuries. Open fires in construction camp can result in accidents. Safety of workers and general public may be compromised due to difficult site conditions. Poor waste management practices and unhygienic conditions at temporary ablution facilities can breed diseases. Standing water due to inadequate storm water drainage systems, inadequate waste management practices, pose a health hazard to providing breeding grounds for disease vectors such as mosquitoes, flies and snails. Road safety may be affected during construction, especially when traffic is detoured.

Mitigation Measures:

- ✓ Implement good housekeeping practices at the construction camp.
- ✓ Strictly implement health and safety measures and audit on a regular basis.

- ✓ Secure enclosed construction site.
- ✓ Use reputable contractors.
- ✓ Provide warning signs of hazardous working areas.
- ✓ The plants and equipments will be installed sufficiently away from the settlement.
- ✓ All the construction equipments and vehicles will conform to the emission standards stipulated by the CPCB.
- ✓ Clearly demarcate excavations and provide barriers (not just danger tape) to protect pedestrians from open trenches.
- ✓ Thoroughly train workers assigned to dangerous equipment.
- ✓ Workers have the right to refuse work in unsafe conditions.
- ✓ Undertake waste management practices (Planned disposal of sludge from pumping stations within surrounding areas of PS) particularly for Pumping Station
- ✓ Control speed and movement of construction vehicles
- ✓ Exclude public from the site
- ✓ Ensure all workers are provided with and use Personal Protective Equipment.
- ✓ Ensure the visibility of workers through their use of high visibility vests when working in or walking through heavy equipment operating areas
- ✓ Ensure that qualified first-aid can be provided at all times. Ensure equipped first-aid stations are easily accessible throughout the site;
- ✓ Provide medical insurance coverage for workers.
- ✓ Provide clean eating areas where workers are not exposed to hazardous or noxious substances;
- ✓ Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazard areas unescorted;
- ✓ Ensure moving equipment is outfitted with audible back-up alarms;
- ✓ Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate.
- ✓ Safe working techniques will be followed up and all the workers will be trained
- ✓ Proper caution signage, barricading, delineators etc. will be installed at Construction zone and temporary diversions
- ✓ Proper traffic management will be ensured at the Construction zone as per IRC.
- ✓ An Emergency Response system in case of any incidence will be developed and implemented

- ✓ Periodical health check facility will be provided at camp sites.

- **Aesthetics**

The presence of heavy duty vehicles and equipment, temporary structures at construction camps, stockpiles, may result in impacts on aesthetics and landscape character.

Mitigation Measures:

- ✓ Properly fence off storage areas.
- ✓ Collection of all domestic solid waste central point of disposal and feed into the city waste collection system.
- ✓ Contractor to exercise strict care in disposing construction waste.
- ✓ Identifying suitable waste disposal site with enough capacity to hold additional waste to be generated by the construction activities.
- ✓ Retaining mature trees on and around the site where possible.
- ✓ Removing unwanted material and litter on a frequent basis.
- ✓ Reinstate pathways and other local infrastructure immediately to at least their pre-project condition upon completion of construction.

- **Employment Generation**

The project will provide employment opportunities for local people during construction. Expectations regarding new employment will be high especially among the unemployed individuals in the area. Labor gathering at the site for work can be a safety and security issue, and must be avoided. The training of unskilled or previously unemployed persons will add to the skills base of the area.

Mitigation Measures:

- ✓ Employment of local labour
- ✓ Training of labour to benefit individuals beyond completion of the project.
- ✓ Ensure recruitment of labors will take place offsite.
- ✓ Ensure at least 50% of all labor is from surrounding communities in the contractual documentation.

9.3.2 Impacts during Operation Phase

A. IMPACTS ON AIR

Sensitive receptors and nearby habitation area may be affected temporarily by increased traffic and other related impacts. Air pollution may generate at jetty/terminal area during transportation and storage activities of material, loading and unloading of material.

Exhaust gases from moving vessel are source of air pollution. However, vessels emit least air emissions compared to the road and railway modes. The impact on air quality due to vessel movement is anticipated insignificant considering the emission levels and projected vessel traffic.

Mitigation Measures:

- ✓ Ensure compliance with the Air Act.
- ✓ Ensure compliance with emission standards
- ✓ Regularly service vehicles off-site in order to limit gaseous emissions
- ✓ Material generating dust should be transported under covered condition
- ✓ Uses of cleaner fuel
- ✓ Material should be stored under cover sheds
- ✓ Water sprinkling should be carried out during all loading and unloading activities and storage period.

B. IMPACTS DUE NOISE AND VIBRATION

Noise generated during operation phase are primarily embarking and disembarking of passengers at site and vessel/barges, movement of vessel, operation of backup power generators, pumps and other equipment. However, the main effect on the environmental noise level will be from increased vehicular movement entering and leaving the terminal site. Sensitive receptors and nearby habitation areas may also be affected by increased traffic and related impacts. Improper handling and irregular maintenance of operating machines may lead to increased noise pollution during operation phases, which would affect the daily life of the surrounding neighborhoods. However, impacts on this account are expected to be marginal.

Mitigation Measures:

- ✓ Restrict maintenance activities to reasonable working hours where near sensitive receptors.

- ✓ Keep adjacent landowners informed of unusually noisy activities planned.
- ✓ Fit and maintain silencers to all machinery on site.
- ✓ Monitor noise levels in potential problem areas
- ✓ Personal Protective Equipment (PPE) should be provided to the worker working in the Terminal/Jetty area.
- ✓ Use of DG set with acoustic enclosure.

C. IMPACTS DUE TO OIL SPILLAGE FROM BARGES AND VESSELS

There may be possibility of oil spillage from barges/vessels during transportation. This will affect the water quality and aquatic ecology of the river.

Mitigation Measures:

- ✓ All waste water and solid waste or maintenance waste should be disposed at the designated barge maintenance facility only.
- ✓ The wastewater from vessels can be sent to STP for treatment and the treated water can be used for landscaping and dust suppression at Jetty sites.
- ✓ Vessels also may have some facilities for treatment of the waste generated.
- ✓ Provision of oil water interceptors.
- ✓ Vessels should not be washed or cleaned at terminal/jetty facility and washings should not be discharge at the terminal/jetty location. Washing should be undertaken only at the maintenance facility only.

D. IMPACTS ON WATER

During operation phase water will be required at terminal/jetties sites for purpose of consumption, dust suppression, cleaning, washing, cooling and landscaping, etc. Water can be used from ground water resources by taking prior permission from the concerned authority. It is proposed to treat the wastewater generated at Jetty site in STP, which will connect to the main municipal line for disposal. Hence, the impact on water resources is anticipated to be low.

Maintenance dredging & on-shore dumping of dredged material are another sources which may impact the water quality of river.

Mitigation Measures:

- ✓ STP to be provided to treat the waste water generated
- ✓ No wastewater should be received from vessels and vessels should not be allowed to discharge their wastewater and solid waste in river
- ✓ No waste/wastewater should be discharged in river or dumped into the ground
- ✓ Fuelling of vessels is not proposed at terminal facility
- ✓ Toilets to be provided with running water facility to prevent open defecation.

E. IMPACTS ON FLORA AND FAUNA

The proposed development is unlikely to have any significant impact on biodiversity. However, maintenance dredging may impact the growth of aquatic life. Impacts may also arise during the movement of vessel/barges.

Mitigation Measures:

- ✓ Dredging should be avoided during breeding season of aquatic fauna.
- ✓ Vessel Operators should be strictly instructed not to harm any unknown/rarely seen fauna if encountered
- ✓ The generated muck due dredging should not be disposed off in the waterway

F. IMPACTS ON HEALTH AND SAFETY

Danger of operations and maintenance-related injuries and accidental drowning may occur during operation stage. Safety of workers and general public must be ensured.

Poor waste management practices and unhygienic conditions at the improved facilities can breed diseases.

Mitigation Measures:

- ✓ Implement good housekeeping practices at terminal and jetty area.
- ✓ Strictly implement health and safety measures and audit on a regular basis.
- ✓ Provision of warning signs of hazardous working areas.
- ✓ Training of workers assigned to dangerous equipment.

- ✓ Undertaking waste management practices- specifically periodic removal of sludge from pumping stations.
- ✓ Provision of life tubes at jetty locations as well as in vessels
- ✓ Ensuring all workers are provided with Personal Protective Equipment.
- ✓ Provision of medical insurance coverage for workers.

G. IMPACTS ON REGIONAL ECONOMY

The project is expected to bring the economic benefits of the region directly through expansion of regional trade, increase new business opportunity, development of new industries. It will also decrease the travel time for crossing one bank to another through ferry facilities.

9.4 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

The main aim of the Environmental Management Plan (EMP) is to ensure that the various adverse impacts are mitigated and the positive impacts are enhanced. The EMP identifies the potential issues of various activities that are anticipated in the design and development, construction, and operation phases of the proposed project. The EMP ensures to suggest appropriate mitigation measures against the issues/ concerns identified during the environmental study.

9.4.1 Implementation of EMP

A copy of the EMP must be kept on site during the construction period at all times. The EMP will be made binding on all contractors operating on the site and will be included within the Contractual Clauses. Non-compliance with, or any deviation from, the conditions set out in this document constitutes a failure in compliance.

The contractor shall be responsible to implement the EMP primarily in assistance with the Supervision Consultant team. The Environmental Specialist from the Supervision Consultant shall monitor the compliance of the EMP.

9.4.2 Environmental Management Action Plan

This section describes the Environmental Management Action Plan for the proposed project during different stages of project. The Environmental mitigation measures have been incorporated at all the stages of the project right from Designing phase to Construction and Operational Phase. The Management Plan has been formulated for implementation of environmental mitigation measures to be carried out and to ensure that the provisions of the EMP are strictly followed and implemented by strengthening implementation arrangements to prevent and minimize the adverse environmental impacts during Construction phase of the project. EMP has also addressed certain environmental measures to be taken to prevent further deterioration of environment components for various stages of the project.

Appropriate measures have also been identified for action during various stages of the project, viz, Design and Pre-Construction, Construction and Operational phases. The measures identified for all three phases, are tabulated in **Table 33** which describes the nature of the potential environmental impact, the measures, which have or will be taken, the timeframe in which they are taken, the implementing agency and responsible organization.

Table 33: Environmental Management Plan (EMP)

S. No.	Environmental issue/ Activity	Mitigation Measures	Institutional Responsibility	
			Implementation	Supervision
A.	**DESIGN AND DEVELOPMENT/ PRE-CONSTRUCTION PHASE**			
1.	Arrangements for temporary land for Establishing Camps/Plants/ Temporary diversions	• The Contractor as per prevalent rules will carry out negotiations with the landowners for obtaining their consent for temporary use of lands for workers camp, construction sites traffic detours etc. • The Contractor will submit the legal agreement/ written Consent letter from the owner of the land for using fir specific purpose along with its rehabilitation plan as agreed by the owner. • The Contractor will ensure that the site is properly restored to the satisfaction of the land owner prior to handling over to the owner and shall submit satisfactory certificate from the Land Owner.	Contractor	Supervision Consultants, IWAI
2.	Establishment of Construction Camp	• The locations of construction camp to be identified by the Contractor. Construction camps will not be proposed within 500 m from the nearest settlements to avoid conflicts and stress over the infrastructure facilities with the local community. Location for stockyards for construction materials will be identified at least 1000m from water sources / and 10	Contractor	Supervision Consultants, IWAI

S. No.	Environmental issue/ Activity	Mitigation Measures	Institutional Responsibility	
			Implementation	Supervision
		Km from Wildlife Sanctuary boundary. • The Contractor will submit the legal agreement/ written Consent letter from the owner of the land for using fir specific purpose along with its rehabilitation plan as agreed by the owner. • The Camp site will be provided with all the necessary facilities as per norms.		
3.	Material Sources	• Finalization of material sourcing and all logistic arrangements are well as compliance to environmental requirements, as applicable, will be the sole responsibility of the Contractor	Contractor	Supervision Consultants, IWAI
B.	**CONSTRUCTION PHASE**			
1.	Impact on Soil			
(i)	Soil Erosion	• Maintaining the excavation by shoring trench sides by placing sheeting, timber shores, trench jacks, bracing, sheet piling materials to resist pressures surrounding the excavation • Exposed surface will be resurfaced and stabilized by making the sloping sides of trench to the angle of repose at which the soil will remain safely at rest • Proper stock piling of excavated soil and must be bordered by berms • Soil erosion checking measures as the formation of sediment basins, slope drains, etc, will be carried out.	Contractor	Supervision Consultants, IWAI
(ii)	Loss of Topsoil	• The topsoil from all areas of cutting and all areas to be permanently covered will be stripped to a specified depth of 150 mm and stored in stockpiles of height not exceeding 2m. • The stored topsoil will be spread back to maintain the soil physico-chemical and biological activity. The preserved top soil will be used for restoration of sites, in landscaping and avenue plantation • To prevent excessive disturbance of natural vegetation, the top soil excavated should be stored and utilized for re-vegetation after completion of work.	Contractor	Supervision Consultants, IWAI

S. No.	Environmental issue/ Activity	Mitigation Measures	Institutional Responsibility	
			Implementation	Supervision
		• Topsoil and subsoil must be placed on opposite sides of the trench and must be kept separate throughout construction and rehabilitation.		
(iii)	Compaction of soil	• Construction vehicles, machinery and equipment will move, or be stationed in the designated area to avoid compaction of soil. • If operating from temporarily hired land, it will be ensured that the topsoil for agriculture remains preserved & not destroyed by storage, material handling or any other construction related activities.	Contractor	Supervision Consultants, IWAI
(iv)	Contamination of land from fuel and lubricants	• Impervious platform and oil and grease trap for collection of spillage from construction equipment vehicle maintenance platform will be appropriately provided at construction camp, servicing area and liquid fuel and lubes at storage areas.	Contractor	Supervision Consultants, IWAI
(v)	Contamination of land from construction wastes and spoils	• All spoils will be disposed off as desired and the site will be fully cleaned before handing over. • strict care in the disposal of construction waste with proof of disposal at an approved site provided after offloading each waste load and this logged/registered. • Waste containing contaminated water to dispose off site at an approved disposal site in consultation with State Pollution Control Board. • Dispose of waste from the oil interceptors only through suitable waste-handling contractor and request for safe disposal certificates	Contractor	Supervision Consultants, IWAI
2.	Impact on Air			
(i)	Emission from construction vehicles and machinery	• All vehicles, equipment and machinery used for construction will be regularly maintained to ensure that the pollution emission levels conform to the SPCB	Contractor	Supervision Consultants, IWAI

S. No.	Environmental issue/ Activity	Mitigation Measures	Institutional Responsibility	
			Implementation	Supervision
		norms. • The Contractor will submit PUC certificates for all vehicles/ equipment/machinery used for the project. Monitoring results will also be submitted to 'PIU' through the 'Engineer'. • Workers at mixing sites will be provided with good quality personal protective equipments (PPE) reduce the chances of ill effect of dust • DG sets will conform to the emission standards as stipulated under Environment (Protection) Rules, 1986 • Vehicles transporting earth and other materials will be covered properly to prevent fugitive emissions • Mixing equipment will be well sealed and equipped as per PCB norms. • Sprinkling of water in construction area and other excavation areas for suppressing fugitive dust • Periodical monitoring of fine Particulate Matters (PM10 and PM2.5) will be carrier out as per Environmental Monitoring Plan.		
(ii)	Dust Pollution	• The Contractor will take every precaution to control dust nuisance at all the construction zones and allied sites where works are under progress. • Every equipments and machinery will be fitted with dust suppression devices such as water sprinklers, dust bags, cyclone etc. as appropriate. • At all the construction zones and unpaved lead roads, earthen temporary diversions and plant premises periodical water sprinkling will be carried out to suppress dust. • Transportation of loose earth, sand will be done in covered vehicles. • All equipments and machineries will be maintained properly. • Periodical monitoring of fine Particulate Matters (PM_{10} and $PM_{2.5}$) will be carried out as per Environmental Monitoring Plan. • Workers at mixing sites will wear masks	Contractor	Supervision Consultants, IWAI

S. No.	Environmental issue/ Activity	Mitigation Measures	Institutional Responsibility	
			Implementation	Supervision
		to reduce the chances of exposure to fugitive dusts.		
3.	Impact on Noise Pollution			
(i)	Noise from vehicles and construction equipments	The Contractor will confirm the following: • All plants and equipments used in construction shall strictly conform to the MoEFCC/CPCB/SPCB noise standards. • All vehicles and equipment used in construction will be fitted with exhaust silencers. • Servicing of all construction vehicles and machinery will be done for exhaust silences and will be checked and if found defective will be replaced. • All the construction sites within 150m of the nearest habitation, noisy construction work such as crushing, concrete mixing will be stopped during the night time between 10.00 pm to 6.00 am. • No noisy construction activities will be permitted around educational institutions/health centers (silence zones) up to a distance of 100 m from the sensitive receptors. • Monitoring shall be carried out at the construction sites and results will be submitted to Supervision Consultants (SC) and IWAI. • Environmental Expert of SC will be required to inspect regularly to ensure the compliance of EMP.	Contractor	Supervision Consultants, IWAI
4	River Water contamination	• The site surface should be engineered and shaped in such a way that rapid and efficient evacuation of runoff is achieved. • Provide containment areas for potential pollutants at construction camps, refueling, depots, asphalt plants and concrete batching plants. • Implement waste management practices. • Control and manage transport, storage, handling and disposal of hazardous substances • Use of tarpaulin shees during transportation of construction material. Proper stacking of material	Contractor	Supervision Consultants, IWAI

S. No.	Environmental issue/ Activity	Mitigation Measures	Institutional Responsibility	
			Implementation	Supervision
		• Use of Silt fencing during construction • Stockpiling of subsoil and overburden in all construction and lay down areas		
5.	Impact on Flora and Fauna	• If required, Vegetation will be removed from the construction zone before commencement of construction • Construction vehicles, machinery and equipment will move or be stationed in the designated area only to prevent compaction of vegetation • Construction workers will be directed not to disrupt or damage the fauna. • Dredging should be avoided during breeding/spawning season of aquatic fauna. • The generated muck due to dredging should not be disposed off in the waterway • Construction vehicles should run along specified access to avoid accidents to cattle	Contractor	Supervision Consultants, IWAI
6.	Safety			
(i)	Accidents due to construction activities	• To ensure safe construction in the temporary accesses during construction, lighting devices and safety sign boards will be installed. • Traffic rules and regulations will be strictly adhered to. • Safety of workers undertaking various operations during construction will be ensured by providing helmets, masks, safety goggles, etc • The electrical equipment will be checked regularly • At every camp site, a readily available first aid unit including an adequate supply of dressing materials, a mode of transport (ambulance), para medical staff and an attending doctor will be provided. • Road safety education will be imparted to drivers running construction vehicles. In case of negligent driving, suitable action will be taken. • Adequate signage, barriers and persons with flags during construction to control	Contractor	Supervision Consultants, IWAI

S. No.	Environmental issue/ Activity	Mitigation Measures	Institutional Responsibility	
			Implementation	Supervision
		the traffic will be provided.		
(ii)	Occupation Health and Safety	• The Contractor will provide adequate good quality Personal Protective Equipments (PPE) to all the workers working at construction zones and Plant sites and will ensure that these PPEs are used by workers at all time during works. • Adequate drainage, sanitation and waste disposal will be provided at workplaces. • Proper drainage will be maintained around sites to avoid water logging leading to various diseases • Adequate sanitation and waste disposal facilities will be provided at construction camps by means of septic tanks, soakage pits etc. • A health care system will be maintained at construction camp for routine check up of workers and avoidance of spread of any communicable disease • Readily available First Aid kit bearing all necessary first aid items will be proved at all the work sites and should be regularly maintained.	Contractor	Supervision Consultants, IWAI
7.	Wastes	• Ensure that no litter, refuse, wastes, rubbish, rubble, debris and builders wastes generated on the premises must be collected in rubbish bins and disposed of weekly at registered refuse facility sites. • Toilet facility must be provided at construction site and should be maintained properly. Toilets must be emptied regularly at treatment plants and every effort must be made to prevent the contamination of surface or sub-surface water • Muck generated due to dredging should be disposed as per the proposal of disposing around the proposed terminal area for flood protection	Contractor	Supervision Consultants, IWAI
8.	Camp Site management	• Contractor will follow all relevant provisions of the Factories Act, 1948 and the Building and the other Construction Workers (Regulation of Employment and	Contractor	Supervision Consultants, IWAI

S. No.	Environmental issue/ Activity	Mitigation Measures	Institutional Responsibility	
			Implementation	Supervision
		Conditions of Service) Act, 1996 for construction and maintenance of labour camp. • The location, layout and basic facility provision of each labour camp will be submitted to the Engineer and IWAI prior to their construction. • The construction will commence only upon the written approval of the Engineer. • The contractor will maintain necessary living accommodation and ancillary facilities in functional and hygienic manner and as approved by the Engineer. • Periodical medical check up will be ensured for all the workers • The Contractor will provide potable water facilities within the precincts of every workplace in an accessible place. • The sewage system for the camp will be designed, built and operated in such a fashion that it should not pollute the ground water or nearby surface water. • Separate toilets/bathrooms, will be arranged for men and women • Adequate water supply is to be provided in all toilets and urinals • The Contractor will provide segregated garbage bins in the camps and ensure that these are regularly emptied and disposed off in a hygienic manner as per the Comprehensive Solid Waste Management Plan approved by the Environmental Expert of SC.		
9.	Monitoring of Air, Water & Noise Quality Pollution Monitoring	• The periodic monitoring of the ambient air quality, noise level, water (both ground and surface water) quality, soil pollution/contamination in the selected locations as suggested by SC will be the responsibility of Contractor	Contractor	Supervision Consultants, IWAI
C.	**OPERATION PHASE**			
1.	Monitoring of Operation Performance	• The IWAI will monitor the operational performance of the various mitigation/enhancement measures	Contractor	IWAI

S. No.	Environmental issue/ Activity	Mitigation Measures	Institutional Responsibility	
			Implementation	Supervision
		carried out as a part of the project.		
2.	Air	• Ensure compliance with the Air Act. • Ensure compliance with emission standards • Uses of cleaner fuel • Water sprinkling should be carried out at terminal sites to bring down the dust level	IWAI	IWAI
3.	Noise	• Restrict maintenance activities to reasonable working hours where near sensitive receptors. • Keep adjacent landowners informed of unusually noisy activities planned. • Fit and maintain silencers to all machinery on site. • Monitor noise levels in potential problem areas • Personal Protective Equipment (PPE) should be provided to the worker working in the Terminal/Jetty area. • Use of DG set with acoustic enclosure	IWAI	IWAI
4.	Water and Waste water	• No wastewater should be received from vessels and vessels should not be allowed to discharge their wastewater and solid waste in river • No waste/wastewater should be discharged in river or dumped into the ground • Fuelling of vessels is not proposed at terminal facility • Toilets to be provided with running water facility to prevent open defecation	IWAI	IWAI
5.	Oil Spillage from Vessel/barges	• All waste water and solid waste or maintenance waste should be disposed at the designated barge maintenance facility only. • Provision of oil water interceptors • Vessels should not be washed or cleaned at terminal/jetty facility and washings should not be discharged at the terminal/jetty location. Washing should be undertaken only at the maintenance facility only.	IWAI	IWAI

9.5 LEGAL AND REGULATORY FRAMEWORK

The increase of environmental concern also necessitated appropriate tools/actions to protect environment. During Stockholm Conference, first exclusive Environmental Protection Act was enacted in India in 1986. Prior to this umbrella act, Water (Pollution Prevention and Control) Act was enacted in India in 1974 & Air Pollution act, 1981. In accordance with EPA act (1986) Central and State Boards for Prevention and Control of Water Pollution were set up. Later these boards were renamed into Central Pollution Control Board and respective State Pollution Control Boards. Department of Environment was set up in 1980. Subsequently in 1985, it was upgraded to a full-fledged Ministry of Environment and Forests and Climate Change (MoEFCC) under Government of India to serve as the focal point in the administrative structure for the planning, promotion and coordination of environmental and forestry programmes. The name of MoEF has been revised in the year 2014 to Ministry of Environment, Forests and Climate Change (MOEFCC). This ministry has overall authority for the administration and implementation of government policies, laws and regulations related to the environment, including conservation, environmental assessment, sustainable development, forest conservation and pollution control. MOEFCC identifies the need to enact new laws and amend existing environmental legislation when required, in order to continue to conserve and protect the environment. At the state level, the MOEFCC authority is implemented by the Department of the Environment and the Department of Forests.

In 1976, the 42nd Constitutional Amendment created Article 48A and 51A, placing an obligation on every citizen of the country to attempt to conserve the environment. As a result, a number of laws related to environmental conservation were passed to strengthen existing legislation. Environment (Protection) Act, 1986 is the landmark legislation as it provides for the protection of environment and aims at plugging the loopholes in the other related acts and this Act is called as umbrella Act. Under this Umbrella Act all the environmental acts and rules have been formed.

The laws and regulation applicable under the programme:

- Policy and Regulatory Framework of Government of India
- Environmental Policy of respective State Government
- Legislation applicable to construction activities

9.5.1 Key Environmental Laws and Regulations

The relevant Acts and Rules are given in the **Table 34**.

Table 34: Key Environmental Laws and Regulation

Acts/Rule/ Policy	Year	Objective/ criteria	Authority	Applicability		Remarks
				Yes	No	
Environmental (Protection) Act	1986	To protect and improve the overall environment.	MOEFCC. GoI; CPCB, West Bengal State Pollution Control Board	√	..	This act is applicable to all environmental notifications, rules and schedules are issued under this act.
Environment Impact Assessment Notification	2006	To provide environmental clearance to new development activities following environmental impact assessment	MOEFCC	--	√	Environment Impact Assessment Notification has been issued for requirement of EIA and activities requiring clearance from Central Government in the Ministry of Environment and Forests (MoEFCC). The proposed project does not require environmental clearance as per MoEFCC letter No.

Acts/Rule/ Policy	Year	Objective/ criteria	Authority	Applicability		Remarks
				Yes	No	
						F. No. 14-9/2016-IA-III dated 21st December 2017.
Municipal Solid Waste (Management and Handling) Rules	2000	To manage collection transportation, segregation, treatment and disposal of municipal solid waste	MOEFCC, GoI, West Bengal State Pollution Control Board	√	..	Applicable for the project for the management of Solid waste
Indian Forest Act The Forest (Conservation) Act The Forest (Conservation) Rules	1927 1980 1981	To check deforestation by restricting conversion of forested areas into non forested areas.	Forest Department, Govt. of West Bengal, MOEFCC-Regional Office and MOEFCC.	..	√	No diversion of Forest land required for this project
Wildlife (Protection) Act	1972	To protect wildlife through creation of National Parks and Sanctuaries.	Chief Conservator. Wildlife, Wildlife Wing, Forest Department, Gov. of Odisha and National Board For Wildlife, GoI.	--	√	This act will not be applicable

Acts/Rule/ Policy	Year	Objective/ criteria	Authority	Applicability		Remarks
				Yes	No	
Water (Prevention and Control of Pollution) Act	1974	To control water pollution by controlling discharge of pollutants as per the prescribed standards.	West Bengal State Pollution Control Board	√	..	Applicable during construction and operation stage
Air (Prevention and Control of Pollution) Act	1981	To control air pollution by controlling emission of air pollutants as per the prescribed standards.	West Bengal State Pollution Control Board	√	..	Applicable during construction stage
Noise Pollution (Regulation and Control) Rules The Noise Pollution (Regulation and Control) Amendment Rules	2000 2006	To regulate and control noise producing and generating sources with the objective of maintaining the ambient air quality standards in respect of noise	CPCB; SPCB & Transport Department; Govt. of West Bengal	√	..	This act will be applicable during construction phase of the project.
Central Motor Vehicle Act Central Motor Vehicle Rules	1988 1989	To check vehicular air and noise pollution.	Transport Department and West Bengal State Pollution Control Board	√	..	For construction vehicles (Construction Stage) – Pollution Under Control Certificate
Ancient Monuments and	1958	These Acts are applicable in case	Archaeological Dept. GOI,	--	√	This act will not be applicable

Acts/Rule/ Policy	Year	Objective/ criteria	Authority	Applicability		Remarks
				Yes	No	
Archaeological Sites and Remains Act		any development activity is undertaken in close vicinity of any archaeological site or any are discovered during the construction stage. The Act requires prior authorization of the Archaeological Survey of India (ASI) for development within 300 m of a Protected Property	Indian Heritage Society and Indian National Trust for Art and Culture Heritage (INTACH).			
Wetland Conservation and Management Rules	2010	The rule specifies the activities which are harmful and prohibited in the wetlands such as industrialization, construction, dumping of untreated waste and effluents and reclamation.	Central Wetland Regulatory Authority; MOEFCC	…	√	Not applicable
CRZ Notification	2011	To ensure livelihood security to the fisher communities and	West Bengal State Coastal Zone Management	√	..	CRZ Notification issued for To regulate development

Acts/Rule/ Policy	Year	Objective/ criteria	Authority	Applicability		Remarks
				Yes	No	
		other local communities, living in the coastal areas, to conserve and protect coastal stretches, its unique environment and its marine area and to promote development through sustainable manner based on scientific principles taking into account the dangers of natural hazards in the coastal areas, sea level rise due to global warming.	Authority and MoEF&CC			activities within the 500m of high tide line in coastal zone and 100 m of tidal influence rivers.
Biological Diversity Act	2002	To provide for conservation of biological diversity, sustainable use of its components and fair and equitable sharing of the benefits arising out of the use of biological resources,	National Biodiversity Authority and State Biodiversity Board	...	√	Not Applicable

Acts/Rule/ Policy	Year	Objective/ criteria	Authority	Applicability		Remarks
				Yes	No	
		knowledge and for matters connected therewith or incidental thereto.				

9.5.2 Need for Environmental Clearance

The proposed project will not require Environmental Clearance as per MoEFCC letter No. F. No. 14-9/2016-IA-III dated 21st December 2017, which is enclosed as **ANNEXURE 4**.

9.5.3 Other Major Clearances / Approvals / Permits Applicable to the Project

The CRZ Clearances may be applicable as per the CRZ Notification 2011.

The other clearances and permits required for project at different stages is given in **Table 35.**

Table 35: Other Statutory Clearances required for the Project

S. No.	Type of Clearances / Permits	Regulatory Authority	Applicability	Project Stage	Responsibility
1	NOC and consents under Air & Water Act	West Bengal Pollution Control Board	For development of Waterway	Pre-construction Stage	IWAI
2	NOC (Consent to Establish and Consent to Operate) under Air and Water Act	West Bengal Pollution Control Board	For siting, erection and operation of stone crusher, Hot Mix Plant, batching plant, WMM Plant etc.	Construction Stage	Contractor

S. No.	Type of Clearances / Permits	Regulatory Authority	Applicability	Project Stage	Responsibility
3	Explosive License from	Chief Controller of Explosives,	For storing fuel oil, lubricants, diesel etc.	Construction stage (Prior to storing fuel, lubricants and Diesel, etc.)	Contractor
4	Quarry Lease Deed and Quarry License	State Department of Mines and Geology	Quarry operation	Construction stage (Prior to initiation of Quarrying)	Contractor
5	Environmental Clearance for stone quarry	District Level environmental Impact Assessment Authority,	Opening of new Quarry and Borrow area for earth material	Construction stage (Prior to initiation of Quarrying)	Contractor
6	Permission for extraction of ground water for use in construction activities	Central Ground Water board	Extraction of ground water	Construction stage (Prior to initiation of installation of Bore wells and abstraction of water from such source)	Contractor
7	Permission for use of water for construction purpose	Irrigation department	Use of surface water for construction	Construction stage (Prior to initiation of abstraction of water from such source)	Contractor
8	Labour license	Labour Commissioner Office	Engagement of Labour	Construction stage (Prior to initiation of any	Contractor

S. No.	Type of Clearances / Permits	Regulatory Authority	Applicability	Project Stage	Responsibility
				work)	

9.6 COST IMPLICATION

The estimated environment cost is as follows:

(A) Estimated cost at Pre-construction Stage:

The estimated cost for EIA-EMP & SIA studies have been summarized in **Table 36**:

Table 36: Summary of Estimated Cost of EIA_EMP and SIA Studies

Sl. No.	Particulars	Unit	Amount (Lakh INR)
1.	Man Power Cost (13 nos. of Experts: 1 no. EC and 12 nos. FAE)	Lump sum	35.00
2.	Cost of one Time Baseline Data Generation at Pre-Construction Stage	One season cost (**Table 37**)	10.79
3.	Public Consultation Meeting (PCM)	Lump sum	3.00
4.	Surveys/ Reports / Document Printing	Lump sum	5.00
5.	Travelling Cost for Site Visits	Lump sum	4.00
6.	Lodging & Boarding Cost	Lump sum	5.00
7.	Cost for collection of metrological data and other information like Maps *etc.*	Lump sum	2.00
Total			**64.79**

Table 37: Estimated cost for Baseline data generation

Sl. No.	Environmental Attributes	Parameters	Monitoring Frequency	Unit	No. of Tentative Locations	Unit Rate (Rs)	Amount (Lakh INR)
1.	Ambient Air Quality	$PM_{2.5}$, PM_{10}, CO, SO_2, NO_2 etc.	24 Hourly sampling (Day & Night time) to be done at each location.	No.	3 (Twice a week for twelve weeks): 72 Nos.	10000	7.2
2.	Surface Water Quality	***Physical Properties:***	Grab Sampling	No.	2	8000	0.16

Sl. No.	Environmental Attributes	Parameters	Monitoring Frequency	Unit	No. of Tentative Locations	Unit Rate (Rs)	Amount (Lakh INR)
	monitoring	pH, Temp., DO,					
3.	Ground Water Quality Monitoring	Conductivity, ***Chemical Properties:*** TSS, Alkalinity, Hardness, BOD, COD, NO3, PO4, Cl, SO4, Na, K, Ca, Mg, Silica, Oil & grease, Phenolic compounds, Residual Sodium Carbonate. ***Bacteriological Properties:*** Total Coliform.	Grab Sampling	No.	2	8000	0.16
4.	Noise Quality monitoring	Day & Time time monitoring to be done at each location	24 Hourly sampling (Day & Night time) to be done	No.	3	4000	0.12
5.	Soil	Bulk Density, Colour, Texture, Soil Type, pH, Electrical Conductivity, N, P, K *etc.*	Composite sample shall be prepared based on at least 3 replicates from each location.		2	7500	0.15

Sl. No.	Environmental Attributes	Parameters	Monitoring Frequency	Unit	No. of Tentative Locations	Unit Rate (Rs)	Amount (Lakh INR)
6.	Aquatic Ecology	Trophic Status, Primary Productivity, Species diversity & densities of Phytoplankton, Zooplankton, Benthic Organism (Benthos, Macro-benthos), Fish and Macrophytes, Shanon Weiner Diversity Index.	One time study	No.	2	150000	3.0
	Sub-Total						**10.79**

(B) Estimated cost at construction Stage:

Table 38: Estimated Cost during Construction Stage

Sl. No.	Particulars of Estimated Budget	Unit	Amount (Lakh INR)
1.	Environmental Monitoring Cost at Construction Stage for one year	Table 39	19.23
2.	Greenbelt Development nearby terminal Premises by Contractor	Lump sum	8.00
3.	Solid Waste Management	Lump sum	5.00
4.	Sanitary facilities at labour camps	Lump sum	5.00
5.	Disaster Management Plan	Lump sum	3.00
6.	Environmental Training	Lump sum	1.00
Total			**41.23**

Table 39: Environmental Monitoring Cost during Construction Phase

S. No.	Item	Unit	Quantity	Rate (INR.)	Amount (Lakh INR.)
1.	Ambient Air Quality monitoring of PM_{10}, $PM_{2.5}$, CO, SO_2 &NO_2 (3 locations in the interval of 3 months for 2 years except monsoon) **Break up: 3 Locations X 3 Seasons X 2 Years = 18**	No.	18	10,000	1.80
2.	Ambient Noise level monitoring Leq dB(A) Day & Nighttime (3 locations in the interval of 3 months for 2 year except monsoon) **Break up: 3 Locations X 3 Seasons X 2 Years = 18**	No.	18	4,000	0.72
3.	Monitoring of River water Quality (2 locations in the interval of 3 months for 2 years during HFL and LFL except monsoon) **Break up: 2 Locations X 3 Seasons X 2 Years X 2 (HFL&LFL) = 24**	No.	24	8000	1.92
4.	Monitoring of ground water (2 locations in the interval of 3 months for 2 year except monsoon) **Break up: 2 Location X 3 Seasons X 2 Year = 12**	No.	12	8000	0.96
5.	Soil Quality monitoring (2 location along the Bank of River and 1 location at Construction site for three season for two years except monsoon) **Break up: 3 Locations X 3 Seasons X 2 Year = 18**	No.	18	7,500	1.35
6.	Monitoring of drinking water quality at construction camp (1 location in the interval of 3 months for 2 year except monsoon) **Break up: 1 Locations X 3 Seasons X 2 Years = 6**	No.	6	8,000	0.48

S. No.	Item	Unit	Quantity	Rate (INR.)	Amount (Lakh INR.)
7.	Study of Acquatic and terrestrial fauna (2 location twice a year for two year) **Break up: 2 Locations X 2 Seasons X 2 Years = 8**	No	8	150000	12.00
Sub-Total					**19.23**

(C) Estimated cost during operation Stage

Table 40: Estimated Cost during Operation Stage

S. No.	Particulars of Estimated Budget	Unit	Amount (Lakh INR)
1.	Environmental Monitoring Cost at Operational Stage for one year	**Table 41**	3.275
2.	Maintenance & Supervision of Greenbelt Developed	Lump sum	5.00
3.	Solid Waste Management	Lump sum	5.00
4.	Sanitary facilities nearby terminals	Lump sum	5.00
5.	Miscellaneous	Lump sum	5.00
Total			**23.275**

Table 41: Environmental Monitoring cost during operation stage

S. No.	Item	Unit	Quantity	Rate (INR.)	Amount (Lakh INR.)
1.	Ambient Air Quality monitoring of PM_{10}, $PM_{2.5}$, CO, SO_2 &NO_2 (1 locations once in a year for 1 year except monsoon **Break up: 1 Location X 1 Season X 1 Year =6**	No.	1	12000	0.12
2.	Monitoring of River water Quality (2 locations once in a year for 1 years during HFL and LFL except monsoon) **Break up: 1 Location X 1 Season X 1 Years X 2 (HFL&LFL) = 2**	No.	2	10000	0.10
3.	Monitoring of drinking water (1 location in a interval of 3 month except monsoon for 1 year) **Break up: 1 Locations X 3 Season X 1 Year = 3**	No.	3	10000	0.30

S. No.	Item	Unit	Quantity	Rate (INR.)	Amount (Lakh INR.)
4.	Ambient Noise level monitoring Leq dB(A) Day & Nighttime (1 location once in a year for 3 year) **Break up: 1 Locations X 1 Season X 1 Years = 1**	No.	1	5,500	0.055
5.	Soil Quality monitoring (1 locations along the Bank of River once in a year for 1 year except monsoon) **Break up: 1 Locations X 1 Season X 1 Years = 1**	No.	1	9,500	0.95
6.	Study of Acquatic and terrestrial fauna (1 location once in a year for 1 year) **Break up: 1 Location X 1 Season X 1 Years = 1**	No.	1	175000	1.75
Sub-Total					**3.275**

The total estimated Environmental cost for the project is given in **Table 42.**

Table 42: Estimated Environmental and Social Cost for the Project

Sl. No.	Project Stages	Cost (Lacs INR)
1.	Pre-Construction Stage	64.79
2.	Construction Stage	41.23
3.	Operational Stage	23.275
Total Estimated Budget (Except Statutory Fee & Land Acquisition & R&R Costs)		**129.295**

10.0 INSTITUTIONAL REQUIREMENTS

The proposed development of Ichamati waterway near Itinda and Basirhat ghata shall be developed and maintained by a separate Project Management Unit (PMU) under the jurisdiction of Director, Inland Waterways Authority of India, Kolkata.

10.1 ORGANIZATIONAL SET UP / ESTABLISHMENT

The proposed PMU organisation structure is presented in **Figure 42**

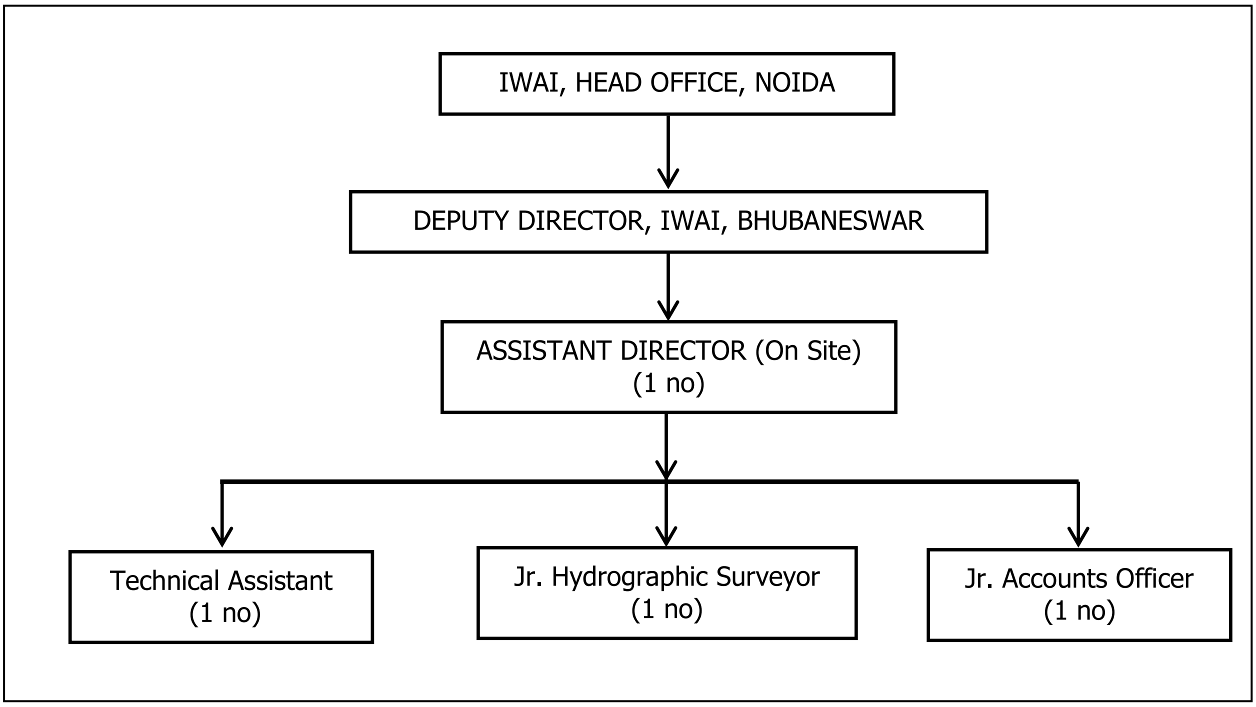


Figure 42: Organisation Structure of Project Monitoring Unit (PMU)

10.2 MAN POWER REQUIREMENT

Following man power is estimated to be required for efficient terminal operations:

a) Assistant Director (On Site) – 1 No
b) Technical Assistant – 1 No.
c) Jr. Hydrographic Surveyor – 1 No
d) Jr. Account Officer – 1 No

In addition to these 4 additional project/support staff are required to be engaged on contract/outsourcing basis. These support staff will work as a Multi-Purpose worker in PMU.

Manpower required in customs office for RO-RO operations shall be provided as per the agency requirement.

10.3 TRAINING REQUIREMENT / CAPACITY BUILDING

1 month of Training is proposed for all technical assistants and surveyors per year, at IWAI HO and other regional offices for skill development. The training to be provided is on latest software's, tools and plants, to upgrade technical skills and to increase awareness of Quality, Health, Safety and Environment (QHSE) policies.

10.4 INFRASTRUCTURE

Infrastructure required for running the organisational set up for Ichamati waterway is covered under this head. The basic infrastructure required for running the services are office complex, computers/laptos and printers/plotters, e-pbax facility, pantry, inspection vehicles etc.

10.4.1 Immovable

In order to optimise the cost to be incurred in purchasing/hiring land for office complex, it is proposed the required office complex including pantry/canteen and toilets will be housed in one of the terminal building.

10.4.2 Movable

Office stationary including computers/laptops, printers/plotters, inspection vehicles and other miscellaneous items are covered under movable assets. The detail list of movable assets required is as follows:

Sl. No.	Movable Asset	No.	Remark
1.	Computer/Laptop	4	For permanent Staff
		2	Additional for support staff
2.	Colour Printers & Scanner	2	
3.	Plotter	1	

Sl. No.	Movable Asset	No.	Remark
4.	Air conditioners	7	
5.	Car	2	
6.	Inspection Vehicle (All wheel drive)	2	
7	Office stationery and other miscellaneous items		

10.5 COST IMPLICATIONS

Cost proposed to be incurred for organisational set up is divided in the following sub heads:

Capital Cost:

Infrastructure: As it is proposed that office complex for the staff shall be located in one of the terminal building, no expense is considered here for immovable infrastructure. Cost implication for purchasing/hiring movable assets is provided as below:

Table 43: Cost for developing infrastructural works for Institutional Setup

Sl. No.	Movable Asset	No.	Rate (INR)	Cost (INR)
1.	Computer/Laptop	6	50,000/-	3,00,000/-
2.	Colour Printers & Scanner	2	10,000/-	20,000/-
3.	Plotter	1	5,00,000/-	5,00,000/-
4.	Air conditioners	7	40,000/-	2,80,000/-
5.	Car	1	7,00,000/-	7,00,000/-
6.	Inspection Vehicle (All wheel drive)	1	20,00,000/-	20,00,000/-
7	Office stationery and other miscellaneous items		LS	1,00,000/-
	Total			**39,00,000/-**

Annual Cost:

Man power: The tentative manpower cost on the basis of 7th CPC is provided in **Table 44** as below:

Table 44: Manpower Cost

Sl. No.	Manpower	Level as per pay matrix	Min. gross salary (INR/month)	Numbers of staff	Annual Cost (INR Lacs)
1	Assistant Director	L-10	56,100	1	6.73
2	Technical Assistant	L-6	35,400	1	4.25
3	Jr. Hydrographic Surveyor	L-6	35,400	1	4.25
4	Jr. Accounts Officer	L-6	35,400	1	4.25
6	Project/support staff		20,000	4	9.60
	Total				**29.08**

The total manpower cost for Ichamati waterway project works out to **INR 29.08 Lacs** annually.

Training/ Capacity Building: An annual budget of INR 5,00,000/- (**INR 5.0 Lacs**) is considered for the same.

Hence total annual O&M cost works out to **INR 34.08 Lacs.**

11.0 PROJECT COSTING

The project cost estimates for development of the Inland Water Transport system as well as for maintenance of the system have been worked out. The cost estimates for development of the system are termed as capital cost while for operation of the system is termed as maintenance or operating cost.

11.1 BASIS OF COSTING

The basis of cost estimates worked out as per following:

a) Standard Schedule of Rates of PWD, Govt. of West Bengal.
b) "Unified Schedule of Rates" prepared by Irrigation and Waterways department, Government of West Bengal.
c) The consultants experience on various projects sites proximity to the project area.
d) Local enquiries at the time of conducting surveys.
e) Market surveys and enquires
f) Judgement based on Consultant's Experience

11.2 DEVELOPMENT COST

Ichamati waterway is proposed to be developed for passenger ferry services at Itinda and Basirhat ghat and for Ro-Ro operations from Basirhat to Indo-Bangladesh border. The development cost for waterway comprises of:

a) Cost for fairway development comprising dredging and navigation & communication system
b) Cost of jetties and terminal buildings
c) Vessel Cost
d) EMP cost.

11.3 CAPITAL EXPENDITURE

The expenses expected to be incurred in construction and development of the waterway, terminal structures including jetties and procurement of vessels are considered as capital expenditure. The detail capital cost estimated to be incurred on the basis of proposed infrastructure and preliminary design at this stage of studies is provided in **Table 45**.

Table 45: Summary of Capital Cost of Project

Sl. No.	Item	Reference Table	Amount in Lacs (INR)
1.0	Capital cost for Fairway Development		466.20
2.0	Capital cost for two (2) Terminals	**Table 18**	1183.87
3.0	Capital Cost for two (2) Passenger ferry Vessels		183.996
4.0	Capital Cost for Aids to Navigation and Communication	**Table 25**	363.30
5.0	Cost allotted for EMP	**Table 42**	106.02
6.0	Cost for Institutional setup works	**Table 43**	39.00
	Total Capital Cost		**2342.386**

11.4 OPERATIONAL AND MAINTENANCE EXPENDITURE

The detail capital cost estimated to be incurred on the basis of proposed infrastructure and preliminary design at this stage of studies are provided in **Table 46** as below:

Table 46: Summary of annual O & M Cost of Project

Sl. No.	Item	Reference Table	Amount in Lacs (INR)
1.0	O&M cost for Fairway Development		46.62
2.0	O&M cost for Terminals	**Table 21**	175.36
3.0	O&M Cost for Vessels	**Table 24**	86.16
4.0	O&M Cost for Aids to Navigation and Communication		183.82
5.0	EMP Cost during operation stage	**Table 42**	23.275
6.0	Operational cost under Institutional requirements		34.08
	Total Capital Cost		**549.315**

11.5 PHASING OF EXPENDITURE

Based on the analysis of the Construction Schedule for a period of 2 years, the phasing of expenditures has been established during construction period. The detail of cost repartition during construction period is provided in **Table 47** and also shown in **Figure 43** below.

Table 47: Phasing of Expenditure

Months >	M1 – M6	M7 – M12	M13 – M18	M19 – M24
Total Cash Flow INR Lacs	351.36	702.72	702.72	585.60
% of Cash Flow	15%	30%	30%	25%

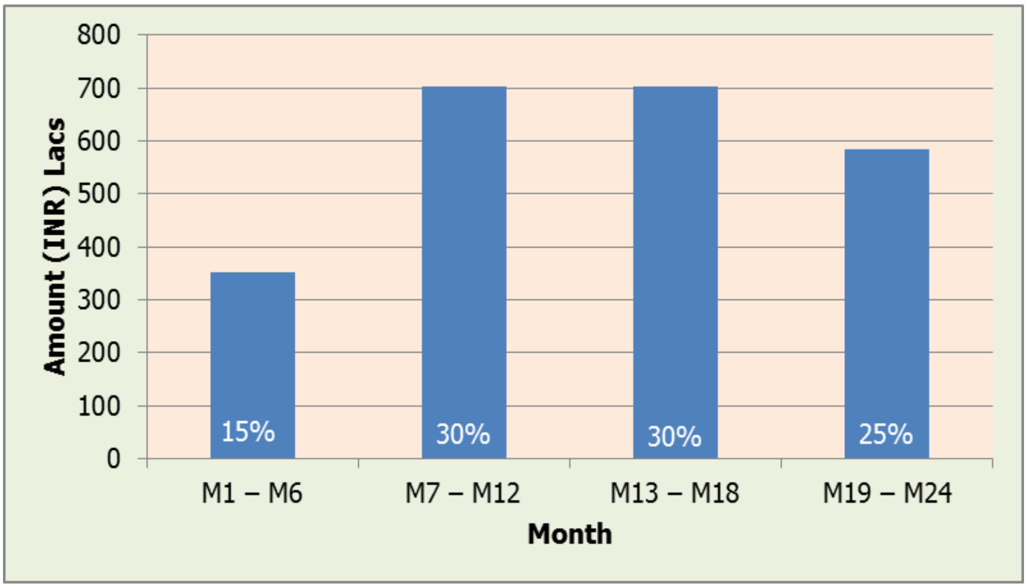


Figure 43: Phasing of Expenditure

12.0 IMPLEMENTATION SCHEDULE

The implementation schedule for the development of Ichamati fairway and its associated facilities are presented in this chapter. The probable time schedule for various activities from onset to completion of the project and commencement of operation are also discussed in this chapter.

12.1 TIME FRAME

The total project is scheduled to be completed in 24 months from the start date of construction.

12.2 PHASING

For timely completion of the project, identification of major project components and sequential planning of various modules is very important for any project. The major components of Ichamati waterway include both the construction of offshore and onshore facilities, apart from installation of mechanical and electrical equipment's.

The offshore facilities includes development of pontoon, gangway, approach platform and dredging whereas the development of onshore facilities includes site development, construction of terminal building and providing utilities like water supply system, sewerage system, storm water drainage system and firefighting facility.

The schedule has been prepared with the presumption that IWAI will be developing the project in single phase through EPC contract.

12.3 SUGGESTED IMPLEMENTATION MECHANISM

The various activities to be carried out prior to commencement of construction, includes selection of site, preparation of detail engineering drawings & Report, survey and investigation, Social and Environmental Impact Assessment, preparation of tender document, Bid process management, selection of EPC contractor and award of work to the selected contractor. It is assessed that the lead time required to carry out the bid process management and selection of EPC contractor would be 3 months.

The schedule for the project also depends on the schedule of various Statutory Clearances required from different Statutory Agencies for the development of the project and therefore, all the requirement clearances need to be in place before the start of the construction activities.

The following are the major activities involved for effective completion of Ichamati waterway project, which involves engineering, procurement, construction and commencement of operational activities.

- Detailed Engineering;
- Environmental clearance;
- Financial closure and Statutory approvals from all concerned authorities;
- Land acquisition and site development;
- Construction of onshore facilities for ferry terminal;
- Construction of offshore facilities for ferry terminal;
- Procurement of vessels;
- Up gradation/construction of access roads;
- Supply, installation and commission of electrical and mechanical equipment's.

13.0 ECONOMIC AND FINANCIAL ANALYSIS

Financial feasibility is a key determinant in a business oriented investment decision. In case of the projects of public/national interest like development of Inland Water Terminals, the viability of the project depends on the economic feasibility which act as the deciding factor. In this chapter, the financial and economic viability for development of Ichamati Waterway is worked out.

13.1 REVENUE

An attempt has been made to estimate the possible revenue available from this service. Although this has been calculated in a thorough and logical manner the study is based on many assumptions and it should therefore be taken as a guide to the magnitude of possible revenue.

The techno-economic model has been run with the following assumption as stated below:

c) Passenger Ferry services from Basirhat to Itinda Jetty - 2 passenger ferry vessels of 150 pax capacity operating 7:00 AM to 7:00 PM at every 30 minute interval from each jetty.
d) RO-RO cargo operations from Basirhat to Indo-Bangladesh Border – assuming 2 vessels of 2000 DWT will be operated daily by M/s River Waterlink Pvt. Ltd.

A downtime of about 2 months is assumed, which could be occurred due to weather, operational or other factors. Hence, it is assumed that the full service is operating for 300 days annually.

The revenue for passenger ferry services has been worked out by considering the tariff of INR 10/- per person per trip for passenger ferry services and INR 1.0 per ton per km for dry bulk cargo in RO-RO operations. On the basis of above assumptions, the revenue that could be generated on Ichamati waterway is provided in **Table 48** & **Table 49.**

Table 48: Annual Revenue Generation

Considerations/Assumptions			
	No of days service is operation per year =	300	days
	Incremental Rate of No. of Passengers =	2.00%	
	Incremental Rate of Tariff =	10.00%	
	Passenger ferry tariff =	10	INR/Pax one way
	Cargo Tariff =	1.0	INR/MT-Km

Annual Revenue			
Passenger Ferry Services			
	Number of passenger per day =	4000	Pax/day
	Revenue per day =	80,800	INR/day
	Revenue per year =	2,42,40,000	INR/annum
		242.40	INR Lacs/annum
Dry Bulk Cargo RO-RO Operations			
	Cargo Traffic =	300000	MT/year
	Cargo Traffic per day =	1000.00	MT/day
	Distance from Basirhat Jetty to Indo-Bangladesh Border=	3.0	Km
	Revenue per day =	3000	INR/day
	Revenue per year =	900000	INR/annum
		9.0	INR Lacs/annum
	Total Revenue per year =	**251.40**	**INR Lacs/annum**

Table 49: Incremental Revenue Generation

Year	Passenger Ferry Services Revenue (INR Lacs)		RO-RO Operations Revenue (INR Lacs)		Total Revenue (INR Lacs)
	No. of Pax.	Revenue	Cargo Traffic (MT)	Revenue	
0	4000	242	300000	9.0	251.4
1	4080	272	440000	14.5	286.5
2	4162	305	580000	21.1	326.2
3	4245	342	720000	28.7	371.1
4	4330	384	860000	37.8	421.9
5	4416	431	1000000	48.3	479.3
6	4505	484	1000000	53.1	536.8
7	4595	543	1000000	58.5	601.1
8	4687	609	1000000	64.3	673.1
9	4780	683	1000000	70.7	753.8

Year	Passenger Ferry Services Revenue (INR Lacs)		RO-RO Operations Revenue (INR Lacs)		Total Revenue (INR Lacs)
	No. of Pax.	Revenue	Cargo Traffic (MT)	Revenue	
10	4876	766	1000000	77.8	844.2
11	4973	860	1000000	85.6	945.5
12	5073	965	1000000	94.2	1059.0
13	5174	1,083	1000000	103.6	1186.1
14	5278	1,215	1000000	113.9	1328.5
15	5383	1,363	1000000	125.3	1488.1
16	5491	1,529	1000000	137.8	1666.9
17	5601	1,716	1000000	151.6	1867.2
18	5713	1,925	1000000	166.8	2091.7
19	5827	2,160	1000000	183.5	2343.2
20	5944	2,423	1000000	201.8	2625.0

13.2 FINANCIAL ANALYSIS/ FIRR

The introduction of the IWT will yield tangible and non-tangible saving due to equivalent reduction in road traffic and certain socio-economic benefits. These include saving in road construction and maintenance, vehicle operation costs, travel time and other socio-economic benefits of travel time, better accessibility, better comfort and quantity of life, increase in mobility etc.

The direct and indirect benefits of the project are following:

- Reduced road stress.
- Better accessibility to facilities in the influence area.
- Economic stimulation in the micro region of the infrastructure.
- Increased business opportunities.
- Overall increased mobility.
- Facilitating better planning and up-gradation of influence area.
- Saving in vehicle operating costs of buses and other vehicles that are using the existing transport network after the IWT is introducing due to decongestion effect on road stress.
- Saving in time of passenger of existing modes, because of reduced congestion on road.
- Saving on account of reduction of vehicular pollution.

The financial analysis of the project is done on the basis of estimated cost proposed to be incurred for construction/development of fairway, terminal and procurement of vessels including other miscellaneous expenses, O& M cost proposed to be incurred during proposed project life cycle of 20 years and revenue that could be generated.

The implementation of this project has been conceptualized as Government funded project and in view of small capital cost, no loan has been considered. However, the FIRR for Ichamati waterway is done with following options:

Option 1: Total Capital Cost + Total O&M cost

Option 2: Option 1 - Vessel Capital & O&M cost

Option 3: Vessel Capital Cost + Vessel O&M Cost.

The Financial analysis for all the above options are worked out and provided in **Table 50** to **Table 52.**

Table 50: FIRR (Option 1: Total Capital Cost + Total O&M cost)

Year	Capital Cost (INR Lacs)	O&M Cost (INR Lacs)	Total Outflow (INR Lacs)	Total Revenue (INR Lacs)	Net Cash Flow (INR Lacs)
-2	1054.07		1054.07		-1,054.07
-1	1288.31		1288.31		-1,288.31
0		549.32	549.32	251.4	-297.92
1		576.78	576.78	286.5	-290.29
2		605.62	605.62	326.2	-279.41
3		635.90	635.90	371.1	-264.77
4		667.70	667.70	421.9	-245.77
5		701.08	701.08	479.3	-221.75
6		736.13	736.13	536.8	-199.38
7		772.94	772.94	601.1	-171.88
8		811.59	811.59	673.1	-138.48
9		852.17	852.17	753.8	-98.35
10		894.78	894.78	844.2	-50.55
11		939.52	939.52	945.5	5.99

Year	Capital Cost (INR Lacs)	O&M Cost (INR Lacs)	Total Outflow (INR Lacs)	Total Revenue (INR Lacs)	Net Cash Flow (INR Lacs)
12		986.49	986.49	1059.0	72.48
13		1035.82	1035.82	1186.1	150.28
14		1087.61	1087.61	1328.5	240.92
15		1141.99	1141.99	1488.1	346.11
16		1199.09	1199.09	1666.9	467.80
17		1259.04	1259.04	1867.2	608.17
18		1321.99	1321.99	2091.7	769.69
19		1388.09	1388.09	2343.2	955.10
20		1457.50	1457.50	2625.0	1,167.53
				IRR	**0.24%**

Table 51: FIRR (Option 2: Option 1 - Vessel Capital & O&M cost)

Year	Capital Cost (INR Lacs)	O&M Cost (INR Lacs)	Total Outflow (INR Lacs)	Total Revenue (INR Lacs)	Net Cash Flow (INR Lacs)
-2	971.28		971.28		-971.28
-1	1187.11		1187.11		-1,187.11
0		463.16	463.16	251.40	-211.76
1		486.31	486.31	286.49	-199.82
2		510.63	510.63	326.21	-184.42
3		536.16	536.16	371.13	-165.03
4		562.97	562.97	421.93	-141.04
5		591.12	591.12	479.33	-111.78
6		620.67	620.67	536.75	-83.92
7		651.71	651.71	601.07	-50.64
8		684.29	684.29	673.11	-11.18
9		718.51	718.51	753.81	35.31
10		754.43	754.43	844.22	89.79
11		792.15	792.15	945.51	153.35
12		831.76	831.76	1,058.97	227.21
13		873.35	873.35	1,186.10	312.75
14		917.02	917.02	1,328.52	411.51

Year	Capital Cost (INR Lacs)	O&M Cost (INR Lacs)	Total Outflow (INR Lacs)	Total Revenue (INR Lacs)	Net Cash Flow (INR Lacs)
15		962.87	962.87	1,488.10	525.23
16		1011.01	1011.01	1,666.89	655.88
17		1061.56	1061.56	1,867.21	805.66
18		1114.64	1114.64	2,091.68	977.04
19		1170.37	1170.37	2,343.19	1,172.82
20		1228.89	1228.89	2,625.03	1,396.14
				IRR	**4.27%**

Table 52: FIRR (Option 3: Vessel Capital Cost + Vessel O&M Cost)

Year	Capital Cost (INR Lacs)	O&M Cost (INR Lacs)	Total Outflow (INR Lacs)	Total Revenue (INR Lacs)	Net Cash Flow (INR Lacs)
-2	0.00		0.00		-
-1	184.00		184.00		-184.00
0		86.16	86.16	251.40	165.24
1		90.47	90.47	286.49	196.02
2		94.99	94.99	326.21	231.22
3		99.74	99.74	371.13	271.39
4		104.73	104.73	421.93	317.20
5		109.96	109.96	479.33	369.37
6		115.46	115.46	536.75	421.29
7		121.24	121.24	601.07	479.83
8		127.30	127.30	673.11	545.81
9		133.66	133.66	753.81	620.15
10		140.35	140.35	844.22	703.88
11		147.36	147.36	945.51	798.14
12		154.73	154.73	1,058.97	904.24
13		162.47	162.47	1,186.10	1,023.63
14		170.59	170.59	1,328.52	1,157.93
15		179.12	179.12	1,488.10	1,308.98
16		188.08	188.08	1,666.89	1,478.81
17		197.48	197.48	1,867.21	1,669.73

Year	Capital Cost (INR Lacs)	O&M Cost (INR Lacs)	Total Outflow (INR Lacs)	Total Revenue (INR Lacs)	Net Cash Flow (INR Lacs)
18		207.35	207.35	2,091.68	1,884.32
19		217.72	217.72	2,343.19	2,125.47
20		228.61	228.61	2,625.03	2,396.42
				IRR	**107.59%**

From the above analysis with various options it is concluded that the passenger ferry services in Ichamati waterway is financially viable in all cases for fare of INR 10/-. However, it would be better that the implementation of the whole project may be taken up as two packages:

Package – 1 : Construction, Operation & Maintenance of fairway and jetties

Package – 2 : Procurement, operation & maintenance of Ferry Vessel

13.3 ECONOMIC ANALYSIS / EIRR

The economic analysis for proposed IWT in Ichamati waterway is done on all the above scenarios discussed in financial analysis section.

In addition to above, economic benefit foreseen due to factors like reduction in pollution, reduction in accidents, carbon savings are considered for economic analysis of dry bulk cargo RO-RO operations. For the analysis following assumptions were made:

a) Road haulage cost : INR 2.0/Ton-Km

b) Road accident cost saving : INR 0.2/Ton-Km

c) Carbon savings : INR 0.1/Ton-Km transferred from road

d) Annual incremental economic benefit : 1%

Passenger ferry services are already operational from Basirhat to Itinda jetty, however a proposal for safe and efficient ferry services along with necessary infrastructure services are made in this DPR. Hence economic benefit due to road and rail haulage cost saving, road accident cost savings and carbon savings is not considered for economic evaluation for passenger ferry services. Also, as the ferry operations are currently active along the proposed fairway route, saving in fuel cost due to IWT operation is not foreseen. Benefit due to job creation is only considered for economic analysis of passenger ferry services. The economic benefit analysis, done for the proposed fairway is provided in **Table 53.**

Table 53: Economic benefits from IWT

Economic Benefit from RO-RO Operations		
Road distance from Jetty to Indo-Bangladesh Border =	4	Km
Cargo proposed to be diverted from road to IWT daily =	1000.00	MT
Cost of transportation by road =	2	INR/MT/Km
Saving in Cargo transportation by IWT =	8000	INR per day
No of days service is operation per year =	300	days
Saving in Cargo transportation by IWT annually=	2400000	INR per year
	24	INR Lacs per year
Carbon saving INR 0.1/tons-km transferred from road =	400	INR daily
	120000	INR per year
	1.2	INR Lacs per year
Road accident costs saving INR 0.2/tons-km transferred from road =	800	INR daily
	240000	INR per year
	2.4	INR Lacs per year
Total savings by using IWT for RO-RO operations =	27.6	INR Lacs per year
Economic Benefit from Passenger Ferry Services		
Job creation per year =	**54**	**numbers**
Average annual salary =	400000	INR
Average existing annual salary =	144000	INR
Annual additional earning by Job creation =	13824000	INR per year
	138.24	INR Lacs per year
Total savings by using IWT from road transport =	165.84	INR Lacs per year
Incremental saving per year =	1%	

Similar to FIRR, EIRR for Ichamati waterway is also done with following options:

Option 1: Total Capital Cost + Total O&M cost

Option 2: Option 1 - Vessel Capital & O&M cost

Option 3: Vessel Capital Cost + Vessel O&M Cost.

EIRR is calculated for all the above three options and summary of all FIRRs and EIRRs is provided in **Table 54**.

Table 54: FIRR and EIRR for various options

Year	Economic Benefit (INR lacs)	Option-1		Option-2		Option-3	
		Financial Income (INR Lacs)	Total Income (INR Lacs)	Financial Income (INR Lacs)	Total Income (INR Lacs)	Financial Income (INR Lacs)	Total Income (INR Lacs)
-2		-1054.07	-1054.07	-971.28	-971.28	-	0.00
-1		-1288.31	-1288.31	-1,187.11	-1187.11	-184.00	-184.00
0	165.84	-297.92	-132.08	-211.76	-45.92	165.24	331.08
1	167.50	-290.29	-122.79	-199.82	-32.32	196.02	363.52
2	169.17	-279.41	-110.24	-184.42	-15.25	231.22	400.39
3	170.87	-264.77	-93.90	-165.03	5.84	271.39	442.26
4	172.57	-245.77	-73.20	-141.04	31.53	317.20	489.77
5	174.30	-221.75	-47.45	-111.78	62.52	369.37	543.67
6	176.04	-199.38	-23.34	-83.92	92.12	421.29	597.33
7	177.80	-171.88	5.93	-50.64	127.16	479.83	657.63
8	179.58	-138.48	41.10	-11.18	168.40	545.81	725.39
9	181.38	-98.35	83.02	35.31	216.68	620.15	801.53
10	183.19	-50.55	132.64	89.79	272.98	703.88	887.07
11	185.02	5.99	191.01	153.35	338.38	798.14	983.17
12	186.87	72.48	259.36	227.21	414.09	904.24	1091.12
13	188.74	150.28	339.02	312.75	501.49	1,023.63	1212.37
14	190.63	240.92	431.55	411.51	602.14	1,157.93	1348.56
15	192.54	346.11	538.65	525.23	717.77	1,308.98	1501.51
16	194.46	467.80	662.26	655.88	850.34	1,478.81	1673.27

Year	Economic Benefit (INR lacs)	Option-1		Option-2		Option-3	
		Financial Income (INR Lacs)	Total Income (INR Lacs)	Financial Income (INR Lacs)	Total Income (INR Lacs)	Financial Income (INR Lacs)	Total Income (INR Lacs)
17	196.41	608.17	804.58	805.66	1002.06	1,669.73	1866.14
18	198.37	769.69	968.06	977.04	1175.41	1,884.32	2082.69
19	200.35	955.10	1155.46	1,172.82	1373.18	2,125.47	2325.83
20	202.36	1167.53	1369.89	1,396.14	1598.50	2,396.42	2598.78
Internal Rate of Return (IRR)		**0.24%**	**5.10%**	**4.27%**	**9.06%**	**107.59%**	**189.93%**

13.4 SENSITIVITY ANALYSIS

Sensitivity analysis shows the uncertainty in the output values for different sources of uncertainty in its inputs. The financial and economic evaluation of proposed IWT operations in Ichamati waterway depends on factors like, fuel cost, demand ratio of IWT, serviceability and operational days in a year. These fluctuations will have a dramatic effect on the profitability of IWT.

Sensitivity analysis of IWT on Ichamati waterway is carried out for varying fare for passenger ferry services keeping tariff for RO-RO operations and considering the basic operational and serviceability conditions as same. For varying fare for passenger ferry services, the change in FIRR and EIRR is shown in **Table 55.**

Table 55: Sensitivity Analysis w.r.t to varying IWT fare

Sr. No.	Fare (INR) (per trip one way)	FIRR (%)			EIRR (%)		
		Option-1	Option-2	Option-3	Option-1	Option-2	Option-3
1	3.00	Not Calculable	Not Calculable	27.53	Not Calculable	Not Calculable	95.13
2	5.00	Not Calculable	Not Calculable	47.72	Not Calculable	-7.80	122.20
3	6.75	Not Calculable	-6.36	67.22	-5.41	1.00	145.67
4	8.00	-7.01	-1.21	81.95	-0.29	4.61	162.16
5	10.00	0.24	4.27	107.59	5.10	9.06	189.93

Sr. No.	Fare (INR) (per trip one way)	FIRR (%)			EIRR (%)		
		Option-1	Option-2	Option-3	Option-1	Option-2	Option-3
6	12.50	5.28	8.67	137.66	9.41	12.97	221.54
	Not Calculable	All/majorly negative cash-flows					

From the above table, it can be concluded that with the existing tariff of INR 3.0/- per person per trip as detailed in traffic chapter, the proposed IWT operation along Ichamati waterway is not financially viable.

However, in case the tariff is increased to INR 10.00 per trip once, the project becomes financially viable.

13.5 RISK FACTORS AND MITIGATION

Environmental and social risk involved in construction and operational stage of the project including their mitigation measures are discussed and provided in detail in Chapter 9.0 above. Other minor risks foreseen at this stage of the project for successful implementation and execution of the project are provided as below:

a) Dependency on inter-modality –

Integrated road transport connectivity is required for passenger ferry services.

13.6 NECESSITY OF GOVT. SUPPORT (VGF/PPP)

The guide lines were notified by the ministry of finance, department of economic affairs for financial support to infrastructure project that are to be undertaken through Public Private Partnerships (PPP).

Proposal is to be made under this scheme shall be considered for providing Viability Gap Funding (GAF), one time or deferred with the objective of making a PPP project commercially viable.

The proposal shall relate to a public private partnership (PPP) project which is based on a contract or concession agreement between a Government or statutory entity (Inland Waterways Authority of India) on the one side and a private sector company on the other side, for delivering an infrastructure service on payment of user charges.

This scheme will apply only if the contract/concession is awarded in favour of a private company in which 51% or more of the subscribed and paid up equity is owned and controlled by a private entity.

For Ichamati Waterway, a private company operating in Indo-Bangladesh trade has shown interest in providing RO-RO services from Basirhat to Indo-Bangladesh border on its own cost and time. The company is ready to use their own RO-RO barges for the services and to provide operation and maintenance services also. Company has also acquired 6.0 Hectare of land on long term rental basis at Basirhat.

From the DPR studies, it is concluded that the proposal of M/s River Waterlink Pvt. Ltd. can be recommended to approving authorities for execution.

A private sector company shall be eligible for VGF only if it is selected on the basis of open competitive bidding and is responsible for financing, construction, maintenance and operation of the project during concession period.

The project should provide a service against payment of a predetermined tariff or user charge.

The proposal for seeking clearance of the Empowered Institution shall be sent (in six copies, both in hard and soft form) to the PPP cell of the Department of Economic Affairs in the prescribed format. The proposal should include copies of all project agreements (such as concession agreement, state support agreement etc.) and the project report.

Once cleared by Empowered Institution, the project is eligible for financial support financial bids shall be invited by the concerned ministry, state Government or statutory entity, as the case may be, for the award of the project within four months of the approval of the Empowered Institution. This period may be extended by the Department of Economic Affairs.

The private sector company shall be selected through a transparent and open competitive bidding process. The criterion for bidding shall be the amount of VGF required by a private sector company where all other parameters are comparable.

14.0 CONCLUSIONS AND RECOMMENDATIONS

The viability of Island Water Transport project for introduction of navigation on any waterway can be judged by both technically and commercially. The technical viability of the project can be assessed based on availability of discharges to maintain navigable depth in a design channel suitable to ply design vessel. The commercial viability of the project can be gauged based on traffic potential and its growth over the project period and return on investment made besides several others socio-economic benefits such as employment generation, poverty alleviation in rural areas and so on. The recommendation for implementation of the project is based on the trade-off between costs to be incurred and benefits derived.

The capital cost for development of the system components of the project viz., development of the design waterway and construction of IWT terminals has been worked out as INR 2342.39/- Lacs and the estimated operating and maintenance cost per annum is INR 549.32/- Lacs.

The cost benefit analysis, calculations done for financial internal rate of return (FIRR) and Economic internal rate of return (EIRR) concludes that the project is financially and economically viable with following option as shown in table below:

Sr. No.	Fare (INR) (per trip one way)	FIRR (%)			EIRR (%)		
		Option-1	Option-2	Option-3	Option-1	Option-2	Option-3
1	3.00	Not Calculable	Not Calculable	27.53	Not Calculable	Not Calculable	95.13
2	5.00	Not Calculable	Not Calculable	47.72	Not Calculable	-7.80	122.20
3	6.75	Not Calculable	-6.36	67.22	-5.41	1.00	145.67
4	8.00	-7.01	-1.21	81.95	-0.29	4.61	162.16
5	10.00	0.24	4.27	107.59	5.10	9.06	189.93
6	12.50	5.28	8.67	137.66	9.41	12.97	221.54
	Not Calculable	All/majorly negative cash-flows					

From the above table, it can be concluded that with the existing tariff, the proposed IWT operation along Ichamati waterway is not financially viable.

However, in case the tariff is increased to INR 10.00 per trip once, the passenger ferry services become financially viable.

For RO-RO operations from Basirhat to Indo-Bangladesh border, a private company operating in Indo-Bangladesh trade has shown interest for investing on development, operation and maintenance of terminal and vessels. The company is ready to use their own RO-RO barges for the services and to provide operation and maintenance services also. Company has also acquired 6.0 Hectare of land on long term rental basis at Basirhat. On the basis of above information and DPR studies, it is concluded that the proposal of M/s River Waterlink Pvt. Ltd. can be recommended to approving authorities for execution.

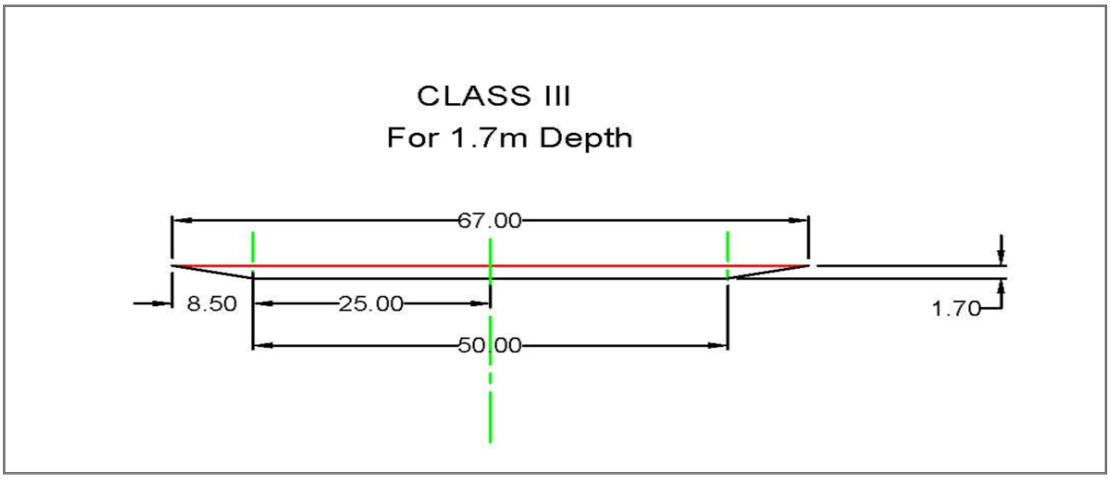
ANNEXURES

ANNEXURE 1: TOR OF THE AGREEMENT

ANNEXURE 2: MINIMUM AND MAXIMUM DEPTH W.R.T SD

(For Class-III WW for entire river stretch proposed in DPR Study)

Class III



Chainage (km)		Observed				Reduced w.r.t. Sounding Datum				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulative Dredging Qty.
0	1	Not Applicable				-0.52	0.56	1000	110010.4	110010.4
1	2					0	1.69	1000	48632.03	158642.4
2	3	Tidal Zone				0.36	2.6	1000	43703.41	202345.9
3	4					0.79	8.7	584	3032.64	205378.5
4	5					0.17	4.21	872	30868.1	236246.6
5	6					-0.56	2.2	1000	85015.42	321262
6	7					-0.81	1.6	1000	68870.78	390132.8
7	8					-0.81	6.61	947	77331.02	467463.8
8	9					-1.53	4.62	1000	56894.39	524358.2
9	10					-1.99	-0.1	1000	149826.02	674184.2
10	11					-2.38	-0.7	1000	201203.41	875387.6
11	12					-2.2	0.78	1000	199680.67	1075068
12	13					-2.28	0.19	1000	195580.31	1270649
13	14					-2.9	0.1	1000	219460.29	1490109
14	15					-2.9	0.56	1000	207982.24	1698091
15	16					-3.34	-0.6	1000	293519.91	1991611
16	17					-3.02	-1.7	1000	251971.01	2243582
17	18					-3.35	0.2	1000	266976.17	2510558
18	19					-2.66	1.08	1000	217827.65	2728386

Chainage (km)		Observed				Reduced w.r.t. Sounding Datum				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulative Dredging Qty.
19	20					-3.2	1.41	1000	236401.12	2964787
20	21					-2.82	-0.6	1000	206808.58	3171596
21	22					-2.1	0	1000	197478.3	3369074
22	23					-0.9	0.87	1000	100539.32	3469613
23	24					-1.69	0.34	1000	125667.24	3595280
24	25					-1.79	0	1000	164568.1	3759849
25	26					-1.67	-0.2	1000	162228.95	3922077
26	27					-1.63	0.23	1000	150157.59	4072235
27	28					-1.25	0.61	1000	149221.9	4221457
28	29					-1.24	0.56	1000	137734.25	4359191
29	30					-0.97	0.1	1000	129787.26	4488978
30	31					-0.89	0	1000	120700.85	4609679
31	32					-1.5	0.1	1000	127466.63	4737146
32	33					-2.25	-0.4	1000	197010.05	4934156
33	34					-2.43	-1	1000	203961.3	5138117
34	35					-1.61	0.75	1000	208936.14	5347053
35	36					-1.61	0.75	1000	85057.51	5432111
36	37					-0.05	1.21	1000	73615.72	5505727
37	38					-0.05	1.08	1000	61698.57	5567425
38	39					-0.23	1.12	1000	67879.22	5635304
39	40					0.14	1.45	1000	58035.69	5693340
40	41					0.05	1.84	1000	39767.82	5733108
41	42					-0.37	1.5	1000	71170.79	5804279
42	43					-0.82	1.01	1000	83086.62	5887365
43	44					-0.52	1.25	1000	95070.03	5982435
44	45					-0.07	1.39	1000	58231.92	6040667
45	46					0.13	1.48	1000	56319.49	6096987
46	47					0.2	1.74	1000	33273.7	6130261
47	48					0.22	1.44	1000	48958.45	6179219
48	49					0.12	1.59	1000	48555.46	6227774
49	50					-0.04	1.68	1000	50937.71	6278712
50	51					-0.16	0.74	1000	83937.18	6362649
51	52					-0.41	0.87	1000	90328.84	6452978
52	53					-0.38	0.16	1000	103573.19	6556551

Chainage (km)		Observed				Reduced w.r.t. Sounding Datum				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulative Dredging Qty.
53	54					-0.51	0.3	1000	105493.59	6662045
54	55					-0.28	0.36	1000	97145.75	6759191
55	56					0.05	1.41	1000	47205.86	6806397
56	57					0.8	1.95	1000	16655.44	6823052
57	58					0.34	2.07	1000	12008.04	6835060
58	59					0.18	2.32	636	8904.31	6843964
59	60					0.49	2.32	510	10304.43	6854269
60	61					0.58	2.25	1000	12511.67	6866780
61	62					0.31	2.04	1000	36932.59	6903713
62	63					0.1	2.19	1000	24263.22	6927976
63	63.986					0.1	1.98	986	14256.41	6942233
								Total	**6942233**	

ANNEXURE 3: ENVIRONMENTAL AND SOCIAL SCREENING TEMPLATE

Screening Question	Yes	No	Details / Remarks
1. Is the project located in whole or part in / near any of the following Environmentally Sensitive Area? If yes, please provide the name and distance from the project site.			
a) National Park		√	
b) Wildlife/ Bird Sanctuary		√	
c) Tiger or Elephant Reserve		√	
d) Biosphere Reserve		√	
e) Reserved / Protected Forest		√	
f) Wetland		√	
g) Important Bird Areas		√	
h) Mangroves Areas		√	
i) Estuary with Mangroves		√	
j) Areas used by protected, important or sensitive species of fauna for breeding, nesting, foraging, resting, over wintering, migration		√	
k) World Heritage Sites		√	
l) Archeological monuments/ sites (under ASI's Central / State list)		√	
2. Is the project located in whole or part in / near any Critically Polluted Areas identified by CPCB?		√	
3. Is, there any defense installations near the project site?		√	
4. Whether there is any Government Order/ Policy relevant / relating to the site?		√	
5. Is the project involved clearance of existing land, vegetation and buildings?		√	
6. Is the project involved dredging?	√		
7. Is the project area susceptible to natural hazard (earthquakes, subsidence, erosion,	√		Prone to Flood, Cyclones and heavy winds

Screening Question	Yes	No	Details / Remarks
flooding, cyclone or extreme or adverse climatic conditions)			
8. Is the project located in whole or part within the Coastal Regulation Zone?	√		
9. Is the project involved any demolition of existing structure?		√	
10. Is the project activity requires acquisition of private land?		√	
11. Is the proposed project activity result in loss of direct livelihood / employment?		√	
12. Is the proposed project activity affect schedule tribe/ caste communities?		√	

S. No.	Result of Screening Exercise	(Yes / No)
1	Environment Impact Assessment is Required	Yes
2	CRZ Clearance is Required	The CRZ Clearances is applicable as per the CRZ Notification 2011.
3	Environmental Clearance is Required	The proposed project will not require Environmental Clearance as per MoEFCC letter No. F. No. 14-9/2016-IA-III dated 21st December 2017
4	Forest Clearance is required	No
5	Wildlife Clearance is required	No
6	NOC from SPCB is required	Yes
7	Social Impact Assessment is required	Yes
8	Abbreviated RAP is required	No
9	Full RAP is required	Yes
10	Any other clearance is required	Various NOCs during construction activities

ANNEXURE 4: MOEFCC MEMORANDUM

No. F.No.14-9/2016-IA-III
Government of India
Ministry of Environment, Forest and Climate Change
(Impact Assessment Division)

Indira Paryavaran Bhawan
Jor Bagh Road, Aliganj
New Delhi-110003

Dated: 21st December, 2017.

OFFICE MEMORANDUM

Subject: Non-requirement of environment clearance for maintenance dredging in rivers for the purpose of navigation - regarding.

This has reference to your Office Memorandum IWT-11011/89/2016-IWT-(Vol.II) dated 7th December 2017 on the above mentioned subject.

2. The minutes of the meeting held under chairmanship of Hon'ble Minister, Road Transport & Highways, Shipping and Water Resources, River Development & Ganga Rejuvenation held on 24.10.2017 concluded that as per the extant legal position, no prior EC is required for maintenance dredging for navigational channel for Inland Waterways.

3. In view of the above the Ministry of Shipping may like to go ahead with the decision taken during the meeting held under chairmanship of Hon'ble Minister, Road Transport & Highways, Shipping held on 24.10.2017 subject to the implementation of the environmental safety measures as enclosed as annexure.

4. This issues with the approval of the competent authority.

Sharath Kumar Pallerla
Director

To

The Secretary,
Ministry of Shipping,
Parivahan Bhavan, 1, Parliament Street,
New Delhi - 110 001

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ANNEXURE

Environmental safety measures to be implemented

i. 'Consent to Establish' and 'Consent to Operate' shall be obtained from State Pollution Control Board under the Air (Prevention and Control of Pollution) Act, 1981 and the Water (Prevention and Control of Pollution) Act, 1974.

ii. The project authority shall ensure that no rivers or tributaries are blocked due to any activities at the project site and free flow of water is maintained.

iii. Shoreline shall not be disturbed due to dumping. Periodical study on shore line changes shall be conducted and mitigation carried out, if necessary.

iv. Dredging shall not be carried out during the fish/turtle breeding seasons.

v. All vessels used in the river will be fitted with noise control and animal exclusion devices so that aquatic life is not unduly disturbed.

vi. Spillage of fuel / engine oil and lubricants from the construction site are a source of organic pollution which impacts aquatic life, particularly benthos. This shall be prevented by suitable precautions and also by providing necessary mechanisms to trap the spillage.

vii. Construction waste including debris shall be disposed safely in the designated areas and in no case shall be disposed in the aquatic environment.

viii. Vessels shall not discharge oil or oily water such as oily bilge water containing more than 15 ppm of oil

ix. The project authority shall ensure that water traffic does not impact the aquatic wildlife sanctuaries that fall along the stretch of the river.

x. All vessels will also have to comply with 'zero discharge' standards to prevent solid or liquid waste from flowing into the river and affecting its biodiversity.

xi. The dredging shall be carried by integrated and systematic planning by selective grid method by allowing migratory movement of Benthic fauna.

xii. All required Noise and vibration control measures are to be adopted in Dredgers. Cutter section Dredgers should be avoided as much as possible which produces more noise and vibration. No Drilling and Blasting is to be carried out.

xiii. Pre geo-tectonic studies has to be completed and the strata to be dredged is predetermined with complete data pertaining to hardness, compressive and tensile strengths.

xiv. Dredger type and other strata loosening methods shall be preconceived.

xv. Staggered dredging shall be carried based on turbidity monitoring to minimise the impact of turbidity.

xvi. Threshold level of turbidity, which has a minimal effect on fauna, has to be predetermined and Dredging planned accordingly.

xvii. Further silt screens needs to be used for minimising the spread of Turbidity.

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xviii. Disposal places of Dredged sediments needs to be predetermined, along the shore by assessment of suitability, which will not affect the shoreline (erosion) and also causing impacts during monsoon and flooding.

xix. As much as possible, it shall not be disposed off in the river itself, and the site should be such that the dispersion is quicker by undertaking modelling studies.

xx. Ballast water control and management measures shall be implemented.

xxi. Waste and waste water reception facilities in Jetty shall be implemented.

xxii. The Risk and Disaster management plan has been prepared in consonance with the manual of terminals and harbours issued by the Ministry of Environment and Forests dated 5th May 2010.

xxiii. Standard Operating Procedures (SOP) and Emergency Response Plan (ERP) for onsite and offsite emergencies shall be prepared and implemented based on Hazard Identification and Risk Assessment to handle, process, store and transport of hazardous substances.

xxiv. Oil spill contingency plan shall be prepared and part of DMP to tackle emergencies. The equipment and recovery of oil from a spill shall be assessed. Guidelines given in MARPOL and Shipping Acts for oil spill management shall be followed.

xxv. No diversion of the natural course of the river shall be made without prior permission from the Ministry of Water resources.

xxvi. All the erosion control measures shall be taken at water front facilities.

xxvii. Necessary Air Pollution Control measures shall be taken during loading, unloading, handling, transport of the material at the berthing and water front facilities.

xxviii. The Vessels shall comply the emission norms prescribed from time to time.

xxix. All safety measures are to be implemented in coordination with the respective state government departments such as State Forest Department, Public Works Department, State Pollution Control Board etc.

Sharath Kumar Pallerla
Director

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ANNEXURE 5: PHOTOGRAPHS OF VISIT TO BASIRHAT JETTY, SEP 2019

Land acquired by M/s River Waterlink Pvt. Ltd. for RO-RO operations (Pic-1)

Land acquired by M/s River Waterlink Pvt. Ltd. for RO-RO operations (Pic-2)

Land acquired by M/s River Waterlink Pvt. Ltd. for RO-RO operations (Pic-3)

Land acquired by M/s River Waterlink Pvt. Ltd. for RO-RO operations (Pic-4)

Land acquired by M/s River Waterlink Pvt. Ltd. for RO-RO operations (Pic-5)

View of entrance to land acquired by M/s River Waterlink Pvt. Ltd.

River Bank along the land acquired by M/s River Waterlink Pvt. Ltd. for RO-RO

Existing jetty for ferry operations at Basirhat

Existing building for passengers at Basirhat ferry Ghat (Pic 1)

Existing building for passengers at Basirhat ferry Ghat (Pic 2)

Existing road connecting to Basirhat ferry Ghat

Existing ferry services at Basirhat ferry Ghat (Pic 1)

Existing ferry services at Basirhat ferry Ghat (Pic 2)

ANNEXURE 6: PHOTOGRAPHS OF ICHAMATI WATARWAY, MAY 2017

0 CHAINAGE, RIGHT BANK

BRICK KLIN, 0.2 CHAINAGE, LEFT BANK

0.5 CHAINAGE, LEFT BANK

BRICK KLIN, 0.6 CHAINAGE, RIGHT BANK

BRICK KLIN, 1.2 CHAINAGE, LEFT BANK

BANK PROTECTION, 1.2 CHAINAGE, RIGHT BANK

1.1 CHAINAGE, RIGHT BANK

BRICK KLIN, 1.5 CHAINAGE, LEFT BANK

BRICK KLIN, 1.5 CHAINAGE, LEFT BANK

RIVER BANK PROTECTION, 1.5 CHAINAGE, RIGHT BANK

BRICK KLIN, 1.5 CHAINAGE, LEFT BANK

BRICK KLIN 1.6 CHAINAGE, LEFT BANK

RIVER BANK PROTECTION, 2.0 CHAINAGE, RIGHT BANK

BRICK KLIN, 2.0 CHAINAGE, LEFT BANK

RIVER BANKPROTECTION, 2.3 CHAINAGE, RIGHT BANK

2.0 CHAINAGE, RIGHT BANK

FISHING NET 2.5 CHAINAGE

BRICK KLIN, 2.5 CHAINAGE, LEFT BANK

RIVER BANKPROTECTION, 2.5 CHAINAGE, RIGHT BANK

BRICK KLIN, 2.6 CHAINAGE, LEFT BANK

BRICK KLIN, 2.7 CHAINAGE, LEFT BANK

3.0 CHAINAGE, LEFT BANK

3.0 CHAINAGE, RIGHT BANK

HIGH TENTION LINE, 3.1 CHAINAGE, LEFT BANK

3.1 CHAINAGE, RIGHT BANK

FISHING NET 3.1 CHAINAGE

RIVER BANK AT CHAINAGE 3.1, LEFT BANK

RIVER BANK AT CHAINAGE 3.1, LEFT BANK

CHAINAGE 3,LEFT BANK

JETTY ENTRY AT CHAINAGE 3.1, LEFT BANK

JETTY AT CHAINAGE 3.1, LEFT BANK

BRICK KLIN AT CHAINAGE 3.2, LEFT BANK

RIVER BANK AT CHAINAGE 3.3, LEFT BANK

BRICK KLIN AT CHAINAGE 3.3, LEFT BANK

RIVER BANKPROTECTION, 3.3 CHAINAGE, RIGHT BANK

3.4 CHAINAGE, RIGHT BANK

POND AT CHAINAGE 3.4, LEFT BANK

RIVER BANK AT CHAINAGE 3.5, LEFT BANK

POND AT NEAR RIVER BANK CHAINAGE 3.5, LEFT BANK

POND AT NEAR RIVER BANK CHAINAGE 3.5, LEFT BANK

POND NEAR RIVER BANK AT CHAINAGE 3.5, LEFT BANK

3.5

CHAINAGE, RIGHT BANK

3.6 CHAINAGE, RIGHT BANK

RIVER BANK AT CHAINAGE 3.6, LEFT BANK

DRY POND NEAR RIVER BANK AT CHAINAGE 3.6, LEFT BANK

POND AT CHAINAGE 3.7, LEFT BANK

POND AT CHAINAGE 3.7, LEFT BANK

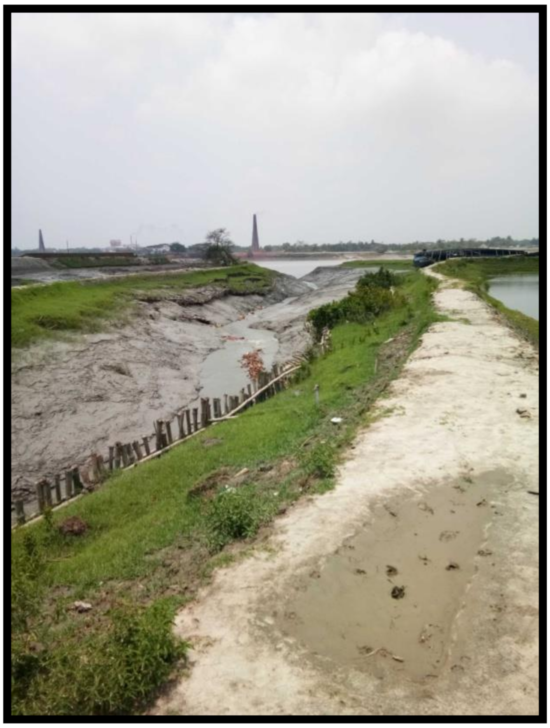
BRICK KLIN AT CHAINAGE 4, LEFT BANK

4.0 CHAINAGE, RIGHT BANK

BRICK KLIN AT CHAINAGE 4, LEFT BANK

BRICK KLIN AT 4.0 CHAINAGE, RIGHT BANK

RIVER BANK AT CHAINAGE 4.1, LEFT BANK



RIVER BANK AT CHAINAGE 4.2, LEFT BANK

BRICK KLIN AT CHAINAGE 4.3, LEFT BANK

4.3 CHAINAGE, LEFT BANK

4.4 CHAINAGE, LEFT BANK

RIVER BANK PROTECTION AT 4.4 CHAINAGE, RIGHT BANK

POND AT CHAINAGE 4.4, LEFT BANK

POND AT CHAINAGE 4.4, LEFT BANK

RIVER BANK AT CHAINAGE 4.4, LEFT BANK

RIVER BANK AT CHAINAGE 4.5, LEFT BANK

RIVER BANK BREAK AT CHAINAGE 4.5, LEFT BANK

RIVER BANK BREAK AT CHAINAGE 4.5, LEFT BANK

4.5 CHAINAGE, RIGHT BANK

4.5 CHAINAGE, LEFT BANK

RIVER BANK AT CHAINAGE 4.7, LEFT BANK

RIVER BANK AT CHAINAGE 4.7, LEFT BANK

RIVER BANK AT CHAINAGE 4.7, LEFT BANK

POND AT CHAINAGE 4.8, LEFT BANK

BRICK KLIN AT CHAINAGE 4.8, LEFT BANK

RIVER BANK AT CHAINAGE 4.8, LEFT BANK

BRICK KLIN AT CHAINAGE 4.9, LEFT BANK

BRICK KLIN AT CHAINAGE 5, LEFT BANK

BRICK KLIN AT 5.0 CHAINAGE, RIGHT BANK

5.2 CHAINAGE, LEFT BANK

BRICK KLIN AT 5.4 CHAINAGE, RIGHT BANK

5.4 CHAINAGE, LEFT BANK

5.6 CHAINAGE, RIGHT BANK

6.0 CHAINAGE, LEFT BANK

6.0 CHAINAGE, RIGHT BANK

RIVER BANK AT CHAINAGE 6.0, LEFT BANK

TREE COVER AREA AT CHAINAGE 6.1, LEFT BANK

6.1 CHAINAGE, LEFT BANK

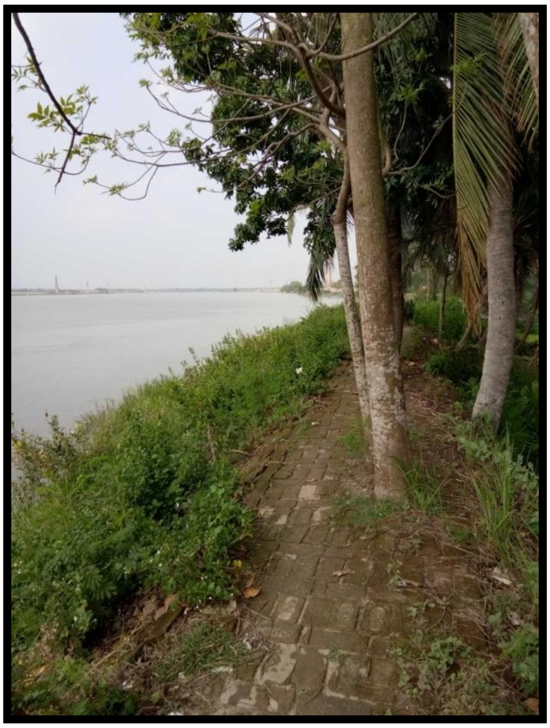
6.1 CHAINAGE, LEFT BANK

RIVER BANK AT CHAINAGE 6.2, LEFT BANK

RIVER BANK AT CHAINAGE 6.3, LEFT BANK

TREE COVER AREA AT CHAINAGE 6.3, LEFT BANK

STRUCTURE AT CHAINAGE 6.4, LEFT BANK



RIVER BANK AT CHAINAGE 6.4, LEFT BANK

6.5 CHAINAGE, LEFT BANK

6.5 CHAINAGE, RIGHT BANK

6.5 CHAINAGE, LEFT BANK

6.6 CHAINAGE, LEFT BANK

6.7 CHAINAGE, LEFT BANK

7.0 CHAINAGE, LEFT BANK

7.1 CHAINAGE, LEFT BANK

HIGH TENTION LINE AT CHAINAGE 7.4, LEFT BANK

HIGH TENTION LINE AT CHAINAGE 7.4, LEFT BANK

ICHAMATI BRIDGE AT CHAINAGE 7.4, LEFT BANK

ICHAMATI BRIDGE AT CHAINAGE 7.4, LEFT BANK

I

CHAMATI BRIDGE 7.5 CHAINAGE

7.5 CHAINAGE, RIGHT BANK

8.0 CHAINAGE, RIGHT BANK

FISHING NET 8.0 CHAINAGE

BRICK KLIN 8.4 CHAINAGE, RIGHT BANK

8.5 CHAINAGE, RIGHT BANK

8.5 CHAINAGE, LEFT BANK

8.6 CHAINAGE, RIGHT BANK

8.6 CHAINAGE, LEFT BANK

9.0 CHAINAGE, RIGHT BANK

BRICK KLIN 9.5 CHAINAGE, RIGHT BANK

BRICK KLIN 10.0 CHAINAGE, RIGHT BANK

BRICK KLIN 10.3 CHAINAGE, RIGHT BANK

LEFT BANK AT CHAINAGE 10.5

RIGHT BANK AT CHAINAGE 10.5

RIGHT BANK AT CHAINAGE 11

LEFT BANK AT CHAINAGE 11

LEFT BANK AT CHAINAGE 11.2

RIGHT BANK AT CHAINAGE 11.2

LEFT BANK AT CHAINAGE 11.5

RIGHT BANK AT CHAINAGE 11.5

RIGHT BANK AT CHAINAGE 12

LEFT BANK AT CHAINAGE 12.4

RIGHT BANK AT CHAINAGE 12.4

RIGHT BANK AT CHAINAGE 12.5

LEFT BANK AT CHAINAGE 12.8

RIGHT BANK AT CHAINAGE 12.8

LEFT BANK AT CHAINAGE 13

LEFT BANK AT CHAINAGE 13

LEFT BANK AT CHAINAGE 13.2

RIVER BANK AT CHAINAGE 13.5 LEFT BANK

LEFT BANK AT CHAINAGE 13.5

LEFT BANK AT CHAINAGE 13.6

LEFT BANK AT CHAINAGE 13.8

LEFT BANK AT CHAINAGE 14

RIGHT BANK AT CHAINAGE 14

RIGHT BANK AT CHAINAGE 14.2

RIGHT BANK AT CHAINAGE 14.4

LEFT BANK AT CHAINAGE 14.4

RIGHT BANK AT CHAINAGE 14.5

HIGH TENSION LINE AT LEFT BANK CHAINAGE 14.5

RIGHT BANK AT CHAINAGE 14

RIGHT BANK AT CHAINAGE 14.5

LEFT BANK AT CHAINAGE 14.8

LEFT BANK AT CHAINAGE 14.9

LEFT BANK AT CHAINAGE 15

RIGHT BANK AT CHAINAGE 15.1

LEFT BANK AT CHAINAGE 15.2

BRICK KLIN AT RIGHT BANK CHAINAGE 15.2

BRICK KLIN AT LEFT BANK CHAINAGE 15.2

LEFT BANK CHAINAGE 15.2

RIGHT BANK AT CHAINAGE 15.5

BRICK KLIN AT LEFT BANK CHAINAGE 15.6

LEFT BANK AT CHAINAGE 15.6

MANGROVE AT RIGHT BANK CHAINAGE 15.7

RIGHT BANK AT CHAINAGE 15.8

RIGHT BANK AT CHAINAGE 15.9

LEFT BANK AT CHAINAGE 16

RIGHT BANK AT CHAINAGE 16.

BRICK KLIN AT LEFT BANK CHAINAGE 16.1

LEFT BANK AT CHAINAGE 16.2

BRICK KLINS AT LEFT BANK CHAINAGE 16.3

RIGHT BANK AT CHAINAGE 16.3

BRICK KLIN AT LEFT BANK CHAINAGE 16.4

RIGHT BANK AT CHAINAGE 16.5

LEFT BANK AT CHAINAGE 16.7

RIGHT BANK AT CHAINAGE 16.7

RIGHT BANK AT CHAINAGE 16.8

LEFT BANK AT CHAINAGE 16.9

LEFT BANK AT CHAINAGE 17

FERRY GHAT AT RIGHT BANK CHAINAGE 17.0

LEFT BANK AT CHAINAGE 17.1

RIGHT BANK AT CHAINAGE 17.3

RIGHT BANK AT CHAINAGE 17.4

LEFT BANK AT CHAINAGE 17.5

RIGHT BANK AT CHAINAGE 17.6

LEFT BANK AT CHAINAGE 17.8

RIGHT BANK AT CHAINAGE 17.9

BRICK KLIN LEFT BANK AT CHAINAGE 18

RIGHT BANK AT CHAINAGE 18.1

LEFT BANK AT CHAINAGE 18.2

RIGHT BANK AT CHAINAGE 18.3

LEFT BANK AT CHAINAGE 18.6

RIGHT BANK AT CHAINAGE 18.7

LEFT BANK AT CHAINAGE 18.8

BOAT RREPAIRING AT LEFT BANK CHAINAGE 18.8

LEFT BANK AT CHAINAGE 19

RIGHT BANK AT CHAINAGE 19.1

LEFT BANK AT CHAINAGE 19.2

RIGHT BANK AT CHAINAGE 19.3

LEFT BANK AT CHAINAGE 19.4

LEFT BANK AT CHAINAGE 19.4

BRICK KLIN AT RIGHT BANK CHAINAGE 19.5

LEFT BANK AT CHAINAGE 19.6

RIGHT BANK AT CHAINAGE 19.7

RIGHT BANK AT CHAINAGE 19.7

RIGHT BANK AT CHAINAGE 19.7

LEFT BANK AT CHAINAGE 19.8

RIGHT BANK AT CHAINAGE 20.5

BRICK KILNS LEFT BANK AT CHAINAGE 20.5

RIGHT BANK AT CHAINAGE 20.5

BRICK KILNS LEFT BANK AT CHAINAGE 20.6

RIGHT BANK AT CHAINAGE 21

BRICK KILNS LEFT BANK AT CHAINAGE 21

LEFT BANK AT CHAINAGE 21.1

LEFT BANK AT CHAINAGE 21.2

LEFT BANK AT CHAINAGE 21.5

BRICK KILNS LEFT BANK AT CHAINAGE 21.6

TEMPORARY RIVER BANK PROTECTION AT LEFT BANK CHAINAGE 21.7

BRIDGE UNDER CONSTRUCTION AT CHAINAGE 21.8

BRIDGE UNDER CONSTRUCTION AT CHAINAGE 21.8

BRICK KLINS AT LEFT BANK CHAINAGE 21.9

LEFT BANK AT CHAINAGE 22

LEFT BANK AT CHAINAGE 23

LEFT BANK AT CHAINAGE 24

LEFT BANK AT CHAINAGE 24.5

LEFT BANK AT CHAINAGE 25

LEFT BANK AT CHAINAGE 25.3

LEFT BANK AT CHAINAGE 25.5

LEFT BANK AT CHAINAGE 25. 5

LEFT RIVER BANK AT CHAINAGE 25.7

LEFT BANK AT CHAINAGE 26

LEFT BANK AT CHAINAGE 26.3

LEFT BANK AT CHAINAGE 26.5

LEFT BANK AT CHAINAGE 26.7

LEFT BANK AT CHAINAGE 27

LEFT BANK AT CHAINAGE 27.2

LEFT BANK AT CHAINAGE 27.3

LEFT BANK AT CHAINAGE 27.4

LEFT BANK AT CHAINAGE 27.5

LEFT BANK AT CHAINAGE 27.6

RIGHT BANK AT CHAINAGE 28

LEFT BANK AT CHAINAGE 28.6

LEFT BANK AT CHAINAGE 28.9

LEFT BANK AT CHAINAGE 29

LEFT BANK AT CHAINAGE 29.5

LEFT BANK AT CHAINAGE 30

LEFT BANK AT CHAINAGE 30.2

LEFT BANK AT CHAINAGE 30.3

DREDGING AT LEFT BANK CHAINAGE 30

DREDGING AT LEFT BANK CHAINAGE 30

RIGHT BANK AT CHAINAGE 30.6

RIGHT BANK AT CHAINAGE 30.7

RIGHT BANK AT CHAINAGE 31

RIGHT BANK AT CHAINAGE 31.2

JETTY AT LEFT BANK CHAINAGE 31.4

JETTY AT RIGHT BANK CHAINAGE 31.4

RIGHT BANK AT CHAINAGE 31.6

LEFT BANK AT CHAINAGE 31.7

RIGHT BANK AT CHAINAGE 32.5

LEFT BANK AT CHAINAGE 33

RIGHT BANK AT CHAINAGE 33

RIGHT BANK AT CHAINAGE 33.5

LEFT BANK AT CHAINAGE 34

RIGHT BANK AT CHAINAGE 34

LEFT BANK AT CHAINAGE 34.5

RIGHT BANK AT CHAINAGE 34.5

LEFT BANK AT CHAINAGE 35

RIGHT BANK AT CHAINAGE 35

LEFT BANK AT CHAINAGE 35.5

RIGHT BANK AT CHAINAGE 35.5

LEFT BANK AT CHAINAGE 36

RIGHT BANK AT CHAINAGE 36.5

LEFT BANK AT CHAINAGE 37

RIGHT BANK AT CHAINAGE 37

DREDGER AT LEFT BANK CHAINAGE 37.1

LEFT BANK AT CHAINAGE 37.5

RIVER BANK CONSTRUCTION AT RIGHT BANK CHAINAGE 38

RIGHT BANK AT CHAINAGE 38.5

RIGHT BANK AT CHAINAGE 40.1

RIVER BANK CONSTRUCTION AT RIGHT BANK CHAINAGE 40.2

DREDGING AT RIGHT BANK CHAINAGE 45

DREDGING AT LEFT BANK CHAINAGE 45

DREDGING AT RIGHT BANK CHAINAGE 45.5

DREDGING AT RIGHT BANK CHAINAGE 45.6

FARM AREA AT RIGHT BANK CHAINAGE 46

DREDGING AT RIGHT BANK CHAINAGE 46.1

DREDGING AT RIGHT BANK CHAINAGE 46

FARM AREA AT RIGHT BANK CHAINAGE 46.2

RIGHT BANK AT CHAINAGE 46.5

RIGHT BANK AT CHAINAGE 46.7

RIGHT BANK AT CHAINAGE 47

RIGHT BANK AT CHAINAGE 47.5

RIGHT BANK AT CHAINAGE 47.7

RIGHT BANK AT CHAINAGE 47.9

CEMETERY RIGHT BANK AT CHAINAGE 47.6

RIGHT BANK AT CHAINAGE 48

RIGHT BANK AT CHAINAGE 48.5

BAMBOO BRIDGE AT CHAINAGE 48.7

RIGHT BANK AT CHAINAGE 48.8

RIGHT BANK AT CHAINAGE 49

RIGHT BANK AT CHAINAGE 49.1

RIGHT BANK AT CHAINAGE 49.4

RIGHT BANK AT CHAINAGE 49.6

RIGHT BANK AT CHAINAGE 49.7

FARM AREA AT CHAINAGE 49.9

RIGHT BANK AT CHAINAGE 50

RIGHT BANK AT CHAINAGE 50

RIGHT BANK AT CHAINAGE 50.5

BAMBOO BRIDGE AT CHAINAGE 51.6

RIGHT BANK AT CHAINAGE 51.6

LEFT BANK AT CHAINAGE 59.7

LEFT BANK AT CHAINAGE 59.8

FARM AREA AT LEFT BANK CHAINAGE 59.5

FARM AREA AT LEFT BANK CHAINAGE 60

FARM AREA AT LEFT BANK CHAINAGE 60.1

FARM AREA AT LEFT BANK CHAINAGE 60.3

LEFT BANK AT CHAINAGE 60.5

LEFT BANK AT CHAINAGE 60.7

LEFT BANK AT CHAINAGE 60.8

BRICK KLIN AT LEFT BANK CHAINAGE 61 .1

BRICK KLIN AT LEFT BANK, CHAINAGE 61.2

RIGHT BANK AT CHAINAGE 61.3

RIGHT BANK AT CHAINAGE 61.4

RIGHT BANK AT CHAINAGE 61.5

LEFT BANK AT CHAINAGE 61.6

FARM AREA AT LEFT BANK CHAINAGE 61.7

LEFT BANK AT CHAINAGE 61.8

RIGHT BANK AT CHAINAGE 62

RIGHT BANK AT CHAINAGE 62.1

VOLUME – II

DRAWINGS