CONSULTANCY SERVICES FOR PREPARATION OF SECOND STAGE DPR OF CLUSTER-6 : (KARNATAKA) - NW 90

DETAILED PROJECT REPORT-SHARAVATI RIVER (29.25KM)-(NW-90)
VOLUME-I MAIN REPORT
Document No. P.010256-W-10305-006

Inland Waterways Authority of India (IWAI) - Government of India
Karnataka and Kerala | India

RESTRICTED

17 January 2022

REPORT
Rev 03

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DPR – SHARAVATI RIVER (28.674KM) NW-90

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Client: **INLAND WATERWAYS AUTHORITY OF INDIA**

Project: **CONSULTANCY SERVICES FOR PREPARATION OF SECOND STAGE DPR OF CLUSTER – 6 OF NATIONAL WATERWAYS**

Subject: **DETAILED PROJECT REPORT – SHARAVATI RIVER (28.674KM) NW-90**

Comments:

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03	22/01/17	Active	Arun Kumar	G.Reddy	G. Reddy	B C Jha
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ACKNOWLEDGEMENTS

Inland Waterways Authority of India (IWAI) assigned the Consultancy Services for "Preparation of Second Stage Detailed Project Report (DPR) of Cluster – 6 of National Waterways". The study has been carried out for this assignment and the result has been compiled in the present study.

The consultant would like to put on record their deep appreciation of cooperation and ready access to information and advice rendered by IWAI.

The consultant is grateful to Mr. ASHUTOSH GAUTAM, Member (Technical), CDR. MAHENDRA KUMAR (Hydrographic Chief), S V K REDDY (Chief Engineer) and Mr Rajeev Singhal (SHS) who provided their valuable guidance from time to time to make this report success.

(B C Jha)
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DISCLAIMER / PROPREITORY RIGHTS

M/s Tractebel Engineering Pvt., Ltd., (M/s TEPL), Gurgaon has been assigned with the Consultancy Services for the “Preparation of Second Stage Detailed Project Report (DPR) of Cluster – 6 of National Waterways” by Inland Waterways Authority of India (IWAI). Accordingly, the study on NW 90 has been carried out for this assignment / analyzed / compiled based on the findings of the following field studies / investigations.

Detailed Hydrographic Survey along with the Topographical Survey was carried out from 20/11/2017 to 17/01/2018 and 06 Jan 2020 to 08 Jan 2020.

Traffic Survey was carried out as detailed and summarized in Annexure 4.2.

Terminal Land Survey was carried out at proposed Sharavati river terminal at D/s of the Gerusoppa Dam, on 10/10/2017.

Geotechnical Borehole was carried out at “D/s of the Gerusoppa Dam” from 12/08/2017 to 16/08/2017 subsequently Laboratory Tests have been carried out on the collected samples.

Proprietary rights of the information contained herein belong to “Inland Waterways Authority of India (IWAI)”, Ministry of Shipping, Government of India. The information contained in this DPR is intended to be used for the mentioned purpose/project only, as permitted by IWAI. In case of misuse of information and any claim arising thereof, cost and consequence will be on the party misusing the information.

This Report can be updated at a later stage, when required by considering the fresh cargo analysis, change in requirement of the Government (or) change in policy either of State Government or Government of India.

B C Jha

Tractebel Engineering Pvt Ltd

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Abbreviations	Acronyms
BFL	Bombay Floating Light
CD	Chart Datum
Ch	Chainage
CRZ	Coastal Regulation Zone
CWC	Central Water Commission
DGPS	Differential Global Positioning System
DMIC	Delhi Mumbai Industrial Corridor
DPR	Detailed Project Report
FSL	Full Supply Level
GAIL	Gas Authority of India Ltd.
HC	Horizontal Clearance
IO	Iron Ores
IOCL	Indian Oil Corporation Ltd.
IWAI	Inland Waterways Authority of India
IWT	Inland Water Transport
JHS	Junior Hydrographic Surveyor
KIOCL	Kudremukh Iron Ore Company Limited
KP	Km Points
LAD	Least Available Depth
MHWS	Mean High Water Spring
MMTPA	Million Metric Tonne Per Annum
MnT	Million Tonnes
MOEFCC	Ministry of Environment, Forest & Climate Change
MOS	Ministry of Shipping
MRPL	Mangalore Refineries and Petrochemicals Ltd.
MSME	Micro Small & Medium Enterprises
MTPA	Metric Tonne per Annum
NH	National Highway
NMPT	New Mangalore Port Trust
NW	National Waterway
OMPT	Old Mangalore Port Trust
PGCIL	Power Grid Corporation of India Limited
PWD	Public Works Department
SEB	State Electricity Board
SH	State Highway
UPCL	Udupi Power Corporation Ltd
VC	Vertical Clearance
WRD	Water Resources Department
WRIS	Water Resources Information System of India

SALIENT FEATURES

#	Particulars	Details			
A	**GENERAL**				
1	***Location***				
a	Cluster	Cluster-6			
b	State(s)	Karnataka			
c	Co-ordinates & Name of Place	**Start**		**End**	
	Place	Honnavar Port		Gerosappa	
	Latitude	14°17'56"N		14°14'15"N	
	Longitude	74°25'27"E		74°39'06"E	
B	**TECHNICAL**				
1	***Waterway***				
a	National Waterway Number	NW-90			
b	Class	IV			
c	Type (Tidal/Non-Tidal)	Tidal			
	Length (Km.)	**Total**	**Tidal**	**Non-Tidal**	
		28.674km	28.674km	--	
d	Average Tidal Variation, if applicable	1.1m			
e	Chart Datum				
	Description/Basis	Gauge 1	Gauge 2	Gauge 3	Gauge 4
	Value (from Zero of Gauge)	0.078	0.335	0.478	0.645
f	LAD Status (w.r.t. CD)				
		Stretch-1 (km)	**Stretch-2 (km)**	**Stretch-3 (km)**	**Total (km)**
	Stretch (From 0.00 To 29.25)	0.00 – 10.00	10.00-20.00	20.00-29.25	
	Length with LAD < 1.2 m	5.75	2.15	6.50	14.40
	With LAD from 1.2-1.4 m	0.00	0.60	0.00	0.60
	With LAD from 1.5-1.7 m	0.15	0.45	0.00	0.60
	With LAD from 1.8-2.0 m	1.40	2.85	2.25	6.50
	With LAD > 2.0 m	2.70	3.95	0.50	7.15
	Total	10.00	10.00	9.25	29.25
g	Target Depth of Proposed Fairway (m)	2.00m upto Ch 28.674km			
h	Conservancy Works Required				
	Type of Work	**Stretch-1**	**Stretch-2**	**Stretch-3**	
		(0.00-10.00)	(10.00-20.00)	(20.00-28.674)	
	Dredging Required (Cum.)	165194.4	71432.2	146102.7	
	Bandalling	Nil	Nil	Nil	
	Barrages & Locks	Nil	Nil	Nil	
	River Training/Bank Protection (Km.)	None			

#	Particulars	Details
i)	Existing Cross Structures	

	Name of Structure	Type	Nos.	Range of Horizontal Clearance	Range of Vertical Clearance w.r.t. FRL/HFL
	Dams/Barrages/Weirs/Aqueducts etc.	Dam	Nil	--	--
	Bridges	Rail/Road	4	28.0-208.0m	5-7m
	HT/Tele-communication lines	HT line	2	253.43-25579m	15.00m
	Pipelines, underwater cables, etc.	Cables	2	-	-

#	Particulars	Details
2	***Traffic***	
A	Present IWT Operations (type of services)	At present, mostly fishing vessels, country boats and motorboats for passengers and tourists ply on Sharavati river. Locals use ferries for crossing the river. There is no cargo movement on the river.
B	Major industries in the hinterland (i.e., within 25 km. on either side)	There exists no large industry in the catchment area of Sharavati river. There are micro & small enterprises and artisan units in Uttara Kannada district. Sharavati river is surrounded by hills, forests and wildlife sanctuaries, which makes it difficult to establish any industry in the region.
C	Connectivity of major industries with Rail/Road network (Distances/Nearest Railway Stations etc.)	• Major roads - NH 66, NH 206, NH 69, NH 4A, SH 144 are the major highways. NH 66 passes through Uttara Kannada district and connects Panvel near Mumbai to Kerala state. • Major railway – Uttar Kannada has railway stations at Kumta & Karwar, which are well connected with Konkan Railway. Konkan railway connects Mangalore and Mumbai via Karwar. Kumta is about 72 km from Karwar and 58 km north of Bhatkal.

#	Particulars	In-bound	Out-bound
D	Commodities	**In-bound**	**Out-bound**
	Nil	--	--
E	Future Potential (MMT)	**In-bound**	**Out-bound**
	Tourist	Indian States & Foreign countries	Shivamogga

#	Name of Commodity	5 yr. (Fy-20)	10 yr. (Fy-25)	15 yr. (Fy-30)	20 yr. (Fy-35)	25 yr. (Fy-40)
1	Tourist (in'000)	3.4	3.7	4.1	4.5	5.0

#	Particulars	Details
3	***Terminals/Jetties***	
A	Terminal/Jetty	Ferry Terminal
	Location (Bank/city/district)	14°14'20.64"N & 074°38'59.16"E D/s of Gerusoppa Dam
	Type/Services	Passenger / Tourism Traffic
	Facilities	Ambulance is provisioned
	Approach	Road is available
	Land Ownership	

<table>
<tr><th>#</th><th>Particulars</th><th colspan="3">Details</th></tr>
<tr><td></td><td>Area (ha.)</td><td colspan="3">0.193 ha (both govt and private land)</td></tr>
<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td>4</td><td>Design Vessel</td><td colspan="3"></td></tr>
<tr><td>A</td><td>Type</td><td colspan="3">Passenger Ferry Vessels</td></tr>
<tr><td>B</td><td>No. & Size</td><td colspan="3">• One Passenger Ferry Vessel
For steel boat
i. Size (L x B x D) – 12m x 2m x 0.8m, 30pax
ii. Engine - 1 Marine Diesel Outboard Engines of 150 hp each.
For FRP boat
iii. Size (L x B x D) – 12m x 2m x 0.5m, 30pax
iv. Engine - 1 Marine Diesel Outboard Engines of 120 hp each.</td></tr>
<tr><td>C</td><td>Loaded Draft</td><td colspan="3"><1.8m</td></tr>
<tr><td>D</td><td>Capacity</td><td colspan="3">30 Pax</td></tr>
<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td>5</td><td>Navigation Aids</td><td colspan="3"></td></tr>
<tr><td>A</td><td>Type</td><td colspan="3">Buoy and Light</td></tr>
<tr><td>B</td><td>Nos.</td><td colspan="3">0</td></tr>
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<tr><td></td><td></td><td colspan="3"></td></tr>
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<tr><td>A</td><td>Capital Cost</td><td>Fairway</td><td>Ferry</td><td>Vessel</td></tr>
<tr><td></td><td>Cost (MINR)</td><td>11.71 cr</td><td>8.95 cr</td><td>--</td></tr>
<tr><td>B</td><td>O & M Cost</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td>2</td><td>User Charges</td><td colspan="3"></td></tr>
<tr><td>A</td><td>For IWAI</td><td colspan="3">-</td></tr>
<tr><td>B</td><td>For Operator</td><td colspan="3">-</td></tr>
<tr><td>3</td><td>Financial Internal Rate of Return (%)</td><td>Fairway</td><td>Ferry</td><td>Vessel</td></tr>
<tr><td>A</td><td>For IWAI</td><td>Non-existent</td><td>Non-existent</td><td>Non-existent</td></tr>
<tr><td>B</td><td>Operator</td><td colspan="3">-</td></tr>
<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td>4</td><td>Economic Internal Rate of Return (%)</td><td>Fairway</td><td>Ferry</td><td>Vessel</td></tr>
<tr><td></td><td></td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td>5</td><td>Any other Important Feature</td><td colspan="3"></td></tr>
</table>

EXECUTIVE SUMMARY

Sharavati River is one of the waterways declared as National Waterway in March 2016 as NW-90. The Sharavati River or Gerusoppa or Banaganga River has its origin at Ambutirtha in Tirthahalli taluk of Shimoga district. After a northerly course of about 64 km from Nagar, it forms the south-east boundary of Uttara Kannada for about 13 km and then passes about 32 km west or 128 Km in all to join the sea at Honnavar. About 30 km west, it reaches the ancient capital of Gerusoppa. During the remaining 27 km to the coast, the river flows between richly wooded banks fringed with mangrove bushes, a broad tidal estuary, brackish in the dry weather but during the rains sweet even close to its mouth. The River is under tidal effect of the Arabian Sea (backwater effect) up to Gerusoppa Dam which is located at about chainage about 29 km. Sharavati River has a relatively medium catchment area and its tributaries are Nandihole, Haridravathi, Mavinahole, Hilkunji, Yennehole, Hurlihole, and Nagodihole. The total catchment area of Sharavati River is 3592 sq. km.

The total length of the river is around 128 km and it joins the Arabian Sea at Honnavar in Uttara Kannada district. Out of the total length of 128 km of river, about 29 km length of the river from Honnavar Port Sea Mouth at Lat 14°17'56"N, Long 74°25'27"E to link at highway at Gerusoppa Lat 14°14'15N, Long 74°39'06"E has been declared as new national waterway and proposed to undertake the two stage DPR study. M/s Tractebel has been assigned with the work of Preparation of a two stage DPR. Subsequent to the completion of Stage I of the DPR, the stretch of Sharavati River of 28.674 kms from Lat 14°17'56.5621" N, Long 74°25'36.4534" E is under consideration for Stage 2 Detailed Project Report (DPR) so as to assess the required developments and the IWT Traffic potential along with inter alia activities including the working out of Cost / Return factors for taking a decision on developments / investments.

The major components in the DPR can be considered as Fairway Development; Traffic Confirmations; Terminal Development; Vessel Requirement and Financial Analysis. Bathymetric Survey of the study stretch has been carried out along with the Topographical Survey so as to arrive at the conservancy requirements including Dredging, Channel demarcation and other Waterway requirements for safe navigation. The next one is Traffic Confirmations. The present Traffic scenario, possible divertible traffic to IWT is to be estimated. In sequence, Terminal Development, Vessel Requirement and Financial Analysis have been considered.

River Morphological analysis of the study stretch has been considered by analyzing the river regime of the past 15 to 20 years with 5 years span and the findings have been recorded. As such there is no major regime disturbance in the study stretch.

Detailed Hydrographic Survey has been carried out so as to assess the required developments in the Fairway along with interrelated activities. Based on the Hydrographic Survey data the full stretch up to Gerusoppa Dam for about 29 Kms is in Tidal Zone. It has been noticed that the 2 Bridges in the initial stretches at 3.447 & 3.551 (1 is under construction) can be manoeuvred with single line operation. The Rail Bridge at Ch 6.113 km also can be manoeuvred with single line operation. The Iron Bridge at Ch 24.107 is having sufficient clearances. 2 HT Lines located is having sufficient clearances. Two pipelines are crossing the study area. No Dams / Barrages / Locks / Weirs / Anicuts / Aqueducts are located. Six Bend locations are observed critical and suggested with the required protection.

Honnavar port, in the mouth of Sharavati River, has been identified with the potential of handling the cargo Steel; Sugar; Fertilizer; Coal; Iron Ore; Molasses & Edible Oil. The development is expected shortly and will have connectivity through Sharavati. Keeping in view the Passenger & Tourism Traffic, Ferry service is suggested through the Sharavati River waterway at this stage using the facility of Hannovar port as one terminal.

Roll-On Roll-Off (Ro-Ro) IWT Terminal may be a possibility in future taking into the consideration of the Passenger & Tourism Traffic initially, which may pave way for cargo mobility, once Honnavar Port is developed. The most probable location identified for ferry terminal is D/s of the Gerusoppa Dam, on the right side of the river at Lat 14°14'20.64"N and Long 074°38'59.16"E. This location is having good accessibility to the road and the tentative land requirement has been arrived at with 1928Sq. M (0.193 Ha) in the Saralagi Village; Gerusoppa Taluka; Uttara Kannada district of Karnataka state.

Accordingly, the fairway requirement for Class IV has been taken into consideration with 50 m (Bottom Width) x 2.0 m (Depth) with Bend Radius of 800. Clearance corridor of 50 m Horizontal Clearance (HC) and 10 m Vertical Clearance (VC) is the requirement specified at Cross structures for safe passage of Vessel / Convoy.

To provide a safe navigable channel, dredging of 4.21 Lakhs Cu. M in Ordinary Soils has been estimated along with the identification of Day / Night Navigation Markings (however the waterway shall cater to tourist activities, hence night navigation is not needed). Since only ferry vessel movement has been proposed which will not affect the banks hence no Bank Protection works have been proposed. No modification is required for bridges and cross structures. Nominal provisions have been suggested towards Communication System and Institutional requirements.

IWAI Terminal requirement has been considered with one Ferry Terminal at Gerusoppa which has been proposed, keeping in view for development of tourism traffic. Geotechnical Investigations have been completed and the test results are placed at Volume IV.

Since there does not exist any opportunity for cargo transportation on river Sharavati due to unavailability of industrial development in the region, development of River Sharavati (NW-90) may be considered for Tourist and Passengers. Passengers use ferry boat to cross over or move along the river. Ferry services along river for tourism and passengers have been proposed. Two terminals shall be needed of ferry boats at Honnavar and Gerusoppa. Gerusoppa terminal is proposed on the Right bank of river and terminal requirement at Hannovar shall be made through Hannovar port.

Targeted depth of River Sharavati (NW-90) is considered as 2 m. Vessels with draught less 2 m is proposed to be deployed in the river for passenger movement. The proposed vessel size and specification has been compiled in the below table.

Vessel Name	Length (m)	Beam (m)	Draught (m)	Capacity (Pax.)
India Bungy	11	3.8	0.6	20
Touring 32	9.8	2.5	0.5	23
25 Pax Transfer	9	3.8	0.5	25
Touring 36	**10.9**	**2.8**	**0.5**	**29**
Grandsea 12m Fibreglass	11.8	2.9	1.2	30
ODC Marine, Mono Pax	12.2	4.2	1.2	36
Wantaim 14m Fast Ferry	14	3.2	1.2	45

Note – Highlighted vessel is the recommended specification.

Any passenger ferry with less than 1.8m draft is suitable for navigating in the defined stretch, as targeted depth of Sharavati is 2 m. The indicative vessel specification proposed for tourist mobility considered at the initial stage is as follows.

- For steel boat
  v. Size (L x B x D) – 12m x 2m x 0.8m, 30pax
  vi. Engine - 1 Marine Diesel Outboard Engines of 150 hp each.
- For FRP boat
  vii. Size (L x B x D) – 12m x 2m x 0.5m, 30pax
  viii. Engine - 1 Marine Diesel Outboard Engines of 120 hp each.

One passenger ferry vessel may be required at the initial stages.

With regard to the Environmental aspects, the requirements as per the norms have been suggested and also a Lump Sum provision has been catered to meet the expenditure on exigency.

Regarding the Institutional requirements, it is suggested / recommended to establish a local office manned through a JHS and one or two support staffs through nearest Kochi office covering such development in Karnataka and Kerala having office infra requirements and a admin setup housed in the terminal building.

The cost estimates have been worked out and segregated i.e., Fairway which is working out to 11.71 Cr (approx) followed with one Ferry Terminal at a capital cost of 8.95Cr (approx).

All the capital assets will be provisioned in 24 months after ascertaining the required confirmations and approvals from the concerned Departments. The FIRR and EIRR have been worked out and the details are placed.

Project Modules	FIRR	EIRR
Fairway	Non-Existent	NA
Ferry Terminal	Non-Existent	NA
Vessel	Non-Existent	NA

The project doesnot have cargo transportation hence this aspect has not been found commercially and economically viable. The development of the entire study stretches of Sharavati river of about 25.2 kms (D/s of Gerusoppa Dam to Hannovar Port) has been examined for tourist related movement with Class IV system of the NW standards however this is also not generating positive returns. In the most optimistic scenario, development of river Sharavati (NW-90) may be considered only for the tourist and passenger services.

CHAPTER 1: INTRODUCTION

1.1. Project Background and Summary of previous study

Globally, the renewal of Inland Water Transport (IWT) is under serious consideration predominantly due to its energy efficient aspect and cheaper mode on comparison. Further overburdening of the Rail and Road network are also the dominant factors. Transport planners are now leaning towards the development of IWT system for transportation of bulk / IWT sensitive cargo.

India has about 14,500km of navigable waterways which comprise Rivers, Canals, Backwaters, Creeks, etc., out of which about 5200km of the river and 4000km of canals can be used by mechanized crafts. Yet, IWT mode remains underdeveloped/ underutilized in India and its share in overall internal cargo transport remains abysmally low. IWT sector presently has a meagre modal share of 0.1% in India compared to other large countries and geographic areas like the United States, China and the European Union.

Inland Waterways Authority of India (IWAI), a statutory authority under the Ministry of Shipping, came into existence on 27th October 1986 with the prime responsibility of development and regulation of inland waterways for shipping and navigation including the development and maintenance of IWT infrastructure on national waterways. It does the function of building the necessary infrastructure in these waterways, surveying the economic feasibility of new projects and also administration. The head office of the Authority is at Noida (Uttar Pradesh). The regional offices of IWAI are at Patna (Bihar), Kolkata (West Bengal), Guwahati (Assam) and Kochi (Kerala) whereas sub-offices are at Allahabad & Varanasi (Uttar Pradesh), Bhagalpur (Bihar), Farakka & Hemnagar (West Bengal), Dibrugarh (Assam), Kollam (Kerala), Vijayawada (Andhra Pradesh), Chennai (Tamil Nadu) and Bhubaneshwar (Orissa).

There are now one hundred and eleven national waterways (NW) across the country which includes five existing national waterways besides 106 waterways which have recently been declared as national waterways through a central legislation i.e., through a bill passed in the Parliament in March 2016.

NW 1, the Ganga – Bhagirathi – Hooghly river system between Haldia (Sagar) & Allahabad was declared in October 1986 for a Length of 1620 km.

NW 2, the Dhubri – Sadiya stretch of Brahmaputra River was declared in September 1988 for a Length of 891 km.

NW 3, the Kottapuram – Kollam stretch of the West Coast Canal along with the Udyogmandal Canal and Champakkara Canal was declared in February 1993 for a Length of 205 km.

NW 4, the Kakinada – Puducherry stretch consisting of canals and the Kaluvelly Tank along with Bhadrachalam – Rajahmundry stretch of River Godavari and Wazirabad – Vijayawada stretch of River Krishna was declared in November 2008 for a Length of 1095 km.

NW 5, the Talcher – Dhamra stretch of the Brahmani River, the Geonkhali – Charbatia stretch of the East Coast Canal, the Charbatia – Dhamra stretch of Matai river and the Mangalgadi – Paradip stretch of the Mahanadi River Delta was declared in November 2008 for a Length of 623 km.

Regarding the **106 Newly Declared National Waterways,** IWAI is carrying out feasibility studies / Detailed Project Report (DPR) preparation through a number of consultants. Two stage preparation of DPR for 53 Waterways have been initiated through 8 Clusters, whereas M/s Tractebel Engineering had been awarded with 2 Clusters i.e., Custer-VI (consisting of 11 waterways – 7 waterways in Karnataka & 4 waterways in Kerala) & Cluster-VII (consisting of 10 waterways – 7 waterways in Maharashtra & 3 waterways in Goa).

The Waterways considered for the study of DPR under Cluster VI are detailed herewith.

TABLE 1-1: List of Rivers/Creeks of under Cluster VI in the States of Karnataka and Kerala (Length-453.895km)

Sl. No.	Name of Rivers/ Creeks	National Water Way (NW)	Length (km)	State
1.	West Coast Canal	NW-3	169.794	Kerala
2.	Alappuzha- Changanassery Canal	NW-8	29.300	Kerala
3.	Alappuzha- Kottayam – Athirampuzha Canal	NW-9	51.700	Kerala
4.	Kottayam-Vaikom Canal	NW-59	18.800	Kerala
5.	Gurupur River	NW-43	10.041	Karnataka
6.	Kabini River	NW-51	23.171	Karnataka
7.	Kali River	NW-52	53.415	Karnataka
8.	Netravathi	NW-74	30.000	Karnataka
9.	Panchagangavali (Panchagangoli) River	NW-76	23.000	Karnataka
10.	**Sharavati River**	**NW-90**	**28.674**	**Karnataka**
11.	Udayavara River	NW-105	16.000	Karnataka
	Total		**453.895**	

Accordingly, the Stage II study for the Sharavati River (NW-90) is under consideration in the present DPR.

1.2. Brief Scope of Work and Compliance statement

The Scope of the Work for the present study is well defined in the Work allocation along with the Terms of Reference (ToR). The same is annexed herewith at Annexure 1.1.

The ultimate requirement from the study is to get a conclusion on the aspect of implementation. Whether the study stretch under consideration is amenable for implementation or not is the final derivative from the study. In order to get this conclusion, the study is subjected to the Infrastructure Requirement for development, the cost for the development with the Expenditure schedules and the viability of the project with the possible revenues and by meeting the social commitment and responsibilities.

The IWT project for development of a waterway stretch can be broadly segregated into the following aspects viz., Fairway Development; Traffic Confirmations; Terminal Development; Vessel Requirement; Financial Analysis.

1.2.1. Fairway Development

In order to ascertain the existing condition of any waterway, the Bathymetric Survey data along the full stretch at the specified intervals and specified width and the Topographical Survey at important / appropriate locations are required. Based on these site surveys, Conservancy requirements including dredging; Channel demarcation requirements can be arrived at.

1.2.2. Traffic Confirmations

The present Traffic scenarios in the hinterland and along the waterway are to be ascertained and possible volumes of divertible traffic to IWT including the type of cargo are to be assessed for planning and development. The possibility of Passenger and Tourism potential are also to be ascertained.

1.2.3. Terminal Development

Terminal development may have to be initiated with the site confirmation linking up with various intricacies including the origin and destination of the traffic. According to the type of cargo/quantum of cargo/tourism potential and accordingly, the Terminal Infrastructure requirements are to be firmed up. The possibility of moulding the Terminal operation and maintenance as a separate business unit also can be looked into.

1.2.4. Vessel Requirement

Based on the type of cargo, quantum of cargo, tourism potential, distance to be moved etc., also keeping in view the travel time, the type of vessel and No. of vessels requirement are to be worked out. As per the existing / present industry standards, the vessel deployment and its operation and maintenance will not form part of the development except the projection of the requirements for the project, as a whole. Hence this aspect is only indicative. The aspect of development of River Sharavati (NW-90) for Tourist and Passengers shall also be explored with the specification of vessel/ ferry boats.

1.2.5. Financial Analysis

Any project, without the mention of the Cost and economic viability will end up as incomplete. Hence, the detailed Cost analysis; Firming up of the cost for all the items indicated for development; implementation schedule and phasing of the project; operation and maintenance cost etc., are the key factors to be looked into. Working out the possible revenues will be the other key factor. Subjecting the above for a critical Financial and Economic analysis will provide clarity on the implementation of the project as a whole.

1.3. Brief Methodology & Approach

The Terms of Reference of the subject study, the scope of work defined for the study itself are indicative about the Methodology to be adopted for the study. Further, the Approach and Methodology had already been explained in the Stage I report and at this juncture, it is prudent to mention the sequential and systematic approach to the project. Accordingly, a flow diagram has been placed at Annexure 1.2, which is self-explanatory and by following the activities as specified, the project report will be in complete shape.

1.4. Project Location / Details of Study Area

Stage 1 study was completed for all the 11 National Waterways under Cluster VI and the Feasibility Study Reports of individual National Waterways have been presented to IWAI. Based on the inputs of the FSR, IWAI asked M/s Tractebel to go ahead with the Stage II study on 9 out of 11 National Waterways i.e., 5 in the state of Karnataka and 4 in the state of Kerala, as detailed.

TABLE 1-2: Waterways for Stage II study

Sl. No.	NW-No. / Name of the Waterway	Defined Limits
Cluster 6 (Karnataka)		
1.	NW-43 / GURUPUR RIVER	10.041 kms from starting point Lat 12°50' 44.093" N, Long 74° 49' 44.783" E.
2.	NW-51 / KABINI RIVER	23.171 kms from starting point Lat 11°56'0.9311" N, Long 76°14'17.5004" E.)
3.	NW-52 / KALI RIVER	53.415 kms from starting point Lat 14°50'33.5786" N, Long 74°07'19.7098" E.
4.	NW-74 / NETRAVATHI RIVER	30.00 kms from starting point Lat 12°50’44.6904" N, Long 74°49'33.3734" E.
5.	**NW-90 / SHARAVATI RIVER**	**28.674 kms from starting point Lat 14°17’56.5621" N, Long 74°25'36.4534" E.**
Cluster 6 (Kerala)		
1.	NW-3 / WEST COAST CANAL	169.794 kms from starting point Lat 10°11'38.9421" N, Long 76°12'04.152" E.
2.	NW-8 / ALAPPUZHA – CHANGANASSERY CANAL	29.3 kms from starting point Lat 9°30'03"N, 76°20'37"E.
3.	NW-9 / ALAPPUZHA-KOTTAYAM-MANIYAPARAMBU CANAL	51.7 kms from starting point Lat 9°31'1.31"N, 76°22'44.15"E.
4.	NW – 59 / VECHOOR – ATHIRAMPUZHA CANAL	18.8 kms from starting point Lat 9°40'0"N, 76°24'11"E.

The present study is about the Sharavati River (NW-90) for a distance of 28.674km from the Arabian Sea mouth at Sadashivgad Bridge to upstream upto Gerusoppa. The detail description of the Sharavati River has been compiled in below Table.

TABLE 1-3: Description of Sharavati River (NW-90)

Sl No.	Introductory Consideration	Description of the River
1.	Name of the river / canal	Sharavati River (NW-90)
2.	State/ District through which river passes	The Sharavati River mostly passes through Shimoga Distt of Karnataka State and meets the Arabian sea Arabian Sea at Honnavar in Uttara Kannada district.
3.	Length of the river / canal	The total length of the Sharavati river is around 128 km and it joins the Arabian Sea at Honnavar in Uttara Kannada district. Out of the total length of 128 km of river, about 29 km length of the river from Honnavar Port Sea Mouth at Lat 14°17'56"N, Long 74°25'27"E to link at highway at Gerusoppa Lat 14°14'15N, Long 74°39'06"E has been declared as new national waterway and proposed to undertake the two stage DPR study.
4.	Map	The index map of Sharavati River showing proposed waterway stretch, topographic features and road networks are given in **Figure 1.1**. The section of the Sharavati River under feasibility study for inland waterway showing reconnaissance survey routes is presented in **Drawing No. P.010256-W-20301-A06 (Sheet- 4 Nos):** Sharavati River (Karnataka) Proposed National Waterway Number 90 Layout Plan.
	Characteristic of River	
5.	River Course	The Sharavati river or Gerusoppa or Banaganga river has its origin at Ambutirtha in Tirthahalli taluk of Shimoga district. After a northerly course of about 64 km from Nagar, it forms the south-east boundary of Uttara Kannada for about 13 km and then passes about 32 km west or 128 Km in all to join the sea at Honnavar. About 30 km west, it reaches the ancient capital of Gerusoppa. During the remaining 27 km to the coast, the river flows between richly wooded banks fringed with mangrove bushes, a broad tidal estuary, brackish in the dry weather but during the rains sweet even close to its mouth.
6.	Tributaries / Network of Rivers / Basin	The major tributaries of the river are Nandihole, Haridravathi, Mavinahole, Hilkunji, Yennehole, Hurlihole, and Nagodihole.
7.	Catchment Area	The total catchment area of Sharavati is 3592 km^2

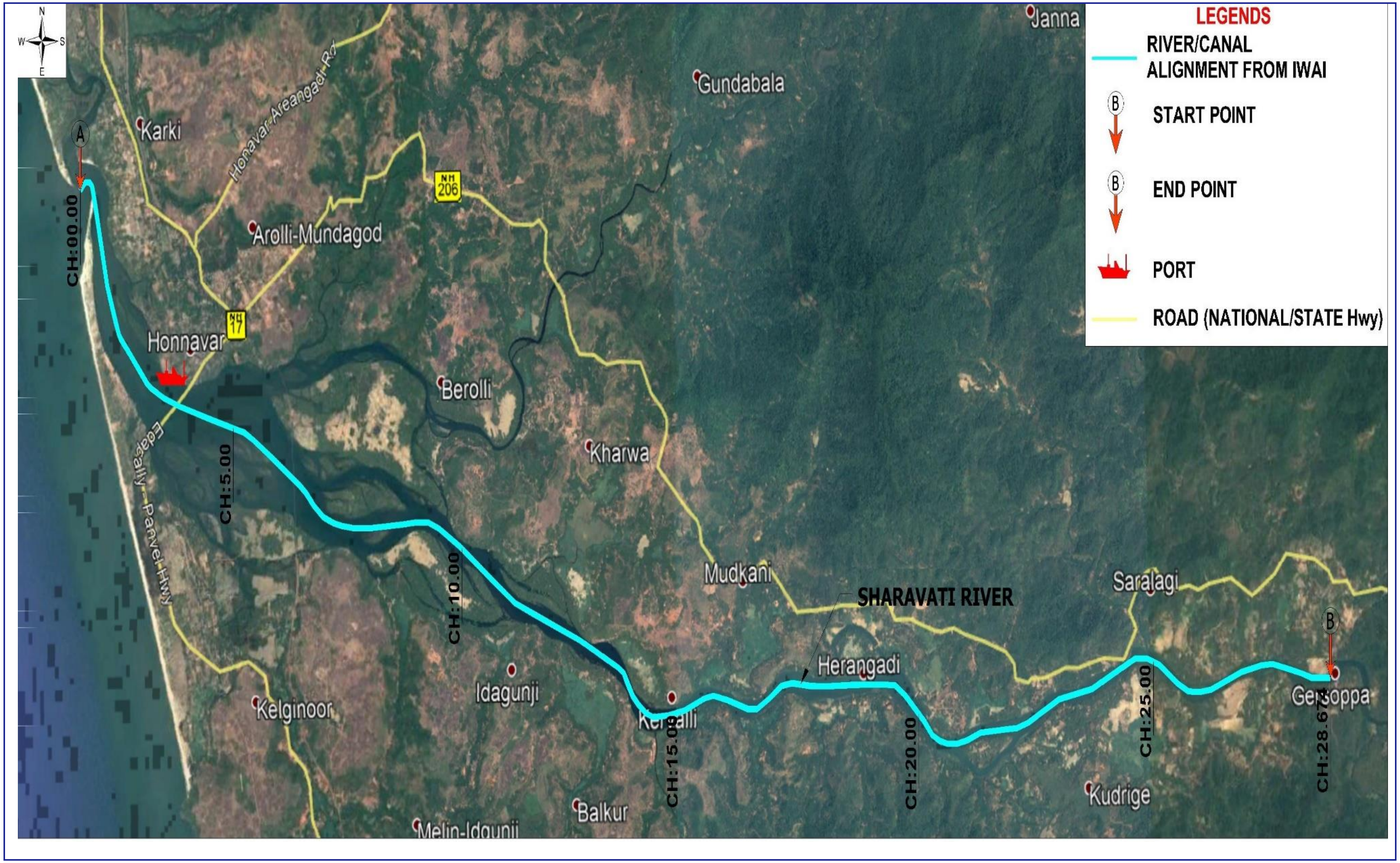


FIGURE 1.1 : INDEX MAP

CHAPTER 2: WATERWAY / DETAILED HYDROGRAPHIC SURVEY

2.1. Hydrographic Survey

Hydrographic survey is the science of measurement of Water depths and description of features which affect maritime navigation, marine construction, dredging, offshore oil exploration / offshore oil drilling and related activities. Hydrographic survey is being carried out for one or more of the following activities like measurement of tides for sea coast works (e.g. construction of sea defence works, harbours etc.), determination of bed depth of water bodies, by soundings (for navigation, location of rocks, sand bars, navigation light).

2.1.1. Waterway in General and Hydro-morphological Characteristics

Waterway in General

The Sharavati River originates at Ambutheertha in the Thirthahalli taluk in the state of Karnataka. The total length of the river is around 128 km and it joins the Arabian Sea at Honnavar in Uttara Kannada district. On its way, the Sharavati forms the Jog Falls, where the river falls from a height of 253 m. The river is dammed at Linganamakki. The major tributaries of the river are Nandihole, Haridravathi, Mavinahole, Hilkunji, Yennehole, Hurlihole, and Nagodihole. Sharavati river basin falls into two districts of Karnataka namely Uttara Kannada and Shimoga.

The Sharavati River is bounded by Gerusoppa, Saralagi, Samshi, Upponi and Kudrige in the upper stretch, Kodani, Herangadi, Kervalli, Idagunji and Molkaod in the middle stretch and Mandalakurve, Hosapattana, Kulakod, Kasarkod and Honnavar in the lower stretch. The present study is for 28.674 kms from the confluence with the sea as 0.00 km.

(Source: Google Earth)

FIGURE 2.1: Catchment Area Map of Sharavati River

The entire basin has an area of 3592 km2 (http://waterresources.kar.nic.in/river_systems.htm). Sharavati River Basin has the monsoon period from May to October, followed by winter from November to January and summer from February to May. The average rainfall variation in the sub-basin ranges from 1200 mm to 5000 mm. Average minimum and maximum temperature is about 15-38ºC.

A map showing Sharavati catchment basin is shown in above figure. The figure indicates that the river flows close to the coastal region; thus, the lower stretch of river is expected to be tidal affected zone. Given the size and terrain of the river, lower reaches may have navigation potential.

Hydro-morphological Characteristics

The combined study of hydrology and morphology gives a clear picture of hydro morphological characteristics of any water body.

Hydro morphology of the study area

Karnataka experiences lowest temperature during the month of January and then the temperature gradually increases. The temperature begins to soar rapidly during the month of March. The southern parts of the state generally experience the highest temperature during the month of April while in the coastal plains the temperature reaches its maximum during the month of May. Post monsoon, during the months of October and November the temperature decreases in the state and comes down further during the month of December. The average high temperature during summer is 34 degrees Celsius across the state. The average day temperature is 29 degrees Celsius in the monsoon season. During winter temperatures range from 32 degrees Celsius to below 20 degrees Celsius.

Monsoon season starts from June and lasts till September, as prominent downfalls in temperature are noted but at this time the percentage of humidity gets a little higher in atmosphere. The average annual rainfall in Coastal Karnataka is about 3456 mm, which is much more than the rainfall received in the other parts of the state. North Interior Karnataka receives the least amount of rainfall in the state and the average annual rainfall is just 731 mm. This zone experiences semi-arid type of climate. South Interior Karnataka receives an annual average of 1286 mm rainfall.

Eleven groups of soil orders are found in Karnataka viz. Entisols, Inceptisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, Aridisols, Vertisols, Andisols and Histosols. The common types of soil groups found in Karnataka are:

i. Red soils: Red gravelly loam soil, Red loam soil, Red gravelly clay soil, Red clay soil
ii. Lateritic soils: Lateritic gravelly soil, Lateritic soil
iii. Black soils: Deep black soil, Medium deep black soil, Shallow black soil
iv. Alluvio-Colluvial Soils : Non-saline, saline and sodic
v. Forest soils: Brown forest soil
vi. Coastal soils: Coastal laterite soil, Coastal alluvial soil.

The soil texture of the riverbed has been observed. It is observed that Coastal Alluvial Soil and Red Soil are present in almost equal proportion in the river under study stretch.

Formation of braiding pattern is popularly attributed to heavy sediment load in a river having a wide and shallow cross section. Rise in riverbed levels, rise in flood levels, accumulation of silt rendering channels shallow, bank erosion as a result of development of multiple channels and sudden change in flow direction are some of the conditions associated with braided rivers. However, from the survey it was seen that there is no braiding in this river course.

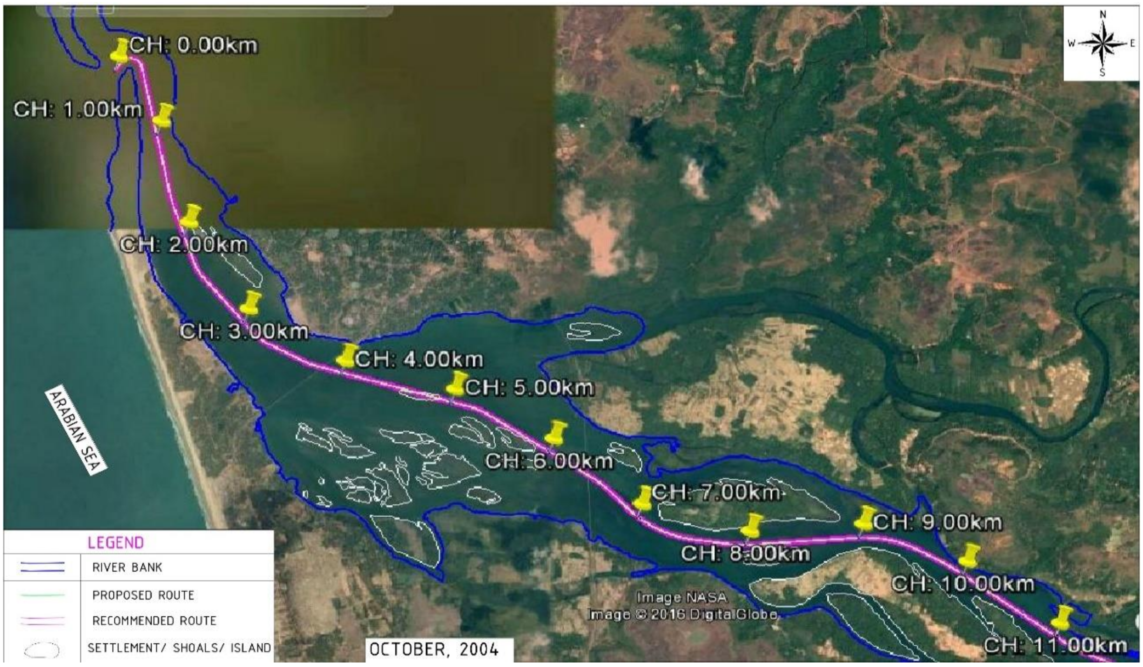
Any part of river falls under rapid zone, i.e. having relatively steep gradient in the riverbed may cause increase in velocity and turbulence. Thus, rapid zone characterization is important as it indicates whether navigation will be safe or not. The slopes of this river indicate that the study stretch does not fall under rapid zone.

Geomorphology

According to the classification of the waterway class IV, the minimum width required, and minimum depth required has been given as 50 m and 2 m for navigation. Though the river Sharavati was classified as class II for the entire stretch at the FSR stage. However, the present analysis has been done according into the waterway class IV,so relooked with the possibilities for 50 m width and 2 m depth.

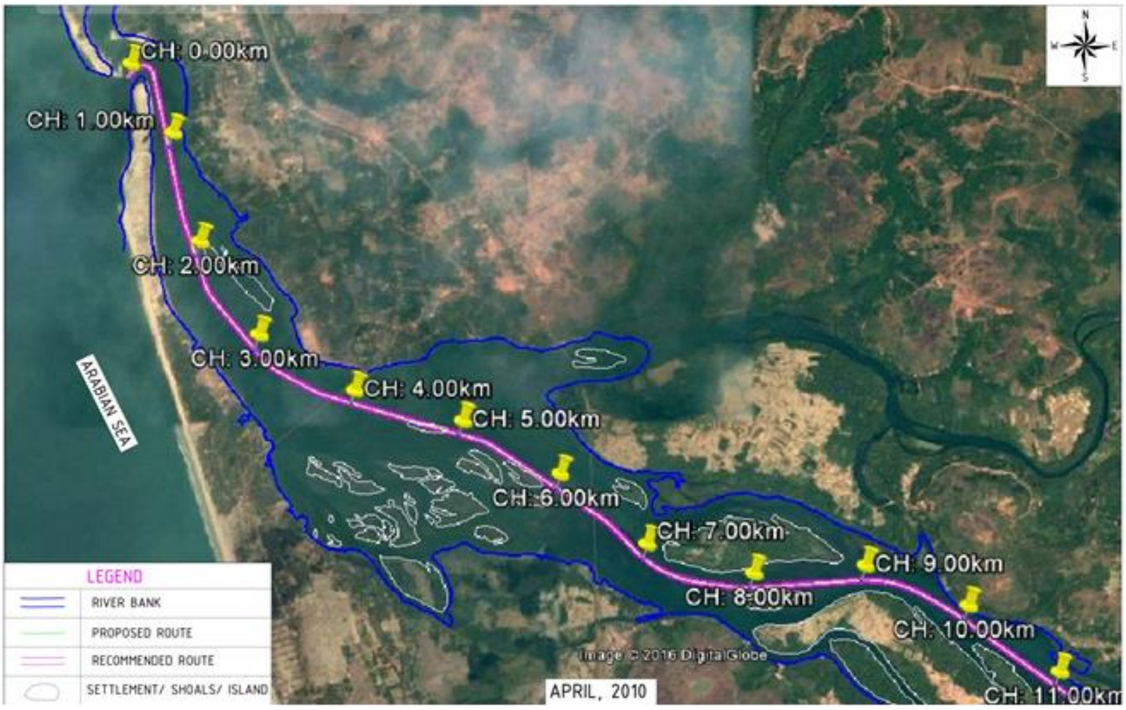
Sharavati River (Ch 0.00 km - Ch 10.00 km)

The satellite images for the stretch of first 10 km for four time periods have been placed (October 2004, April 2010, April 2013 and January, 2016).



(Source: Google Earth)

FIGURE 2.2: River stretch from Ch 0.00km to 10.00km in October, 2004

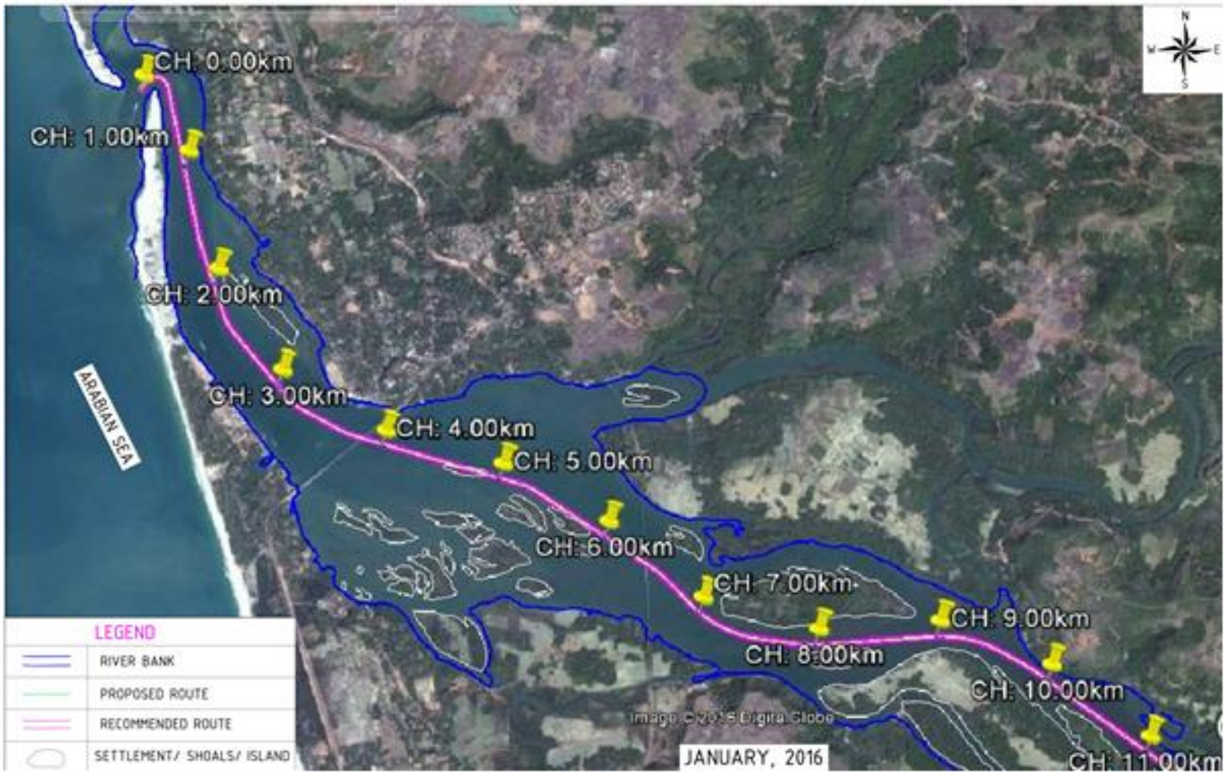


(Source: Google Earth)

FIGURE 2.3: River stretch from Ch 0.00km to 10.00km in April, 2010

(Source: Google Earth)

FIGURE 2.4: River stretch from Ch 0.00km to 10.00km in April, 2013



(Source: Google Earth)

FIGURE 2.5: River stretch from Ch 0.00km to 10.00km in January, 2016

Many small shoals are observed near Ch 5.00km towards the left bank which show negligible movement throughout the time period. One big shoal is observed near Ch 7.00km. A small islet is present near Ch 10.00km which is observed to be connected with the left bank with a small road bridge after 2010. A tributary joins the river from the right bank near Ch 5.00km. The water depth remains sufficient in all the time periods.

Sharavati River (Ch 11.00 km - Ch 20.00 km)

The satellite images for the stretch of next 10 km for four time periods have been placed (October 2004, April, 2010, April, 2013 and January, 2016).

(Source: Google Earth)

FIGURE 2.6: River stretch from Ch 11.00km to 20.00km in October, 2004

Source: Google Earth)

FIGURE 2.7: River stretch from Ch 11.00km to 20.00km in April, 2010

Source: Google Earth)

FIGURE 2.8: River stretch from Ch 11.00km to 20.00km in April, 2013

Source: Google Earth)

FIGURE 2.9: River stretch from Ch 11.00km to 20.00km in January, 2016

The width of the river reduces as compared to that up to Ch 10.00km. The water depth remains sufficient throughout the stretch however minor effect of accretion in 2010 after Ch 18.00km is noticed.

One islet is located near Ch 19.00km which is found to be recently connected with the right bank through a road bridge.

Sharavati River (Ch 21.00 km - Ch 28.674 km)

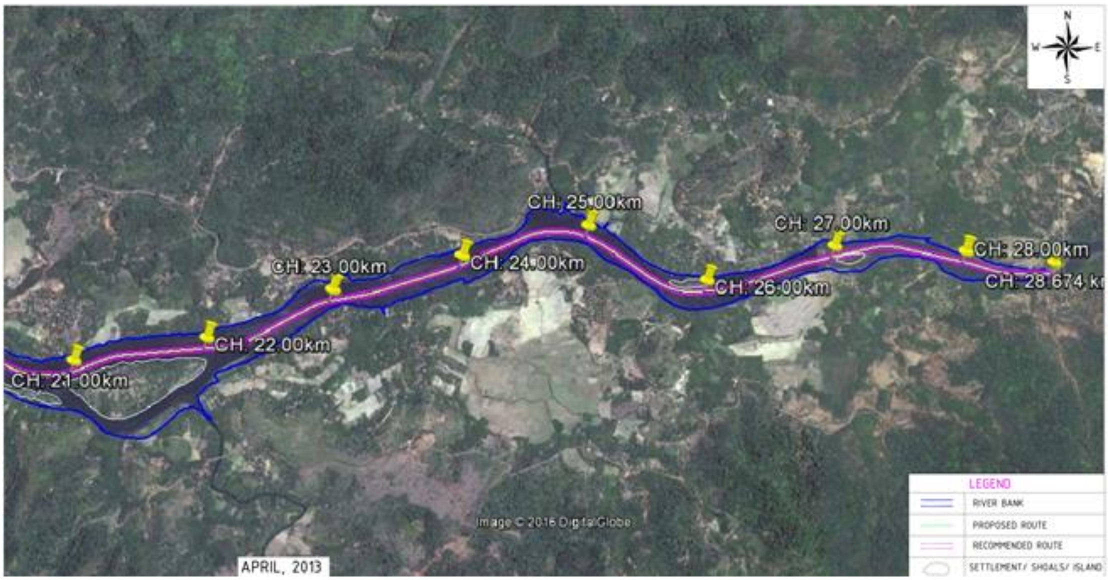
The satellite image for the stretch of last 8.674 km for four time periods have been placed (October, 2004, April, 2010, April, 2013 and January, 2016).

Source: Google Earth)

FIGURE 2.10: River stretch from Ch 21.00km to 28.674km in October, 2004.

Source: Google Earth)

FIGURE 2.11: River stretch from Ch 21.00km to 28.674km in April, 2010 .



Source: Google Earth)

FIGURE 2.12: River stretch from Ch 21.00km to 28.674km in April, 2013

Source: Google Earth)

FIGURE 2.13: River stretch from Ch 21.00km to 28.674km in April, 2016

There is one islet present near Ch 21.00 km. Two very small shoal is present at Ch 26.00 km and Ch 27.00km which shows little migration towards the right between 2004 and 2016. However, with sufficient width available and the small size of shoal, no hindrance is expected in the waterway route.

In April, 2010 deposition around the islet, in between Ch 25.00km and Ch 26.00km and near Ch 28.00km is observed.

No other significant changes are observed.

2.1.2. Existing Hydrological / Topographical Reference levels

GTS benchmark located at Honavar port was used as origin of survey. Benchmark position and MSL heights are mentioned below: -

Value of GTS Benchmark: - 2.10m above MSL.

2.1.3. Chart Datum / Sounding Datum

The water depths have been determined as a result of short period observations at both an established gauge (where the chart datum is known) and new gauge (where the chart datum has been established) in the area. The four consecutive low waters and the three intervening high waters have been recorded during spring tide, when the range of differences between high and low waters was the greatest. The locations with coordinates of established gauge and new gauge that have been used to reduce the soundings along the surveyed stretch are tabulated below.

TABLE 2-1: Transfer of sounding datum by few hour tide observations at Gauge -1, 2, 3, 4

Particulars	**SR-1**	**SR-2**	**SR-3**	**SR-4**
Observed high water	1.85	1.64	1.41	1.12
Observed low water	0.16	0.35	0.46	0.63
Observed range (Observed high water - Observed low water)	1.69	1.29	0.95	0.49
Mean Tide Level (M.T.L.) (Mean of observed high and low water)	1.005	0.995	0.935	0.875
High water	1.93	1.92	1.94	1.95
Low water	0.29	0.16	0.07	0.03
Range (High water - Low water)	1.64	1.76	1.87	1.92
Mean Tide Level (M.T.L.) (Mean of high and low water)	1.11	1.04	1.005	0.99
Ratio of Ranges (Observed range / Standard Port Range)	1.030	0.733	0.508	0.255
Study the predicted tide table and select maximum high water of particular day, when low water is nearest to the datum/zero				
Maximum high water	1.8	1.8	1.8	1.8
Equivalent range at the port (Maximum high-water x Ratio of range)	1.855	1.319	0.914	0.459
Equivalent half range (11/2)	0.927	0.660	0.457	0.230

Particulars	SR-1	SR-2	SR-3	SR-4
Sounding Datum (SD) at new gauge				
Observed (M.T.L.) - equivalent half (maximum) range	0.078	0.335	0.478	0.645
zero of tide pole from MSL	-0.085	0.196	0.116	1.357
	-0.007	0.531	0.594	2.002
	3.376	3.192	6.752	4.254
BenchMark Above Chart Datum	3.383	2.661	6.158	2.252

2.2. Existing Waterway Structures

2.2.1. Bridges

There are three bridges present in the entire survey stretch of Sharavati River and one under construction. The vertical clearance of the bridges is sufficient for class II vessels. The horizontal clearance of the bridges is sufficient for class I vessels. The horizontal clearance of the Iron bridges is sufficient for all classes. However, for other bridges, they will need modification for higher classes.

TABLE 2-2: Details of Bridges

Sl No	Structure Name	Chainage (km)	Type of structure	Location	Position (Lat Long)	Position (UTM)	Length (m)	Width (m)	No of Piers	Horizontal Clearance	Vertical clearance	Remarks
01	Saravati Bridge	3.447	RCC	Edapally-Panvel Highway	14°16'32.8098"N 074°26'39.7353"E	440068.599 E 1578298.267 N	390.00mtr	11.0	31	30.0	6.0	In Use
	Saravati Bridge	3.451	RCC	Edapally-Panvel Highway	14°16'32.8098"N 074°26'39.7353"E	440068.599 E 1578298.267 N	390.00 mtr	11.0	31	30.0	6.0	under construc tion
02	Railway Bridge	6.113	IRON	Margaon-Mangalore Railway Bridge	14°16'09.1333"N 074°27'44.9809"E	442021.838 E 1577566.262 N	1008.00 mtr	7.5	49	28	5.0	In Use

03	Iron Bridge	24.107	IRON	Samshi to Kudrige	14°14'22.4264"N	074°36'47.8265"E	458281.705 E	1574255.666 N	208.0 mtr	2.0	-	208	7.0	In Use

2.2.2. Electric Lines / Communication Lines

There are two high tension lines present in the entire survey stretch of Sharavati River. The vertical clearance required for power cables or telephone lines is 19 m. The support base of these HT line will have to be raised by 4.0 m to get the required clearance.

TABLE 2-3: Details of HT lines

Sl No	Structure Name	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	Horizontal Clearance (m)	Vertical clearance (m)	Remarks
01	HT LINE-1	11.322	Near Padukuli	14°14'54.8294"N 074°30'17.6788"E	446592.309 E 1575273.297 N	253.43	15.0 Mtr	MHWS
02	33 KV Line	16.842	Near Adkar	14°14'14.9678"N 074°33'03.8949"E	451570.748 E 1574038.557 N	255.79	15.0 Mtr	MHWS

2.2.3. Pipe Lines / Cables

Two Cables are present at Ch 13.07 & Ch 13.90km.

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

There are no Barrages, weirs, anicut, Locks etc. in Sharavati River in the entire survey stretch.

2.3. Bends

On the proposed waterway route, there are many bends in Sharavati River, which are given below in Table. Some of the river bend radius lower than the prescribed bend radius for Class-IV waterway may need smoothening.

TABLE 2-4: River Bend Radius in River

Sr. No.	Chainage (Km)	Radius
1	0.06	100
2	0.16	295
3	0.34	475
4	1.25	925
5	1.60	685
6.	2.09	730
7.	3.19	475
8.	4.40	1110
9.	5.11	765
10.	6.00	990
11.	8.01	845
12.	9.64	795
13.	10.45	667
14.	11.12	328
15.	12.14	605
16.	13.40	2100
17.	14.47	334
18.	14.94	600
19.	15.29	700
20.	15.41	500
21.	15.53	445
22.	16.55	685
23.	16.88	755
24.	17.14	680
25.	17.91	1060
26.	18.25	760
27.	19.47	465
28.	20.00	540
29.	21.29	1180
30.	24.80	345
31.	26.00	445
32.	27.20	290
33.	28.27	305

It has been recommended to develop the entire study stretch of Sharavati river as per Class-IV waterway system of NW standards which shall have 800m of bend radius. There are altogether 33 number of bends identified in the study stretch and among these six bends appear to be sharp and therefore identified for smoothening and these are (Ch. 0.16, 11.12, 14.47, 15.53, 19.47 & 27.20).

2.4. Velocity and Discharge Details

The details of Velocity and Discharge in the Sharavati River are given below in Table 2-5.

TABLE 2-5: Current meter discharge details

Stretch No.	Chainage (km)	Position				Observed Depth (m) (D)	High tide	Stag water	X-Sectional area (sq. m.)	Discharge (Cu.m)
		Latitude	Longitude	Easting (m)	Northing (m)		0.5 D			
1	3.184	14°16'26.9513"N	074°26'17.9044"E	439414.052	1578119.852	2.0 m	4 m/s	0.1 m/s	200sq	
2	8.320	14°15'20.6581"N	074°28'45.0576"E	443818.599	1576072.88	2.4 m	4 m/s	0.1 m/s	200sq	Tidal Zone
3	19.28	14°14'11.9838"N	074°34'23.1070"E	453944.34	1573942.42	3.5 m	4 m/s	0.1 m/s	200sq	
4	28.47	14°14'14.5880"N	074°39'02.3867"E	462313.662	1574008.485	2.5 m	4 m/s	0.1 m/s	200sq	

2.5. Waterway description

Sharavati River (Ch 0.00km – Ch 10.00km)

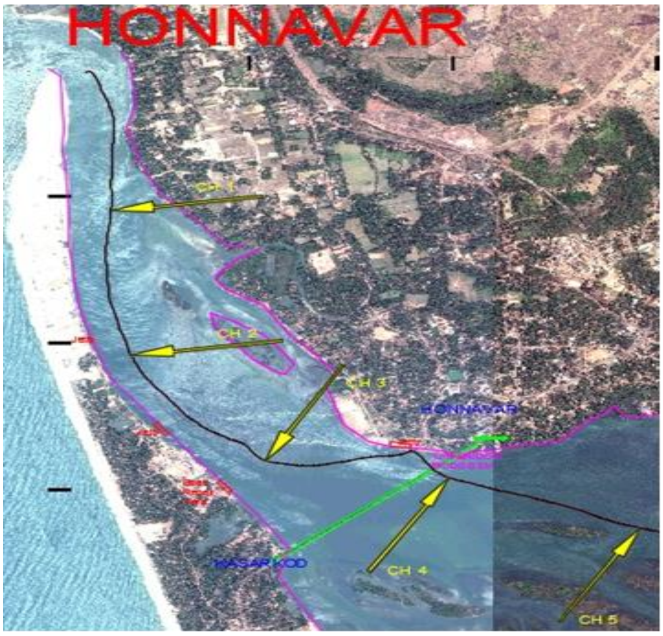


FIGURE 2.14: Sharavati River from Ch 0.00km to Ch 5.001km

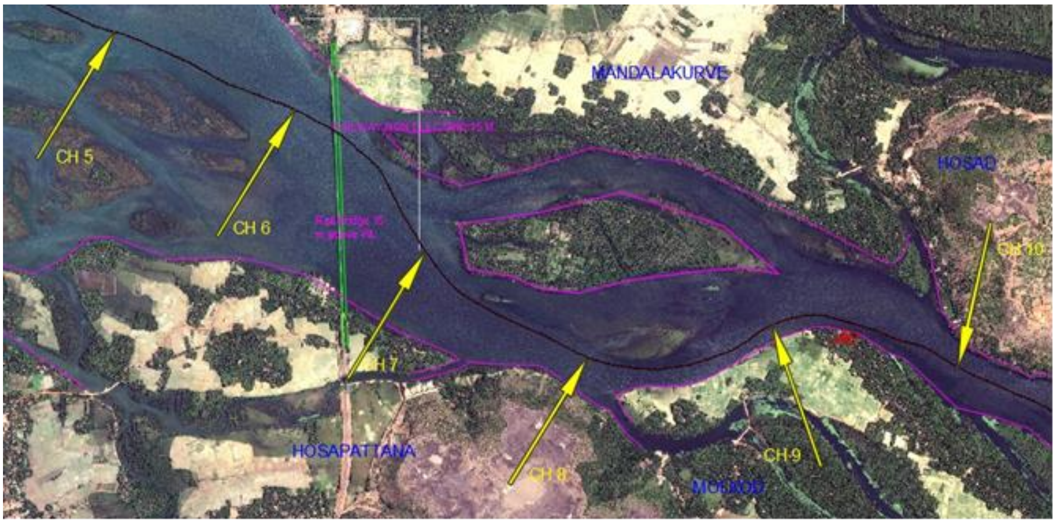


FIGURE 2.15: Sharavati River from Ch 5.00km to Ch 10.00km

TABLE 2-6: Reduced depth from Ch 0.00km – Ch 10.00km

Chainage (km)		**Reduced depth with respect to Sounding Datum**				
		Reduced Depth (m)		**Length of Shoals (m)**	**Dredging Qty (cum)**	**Cumulative Qty (cum)**
From	**To**	**Min**	**Max**			
0	1	1.6	6.4	150	73.7	73.7
1	2	2.7	4.7	0	0	73.7
2	3	0.7	4.8	150	1951	2024.7
3	4	0.5	2.4	1000	47825.6	49850.3
4	5	0.6	2.4	900	26138.6	75988.9
5	6	0.9	2.5	900	15525.8	91514.7
6	7	0.7	2.5	1000	45857.1	137371.8
7	8	1.2	3.6	750	15239.2	152611
8	9	0.7	4.3	300	259.1	152870.1
9	10	0.7	2.7	750	12324.3	165194.4

The maximum and minimum LAD for the above-mentioned stretch is given in the above table (as per class IV). There is one port and one jetty on the left bank of the river. At Ch 3.00km, there is a boat repair yard on the left bank of the river. At Ch 3.800km, there is a bridge with 11.0m vertical clearance. At Ch 3.447km, there is a Bridge under construction. Villages Hosapattana and Molkod are on the left bank of the river and Mandalakurve and Hosad on the right bank of the river. Mangrove forest can be seen on both sides of the river in this reach. At Ch 6.113km, there is a railway Bridge with 5.0m vertical Clearance. At Ch 6.113km, Ch 7.10km and Ch 8.25km, the river bifurcates due to formation of shoals in the River.

Sharavati River (Ch 10.00km – Ch 20.00km)

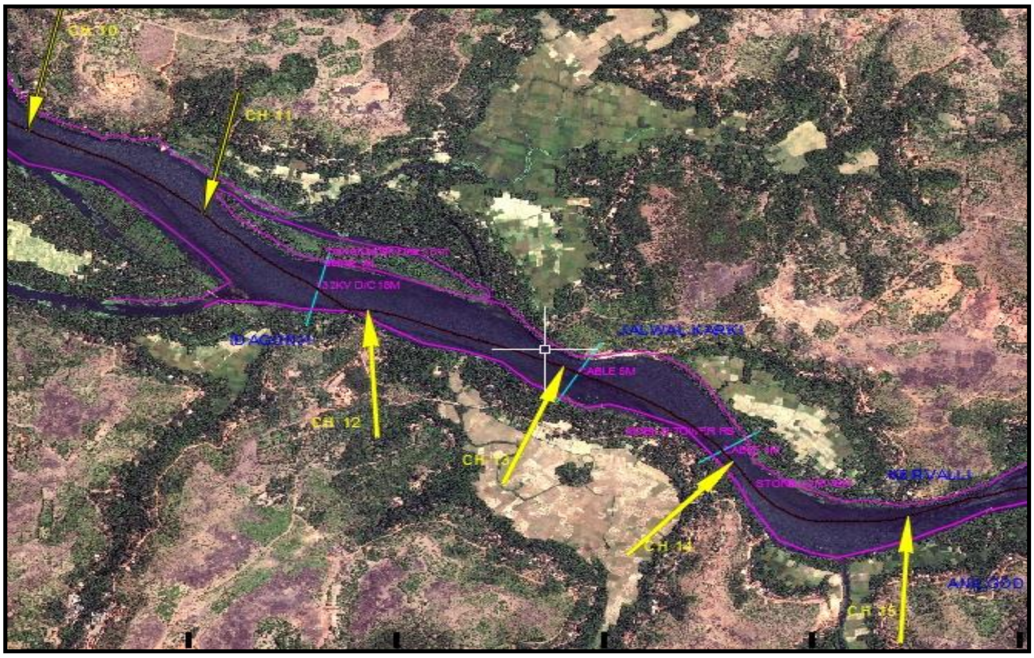


FIGURE 2.16: River from Ch 10.00km to Ch 15.00km

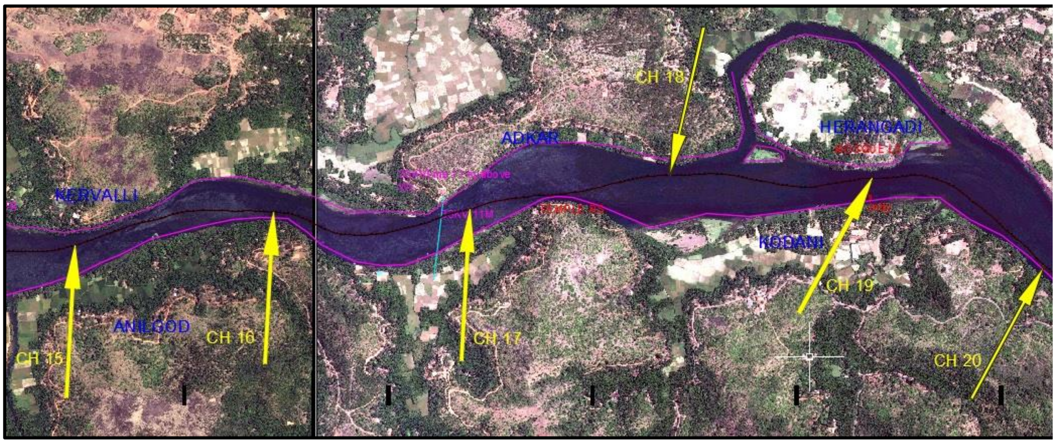


FIGURE 2.17: Sharavati River from Ch 15.00km to Ch 20.00km

TABLE 2-7: Reduced depth from Ch 10.00km – Ch 20.00km

Chainage (km)		Reduced w. r. to Sounding Datum				
		Reduced Depth (m)		Length of Shoals (m)	Dredging Qty	Cumulative Qty.
From	To	Min	Max			
10	11	1.6	4.4	450	743.9	743.9
11	12	1.3	3.9	600	1701	2444.9
12	13	2.2	5.5	0	0	2444.9
13	14	2.0	8.6	0	0	2444.9
14	15	2.6	9.9	0	0	2444.9
15	16	2.0	7.4	0	0	2444.9
16	17	1.9	7.5	0	0	2444.9
17	18	0.7	5.0	150	2021	4465.9
18	19	0.7	2.1	1000	45922.9	50388.8
19	20	0.5	6.1	1000	21043.4	71432.2

The maximum and minimum LAD for the above-mentioned stretch is given in the above table (as per class IV). On both sides of the river in this change there is mangrove forest. At Ch 10.95km, the river bifurcates due to shoal in the river. At Ch 11.322km, there is a 132KV Transmission line. At Ch 13.07km and at Ch 13.90km, there are cables running across the river. At Ch 16.842km, there is 33KV line with vertical clearance of 15m. At Ch 18.40km, the river bifurcates due to shoal formation. There is one jetty existing at Ch 19.00km of the river.

Sharavati River (Ch 20.00km – Ch 28.674km)

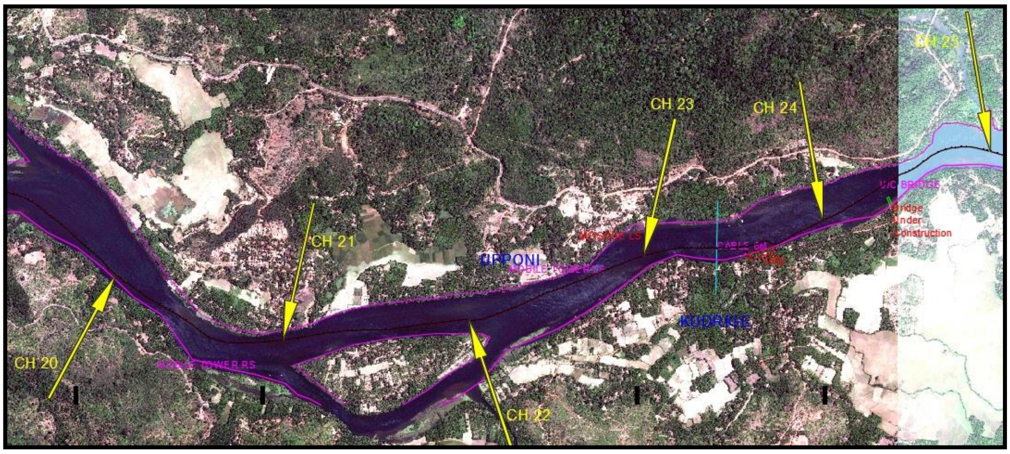


FIGURE 2.18: Sharavati River from Ch 20.00km to Ch 25.00km

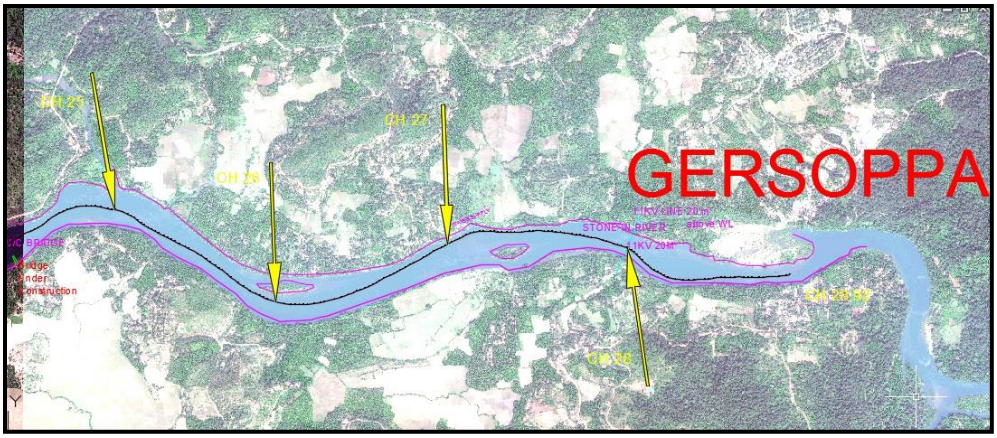


FIGURE 2.19: Sharavati River from Ch 25.00km to Ch 28.674km

TABLE 2-8: Reduced depth from Ch 20.00km – Ch 28.674km

Chainage (km)		Reduced w. r. to Sounding Datum				
		Reduced Depth (m)		Length of Shoals (m)	Dredging Qty (cum)	Cumulative Qty. (cum)
From	To	Min	Max			
20	21	0.4	6.7	600	28926.9	28926.9
21	22	0.8	3.6	900	15922.9	44849.8
22	23	0.2	2.4	1000	56537.8	101387.6
23	24	1.1	4.6	600	1774.8	103162.4
24	25	1.0	3.7	1000	6145.2	109307.6
25	26	1.2	6.5	750	1938.3	111245.9
4.1	27	1.2	5.1	300	18.2	111264.1

Chainage (km)		Reduced w. r. to Sounding Datum				
		Reduced Depth (m)		Length of Shoals (m)	Dredging Qty (cum)	Cumulative Qty. (cum)
From	To	Min	Max			
26						
27	28	0.1	2.9	600	16780	128044.1
28	29	0.1	7.6	600	18058	146102.1
29	29.25			150	0.6	146102.7

The maximum and minimum LAD for the above-mentioned stretch is given in the above table (as per class IV). At Ch 23.50km, there is one jetty on the left bank of the river. At Ch 24.107km, there is a bridge under construction. On both sides of the river there is a mixture of residential area and forest area up to the end of the change. At Ch 25.90km and at Ch 27.30km, the river bifurcates due to formation of shoals. There are stones in the river near Ch 28.00km. The Survey ends at Gerusoppa at Ch. 28.647 km.

2.6. Water and Soil Samples analysis and Results

TABLE 2-9: Water sample results

SAMPLE NO.	Latitude	Longitude	WATER SAMPLES	
			Sediment concentration (ppm)	pH
1.	14°16'26.9513"N	074°26'17.9044"E	123	7.96
2.	14°15'20.6581"N	074°28'45.0576"E	215	7.48
3.	14°14'11.9838"N	074°34'23.1070"E	48	7.74
4.	14°14'14.5880"N	074°39'02.3867"E	33	7.76

The river water is slightly basic in nature with average pH being 7.74.

TABLE 2-10: Soil sample results

Sr. No.	Sample No.	Specific Gravity	Latitude	Longitude	Grain size analysis (%)				Cu	Cc
					Mechanical analysis		Hydrometer analysis			
					Gravel	sand	Silt	Clay		
1.	SVR-1	2.65	14°16'26.9513"N	074°26'17.9044"E	8	60	25	7	236.1	1.025
2.	SVR-2	2.67	14°15'20.6581"N	074°28'45.0576"E	9	50	34	7	84.72	0.664
3.	SVR-3	2.65	14°14'11.9838"N	074°34'23.1070"E	9	63	22	6	79.36	0.425
4.	SVR-3	2.66	14°14'14.5880"N	074°39'02.3867"E	7	58	29	6	81.52	1.215

From the above table the riverbed can be concluded to be sandy with silt throughout the study stretch.

CHAPTER 3: FAIRWAY DEVELOPMENT

3.1. Proposed Class / Type of Waterway

The Fairway availability and its utilization along with the developments required etc., are to be concluded based on the detailed Hydrographic survey, Traffic mobilization including the hinterland requirement, future planning of the hinterland amenability and the stake holder's viewpoint etc.,

The detailed Hydrographic survey conducted on river Sharavati and Survey charts prepared have been referred. As per the data available, the study stretch of the waterway is amenable for up to ***class IV*** of the waterway from the Fairway point of view so as to consider the Ro-Ro operation with through put traffic from Arabian Sea linking Honnavar Port to the hinterland through the proposed Terminal D/s of Gerusoppa Dam.

The initial stretch up to the D/s of the Gerusoppa Dam has been observed under the tidal zone and is traversing through a moderately clustered habitant zone in the Honnavar Town area and subsequently in the Rural area.

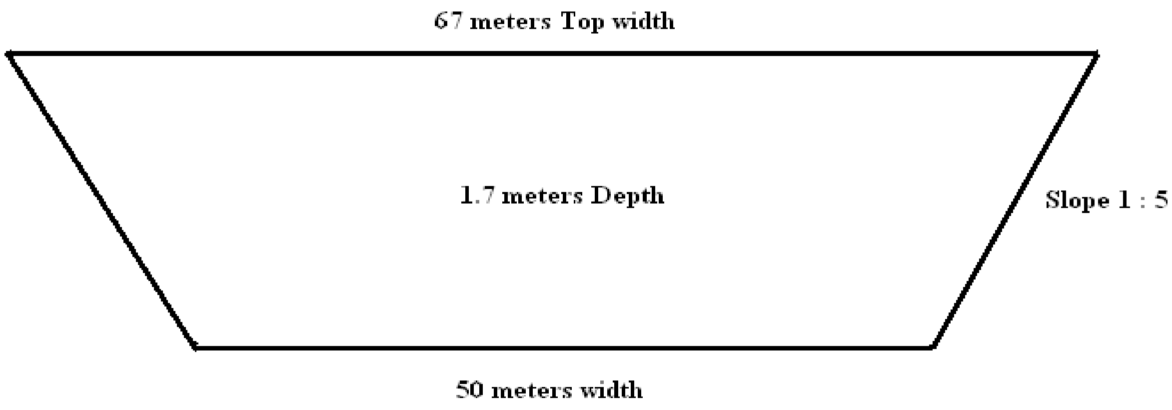
Keeping in view the above, the most amenable class will be Class IV waterway to facilitate for the mobilization of the Tourism Traffic, which may in the long run usher facilitating operation of the cargo Traffic.

The present Study stretch in the Sharavati River can be Considered as ***Class IV*** waterway.

3.2. Details of Shoals (Length, Width and proposed development works)

Dredging quantities have been worked out for the suggested Class IV Waterway standards.

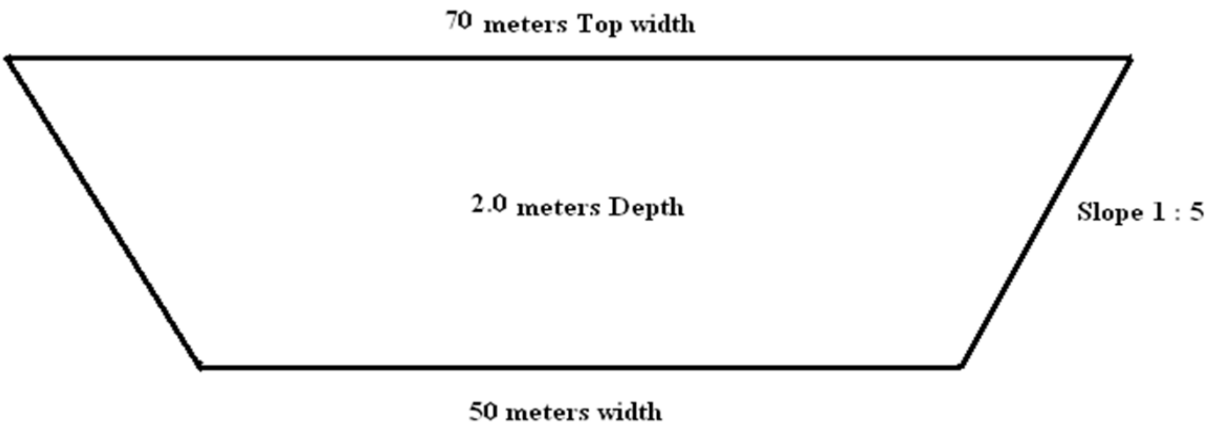
CLASS 3



CLASS-III

Observed						Reduced w. r. t. Sounding Datum			
Chainage (km)		Observed depth (m)		Length of Shoal (m)	Dredging quantity (cu.m.)	Reduced depth (m)		Length of Shoal (m)	Dredging quantity (cu.m.)
From	To	Max.	Min.		Per km drg	Max	Min		Per km drg
0.0	10.00	TIDAL ZONE				0.5	6.4	4750	102436.9
10.00	20.00					0.5	9.9	2200	41797.3
20.00	28.674					0.1	7.6	4900	91952.2
Total								**11850**	**236186.4**

CLASS 4



CLASS-IV

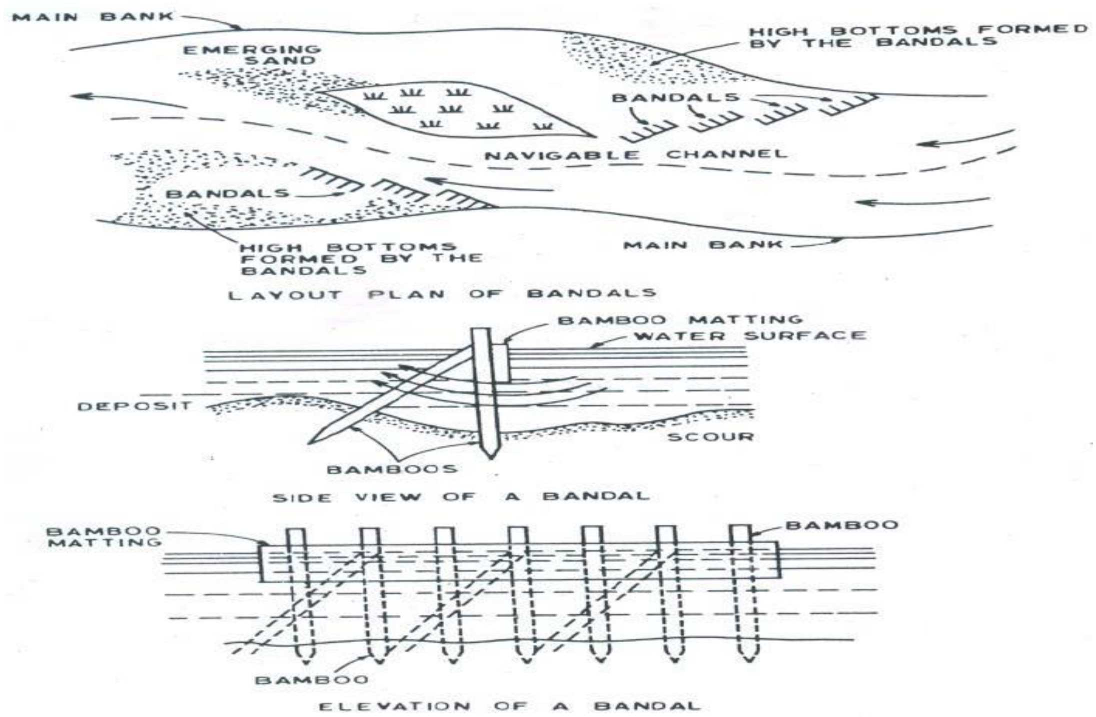
Observed						Reduced w. r. t. Sounding Datum			
Chainage (km)		Observed depth (m)		Length of Shoal (m)	Dredging quantity (cu.m.)	Reduced depth (m)		Length of Shoal (m)	Dredging quantity (Cu. M)
From	To	Max.	Min.		Per km drg	Max	Min		
0.0	10.00	TIDAL ZONE				0.5	6.4	5900	165194.4
10.00	20.00					0.5	9.9	3200	71432.2
20.00	28.674					0.1	7.6	6500	146102.7
Total								**15,600**	**3,82,729.3**

Proposed Conservancy Activities Rivers are the natural channels of drainage carrying water along with sediments from the catchment to the sea. The main river course will be joined with various tributaries depending on its catchment configuration carrying the water from run-off and also carrying the sediments enroute. The dynamic equilibrium of such river flow tends to change the course of the river on the Geometric cross section and on the Gradient. The braiding channel of the river will create meandering streams leading to multiple channel flow. This type of distribution of the cross-section discharge into multiple channels is a major threat for safe navigation in the particular stretch of the river / waterway. The meandering tendency of a particular stretch / river always leads to the formation of loops / bends. Hence, the perspective appreciation over the behaviour of the river / study stretch for navigation is most essential to arrive at a dependable River Training measures for achieving the safe navigational fairway of the study stretch.

The taming of the river / study stretch for provision of a safe fairway for navigation is ultimately depending on the cost criteria and also the economics. Certain low cost solutions are already in practice in the national waterways on NW 1 and NW 2 systems viz., Bandalling; Bottom Panelling; Submerged Vanes etc., Considering the seasonal aspects in the river like Lean season and Flood season and in order to meet the quick time lines for providing the safe channel, the Dredging of the river is also under consideration. However, to have a sustainable channel with long term requirement, the permanent solution of taming the river through the training measures viz., Spurs; Groins etc. Bank protection measures also can be adopted at certain critical locations as Training measures.

3.2.1. Low Cost structures

Bandalling” is a low cost and ancient technique adopted in NW 1 & NW 2 in order to improve the navigation conditions. Bandalling is the temporary structure made up of “Bamboos” and “Bamboo Mats”. The ideology of this structure is to divert the flow of secondary channel to main channel, where split discharge observed. Bamboos will be driven in line for 25m to 30m (1 Chute) and arranged with the screen made up of Bamboo Mats placed / immersed from the surface of water by a third of the depth. This structure will be placed at 35 degrees to 45 degrees to the secondary channel flow. No. of Chutes will vary on the width of the secondary channel. These Chutes will be supported by cross Bamboos to withstand the flow. This can improve the channel depths from 1.8 m to 3.0 m. The process ultimately silts up the secondary channel and improves the velocity / discharge in the main channel. The below mentioned Figure will give an idea about the structure. The Bandalling locations may have to be identified, during the receding stage of the Flood and are to be placed while considerable flow is observed both in main and secondary channels.



In the study stretch, there is no need of any conservancy activity due to the submergence area.

3.2.2. Dredging

"Dredging" is the removal of sediments and debris from the bottom of lakes, rivers, harbours, and other water bodies. It is a routine necessity in waterways around the world because of the sedimentation process (the natural process of sand and silt washing downstream and gradually fills channels and harbours). Dredging often is focused on maintaining or increasing the depth of navigation channels, anchorages, or berthing areas to ensure the safe passage of boats and ships. Vessels require a certain amount of water in order to float and not touch bottom. This water depth continues to increase over time as larger and larger ships are deployed and with the increased volumes of bulk cargo operation, dredging plays a vital role in the nation's economy.

Dredging is also performed to reduce the exposure of fish, wildlife, and people to contaminants and to prevent the spread of contaminants to other areas of the water body. Environmental dredging is often necessary because sediments in and around cities and industrial areas are frequently contaminated with a variety of pollutants. The sediment management and disposal of dredged material are also important issues to be managed and carried out effectively.

Dredging used to be carried out in the river by various types of Dredgers viz., Bucket and grab dredgers; Suction and cutter-suction dredgers; Trailing hopper dredgers etc. However, the most acceptable form of the dredger is "Cutter Suction Dredger" (CSD) being deployed on National Waterways by IWAI.

In the study stretch, in particular between the Honnavar Port area to Ferry Terminal (D/s of Gerusoppa Dam up to Ch. 28.674km), dredging has been identified to maintain the channel for the mobility of Ferry vessel. The shoal length for ***Class IV*** is 15600 m with an estimated quantity of Dredging as 3.83 Lakhs Cu. M. In order to maintain a depth of 2.0 m and by adding 10 % quantity, it is estimated that a quantity of 4.21 Lakhs Cu. M of Ordinary Soil may have to be considered for dredging.

3.2.3. River Training

River Training is nothing but taming of a river section to achieve the objective / purpose with the encroachment over the natural flow condition. Navigation and Flood Control are generally the common purposes for taming the river with various training measures.

In general, there are two types of waterway training structures: Re-directive and Resistive. Re-directive, as the name implies, is the use of the River's energy and Managing the energy in a way that benefits the system i.e., enhance the navigation channel. A resistive structure acts to maintain the system as status quo i.e., reducing bank erosion.

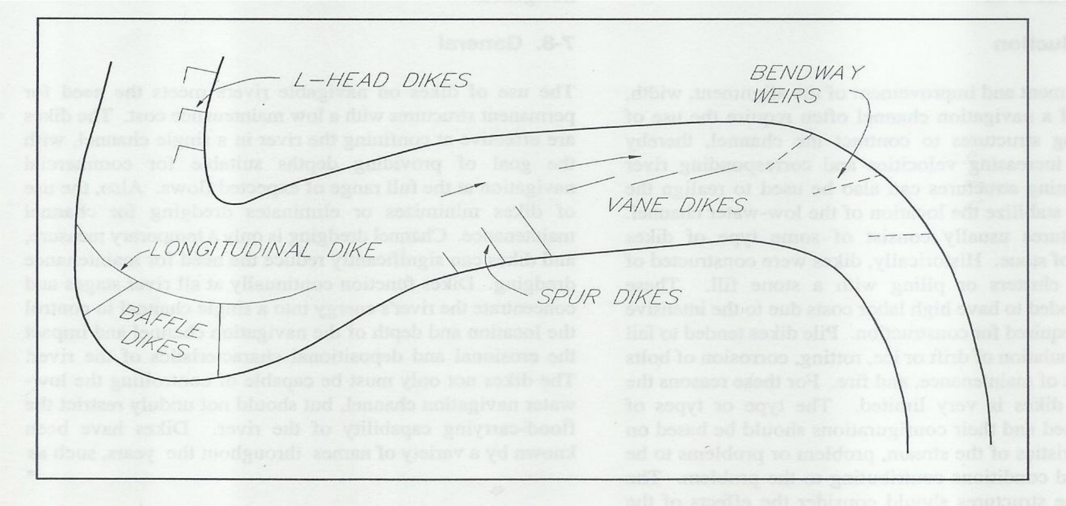


FIGURE 3.1: Types of dike structures

Re-directive structures are usually a series of dikes placed along the inside of a river bend where sediment usually deposits. Dikes have been known by a variety of names, such as groins (or groynes), contracting dikes, transverse dikes, cross dikes, spur dikes, spur dams, cross dams, wing dams, and spurs. The most common dikes in use today are shown in the Figure, as under.

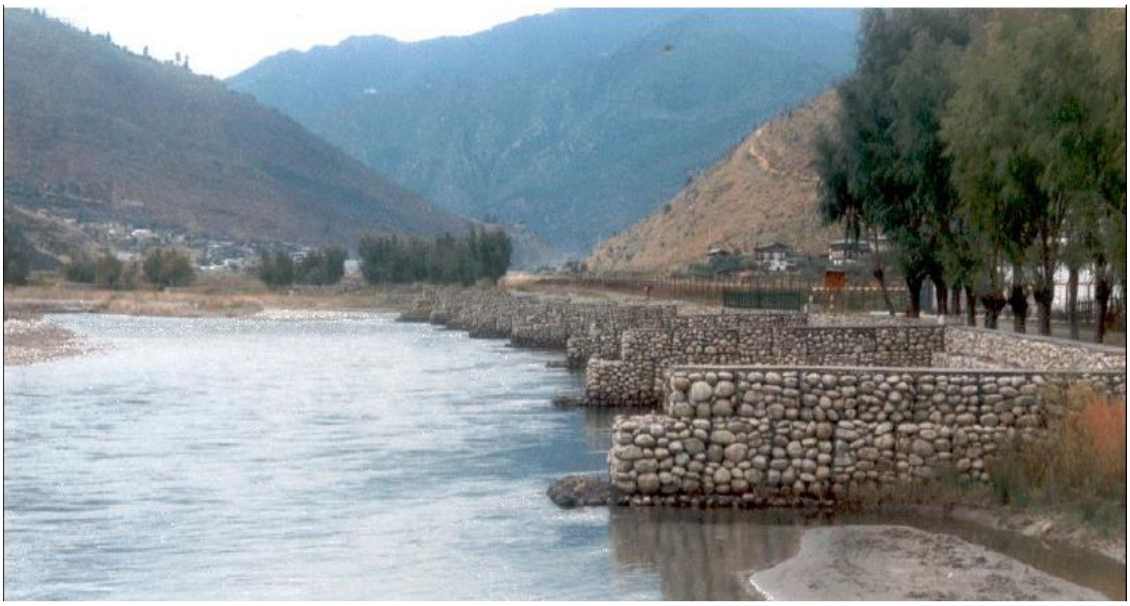
Resistive structures are primarily used to prevent bank erosion and channel migration to establish or maintain a desired channel alignment. Revetments and Bank Protection works are examples for such structures.

In the rivers of Maharashtra, especially the west flowing rivers, in general have the tendency of rapid draining off due to the comparative limitation in traverse length between the lower mountain range and the Arabian Sea.

Keeping in view the above, the suggested River Training works are Spurs; R. C. C. Porcupines; Bamboo Porcupines. Further the Bank Protection / Revetments also can be considered as a part of the River Training at certain amenable locations. The structures are detailed with the figures and the preliminary designs have been placed in appropriate chapter (Chapter 6).

The "Gabions with Boulders" type of structure can be considered as Spurs and also as Bank Protection on these rivers, as detailed in the Figure.

In wider reaches, it is suggested the provision of spurs with “Gabions with Boulders” as detailed in the Figure, given below. The preliminary Design details have been placed in Chapter 6.



River Training works may be essential, in general, at the sharp bend locations and at other locations where there is a need of taming the river with morphological variations / disturbances creating hurdle for smooth navigation.

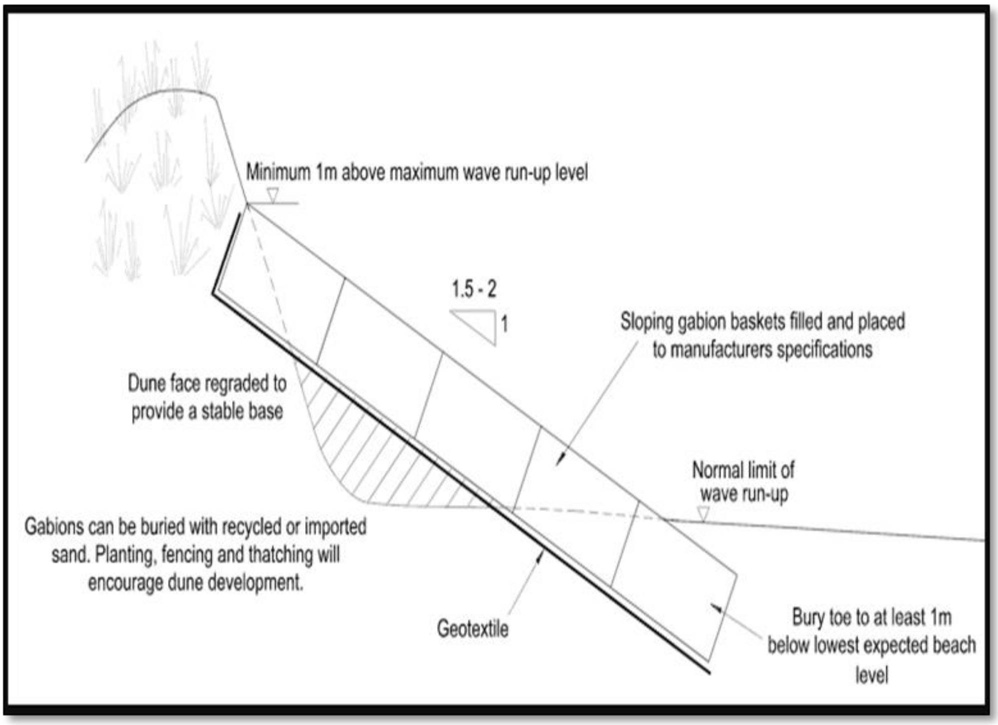
In the present study stretch, there is no need of any River Training requirements.

3.3. Bank Protection / Embankment Strengthening

In the rivers, wherever bends or curves exist, the concave side of the river will always be subjected to the erosion. The pace of erosion will depend on the soil condition and terrain and also the velocity of the flow at the location.

As early as the seventeenth century, the Germans were protecting the banks of rivers with masses of brush formed into fascines (bundles). This method of bank protection, called blesswerk, was also used for bank and shore protection in Holland.

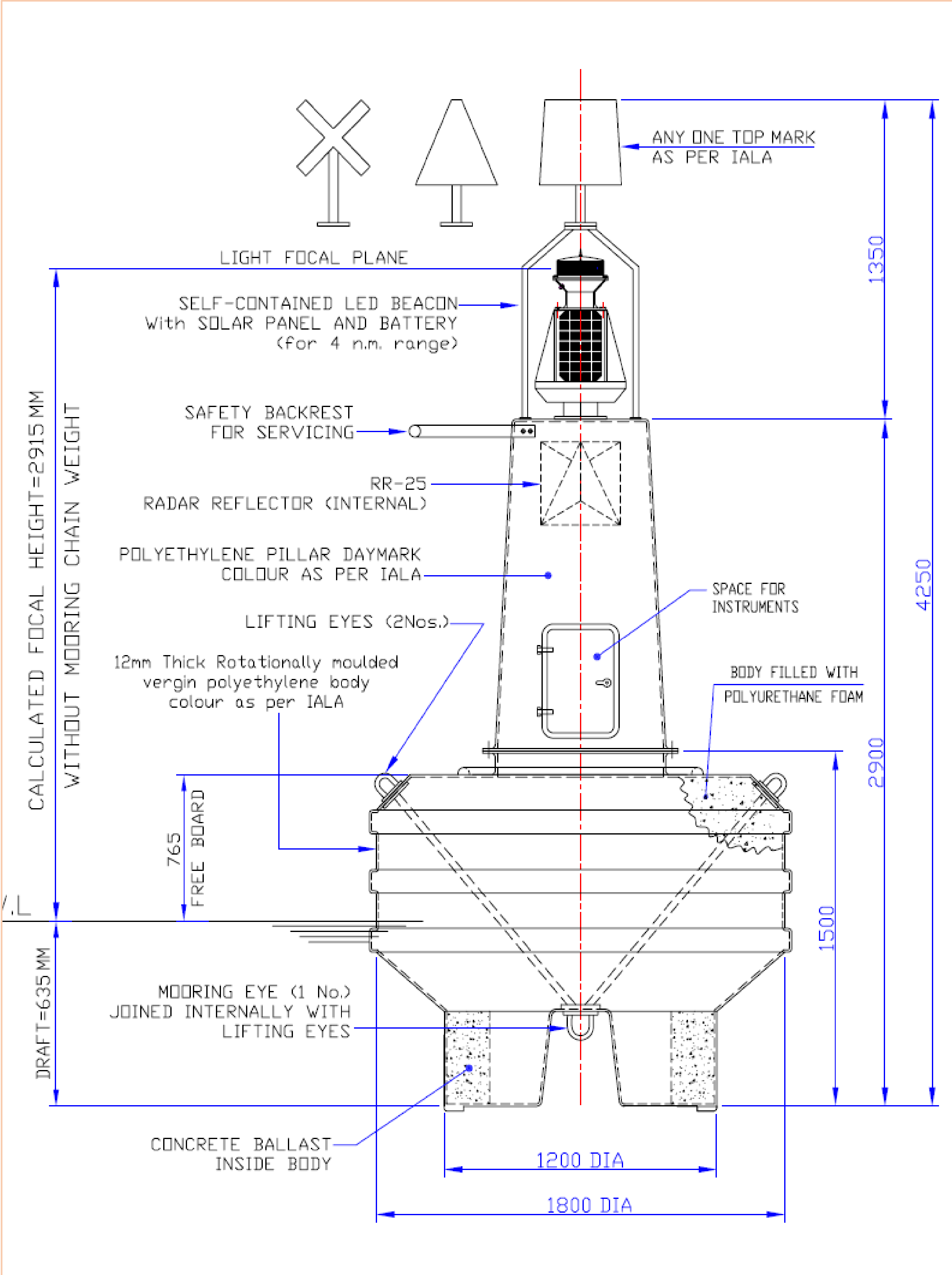
As explained earlier, the characteristics of the rivers originating from Western Ghats are unique. In such a condition, Gabions filled with rocks will be the most advantageous type of the Bank Protection. Further, the basic raw material, rock, is abundantly available within a reasonable lead. Gabions are wire mesh baskets filled with crushed rock. They are filled in situ, with locally available material (rocks) and thus have a low capital cost. Because they are flexible and porous, they can absorb some wave and wind energy, thereby reducing the scour problems.



It has been proposed to consider the Bank Protection in the vulnerable locations. In the stretch, up to ch 28.674 km, there is no such location with any Bank Protection requirement. The proposed dredging activity may have nominal morphological disturbance, however banks shall not be affected hence no bank Protection requirements is needed.

3.4. Navigation Markings / Navigation Aids

It has been proposed to consider the same type of Buoy and Light deployed in NW 1, NW 2 & NW 3 with the details as sketched in the figure below. Further the Technical specifications of Buoy & Light, as available in the Market as a proprietary item are also detailed.



<u>POLYETHYLELENE CHANNEL MARKING BUOYS: (PORT HAND) 1 No. - PEB/1</u>

800 Polyethylene Buoys, each complete with Day Mark, Top Mark and Radar Reflector. Main features are as given below:

Body Diameter: 1800 mm / Wall Thickness : 12 mm thick body / Body Material : Rotationally moulded in low density UV-Stabilized virgin polyethylene / Foam : Body filled with Closed Cell Polyurethane Foam / Weight without Mooring : 645kg (approx) / Focal Height : 29 15 mm / Draft : 635 mm / Free Board : 765 mm / Reserve buoyancy : 1893 kgs/ Displacement : 26.0 kg./cm of immersion / Mooring Eyes : 1 No. of Steel / Lifting Eyes : 2Nos / Body Colour : As per IALA system, UV-stabilised colour pigments mixed thoroughly with polyethylene powder before moulding operation / Daymark : P E Module (as per IALA system) / Radar Reflector : RR - 25 as specified (25M2).

<u>1 Set - Mooring gear – Each set comprised of the following:</u>

1 No. - 3M x 26 mm dia open link chain with enlarged end links.

1 No. - 15M x 26 mm dia open link pendant chain with enlarged end links.

4 Nos. - 26 mm nom. dia forelock end shackles.

1 No. - 26 mm nom. dia swivel piece with end links.

1 No. - 250 kg. M.S. stockless Anchor.

<u>Note</u>: The chains shall be made as per 1S: 4692, shackles and swivel as per IS: 4484 and stockless steel Anchor. The chain shackles and swivel shall carry proof load test certificate witnessed by the IRS. All the above shall be given one coat of coaltar paint.

<u>Solar Operated LED lighting 1 No. MLB-200-4 Self-contained LED beacon fitted with PLC-12 programmable LED controller. Specification of Each Light is as detailed below:</u>

Luminous range: 4 n. miles. (T 0.74) / Light Colour: as per IALA System. (Red) / Light Source: High intensity Light Emitting diodes (LEDs) with UEP to 60,000 hrs of burning life / Optical system: 200 mm dia clear polycarbonate UV stabilized diffuser lens / Lantern Body: High impact polystyrene / Cable entry: M l6 Cable glands fitted / Fixing: 4 fixings for Ml 0 bolts at 200 mm PCD / Lantern weight: 3.0 kg (approx).

<u>1 No. - PLC 12 programmable microprocessor-based LED controller (fitted in the base of the Lantern). Main description is given as below:</u>

Input Voltage: 12 V to 18 V d. c / Output Voltage: Switch-mode stabilized to suit LED operating current / LED load (max): upto 12 Amp. at 12 V d.c / Light Character: Any of the 256 IALA character can be selected / Solar charge regulator: Provided in the PLC-12 circuit / Light control: Automatic ON/ OFF by Photo diode / Protection: Against reverse polarity and excessive input voltage / Temperature range : - 20°C to + 60°C.

SOLAR SUPPLY SYSTEM FOR MLB-200-4 LED Light: 1 Set — Solar supply system as detailed below:

4 Nos. - 12V 5-watt solar panel / 1 No. – 12 V 42 AH sealed, maintenance free battery / Autonomy period = 21 days Light Assembly: Lantern, Solar panel and battery are mounted on the GRP box, all assembled and wired as one self-contained unit, ready for fitting on top of buoy structure.

The above specification of Buoy & Light is most suitable for the Inland Waterway system and the viability has already been established with such type of deployment in NW 1 / NW 2 / NW 3.

Keeping in view the 4 NM light and considering the clear visibility range as 1000 m, the interval can be considered as 500 m / 750 m. However, it is proposed to work out the requirement with 500 m interval and in Zigzag position (i.e., 1 Left Mark then 1 Right Mark and 1 Left Mark). Accordingly, it is estimated to provide 70 Nos {29000 / 500 + 6 at Bends + 10 % apprpox) of Buoy and Light unit (with chain attachments etc). A provision of Tug – cum – Buoy laying vessel has been considered if so needed, which will act as a multi-purpose vessel. Hence the provision has been catered as a part of overall cluster 6 requirement for all the waterways.

3.5. Modification Requirement in existing Bridges / Cables / Dams / Barrages / Locks / Weirs / Anicuts / Aqueducts

In the present study stretch, 4 Bridges are there, keeping in view of the vertical clearance available at these eisting bridges, the deployment of the vessel to this strtch to be considered in a way that these vessels are amenable to this waterway, therefore, there are no modification cost considered for the modification of the existing structures.

No cross structures viz., Dams / Barrages & Locks / Weirs / Anicuts / Aqueducts are observed in the present study stretch. Hence, modification doesn't arise.

3.6. Proposed Dams / Barrages / Locks / Weirs to improve depth

In order to improve the fairway, including the depth, there is no requirement of Dams / Barrages & Locks / Weirs in the present study stretch.

3.7. Land Acquisition

No Land Acquisition requirement was observed for Fairway Development in the present study stretch. Land Acquisition requirement for Terminal purpose is being considered, as a part of Terminal development, wherever required.

3.8. Fairway Costing

3.8.1. Capital Cost

The Capital Cost for the fairway has been considered in Chapter 11 along with the proposed development for capital terminal operations.

Abstract of Cost for Shravati Fairway Development

S.No.	Item Description	Amount (in Lakh Rs.)
A	**Fairway**	
1	Dredging	
(i)	General Soil	1031.45
(ii)	Hard Soil	0.00
2	Low Cost River Structures	
(i)	Bandaling	0.00
(ii)	Bottom Paneling	0.00
3	River Training Works	
(i)	Spurs	
(ii)	Bank Protection Works for river	0.00
(iii)	Porcupine	
4	Night Navigation	0.00
(i)	Channel Marking Buoy, Mooring Gear & Lighting Equipments	
5	Land Acquisition	0.00

Abstract of Cost for Shravati Fairway Development

S.No.	Item Description	Amount (in Lakh Rs.)
	Sub-total (A)	**1031.45**
B	**Modification of Structures**	
(i)	Bridges	0.00
(ii)	Cables	0.00
(iii)	Dams	0.00
(iv)	Barrages	0.00
(v)	Locks	0.00
(vi)	Others	0.00
	Sub-total (B)	**0.00**
C	**Communication System**	0.00
(i)	RIS Centre	0.00
(ii)	AIS Base Station	0.00
(iii)	Vessels - Survey vessel & Other Vessel	0.00
(iv)	Buoys	0.00
	Sub-total (C)	**0.00**
D	**Institutional Requirement**	
(i)	Office Development Cost	23.75
	Sub-total (D)	**23.75**
	Sub-total (A)+(B)+(C)+(D)	**1055.20**
E	Enviornmental Management Plan Cost @5% of Prime cost	52.76
F	Project Management & consultancy Charges @3% of Prime cost	31.66
G	Contingencies and Unforseen Items of Works @3% of Prime cost	31.66
	Project total Hard Cost	**1171.27**

3.8.2. O&M Cost

The item wise Operation and Maintenance cost have been considered as per the circulated parameters, as defined, by IWAI, which have been analyzed and considered. Some more assumptions have been considered appropriately, wherever required. The operation & Maintenance expenditure has been considered as at Annexure 11.1 and as per the industrial standards

CHAPTER 4: TRAFFIC STUDY

4.1. General

Market analysis for Sharavati river catchment area covers the analysis for existing and potential waterway traffic of both cargo, passenger and tourism. The analysis also covers the existing trends of flow between origin and destination and the feasibility of diverting the existing transport/shipping modes to the proposed waterways.

Karnataka is strategically located on both Deccan Plateau and Coastal Plains and Islands. The state has mountains, plateaus, hills, coastal plains, falls and beaches. There are 7 river systems in Karnataka with their tributaries, namely Godavari River System, Krishna River System, Cauvery River System, North Pennar River System, South Pennar River System, West Flowing River System and Palar River System. West Flowing Rivers consists of Sharavati, Mandavi, Kalinadi, Gangavalli, Aghanashini, Chakra Nadi, Varahi, Netravathi & Barapole River. The west flowing rivers in the Western Ghats region generally originate at an elevation ranging from 400 meters to 1,600 meters above the sea level, close to the Western Ghats ridge. These rivers flow westward and meet the Arabian Sea after a short run from 50 km to 300 km. These rivers are very steep in the upper reaches and fairly steep in the middle reaches. It is only near the sea that they have relatively flat bank. The steep nature of river could be a problem in navigation from plains towards origin typically on elevation of 400 metre to 1,600 metre. Vessels could not be moved up on the steep part of the river.

Sharavati's catchment area is spread over 3,592 Sq. km. It originates at Ambuthirtha in Thirthahalli taluka, Shivamogga district and flows north-west through the Western Ghats. It forms the famous Jog Falls before joining the Arabian Sea at Honnavar in Uttara Kannada district. Linganamakki Dam is constructed to this river at Linganamakki in the Sagara taluka. There is a hydel power station with two generating units of 27.5 MW each on Linganamakki dam. Inland Waterways Authority of India (IWAI) intends to develop Sharavati (NW 90) which could help in diversion of a major part of road and rail traffic to the waterways.

This could help in decongestion of roadways and railways and would help in efficient utilisation of the waterways. The study stretch is for a length of approximately 29 km and covers Gerusoppa, Kodani, Mundakani, Karki, Balkur, Anilgod, Edukungi and Honnavar villages on either banks of the River in Honnavar taluka of Uttara Kannada district before merging into the Arabian Sea.

Apart from Sharavati, IWAI intends to develop other major rivers of Karnataka, namely Gurupura, Kabini, Kali & Netravathi. The navigable length of Sharavati River is about 29 km. Based on the deepest bathymetry single line survey carried out during the study and as per the classification of “Inland Waterways” by Ministry of Shipping, Govt. of India notification; it has been classified as “Class IV & Category-B” for 28.67 Km from Chainage (CH) 0 to CH 28.67 km till Gerusoppa.

FIGURE 4.1: Mapping of hinterland for Sharavati River

4.2. Hinterland Analysis

The basin of Sharavati River covers two districts Shivamogga and Uttara Kannada. The entire basin has an area of 2,985 km2 with upstream being 1,989 km2 and the downstream being 997 km².

Uttara Kannada district is situated in the north-western side of the State covering an area of 10,277 sq. km. It is bounded by the Arabian Sea on its west. Shivamogga district is spread over an area of 8,465 sq.km. and is 9th district of Karnataka by area. The upstream river basin of Sharavati is extended to two talukas of Shivamogga, Hosanagar and Sagar. As Shivamogga is far from the navigable length of Sharavati River, so Shivamogga would be considered as Secondary Catchment Area.

.

FIGURE 4.2: Sharavati River

- **Primary Catchment Area**

In Uttara Kannada, there are 11 talukas, namely Karwar, Ankola, Kumta, Honnavar, Bhatkal, Sirsi, Siddapur, Yellapur, Haliyal, Joida & Mundgod. Karwar is the administrative headquarter and a developing city. Three talukas, Honnavar, Kumta and Bhatkal are closer to Sharavati river, so the proposed waterway could be used by only these talukas.

Other talukas, which are far from the river would not consider using waterways on Sharavati. Talukas, which are located on the northern part of Uttara Kannada would prefer waterways on Kali river, which flows from the northern part of the district.

- **Secondary Catchment Area**

Secondary catchment area consists of Hosanagar, Sagar, Shivamogga and Sorab talukas of Shivamogga district. Shivamogga has total 7 talukas, but only four talukas are closer to Sharavati river. In the catchment area of Sharavati river, there exist few small industries; however there exist industrial estates in Shivamogga. The following image shows the primary &secondary catchment area of the river and connectivity around it.

FIGURE 4.3: Primary & Secondary Catchment Area of Sharavati River

4.2.1. Demography Profile of Hinterland

This section would study population of primary and secondary catchment area of Sharavati river. In primary catchment area, only those talukas of Uttara Kannada are considered, which are within 25 km catchment area of Sharavati river.

Primary Catchment Area

As per census 2011, total population of Uttara Kannada is about 14,36,847 (Urban- 4,18,631, Rural- 10,18,216) and Shivamogga's population is about 17,55,512 (Urban- 6,23,226, Rural- 11,32,286).

Detailed population in talukas of Uttara Kannada District, which are located in the catchment area of Sharavati river is given below.

TABLE 4-1: Population living in talukas of Uttara Kannada along Sharavati catchment Area

Talukas	Population
Honnavar	1,66,390
Kumta	1,54,515
Bhatkal	1,61,577
Total	**4,82,482**

Source: Census, 2011

As seen in the above table, the talukas with higher population in Uttara Kannada, which are close to Sharavati river are Honnavar, Kumta & Bhatkal. The table does not include the talukas, which are far from the catchment area of Sharavati river. For example, Karwar taluka has 1,55,143 population, but it is close to Kali river; hence people of this taluka would prefer Kali river instead of Sharavati river. Apart from Karwar, the talukas in Uttara Kannada district, which are far from the catchment area of Sharavati river are Haliyal, Yellapur, Mundgod, Ankola, Siddapur & Supa.

Secondary Catchment Area

Secondary catchment area includes 3 talukas of Shivamogga district, which are located closer to Sharavati river. Detailed population of these talukas is given below

TABLE 4-2: Taluka wise population of Shivamogga District near Sharavati

Taluka	Population
Sagar	2,06,319
Sorab	2,00,809
Hosanagara	1,18,220
Total	**5,25,348**

Source: Census, 2011

As seen in the above table, the taluka with higher population in Shivamogga district, which is near to Sharavati river is Sagar. There are total 7 talukas in Shivamogga district, but for secondary catchment area, only three talukas are considered which are closer to Sharavati river than other talukas. The other 4 talukas of Shivamogga district have not been considered due to long distance from the river.

4.2.2. Economic profile of Primary Catchment Area

4.2.2.1 PRIMARY SECTOR

Primary sector of Uttara Kannada district consists of Agriculture, Forestry, Fishing, Animal husbandry & Mining.

The district has a significant fishing area and contributes more than 30 percent of fish catch in the state. A large population of the district is engaged in the MSME sector comprising of fish related processing foods due to 120 km coastline in the district. Local people are also engaged in the medicinal herbs segment due to more than 75% of forest area in the district. Livestock and poultry segments have also grown along with agriculture occupation.

a. Agriculture

Agriculture and allied industries contribute INR 1,248 CR to the district's GDP i.e. 20% by value. This sector engages more than 50% of the district's population. The area available for cultivation is limited, which gives very little scope for expansion or diversification of agricultural activities. The major land use for agricultural produce is for cereals namely Paddy, Maize and Jowar accounting to 80.42%. The commercial crops like sugarcane and groundnut are grown in 7.93% of the agricultural land. Rest of the land is consumed by other segment crops. Fruits and spices along with some plantation crops are also cultivated in the region. Vanilla grown in Uttara Kannada is exported. Agriculture is one of the priority sectors of the catchment area of Sharavati river.

About 5.6 lakh MT of food grains, comprising of Paddy, Pulses, Oil seeds and commercial crop of Sugarcane is produced in Uttara Kannada district. Only 13,500 MT (Paddy & Groundnut) of this is produced in Honnavar taluka and is unlikely to move through Sharavati River. The below table shows the major crop produced in the catchment area of Sharavati River. This table is included in the commodity section, as food grain is a potential commodity.

- **Horticulture**

Uttara Kannada district consists of five forest divisions namely Haliyal, Yellapur, Karwar, Sirsi and Honnavar. Only Honnavar forest division falls on the primary catchment area. About 1.9 lakh Tonne of Horticulture products are produced in Uttara Kannada District and a small part of it can move through Sharavati River.

TABLE 4-3: Major Horticulture produced in Uttara Kannada near Sharavati River

	Production (MT)		
Plantation	**Honnavar**	**Bhatkal**	**Kumta**
Coconut (lakh nuts)	40,212	15,408	28,548
Arecanut	5,047	1,144	2,383
Cashew	1,766	1,101	1,938
Banana	577	131	595
Mango	118	62	190
Others	66	0	46
Total	**47,786**	**17,846**	**33,700**

Source: Uttar Kannada District at a Glance 2014-15

The chief plantation and horticultural crops grown are mango, cashew nut, banana and coconut. Areca nut, coconut and cashew nut are the main cash crops of Uttara Kannada. Dry chillies, dry ginger, black pepper, cardamom and turmeric are the other condiments and spices crops. Vanilla grown in Uttara Kannada district is exported.

Uttara Kannada district makes a significant contribution to the state's total agriculture products. In Bhatkal, Honnavar, Kumta talukas, there are cashew processing units, rice & oil mills. Sugarcane is also produced in the talukas near Sharavati catchment area, but they are less in volume. At present, roadways is used to transport the crops produced in the region. The volume of agriculture yield is less; hence it would provide no opportunity for the waterways in Sharavati river.

b. Sericulture

Mulberry is cultivated in an area of 49 Hectares in Honnavar, Bhatkal & Kumta talukas near Sharavati catchment area. Since, statistics is not available for the production of silk, so based on the data of cocoon production, it could be analyzed that around 4-5 tonne silk is produced in this area, worth INR 17 Lakhs. As production of cocoon and silk is very less in volume, so it would not provide any opportunity for the waterway. Also, silk is a high value commodity, so it would not be transported through waterways.

TABLE 4-4: Sericulture produced near Sharavati Catchment Area (2011-12)

Taluka	Mulberry Area (Hectare)	Cocoon Production (Tonne)	Silk Production (Rs in Lakhs)
Honnavar	16.3	1.5	2.4
Bhatkal	4.5	0.3	0.5
Kumta	28.2	5	14.8
Total	**49**	**6.8**	**17.7**

Source: Perspective Industrial Development Plan 2013-17

c. Animal husbandry

In Uttara Kannada, animal husbandry is an important activity in the economy of the district. Despite the abundance of green vegetation in the district, the livestock wealth of the district does not grow proportionally.

Animal husbandry plays an important role to provide supporting activity required for farming. In Honnavar, milk and meat production is significant in the catchment area of Sharavati. The poultry has become one of the major occupations in the district; hence there is good scope for poultry related activities in Sharavati catchment talukas.

TABLE 4-5: Animal Products near Sharavati catchment Area (2011-12)

Taluka	Production (Thousand Tonnes)			
	Milk	Meat	Egg	Total production of each taluka
Honnavar	11.40	0.56	3.84	15.8

Taluka	Production (Thousand Tonnes)			
	Milk	**Meat**	**Egg**	**Total production of each taluka**
Bhatkal	6.10	0.09	4.08	10.27
Kumta	8.30	0.23	4.68	13.21
Total	**25.80**	**0.88**	**12.60**	**39.28**

Source: Perspective Industrial Development Plan 2013-17

There is great demand for milk & milk products in Uttara Kannada district. With proper planning, training and market support, this industry could be developed. River transportation would take multiple handling and longer time. Hence, perishable items, including animal products could not be transported on waterways.

d. Forestry

30,71,833 hectares i.e., 16.1% of the total geographical area of Karnataka is covered by forests. The districts with largest forest area are Uttara Kannada and Shivamogga.

Uttara Kannada district has a large proportion (around 80%) of its geographical area as forests. It is one of the few districts of Karnataka, which is densely forested. The types of forests found here consists of evergreen, semi-evergreen, moist deciduous, scrub and thorny and unwooded forests. Teak, Sissum (Rosewood), Nandi, Kindal, Jamba, Matti, Toon, Burga are the famous species of trees. Medicinal plants are also available in the vast thick forest. The following table shows the forest resources available in Uttara Kannada district.

TABLE 4-6: Annual Extraction of Forest Resources in Uttara Kannada

Products	Annual Average Extraction	Potential	Reasoning
Cashew	2,500 tonne	χ	Seasonal product, less volume
Cocum	200 tonne	χ	Less volume
Shikakai	120 tonne	χ	Less volume
Soap Nut	100 tonne	χ	Less volume
Honey	50 tonne	χ	Less volume
Cane	2,00,000 Nos.	χ	Less volume
Bamboo	5,00,000 Nos.	χ	Less volume

Source: Perspective Industrial Development Plan 2013-17

As shown on the above table, the volume of forest products is low. Cashew nut is a seasonal produce, and the yield is not enough to move through waterways. Other forest products are also less in volume and consumed by local small industries. Hence, it produces no scope for the proposed waterway. At present, the major mode of communication and transport of forest produce to places within and outside the districts are roads. Almost all the forest areas of Uttara Kannada district are connected by Bangalore- Honnavar National Highway and Hospet- Mangalore National Highway, by linking with other districts and forest roads. These roads could be competitor for the proposed waterways.

e. Fisheries

Uttara Kannada district has a coastal line of 144 km. with rich marine resources. The district has about 23,000 sq km. fishing area and contributes more than 30% of the total share of fish catch in the state. There exists huge potential in fishing sector. There are 16 fish landing centres, 4 fishing harbours and 13 estuaries on an area of 4,188.5 hectares in the district.

Source: Site Visit

FIGURE 4.4: Fishing Harbour at Honnavar

About 1.0 lakh tonnes of fish are caught in Uttara Kannada District; out of that 38,000 MT fish catch is obtained in Sharavati catchment area. Shivamogga district's fish catch is about 20,568 T. This is a small amount to move through River.

TABLE 4-7: Fisheries in Sharavati Catchment Area (2014-15)

Taluka	Fish Catch (T)	Ice Plants No/ Capacity (MT)	Cold Storage No/ Capacity (MT)
Honnavar	16,224	8/145	0/0
Bhatkal	21,800	12/ 255	2/80
Kumta	9,424	3/35	0/0
Total Uttar Kannada	96,516	38/645	6/373

Source: Uttara Kannada District at a Glance 2014-15

Fishing and fisheries related industries also provide job opportunities to local people in this region. The number of active fishermen in the district is 54,075. There are about 45 fishermen co- operative societies and 28 fish markets in Uttara Kannada district. Apart from Ice plants and cold storage, there are 5 freezing plants in the district. The fish are marketed both inside and outside district. About 10 percent are utilized for manure purposes, for coconut and other crops.

The government has started a number of schemes for the development of fishing industry in the district. Canned fish, fish meal and oil extractions, and quality exporting are the newer avenues of development in fishery sector of the district. Adequate training in fish processing, and modernizing the fish transport system are essential for further growth.

f. Mining & quarrying

Uttara Kannada district is rich in mineral wealth. Iron and Manganese are the major minerals, while Limestone, Bauxite, Quartz, Silica, Lime shells and Sand are the other important minerals. The Iron ore occurs mainly in the western half of the district, like in the talukas of Honnavar.

Details of available minerals & ores reserves in Uttara Kannada district has been referred in the commodity section.

Economic Profile of Secondary Catchment Area

Shivamogga: Agriculture, Animal Husbandry, Fishing and Forestry contribute to the primary sector of the district’s economy. The agricultural and allied industries contribute INR 1,682 i.e. 14% to the district’s GDP.

a. Agriculture

Agriculture is one of the priority sectors of Shivamogga’s economy. In the state, the yield of cereals and minor millets is highest in Davangere (3,650 kg per hect) followed by Shivamogga (3,467 kg per hectare) and lowest in Gulbarga (964 kg per hectare).

The yield rate of food grains of Karnataka State was 1,762 kg per hectares with Shivamogga in the second highest producer with 3,420 kg per hectares during FY 10-11. Haliyal, Mundgod & Sirsi are large producers of paddy. These talukas could be considered as the secondary catchment area. The other important crops grown in Uttara Kannada are sugarcane and groundnut. The other minor crops are Ragi, Jowar and pulses. The volume of agricultural products needs to be high to consider it as a potential cargo for waterways.

TABLE 4-8: Principal Crops productions of Shivamogga (2009-10)

Principal Crops	Area (Ha)	Production (T)	Yield in kg. per Ha	Opportunity	Reasoning
Paddy	1,33,259	4,79,487	3,788	χ	Far from river; less volume
Rice	1,33,259	3,19,806	2,526	χ	Far from river; less volume
Jowar	555	1000	1,897	χ	Far from river; less volume
Maize	69,481	1,99,932	3,029	χ	Far from river; less volume
Ragi	1,628	2,195	1,419	χ	Far from river; less volume
Total	**3,38,182**	**10,02,420**	**12,659**	**-**	**-**

Source: Census India 2011

Shivamogga district is the Granary of paddy in Karnataka. Paddy is the most grown cereal crop in this district. Ragi, Maize and Jowar are the other principal cereal crops of the district. Shivamogga is the major producer of Areca nut in the State. Sugarcane, cotton, tobacco are the other cash crops. The other oil seeds crops grown in Shivamogga are groundnut, sesame and sunflower. Agricultural resources can be properly used for conversion into value added products.

The volume of crops grown in Shivamogga is not much to be transported through waterways. At present, Roadways is used to transport the agriculture produce. Due to the long distance from the river and less yield, agriculture sector of secondary catchment area provides no opportunity for waterways.

- **Horticulture**

Major forests in Uttara Kannada district are concentrated in Supa, Yellapur, Sirsi and Ankola talukas. These four talukas account for 57 percent of total forest area. Shivamogga district has 81,000 Hectares of land and it produces different horticulture products. The following table shows the major Horticulture produced in Shivamogga district.

TABLE 4-9: Major Horticulture annual production in Shivamogga District

Horticulture Products	Area (Ha)	Production (T)	Opportunity	Reasoning
Food Produce & spices	38,654	73,036	✗	Far from river; less volume
Fruits	24,279	4,39,187	✗	Far from river; less volume
Vegetables	9,140	1,00,920	✗	Far from river; less volume
Commercial Crops	9,002	3,140	✗	Far from river; less volume
Total	**81,075**	**6,16,283**	**-**	**-**

Source: Zila Panchayat Shivamogga

b. Sericulture

In the secondary catchment area, sericulture is mainly implemented in Sirsi, Siddapur, Yellapur & Mundgod. Among these talukas, Siddapur produces the most, i.e. 5.6 tonnes cocoon. These talukas are far from the catchment area, so they could not be considered as a potential market for Sharavati waterways. Moreover, silk is a high value commodity and it needs proper handling and packaging for transportation.

c. Animal husbandry

The four talukas of Uttara Kannada constituting Malnad region, Siddapur, Sirsi, Haliyal, Mundgod and Yellapur are considered as potential area for dairy development; however, as these talukas are far from the catchment area, so the potential for transporting dairy products through waterways is not viable. In Shivamogga, there is scope for increasing the strength of cattle as there is demand for milk.

d. Forestry

The Teak of Dandeli area of Uttara Kanadda district is famous as the finest in the world. As Dandeli is closer to Kali river, so the forest products from this region would not use Sharavati river.

Forests of Shivamogga district cover more than 30 per cent of the total area and yield valuable products. The district comprises of three forest divisions-Shimoga, Bhadravathi and Sagar. About 80 per cent of these forests belong to the moist deciduous category. Evergreen forest and dry deciduous forest accounts for about 9 per cent and 7 per cent respectively.

The timber yields from evergreen forest are used for the manufacture of electric poles and railway sleepers. The deciduous forest supply timber, firewood, charcoal, bamboo, soft wood and sandal wood all of which are of great economic value. Variety of Areca nut is an important cash crop of Shivamogga. The district is also noted for coconut gardens. The kan forests of Central Western Ghats of Karnataka, specially Shivamogga district are most often climax evergreen forests.

Large chunks of kan lands were allotted to the Mysore Paper Mills for raising of pulpwood plantations, especially in Shivamogga district. The Bangalore-Honnavar National Highway passes through Shivamogga. The Hospet-Mangalore National Highway passes through Thirthahalli and Agumbe towns. Timber and other forest products of the secondary catchment area could be transported by using roadways to the nearest landing point of Sharavati river. From there they could be moved ahead using bargese

e. Fisheries

The fish catch of talukas in secondary catchment area are Ankola (23,140 tonnes), Siddapur (56 tonnes) and Sirsi (93 tonnes). Ankola has 6 ice plants and 2 cold storages.

Shivamogga has potential for inland fishing. By using cold storage facilities and proper packaging, the fish catches and fish products of this district could be transported by roadways and then through waterways. However, volume of fish catch needs to be high to transport it through waterways. At present, the volume is not much, so it presents no opportunity for waterways.

f. Mining & quarrying

Ankola and Yellapur talukas of Uttara Kannada are located in the secondary catchment area. Iron Ore occurs in these talukas. The extensive reserves are located in Bisgod, Kalche and Kadlagadde areas of Yellapur taluka and Kuntagani area of Ankola taluka.

The major minerals found in Shivamogga district are Iron ore, Manganese ore, Chromites, Quartz and Clay.Other minerals namely Quartz, Dolerite, Lime Shell and Lime Kankan are available in a minor quantity. These minerals are in less quantity; hence they provide less opportunity for Sharavati waterways

4.2.2.2 SECONDARY SECTOR

Secondary Sector of the economy consists of Manufacturing, Construction, Electricity, Gas & Water Supply of Honnavar, Kumta & Bhatkal talukas of Uttara Kannada. There are few manufacturing industries in the catchment area of Sharavati. These industries are also small and provide less opportunity to waterways.

Jewelry making industry has prominence in the region. Uttara Kannada is famous for gold & silver artisans. As jewelry is a high value commodity, it would not be considered as a potential cargo for the waterways as shown in the Industries section covering the primary catchment area of Sharavati River.

4.2.2.3 TERTIARY SECTOR

Primary Catchment Area

The tertiary sector consists of Tourism, Infrastructure, Hotels, Real estate, Service sector, Transport, Education, Storage, Communication, Banking & insurance, Business Services, Public administration & other services etc. Tertiary sector has grown steadily over the years in Uttara Kannada. The service sector comprising of tourism is the major contributor to the district's GDP i.e. INR 3,555 Cr., which is more than 50% of Uttar Kannada's GDP. There exist diverse tourist places such as temples, beaches, waterfalls, forts and peaks. The coastline of the district is spread over 5 talukas and more than 75% of the district's area being covered by the thick forests of Western Ghats.

Tertiary sector consists of mostly service-based industry, so it would not provide much opportunity for cargo traffic through waterways in Sharavati river. However, tourism sector could be a potential market for waterways. Growing Tourism sector in the district would boost passenger traffic on the waterways as shown in Passenger Traffic section describing the famous tourist places in the catchment area of Sharavati river, which would provide opportunity for Passenger traffic.

Secondary Catchment Area

In Shivamogga district, the service sector contributes a massive INR 3,875 Cr., more than half of the district's GDP. Tourism sector plays an important role in local economic development and contributes a significant share of the State's economy also identified as alternative economic growth source for the State and it acts, as a transit point for domestic and foreign tourists as described in Passenger Traffic section showing the tourist places in the secondary catchment area. At present, tourists use Railway and roadway, which could be diverted to waterways for recreational and entertainment purpose.

4.2.2.4 INFRASTRUCTURE ANALYSIS

Infrastructure is a crucial aspect in the development of a region. It is essential to understand various types of infrastructure around river and new development that would become support-connecting waterway with other modes of transportation.

4.2.2.5 CONNECTIVITY ANALYSIS

Existing and upcoming facilities of Railway, roadway and airports around the waterway help to analyze various ways through which cargo and passengers could be evacuated. It also helps to determine best multimodal route for transporting cargo and passengers. Following table depicts connectivity around Sharavati river.

Apart from local and state highways, NH 66, NH 206 and NH 4A are the major national highway passing through this river. At present Mangalore & Bangalore Airport are the two nearest airports from Uttara Kannada & Shivamogga.

Sharavati river basin & the industries in its vicinity are also connected to Indian Railway network by Konkan Railway. The strong local & regional connectivity of Rail & Road network poses a threat for the development of inland water transport, unless otherwise effectively utilized for IWT mobility.

TABLE 4-10: Connectivity from Uttara Kannada & Shivamogga Districts

District	National Highways	Nearest Airport	Sea Port/ Distance (KM)	Railway
Uttar Kannada	NH 66, connecting Goa Border to Bhatkal Border	Goa (International)	Goa / 100	Konkan Railway, Railway route length of 176 KM passes through the district
	NH 4A, connecting Karnataka border to Panaji, Goa	Hubbali (Domestic)	Karwar/ 153	Nearest Railway Station- Honnavar
	NH 206 (NH 69), connecting Tumkur, KA to Honnavar	Belagavi (Domestic)	Mangalore/ 275	
		Mangaluru (International)		
		Bengaluru (International)		
Shivamogga	NH 206 (NH 69), connecting Tumkur & Honnavar	Kempegowda (International)	Mangalore/ 206	Train from Shivamogga to Bangalore & Mysuru.
		Shivamogga Airport (Under construction)	Karwar/ 253	

a) **Road**

NH 66 passes through Uttara Kannada district and connects Panvel near Mumbai to Kerala state. Ministry of Road Transport & Highways has proposed a Greenfield access-controlled Expressway Corridor connecting port cities of Mangalore-Karwar-Panaji as part of Indian National Expressway Network. This expressway will be parallel to NH-66 and will be located majorly in Coastal Karnataka.

Shivamogga district has 2,420 km. length of surfaced roads. All the towns and cities of the Shivamogga district, other districts of Karnataka and the cities of the neighboring states are very well connected with Shivamogga through the widespread road network of state and national highways. Shivamogga is 194 km away from Mangalore and 278 km away from Bangalore.

b) **Rail**

Uttar Kannada has railway stations at Kumta & Karwar, which are well connected with Konkan Railway. Konkan railway connects Mangalore and Mumbai via Karwar. Kumta is about 72 km from Karwar and 58 km north of Bhatkal. These rail stations are well connected with the major Indian cities. Shivamogga has 124 km length of railway line. It is also fairly linked with Mumbai and other major destinations of the country via the Birur Junction. The Intercity Express also connects Mysore and Talaguppa via Sagar.

c) **Air**

Karnataka has two airports, at Bangalore and Mangalore. Bangalore is the only major Airport of the state. There are 11 airstrips at various other district headquarters, which include Belgaum, Hubli, Mysore, Bellary, Kolar, Hassan, Davanagere, Tornagullu, Mangalore, Wadi, Gulbarga. Fresh airstrips have been planned to come up at Bijapur, Raichur, Karwar, Shivamogga and Kodagu.

The Shivamogga Airport is presently under construction and it will be India's first private regional Greenfield Airport developed under the 'Public-Private Partnership'. This Airport will be located at Sogane Village, about 9 km. away from Shivamogga City.

4.2.2.6 EXISTING INFRASTRUCTURE OF PRIMARY CATCHMENT AREA

There exist two non-major ports in the primary catchment area of Sharavati river, namely Honnavar Port and Bhatkal port.

In the secondary catchment, there exists a major port, i.e. New Mangalore Port (NMPT) and a non-major port, Karwar Port. New Mangalore Port is the only major port of Karnataka. NMPT is far from Sharavati river's catchment area, but this port is crucial as most of the EXIM trade is handled at New Mangalore Port in Karnataka. If industries start using Sharavati waterways, they will require to move the cargo to/from New Mangalore Port for further transport for export/import.

This deep-water, all-weather port at Panambur, Mangalore has been functioning as a backbone for the economic development of this region and caters the needs of the shippers.

Karwar Port is a prominent port of Uttara Kannada, but it is far from the catchment area of Sharavati river. Karwar is situated at the northern extremity of Karnataka coast 64 km south of Mormugao Port on the Southern side of the Kali River and caters to the requirement of 2.00 lakh square Km of hinterland.

This is an all-weather port in the Karwar bay and is declared for handling all types of commodities including class "B" and Class "C" petroleum products.

a) Honnavar Port

This Port is in the vicinity of the confluence of the River with Arabian Sea. It is located on the right bank of Sharavati river and is a fair weather lighterage port. Honnavar port has been included in the "Sagarmala Project". This port could not be developed yet and the major hindrance is the sand bar at the entrance of the river. This port is a fishing port and has a good highway connection to the hinterland as well as the Konkan Railway connection.

The nearest railway station to Honnavar port is Honnavar Railway station in Karki, which is 6km away. Konkan Railway line and NH 66 passing very close to the port. NH 66 is going to be expanded to four lane highway.

A new bridge at Honnavar is under construction, which is a part of NH 66. The state government has ambitious plan for the development of Honnavar port, which would further provide opportuniuty for the proposed waterway in future.

Existing facilities at Honnavar Port:

- ✓ First stage lighterage wharf of 400 feet long with a stacking area of 69,000 Sq.ft.
- ✓ Second stage lighterage wharf 564 feet long with about 3,00,000 Sq.ft of stacking area.
- ✓ Transit shed facility for the storage of cargo.
- ✓ Cold storage facility in fishing harbour.

b) Bhatkal Port

This port is a well- protected port and it is near Sharavati river’s catchment area. At present, fishing vessels are using the facilities of this port. This port could be developed as a modern fishing harbour with full-fledged fish handling facilities.

Existing facilities at Bhatkal Port:

- ✓ Lighterage wharf of 186 metre length with a stacking area of 15,888 sq. metres
- ✓ Transit shed facility
- ✓ Import/ Export cargo shed facility.

c) Existing Landing Points on Sharavati River

There exist three jetties along Sharavati River, which includes fishing and passenger jetties. Following image shows some of the existing landing points, which are currently used by country boats and motorboats for passengers and tourists.

FIGURE 4.5: Landing Point at Sharavati River

At Upponi village, there is potential to develop a passenger terminal. Upponi is 24 km away from Honnavar. NH 69 Bangalore- Honnavar Road crosses near to this point; hence it would be convenient for passengers to reach the terminal or travel ahead by using roadways. This Highway connects to Tumkur region. Honnavar Railway station is the nearest railway station which is 30km away.

Upponi and Gerusoppa Villages comes on one side of the river. Upponi has Plain land for development of Passenger terminal. A motor-boat agency is in the process of acquiring land just below the Suspension Bridge at Upponi, for constructing motor-boat facilities for tourists. At present, Passenger ferries operate here to carry passengers on the other side of the river that is Samshi village. Passenger ferry charge INR 10 per passenger and INR 20- 30 per vehicle.

On the other side of the bank, there exists Samshi Dock, which is used by the boats operating on Samshi Ferry Boat line. Samshi Road crosses from Samshi Dock. This dock is 35 km away from Honnavar. Samshi is a hilly forest area.

There exists another dock, Mavinhole Dock, which is 1.7 km away from Samshi. Like Samshi, Idagunji also is located on the other side of the river. These villages have access to NH 66, but there are hilly forest areas which lie between National highway and Sharavati River. Idagunji is a tourist place. It is hilly forest area and there is scarcity of Plain lands here for any infrastructure development.

Ferries ply between Idagunji- Jalwali for passengers. These passengers cross the river to go to the villages located on either side of the river.

At Gerusoppa also, there is a small landing point, which is used by country boats. The surrounding region has tourism potential; hence this point could be developed as a passenger terminal to cater passenger boats.

FIGURE 4.6: Landing Point at Gerusoppa, Sharavati River

d) Bridges

FIGURE 4.7: Edapally-Panvel Highway Bridge on Sharavati River at Honnavar

Edapally- Panvel Highway Bridge- This bridge is built over Sharavati river at Honnavar.

FIGURE 4.8: Edapally-Panvel Highway Bridge on Sharavati River

Haigund Island Bridge- This bridge is under construction, which connects famous tourist place Haigund Island with Heragaddi village in Honnavar taluka. Once this bridge becomes operational, Haigund Island would be easily accessible by locals and tourists.

FIGURE 4.9: Haigund Island Bridge

The following image shows a suspension bridge, which connects Upponi village to Kudrigi village in Honnavar taluka. This bridge does not have breadth to accommodate four wheelers; however, it could be used for two wheelers and pedestrians.

FIGURE 4.10: Suspension Bridge in Upponi, Honnavar

4.2.2.7 UPCOMING INFRASTRUCTURE

For the growth of industrial, fisheries and tourism sectors of the state, it is crucial to develop new infrastructure in the coming years. Tadadi and Bhatkal ports in Uttara Kannada district have the potential for development of fishing harbours with all modern facilities. Keeping the tourism potential in mind, Honnavar & Karwar port could be developed for the better utilization of the coastal part of the district. Government of Karnataka has proposed to develop the ports of Karnataka. In future, after the development of Honnavar port, it would be a preferable port for the industries and passengers from the catchment area of Sharavati river.

4.2.3. Existing & Proposed Industries

Existing Industries

In the primary catchment area, there exist no major industry. Hence, primary sector industries provide no opportunity for Sharavati river. Industries located far away from the river are also considered for secondary catchment area, to show the possibility of potential cargo movement through the river. If IWAI widens its scope of hinterland than this river could be commercially viable.

Industries of Primary Catchment Area

Uttara Kannada's contribution in terms of registered manufacturing is negligible. There do not exist many major manufacturing industries. The talukas that fall in the catchment area have scarcity of open lands. There exist mountainous, hilly and forest areas, which is a major obstacle in establishing industries in this region. The following map shows the existing industries on the primary and secondary catchment area of Sharavati River.

FIGURE 4.11: Industries Located on the Primary & Secondary Catchment Area

Uttara Kannada is rich in natural mineral water and forest resources. Hence, there exist many micro & small enterprises and artisan units in this district. The following table presents a list of micro and small industries and artisan units in Uttara Kannada district.

TABLE 4-11: Micro & Small Enterprises and Artisan Units in Uttara Kannada District

Industry	Uttara Kannada No. of Units
Wood/wooden based furniture	1,235
Agro based	1,102
Engineering units	565
Metal based (Steel Fab.)	578
Chemical/Chemical based	303
Ready-made garments & embroidery	455
Paper & Paper products	208
Leather based	120
Rubber, Plastic & petro based	106
Others	3,698
Total	8,370

Source: Ministry of MSME, Government of India

As per District Statistics, there exist 1,480 small-scale industrial units in Honnavar and 1,134 units in Bhatkal. The products of these units could be potential market if there would be good facility to handle containerized cargo through waterways.

Following table shows industries located in the catchment area of Sharavati river. The table also shows the location of these industries and connectivity around it.

TABLE 4-12: Industries in Uttara Kannada District near Sharavati River

Industry	Taluka	Annual Capacity (Tonnes)	Distance (KM) from Sharavati	Sharavati to NMPT	Distance (Road) to NMPT	Distance (Rail) to NMPT	Potential	Reasoning
M. N. Chemicals	Kumta	200	23	175	198	281	✗	Less volume
Canara Cement Pipes	Kumta	N.A.	23	175	198	281	✗	Small Unit
Sharika Plastic Industry	Kumta	N.A.	25	175	200	281	✗	Small Unit
Nawaz Plastic Industries	Kumta	N.A.	25	175	200	281	✗	Small Unit
Vatsalya Plastic Industries	Kumta	N.A.	23	175	198	281	✗	Small Unit

Source: Consultant’s Analysis

The table above does not include the industries located in northern Uttara Kannada or which are far from Sharavati river. In the catchment area of Sharavati river, there are few industries. Kumta and Bhatkal each has one industrial estate. The opportunity from industries is less as there are only few small industries near Sharavati river. There are no large and medium scale industries in Honnavar taluka as it is an eco sensitive zone, there is no possibility of moving the unloaded/loaded cargo from/to the port from this River. The small-scale industries are the major employment providers in the district. It can be seen that it is the wood/ wooden based furniture industries and agro based industries dominate the region of Uttara Kannada. In Honnavar taluka, there exist companies, which are involved in edible oil production. There is palm oil, ground nut oil, coconut oil plants. There is a good potential for obtaining growth in this industry. These commodities could not be considered as potential cargo for the proposed waterways in Sharavati River because at present, the volume of cargo is not high which could not be moved through waterways. Transporting oil through barges on waterways require to be packed or containerized properly before moving through waterways.

Karwar Port is near, which is a minor port and for the industries located in the Southern part of the district, Honnavar Port is closer. As both Karwar & Honnavar are minor ports, so for EXIM trade of these industries New Mangalore Port is considered. The table above shows the distance from the industries to New Mangalore Port and the distance from Sharavati river to New Mangalore Port.

Government of Karnataka has proposed to develop Karwar and Honnavar ports, so there exists potential for these ports to handle EXIM trade of local industries in future. Honnavar Port is located at the mouth of Sharavati river, and when it is upgraded to handle cargo, local industries would prefer Honnavar port than New Mangalore Port.

Industries of Secondary Catchment Area

Industries in Uttara Kannada contribute INR 1,267 Cr. i.e. 27% to its GDP. There are 8 industrial estates and 1 industrial park in the district to support the district's INR 660 CR aggregated investments in the large, medium and small-scale enterprises. However, these industrial areas are far from the catchment area of Sharavati river.

Large industries in Uttara Kannada are very few, like Sugar and Paper Mill in Haliyal Taluka and a Chemical Plant at Binaga. As they are close to Karwar Port, so they would not use Sharavati river. Most of the industries in Uttara Kannada like West Coast Paper Mills, Parrys Sugar, Solaris Chemtech Industries, Bahtey Chemicals & Minerals are far from Sharavati river. As they are closer to Kali river, so these industries would prefer to use Kali river instead of Sharavati.

Industries located in Shivamogga district are far from Sharavati river, but they could be secondary potential market for Sharavati. As these industries are dependent on roads and there is no other river nearby, they may consider using waterways of Sharavati river to remove the congestion on roads. These industries could use waterways to reach New Mangalore Port or other ports from where they handle their EXIM trade.

The industries of Shivamogga contribute INR 2,028 Cr. i.e. 27% of the district's GDP. The Government of Karnataka has created the following industrial regions to encourage industrialization of Shivamogga district:

- Nidige Industrial Area, Nidige, Bhadravathi Taluk
- Mandli-Kallur Industrial Area, Shivamogga
- Shimoga Industrial Estate, Shivamogga
- Kallahalli Industrial Estate, Shivamogga

There exist manufacturing companies in the Industrial Estates of Shivamogga, but they are far from the catchment of the river. As Solapur- Mangalore Highway (NH 169) passes near these Industrial Estates, it is unlikely that these industries would use the waterways, which is very far. Hence, these Industrial Estates would not provide any opportunity for the proposed waterways in Sharavati river

TABLE 4-13: Industries in Shivamogga District

Industry	Location	Distance (KM)				
		Annual Capacity (Tonnes)	**To Sharavati**	**Sharavati to NMPT**	**Distance (Road) to NMPT**	**Distance (Rail) to NMPT**
Shahi Exports (Garment unit)	Sagar	66 Lakh pieces	62	156	205	497
SNS Industries	Shivamogga	-	134		196	415
Shanthala Spherocast		-	147		208	
Pearlite Liners		12,000	133		194	
Karnataka Soaps & Detergents		-	132		195	
Paper Packaging		-	132		195	
Balaji Oil Palm Ltd		86,400	151		201	
Sudha Traders		-	133		196	
Century Auto Components		-	134		203	
Prathana Engineering		-	146		206	
Sharada Oil Industries		-	136		197	
Himalay Gas supplies		-	133		195	
Rajtec Machinery		-	134		199	
Thermit Alloy Pvt. Ltd		-	135		199	
Perfect Alloy Component		3,000	135		199	
Zuari Cements Ltd		-	134		197	
Sree SGK Industries		-	130		197	
Volmac Components		-	130		197	
Auto Clutches		-	130		198	

Source: Consultant's Analysis

Agro-based, automobile-based and engineering are the major industries of the district. Maximum investment has been made in the Food and Beverages sector followed by Engineering/Mechanical goods sector. To encourage rural industry, rural residents are being trained in tailoring, embroidery, motor winding, hand pump repair and other areas. Other rural industries in Shivamogga are related to carpentry, blacksmith, leather, pottery, beekeeping, stone cutting, handlooms, incense sticks and sandalwood carving. Sagar in Shivamogga is famous for its ivory and sandalwood industries. In Shivamogga, handicraft artisans produce sandalwood and rosewood articles and other precious articles, which have great demand in domestic and international market. There is also a sandalwood oil extraction factory and a sugar factory in Shivamogga City. The following table presents a list of micro and small industries and artisan units located in Shivamogga district.

TABLE 4-14: Micro & Small Enterprises and Artisan Units in Shivamogga District

Industry	**Shivamogga**
	No. of Units
Wood/wooden based furniture	1,650
Agro based	2,505
Engineering units	1,300
Metal based (Steel Fab.)	240
Chemical/Chemical based	190
Ready-made garments & embroidery	1,500
Paper & Paper products	410
Leather based	740
Rubber, Plastic & petro based	281
Others	3,332
Total	12,148

Source: Ministry of MSME, Government of India

Most of the industries located in Shivamogga are small scale and not EXIM based. There exist edible oil production industries, like palm oil, groundnut oil, coconut oil plants. Edible oil industry would likely grow in coming years, which could be an opportunity for waterways. However, oil could not be transported in bulk form.

4.2.4. Traffic from Major & Non Major Ports

This section discusses the opportunities for waterways with respect to Major and Non-major ports located in the region. This section would discuss the strategic location and infrastructural advantages of the ports in brief. There are very few industries located nearby the bank of Sharavati River and they do not have large volume of cargo that they could use waterway for transportation.

The two districts in the catchment area of Sharavati River, Uttara Kannada and Shivamogga have one major port New Mangalore Port in their vicinity. The non-major ports are Karwar Port and Honnavar Port. Mormugao Port of Goa is also not very far from the catchment area. Karwar port and Honnavar port lacks infrastructure facility compared to New Mangalore Port & Mormugao port. The

Government has proposed to develop Karwar and Honnavar ports along with other ports of Karnataka.

a. Non major Port in Primary Catchment Area

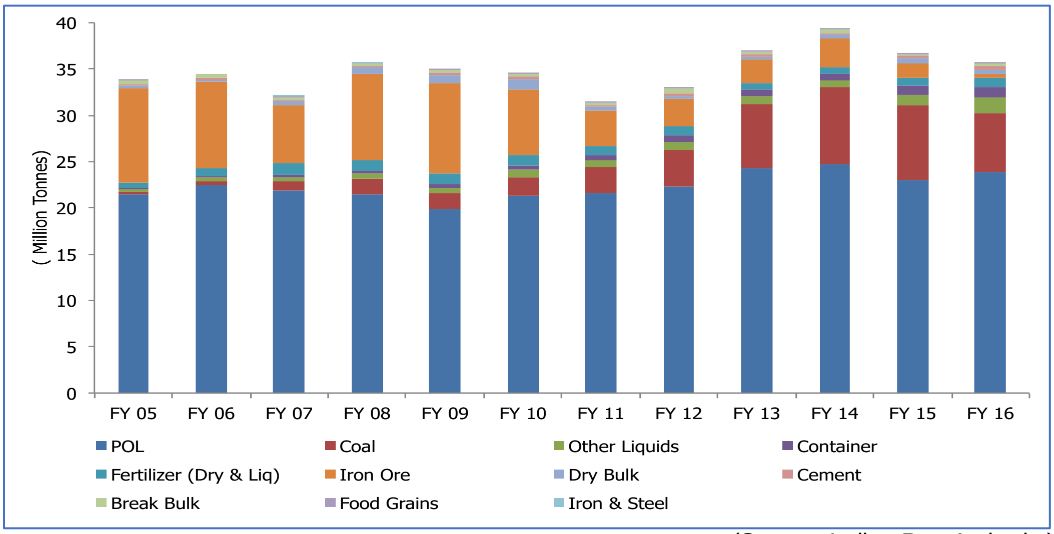
Honnavar Port

In the year 2014-15, 0.65 MMTPA of cargo handled at all nine Non-major Ports in Karnataka, the cargo handled at Honnavar Port was Nil. At present, no cargo is handled at Honnavar Port; hence there is no possibility of moving the unloaded/loaded cargo from/to the port from this River. However, when Honnavar port is developed, it has potential to handle cargo, like Steel, Sugar, Fertilizer, Coal, Iron Ores, Molasses & Edible Oil.

b. Major port in Secondary Catchment Area

New Mangalore Port

The major commodities exported through New Mangalore port are Iron ore Pellets, POL products, Granite, Stones, Coffee and Containerized cargo. The major imports of the port are Crude and POL products, LPG, Coal, Limestone, Timber logs, Wood pulp, Finished fertilizers, Liquid Ammonia, Phosphoric Acid, Other Liquid Chemicals, Edible oil, Cashew and Containerized cargo.



(Source: Indian Port Authority)

FIGURE 4.12: Commodity wise historic Traffic handled at NMPT

TABLE 4-15: Commodity wise Imports of NMPT (mn T)

Commodities	FY 12	FY 13	FY 14	FY 15	FY 16
POL	15.6	16.5	16.8	16.2	18.2
Other Liquids	0.7	0.7	0.6	0.7	0.8

Iron Ore	1.2	1.5	1.7	1	0.1
Fertilizer	1	0.7	0.7	0.9	1
Coal	4	6.9	8.3	8.1	6.3
Cement	0.3	0.3	0.2	0.3	0.4
Dry Bulk	0.3	0.2	0.3	0.4	0.4
Break Bulk	0.4	0.3	0.3	0.1	0.1
Container	0.3	0.3	0.4	0.5	0.6
Total	23.7	27.3	29.3	28.3	28

Source: Indian Port Authority

TABLE 4-16: Commodity wise Exports of NMPT (mn T)

Commodities	FY 12	FY 13	FY 14	FY 15	FY 16
POL	6.6	7.8	7.9	6.8	5.7
Container	0.4	0.4	0.4	0.4	0.5
Iron Ore	1.9	1.1	1.5	0.5	0.4
Food Grains	0.1	0.2	0.1	0	0
Others	0.2	0.2	0.2	0.4	0.9
Total	9.3	9.7	10.1	8.2	7.6

Source: Indian Port Authority

Ratio of Imports to Exports at New Mangalore Port was 3:1 in 2015-16. Total traffic handled at the port has reduced to 35.6 MTPA in 2015-16 from 36.5 MTPA in 2014-15. The major drop was reported in iron-ore traffic and also in crude oil imports.

- **Karwar Port**

Presently Karwar port handles Import & Export of about 24.88 lakhs M.Tons of various commodities and earn a revenue of 11 to 12 crores.

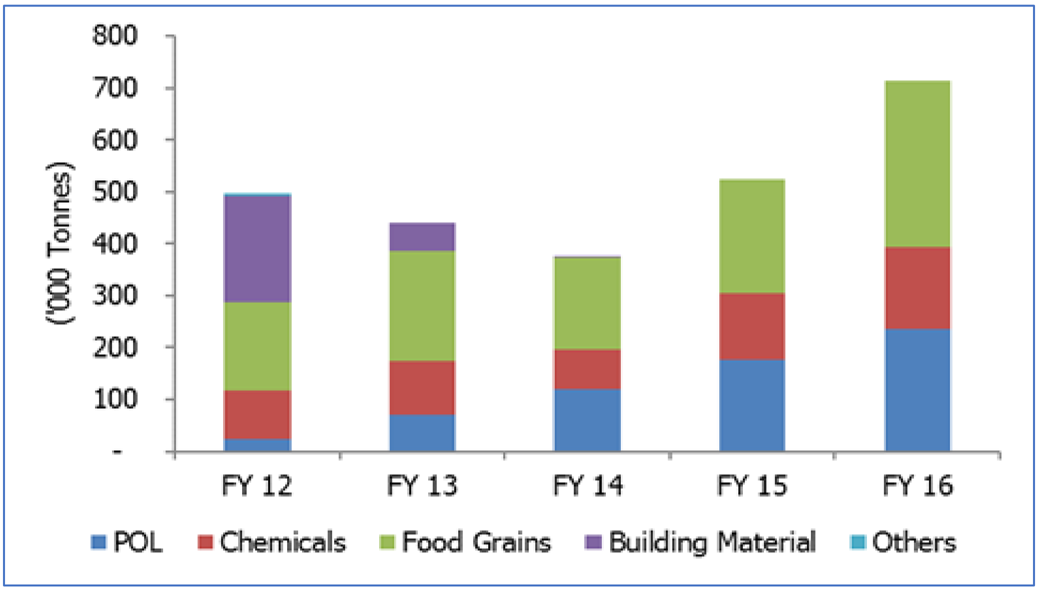


FIGURE 4.13: Cargo handled at Karwar Port

TABLE 4-17: Commodity wise Imports/Export of Karwar Port (mn T)

Import	Commodities	FY 12	FY 13	FY 14	FY 15	FY 16
	POL	24	66	115	176	235
	Chemicals	93	102	75	127	158
	Food Grains	26	42	64	33	53
	Building Material	3	0	0	0	0
Total Import		146	210	261	336	446
Export	POL	0	5	0	0	0
	Food Grains	144	171	113	189	2268
	Building Material	202	54	4	0	0
	Others	6	0	0	0	0
Total Export		352	230	117	189	2268

Source: Karwar Port Office

The state Government has decided to start container handling facility at Karwar Port. However, Karwar Port could not be considered for any trade via Sharavati river due to its long distance from the river.

4.3. Commodity Composition

As bulk commodities in the catchment area of Sharavati river is less in volume, so transportation through waterways would not be viable for movement of bulk commodities like minerals.

4.3.1. Minerals of Primary Catchment Area

There exist mineral reserves in Uttara Kannada district. The table below shows the availability of ores taluka wise in Uttara Kannada district, which exist in the catchment area of river.

TABLE 4-18: Ores Availability in Uttara Kannada

Mineral	Reserves	Talukas	Opportunity	Reasoning
Iron Ore	20 MMT	Honnavar, Ankola, Kumta, Bhatkal	X	Less volume, Ankola is far from river
Manganese	15 MMT	Supa, Yellapur, Sirsi, Kumta, Ankola	X	Less volume, Far from river
Bauxite	-	Bhatkal	X	Less volume
Clay	-	Supa, Bhatkal, Honnavar, Yellapur	X	Less volume, Supa, Yellapur are far from river
Lime Stone	-	Supa, Yellapur, Kumta	X	Less volume, Supa, Yellapur are far from river
Beach Sand	-	Bhatkal, Honnavar	X	Less volume, consumed locally
Building Stone	1,28,083 MT	Supa, Haliyal, Yellapur, Mundgod, Ankola, Honnavar, Bhatkal	May be	Building stones are cut in brick size for building purpose and could be transported by waterways

Source: Perspective Industrial Development Plan: Uttara Kannada 2013-17

Minerals found in Uttar Kannada District are Iron Ore, Manganese Ore, Asbestos, Silica sand, Kaolin, Lime stone, Pyrites, Quartz, Building stones etc. covered in an area of about 5,360 sq km Table 4 18.

Following mineral extraction points are near Sharavati catchment area.

- **Iron Ores:** A reserve of 95.26 million tonnes of float and reef ore iron deposits are located in Sarkanda (Honnavar Taluka), Bisgod area (Yellapur taluka), Kalche (Yellapur taluka), Kumta taluka, Kodalgadde (Yellapur taluka) Kuntgani area (Ankola taluka) and Bhatkal.
- **Manganese:** In Kumta taluka, Manganese reserves are located.
- **Bauxite:** Aluminous laterite is found about 4 miles south of Honnavar adjoining the Honnavar Bhatkal Road. Bauxite reserves are located in 2 sq. miles at Mundalli and Taglod villages near Bhatkal.
- **Clay:** Deposits of China Clay (Kaolin) is available at Hadinbal village of Honnavar taluka and Venkatpur & Bhatkal of Bhatkal taluka.
- **Beach Sand (Glass Sand):** Beach sand is available at one mile west of Haladipur at Honnavar taluka.
- **Lime Shell:** In Kumta taluka, lime shells are extracted from Tadri.

The volume of minerals available in the catchment area is less; hence it provides no opportunity for waterways.

Sand & Gravel

Sand is available at shore near Bengre and close to the sea at Karikallu in Bhatkal taluka and Haldipur at Honnavar taluka. Fine to medium white silica sand is available in these regions in the Malki land below two feet of surface sandy soil. Silica sand is also available at Balkur and Hosad region of Honnavar taluka.

For the smooth navigation, Sand is extracted from the mouth of Sharavati river at Honnavar. The extracted sand is collected and stocked at the bank of river owned by communities and port land. This sand is categorized as non specified minor mineral or 'ordinary sand'. Local buildings and infrastructure consume the locally extracted sand. There is less/ negligible scope for sand as potential cargo for the proposed waterway. At Honnavar district, sand extractors are illegally building jetties in Sharavati river by dumping red soil. Illegal sand traders are closing the mouth of Sharavati river, just 2 km from where it joins the Arabian Sea. However, the state government is trying to stop illegal sand extraction as it causing sea erosion.

4.3.2. Minerals of Secondary Catchment Area

In Uttara Kannada Manganese ore deposits are located in the dense forests of Dandeli, Virnoli and Kulgi. Manganese reserves also exist in 170 sq. miles in Joida-Petha region, 20 sq. miles in Yellapur region and 12 sq. miles in Sirsi, Kumta & Ankola regions. Except Kumta, all the reserves are far from the catchment area of Sharavati river. Out of total Manganese reserves in Uttara Kannada i.e. 10 million tonnes, only 4-5 million tonnes are of workable grade.

Limestone containing 49.54% with silica is found in Supa, Yellapur and Kumta taluks. The area is expected to yield about 130 million tonnes of ore. Limestone containing high calcium percentage is found in Yellapur taluka. Including the Dandeli Ferro Allies Pvt Ltd., there are few industries based on mineral resources of the district. Mining area in the district is about 14,894 hectares, mostly situated in the forests of Supa, Yellapur and Karwar talukas. These talukas are far from the catchment area of Sharavati, so they could be considered for secondary catchment area.

The table below shows the mineral production in Shivamogga district, which is far from the primary catchment area. These minerals could be considered for secondary catchment area.

TABLE 4-19: Production of Mineral in Shivamogga District 2010-11

Mineral	Production (MT)	Taluka	Opportunity	Reasoning
Building Stone	53,910	Shivamogga	✗	Far from river
Building Stone	25,870	Hosanagara	✗	Less volume, Far from river
Building Stone	10,485	Sagara	✗	Less volume, Far from river
Laterite	3,460	Sagara	✗	Less volume, Far from river
Building Stone	20,360	Soraba	✗	Less volume, Far from river
Total	1,14,085	-	-	-

Source: Ministry of MSME, Government of India

The major minerals found in Shivamogga district are iron ore, manganese ore, chromites, quartz and clay. There exist minerals like Limestone & Building stone in Bhadravati taluka, Manganese & Building stone in Shikaripura, China clay in Thrithahalli, but they are located far from the catchment area of Sharavati river, so they provide no opportunity for waterways. Minerals produced in Shivamogga, Hosanagara, Sagara and Soraba are low in volume, so they also provide no scope for the proposed waterway.

4.3.3. Food Grains

About 5.6 lakh MT of food grains, comprising of Paddy, Pulses, oil seeds and commercial crop of Sugarcane is produced in Uttara Kannada district. However, only 13,500 MT crop (Paddy & ground nut) is produced in Honnavar taluka, which is less volume and is unlikely to move through Sharavati River. Following table shows the annual production of major grain, paddy, ground nut and commercial crop Sugarcane in the three talukas on the catchment area of Sharavati river.

TABLE 4-20: Major Crop Production in Sharavati catchment area (2014-15)

Taluka	Production (tonnes)		(hectors)
	Paddy	Ground Nut	Sugarcane
Honnavar	12,948	477	2,204
Bhatkal	11,906	574	771
Kumta	15,580	838	5,235
Total	40,434	1,889	8,210

Source: Uttara Kannada District at a Glance 2014-15

4.3.4. Fertilizers & Chemicals

As the agricultural potential is very limited in Uttara Kannada district, only a small amount of about 155 T fertilizer is required in Sharavati catchment area Table 4 21. This quantity is a small requirement to move through River.

TABLE 4-21: Allotment of Fertilizers in Sharavati catchment Area

Taluka	Fertilizer (in Tonnes)			
	Nitrozen	**Phosphorous**	**Potash**	**Total**
Honnavar	76	42	35	**153**
Bhatkal	86	36	47	**169**
Kumta	65	55	35	**155**

Source: Uttara Kannada District at a Glance 2014-15

The distribution of chemical fertilizers in total Uttara Kannada district in 2014-15 was 11,543 tonnes, Nitrogen 7,092 tonnes, Phosphorous 2,448 tonnes and Potash 2,002 tonnes.

4.3.5. Fish Catch

The coastal region of Uttara Kannada is well developed and densely populated. There are fishing points where traditional fishermen carry out fishing activity. Karwar, Honnavar are famous fishing harbours and they are largely used by fishermen to transport their fish catch in the neighboring regions. The fish catch from this area are sold in local market also. There are fish meal, fish oil plants in Karwar, Uttara Kannada. Dry fish are also packed in bags and transported. Honnavar is located at the mouth of Sharavati river. Export activities take place in the Fishing harbour of Honnavar. Karnataka Fisheries Development Corporation has branches in Honnavar and Bhatkal. KFDC’s 20 MT ice plant is supplying ice to fishing boats and fisher women in Honnavar and a 10MT ice plant is supplying ice to fishing boats and fisher women in Bhatkal. Fishes are exported to Idgunji, Sirsi, Yellapur, Hubli, Goa, Udupi.Following figure shows fish handling at Fishing Harbour, Honnavar.

FIGURE 4.14: Fish handling at Fishing Harbour, Honnavar

Honnavar has the potential to be used by fishermen who are engaged in inland fisheries in Shivamogga. About 1.0 lakh tonnes of fish are caught in Uttara Kannada District; out of that 38,000 MT fish catch is obtained in Sharavati catchment area. Shivamogga district's fish catch is about 20,568 T. This is a small amount to move through the river; hence fish catch also provides no opportunity for the waterway.

4.4. Originating/Terminating commodities

There is no opportunity for cargo movement in the proposed waterway in Sharavati river as there exist no large industry in the catchment area. There exist few small and medium (MSME) industries with very low production, which would not provide any opportunity for the waterway.

4.5. Passenger Traffic

About 1.66 lakh people reside in Honnavar, which is located on the banks of Sharavati river. This population would grow in coming years. Apart from Honnavar, population of neighboring talukas like Kumta & Bhatkal would form a component of potential future traffic. However, the entire population of the catchment area would not use the waterway in Sharavati river because the surrounding talukas and villages have accessibility of roadways.

TABLE 4-22: Population living in villages along Sharavati catchment Area

Taluka	Area Sq Km	Population
Honnavar	754	1,66,264
Kumta	589	1,54,280
Bhatkal	351	1,61,576
Total	1,694	4,82,120

Source: Uttara Kannada District at a Glance, 2014-15

- ✓ After Honnavar, Sharavati River is surrounded by hills and valleys; hence it is unlikely that passengers would use waterways for transportation.
- ✓ Between Samshi and Upponi villages, there exists a ferry line, which is used by passengers to cross the river. At present, a suspension bridge is developed here to connect these two villages. Since the bridge became operational, less passengers use the ferry service. At present, the ferry service caters around 25-30 passengers everyday.
- ✓ At Idagunji and Gerusoppa also people use ferries to cross the river. During site visit, it was observed that there exist 2 ferries in Gerusoppa, which make frequent trips on the river. Gerusoppa ferry service caters around 100 passengers daily. These passengers from nearby villages could be included in potential passenger traffic.

4.6. Tourism Traffic

Tourism Traffic of Primary Catchment Area

As per the information gathered from Ministry of Tourism, Karnataka accounted for 4.95 percent of the total foreign tourists visiting India during the year 2006 and ranked 8th among all the Indian states. In the case of domestic tourist, the overall contribution is 8.14 percent.

There are several tourist potential spots in the catchment area of Sharavati River and some of them can be connected through water transportation. As per the study on Development of IWT in Karnataka carried out by Directorate of Ports and IWT, a total of 2,500 tourists visited the tourist region of Sharavati River in 2005. Two tourist landing sites have also been proposed along Sharavati River at Haigund & Honnavar.

The tourist places near Sharavati river are listed in table below. Other famous tourist attractions in the region are little far from the river, but they could also be considered as potential market for passenger ferry. Some tourist places are located in Bhatkal and Kumta talukas; these talukas are considered as primary catchment area. However, due to the road distance (more than 25 km) from these tourist places to Sharavati river, these tourist spots are included in the tourism of secondary catchment area.

The following table shows the famous tourist spots in the catchment area of Sharavati river and their distance from the taluka headquarter and Sharavati river.

TABLE 4-23: Existing tourist attractions in Uttara Kannada nearby Sharavati River

Taluka	Tourist Spot	Distance in KM	
		from Taluka Head Quarter (KM)	from Sharavati River (KM)
Honnavar	Sharavati Back Water	2	0
	Haigund Island	15	0
	Apsara Konda	10	4
	Idgunji Temple	11	2
	Kasarkod Beach	4	2
	Chandavar Church	30	1
Shivamogga	Sharavati Wildlife Sanctuary	28	19
Sagar	Jog Falls	28	19
	Linganamakki dam	29	22
Kumta	Dhareshwar Temple & Beach	10	9
	Kagal Temple & Beach	11	23
	Mirjan Fort	12	25

Source: Perspective Industrial Development Plan: Uttara Kannada 2013-17

The districts of Uttar Kannada and Shivamogga have existing as well future opportunities for Nature Tourism, as these two districts are located in Western ghats and boast of dense forests, hills, valleys, waterfalls etc. Uttara Kannada district is hilly and has thick forests and a long coastal line, which attracts nature lovers.Honnavar taluka has great tourism importance.

4.6.1. Sharavati Back water

Sharavati Back water attracts tourists for its scenic beauty. The green hills and valleys are covered with thick forests. Traveling on passenger ferries on Sharavati waterway would give the tourists opportunity to have a closer look at these valleys and enjoy the beauty of nature. Leisure and water sport activities could also be introduced here to attract more tourists.

FIGURE 4.15: Sharavati Back Water

4.6.2. Haigund Island

Haigund is a beautiful island in river Sharavati. The island is formed just before the river joins in Arabian Sea. This island is located 3 kms from Honnavar Bangalore National Highway. The island is accessible from Adkar village and Kodani village through country boat. The sunset view from the island is breathtaking. According to the local authorities, the annual tourist traffic at this place is around 2500 in Fy 2005.

4.6.3. Jog Falls

The well known and very famous Jog falls originate from the Sharavati River and are the second largest waterfalls in India. Jog Falls attracts most foreign tourists in the catchment area of Sharavati river. It has shown the highest growth in the total tourist arrivals in Karnataka in the last few years. The river is home to a much rare variety of flora and fauna. Following image shows Jog Falls at Sagar taluka of Shivamogga.

FIGURE 4.16: Jog Falls

4.6.4. Linganamakki dam

Linganamakki dam is built across the Sharavati river and is located 6 km from the Jog Falls in the Sagara taluka. The dam was made to store 4,368 million cubic meter water and the height of the dam is 1,819 feet and the reservoir's capacity is 152 Thousand Million cubic feet. The water in the dam is mainly received from the rains or the nearby reservoirs. These nearby reservoirs are linked through a canal with the dam. At present, Linganamakki dam is prohibited to public, however in future it has potential to attract tourists. There is a Honnemaradu island that has formed on the Linganamakki dam and is famous for a lot of water sports, like windsurfing, kayaking, swimming and canoeing. Following image shows Linganamakki Dam in Sagar taluka.

4.6.5. Gerusoppa dam

Gerusoppa dam is built on the Sharavati River and is located in Uttara Kannada district. The dam is the powerhouse of the state government and there are four turbines that generate energy. The river has three main hydroelectric projects, which include the Gerusoppa dam. The other two are the Sharavati generating station and the Linganamakki dam powerhouse station.

Tourism Traffic of Secondary Catchment Area

The tourist spots located at Sagar, Bhatkal and Kumta talukas have good potential to boost tourist traffic. These places could be considered as secondary catchment area. Murdeshwar and Gokarna can be considered as primary catchment area as they are within 25 km from Sharavati river. However, the consultant has considered the road distance from these places to the river for the below table, which is more than 25 km. Hence, these places are added in tourism of secondary catchment area.

In Kumta, the density of tourists is high in Gokarna. As recent statistics is not available in the published documents, so year 2004-05 data could be considered to analyze the passenger traffic of Gokarna. In year 2004-05, only in first three months, the inflow of domestic tourists in Gokarna was 3,566 and foreign tourists was 3,765. Foreigners directly come from Panjim to Gokarna.

TABLE 4-24: Existing tourist attractions in Secondary Catchment Area

Taluka	**Tourist Spot**	**Distance in KM**	
		from Taluka Head Quarter (KM)	**from Sharavati River (KM)**
Bhatkal	Bhatkal Port Light House	4	27
	Bailur Beach	14	28
	Golden Masjid	2	30
	Murudeshwar Temple	9	31
Kumta	Gokarna Temple	24	42
	Om Beach	29	42
	Yana	26	39
Sagar	Gudavi Bird Sanctuary	41	45
	Hosagunda	34	56

Source: Gazetter of India, Karnataka State, Shivamogga District

There are some famous temples in Uttara Kannada, namely The Madhukeshwar Temple at Banavasi, Ulavi Channabasaveshwar Temple at Ulavi, Siddivinayaka Temple at Idagunji, Mahabaleshwar Temple at Gokarna, Mathobara Temple at Murdeshwar, Marikamba Temple in Sirsi. Jain Basti and Swarnawalli Math, Sonda Fort, Mirjan Fort etc. are famous for ancient monuments. Mosque at Bhatkal is also known for its marvelous designs.

Shivamogga is a district rich with mountains, waterfalls, rivers and dams, which attract tourists from all over the country. Shivamogga district has several places of tourist interest and several waterfalls, like Jog Falls, Kunchikal Falls, Barkana Falls, Achakanya Falls, Vanake-Abbey Falls, Hidlamane Falls, Dabbe Falls etc. Shivamogga is also famous for religious and heritage structures in art and architecture and also has sufficient tropical jungles home to wildlife, including some endangered species.

There are wildlife sanctuaries in and around Shivamogga, namely Tyarekoppa Lion Safari, Sakerbayalu Elephant Camp, Sharavati Wildlife Sanctuary, Bhadra Wildlife Sanctuary, Shettihallu Wildlife Sanctuary, Mandagadde Bird Sanctuary and Guduvi Bird Sanctuary. These wildlife sanctuaries have potential to attract domestic & foreign tourists.

4.6.6. Murudeshwar Temple

The density of tourists is high in Murdeshwar in Bhatkal taluka. As recent statistics is not available in the published documents, so year 2004-05 data could be considered to analyze the passenger traffic of Murudeshwar. In year 2004-05, only in first three months, the inflow of domestic tourists in Murudeshwar was 15,163 and foreign tourists was 549.

FIGURE 4.17: Murudeshwar temple

The domestic tourists mostly hail from Maharashtra and Kerala and they mostly use Konkan Railway. The contribution of Konkan Railway in the promotion of tourism in this region has been significant. The famous Murudeshwar Temple on Murudeshwar beach is situated at a distance of 25 km. from Honnavar and Bhatkal taluka. Following image shows Murudeshwar temple.

4.7. Growth Trend

4.7.1. Ro-Ro Traffic Growth

NH-206 (Bangalore-Honnavar) runs parallel to Sharavati River. Accessible Roadways would present competition to the proposed waterway. There is no possibility to transfer bulk cargo through this river; hence there is no opportunity for Ro-Ro traffic in Sharavati river.

4.7.2. Cargo Traffic Growth

✓ The industries on the catchment area are very few with miniscule production; hence at present, there is no potential for cargo traffic from industries.

- ✓ The mineral reserves on the catchment area produce very less minerals. Other reserves do not extract ores as their volume is very less. Hence, there exists no potential for cargo traffic from minerals.

4.7.3. Passenger Traffic & Tourism Traffic

- ✓ After Honnavar, Sharavati river is surrounded by hills and valleys; hence it is unlikely that passengers would use waterways for transportation.
- ✓ At present, there are ferry landing points in Samshi, Upponi, Idagunji and Gerusoppa, from where passengers use waterways for crossing the river everyday. These passengers use ferries to go to the villages, located on the other side of the river. Around 130 passengers use ferries everyday. Hence, passenger traffic would be around 39,000 annually (considering 300 operational days) in Sharavati river. This passenger traffic would not provide opportunity for IWT as passengers use ferries for crossing the river, not for along the river movement.

4.7.4. Tourism Traffic Growth

- ✓ As per the study on Development of IWT in Karnataka carried out by Directorate of Ports and IWT & Rites Ltd., a total of 2,500 tourists visited the tourist region of Sharavati River in 2005.
- ✓ Base year traffic volume is taken from aforementioned study and site survey done by us. This segment is unorganised, and no data is available with State Departments.

4.7.5. FSR & DPR Comparison

The below table shows identified commodities and potential they would provide for Sharavati river. Few commodities like Mineral, Fertilizer& Chemicals, Food grains, Fish, Horticulture products were considered as potential cargo for Sharavati river in feasibility study; however, in DPR stage, it was analysed that these commodities would not provide opportunity for the proposed waterway.

The below table shows comparison of FSR and DPR study. Commodities that are considered for DPR are presented along with reasoning. Commodities, which were considered for FSR, but were not considered in DPR are also mentioned with reasoning.

TABLE 4-25: Analysis of FSR Study

Commodity	Source	Considered in DPR	Potential for Sharavati	Reasoning
Mineral	Extracted from the catchment area	✓	✗	Available in less quantity/ Far distance from river
Food Grains	Grown in the catchment area	✓	✗	Available in less quantity
Horticulture products	Produced in the catchment area	✓	✗	Available in less quantity
Fish Catch	Honnavar, Bhatkal & catchment area	✓	✗	Available in less quantity
Fertilizer & Chemicals	Allotted in the region	✓	✗	Available in less quantity
Industries	Small & Micro Industries	✓	✗	No large & medium scale industry in the area, Less Production
Passengers	Population of catchment area near the river	✓	✗	Local People using country boats at present would continue using waterway for crossing the river. No opportunity for along the river movement for passengers.
Tourism	Tourist sites near the river	✓	✓	Tourism likely to grow in future

4.8. Forecasting & Potential IWT Assumption

Tourist Traffic

- ✓ Considering Uttara Kannada's GDP is 2% in the state and this district is the primary catchment area, future tourist traffic is projected.
- ✓ As per the study on Development of IWT in Karnataka carried out by Directorate of Ports and IWT & Rites Ltd. And local site survey, 2,500 tourists visited the tourist region of Sharavati River. Hence, number of tourists 2,500 has been considered as base data for future traffic projection.
- ✓ Tourist traffic includes both Indian and foreign tourists.

The following table shows future tourist traffic for Sharavati River.

TABLE 4-26: Annual Tourist Traffic for Sharavati River ('000 number)

Year	Tourist Traffic
2016	3
2020	3
2025	4

Year	Tourist Traffic
2030	4
2035	5
2040	5

Source: Consultant's Analysis

Passenger Traffic (Projecting existing passenger traffic)

- ✓ At present, passengers use existing ferry service to cross the river. Villagers use ferries to cross the river and go to villages located on the other side of the river. These passengers would not provide opportunity for IWT, as passengers would not use ferries for along the river movement.

  The following table shows Future Passenger Traffic for Sharavati River.

- ✓ Considering the present passenger traffic 39,000 annually (considering 300 operational days) in Sharavati river in 2017 and considering Uttara Kannada's GDP is 2% in the state as this district is the primary catchment area, future passenger traffic is projected.

TABLE 4-27: Future Passenger Traffic ('000 number)

Year	Passenger Traffic
2016	39
2020	42
2025	47
2030	51
2035	57
2040	63

Source: Consultant's Analysis

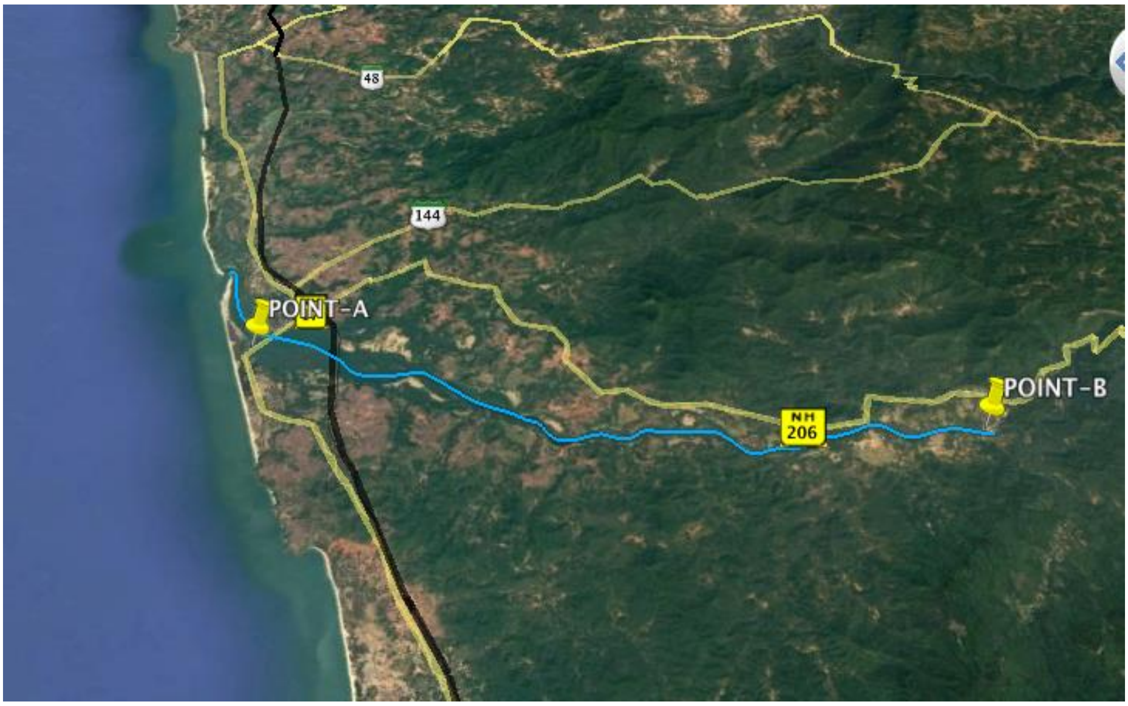
At present, there exist some operational ferry services at the navigable stretch of Sharavati river. Refer to below table for details of existing landing points on the river.

4.9. Terminal wise IWT Traffic Analysis

Two terminal locations have been identified to be developed by IWT for the proposed waterway in Sharavati river.

Point A - Honnavar Port is identified as terminal location where tourist could embark and disembark for boat ride. Presently Honnavar Port is in proposed state, it is likely that in near future this port would start operating. Waterside infrastructure at Honnavar Port could be used to handle proposed tourist traffic of Sharavati River.

Point B - The second terminal would be located at Gerusoppa. This terminal would be used by tourists arriving from or destined to nearby areas of Honnavar Port.



(Source: Google Earth)

FIGURE 4.18: Proposed Terminal Location

4.9.1. Terminal wise IWT Traffic analysis

There is no potential for cargo movement for the proposed terminals in Sharavati river. There exist no major industries in the catchment area. Medium & Small industries exist with low production; which would not provide any opportunity for the waterway. Mineral mines in the catchment area have less production; hence there would not be any potential from minerals.

The below table shows passenger traffic projection for across the river movement that would be handled by existing ferry service, no additional infrastructure development required. Passenger traffic would not provide any opportunity for IWT terminal, as passenger movement is limited to crossing the river, not along the river movement. Only Tourist traffic would provide opportunity to IWT terminal, as tourists would use ferries for along the river movement.

TABLE 4-28: Traffic Summary

Sr. No	Name of Cargo	Type of Cargo	Origin	Origin Terminal on NW	Co-ordinates	Final Destination	Destination Terminal on NW	Co-ordinates	Unit p.a	FY 16	FY 20	FY 25	FY 30	FY 35	FY 40	Terminal Land Area in Sq. Mtr
Existing Terminals on River (across the river movement for locals)																
1	Passenger Traffic	N.A.	Samshi, Idagunji, Gerusoppa & nearby villages	Samshi, Idagunji, Gerusoppa	14°14'8.06"N, 74°36'25.33"E/ 14°14'46.39"N, 74°30'18.62"E/ 14°14'15.98"N, 74°39'5.35"E	Uponni, Jalwali, Gerusoppa & nearby villages	Uponni, Jalwali, Gerusoppa	14°14'14.16"N, 74°36'22.23"E/ 14°14'12.23"N, 74°39'7.66"E	('000 Number)	39.0	42.2	46.6	51.5	56.8	62.7	
Proposed Terminal on River (Opportunity for IWAI)																
2	Tourist Traffic	N.A.	Indian states & Foreign countries	Kasarkod (Near NH 66)	14°16'8.00"N, 74°26'9.00"E	Shivamogga	Gerusoppa	14°14'20.64"N, 74°38'59.16"E	('000 Number)	3.2	3.4	3.7	4.1	4.5	5.0	

Source: Consultant'sAnalysis

4.10. Conclusion

- During site visit and interaction with industries it was found that there is small/ negligible potential for cargo movement through waterways on Sharavati.
- As minerals that are extracted from Uttara Kannada & Shivamogga districts are very less in volume, so there exists no opportunity to transport them through Sharavati river.
- Very limited industries exist nearby river and the production of these industries are very low in volume; hence it is not commercially viable to transport those cargoes through river to some other places. These industries are small scale and not EXIM oriented.
- Fishing activities around the river is carried out by local fishermen and fish catch from these areas are consumed locally and distributed in neighboring districts. The volume is also low thereby do not hold export potential. However, fishing harbours in Honnavar and Bhatkal could provide opportunity to waterways, if the volume of fish increases.
- Tourism activities are there on the river that could be further developed. Due to long stretch and beautiful scenery around river, Sharavati river holds tourism potential. A good potential for Tourist movement exists in the River. There is bound to be a port led development in the area particularly tourism using waterway being most recognizable activity in the coming days. Only single ferry terminal at Gerusoppa has been suggested for all weather connectivity providing adequate safety to the users. No ferry terminal has been suggested at the side of Hannovar port, as tourists or passengers would continue to use same infrastructure.
- As of now, passengers may not use the proposed waterway for along the river movement due to availability of good road connectivity, which runs parallel to the river however passengers shall continue to use ferry services only to cross-over the river. In future, with promotion of waterways, passengers may use the proposed waterways for along the river movement to lessen the pressure on road as well as increased commercial activity after the development of port, which may be capable of bringing prosperity in the area. At present, infrastructure development for passenger services for tourism activity may only be considered.

Annexure

4.11. Summary of Interviews

TABLE 4-29 Interview Details

Industry/Port	Contact Person	Designation
M.N. Chemicals Ltd.	Shreedhar Patil	Director Marketing
Karnataka Soap & Detergent	G. Mohan Kumar	Director
Pearlite Liners	Raghudatt	General Manager
Shahi Exports	Vinayak Hegde	HR
	Vinay Bharti	AGM
Karwar Port	Suresh S.	Traffic Manager
Honnavar Port	Ferry Owners	-
	Local People	-
Sharavati River	Ferry Owners	-
	Local People	-

Source: Site Visit

Honnavar Port

Name: Mr. Suresh S

Designation: Traffic Manager, Karwar Port

- Mr. Suresh S, Taffic Manager of Karwar Port, provided information about the upcoming infrastructure development of Honnavar Port. He works with the members of Honnavar Port and an active participant for proposal of Honnavar port development. Mr. Suresh also shared the information that land has been sanctioned by the government to develop Honnavar port.
- Ferry owners in Honnavar port and harbour provided the information about Fishing and exports. They gave information that fish catch isexported to nearby districts by roadways. Fish are transported in lorries from Fishing Harbour of Honnavar.
- Local people of Honnavar gave the information that Tile industry had significant role in the economy of the region, but now all the major four factories of Honnavar had shut down their plants, due to unavailabilty of raw material and lack of market potential.

Sharavati River

- The ferry owners at Upponi, Samshi provided the information about the facilities and rail/ road connectivity.

- Local people of the villages on the bank of Sharavti river gave the information that their main occupation is fishing and agriculture.
- There is a Motorboat facility for passengers at Idgunjito for crossing the river. It is beside Honnavar – Nagarabastikeri road. This facility is not used extensively so far as only locals use this facility for occupational reasons. A plain land is available near the motor boat landing point. Small Roads are also been constructed to meet the Main Roads.
- At present, passenger ferries operate at Upponi to carry passengers on the other side of the river that is Samshi Village. The Ferry operator gave information that ferry charge is INR 10per passenger and INR 20- 30 per vehicle.
- **Industries**

M.N. Chemicals Ltd.

Name: Mr. Shreedhar Patil

Designation: Director Marketing

M. N. Chemicals manufacturers and supplies bulk drugs, fine chemicals, sodium chloride etc. According to Mr. Patil, M.N. Chemicals's total annual capacity is 200 tonnes and it exports to Thailnad through New Mangalore Port. At present this company is using Roadways to transport its cargo to New Mangalore Port. When Sharavati river would be developed, the company is willing to move its cargo through waterways to New Mangalore Port.

Karnataka Soap & Detergent

Name: Mr. G. Mohan Kumar

Designation: Director

According to Mr. Mohan, at present Karnataka Soap & Detergent uses Chennai Port for export. The company exports its products to countries like UAE, USA, Canada, Singapore, Kuwait, Malaysia, South Africa, European Countries, Australia, China & Taiwan.The company's sandlwood oil divison is located at Shivamogga and its headquarter is at Bangalore. The company is not willing to shift its cargo to waterways because the distance from Chennai Port and waterways is same for them, so they don't want to divert their cargo to river.

Pearlite Liners:

Name: Mr. Raghudatt

Designation: General Manager

Mr. Raghudatt shared the information that Peralite Liners procure raw material from Bhadravti and Hospet by using roadways. According to him, the company would not use the waterways on Sharavati river because it is not convenient and economically feasible for them. Bhadravati is only 70 km away from their plant and using roadways is a better option.

Shahi Exports

Name: Mr. Vinay Bharti/ Mr. Vinayak Hegde

Designation: AGM/ HR

Shahi Exports Pvt. Ltd. is engaged in the manufacture and export of readymade garments in the International market. According to Mr. Hegde, the plant in Sagar only produces garments and uses Tuticorin Port for export. If waterway develops in Sharavati river, Shahi Exports' Sagar Plant would use the waterways.

Abbreviation	Full Form
CH	Chainage
Sq. km.	Square Kilometre
Sq. Ft.	Square Feet
km	Kilometer
km2	Square Kilometer
MW	Mega Watt
MTPA	Metric Tonne Per Annum
T	Tonne
MT	Metric Tonne
MMT	Million Metric Tonne
NH	National Highway
Pvt. Ltd.	Private Limited
Ltd.	Limited
INR	Indian Rupee
CR	Crore
GDP	Gross domestic product
MSME	Micro, Small & Medium Enterprises
Ha	Hectare
FY	Financial Year
Ro-Ro	Roll-on Roll-off

CHAPTER 5: TERMINALS

5.1. General Review

Terminals act as a connecting centre for shift of cargo and passengers from one mode to other mode. Inland Waterway Terminal (IWT) is a hub centre with a facility of connecting transport mode from / to the vessels on the water body to land provisioned with all the related infrastructure facilities like structure for berthing of vessels; facilities for loading / unloading of cargo; embarkation / disembarkation of passengers; storing / resting of cargo / passengers; connectivity to other modes of transport etc.

5.2. Functional Requirements for Ferry Terminal

The proposed ferry terminal at Gerusoppa ferry ghat (Lat-14°14'20.64"N & Long-74°38'59.16"E) is proposed to cater the passengers for tourism traffic and also to cross the river. The riverine and landside infrastructure proposed for the ferry terminal are robust structures and provide floating but permanent boarding/deboarding locations for passenger. This also ensures a greater sense of safety among the passengers while ferrying through the river. The boarding/deboarding location is accessible for all passengers and shall have ample waiting areas for convenience of tourists. The terminal utilities and services are provided for ease of operation and maintenance during any water levels.

The following figure shows an overall site plan of the proposed terminal location.

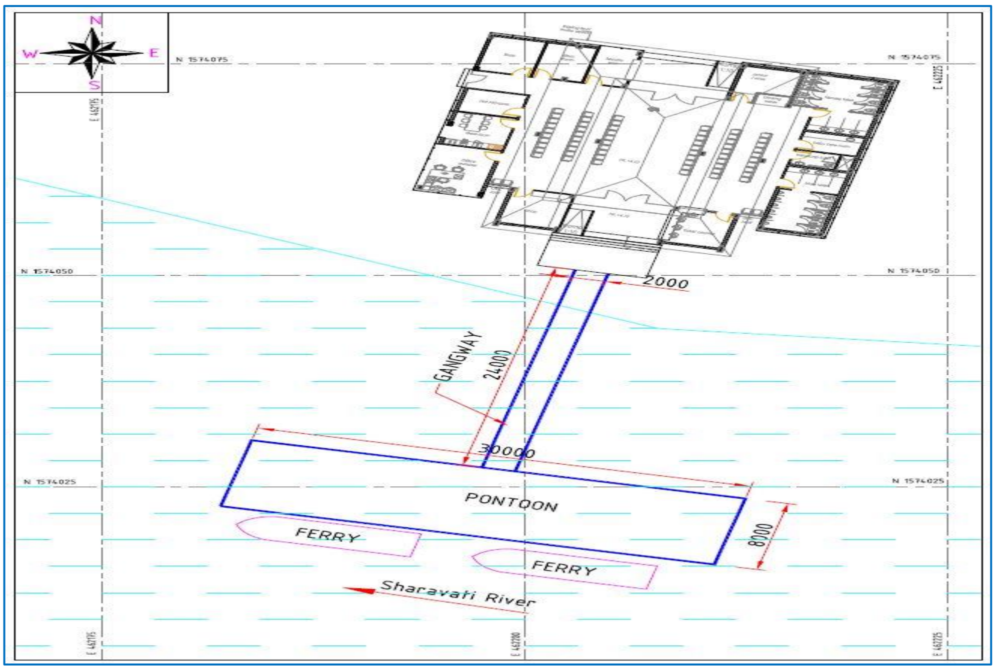


FIGURE 5.1: Overall site plan of proposed ferry terminal.

The following sections describe the basis of planning and design of terminal infrastructure (both riverine and landside).

5.3. Riverine Terminal Infrastructure

The riverine infrastructure comprises of the following components:

TABLE 5-1 : Components of Riverine Structure

1. Berthing pontoons – 30x8m (01 no.)
2. Aluminum Gangway – (approx.) 26m span x 2m wide (1no.)
3. Bankseat (6.6m wide and 4.0m long)

The layout and general arrangement of the components of riverine infrastructure listed above are shown in Volume-II Drawing No. **P.010256-W-20301-A06**.
The dimensions of the above-mentioned structures are based on many factors like pile spacing, rake angle which are governed by forces and proposed stiffness to resist the forces.

The pile layout plan including number of piles, spacing, diameter and thicknesses for riverine infrastructures are shown in the Volume-II Drawing No. **P.010256-W-20309-A06**.

5.4. Planning of riverine infrastructure

The usage of the ferry terminal is greatly enhanced if the proposed location is at the same location or very near to the existing ferry terminal location. Hence the proposed ferry terminal is located at the same location where the current ferry activities are under operation. Since the proposed ferry terminal is at a fixed location, the riverine infrastructure is provided at a depth where a minimum water depth is available round the year. The low water level evaluated at Gerusoppa gateway ghat based on the water levels recorded is found to be 1.13m RL. Considering a minimum draft of pontoon of 0.75m, keel clearance of 0.5m, a conservative allowance for sedimentation at riverbed and the required length of the gangway to cater to the difference in water levels, the proposed berthing pontoons are situated at minimum water level.

5.5. Berthing pontoons and pile system

The berthing pontoons are floating steel structure supporting aluminum gangways, providing safe boarding/deboarding for passengers and vehicles in the operating range of water level and possess fenders and bollards for berthing and mooring of ferries. The size of the berthing pontoons is considered based on the requirement of tourist traffic and also based on the proposed ferry sizes that are going to operate at the terminal.

Considering the above criteria, 30m (long) and 8m (wide) berthing pontoons are provided. The ferry terminal is proposed with one (1) numbers of berthing pontoons. The following figure shows general arrangement of berthing pontoons at high water level and low water level.

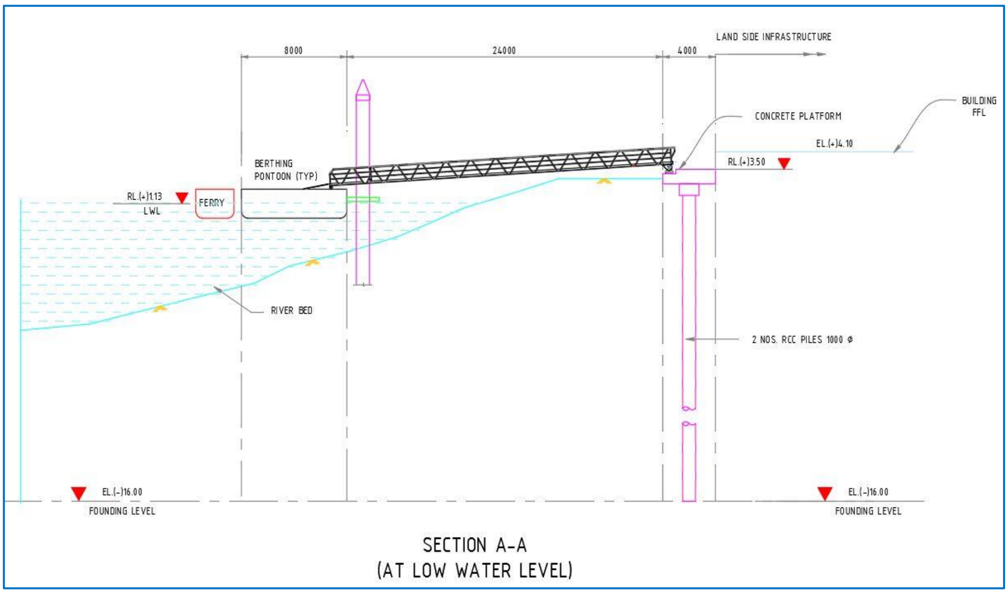


FIGURE 5.2: General arrangement of berthing pontoon at Low Water Level

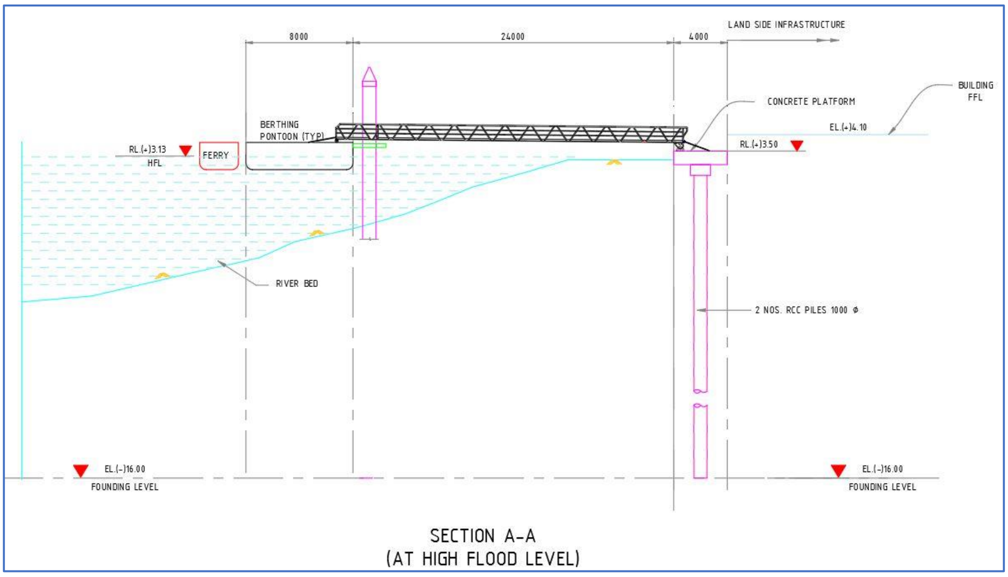


FIGURE 5.3: General arrangement of berthing pontoon at High Water Level

<u>BERTH OCCUPANCY AND BERTHING PONTOON REQUIREMENTS:</u>

The number of berthing pontoons to be provided is evaluated based on the berth occupancy of the vessels and traffic requirements.

The berth occupancy of the vessels and traffic are considered with respect to the vessel turnaround times and traffic requirements respectively as described below:

5.6. Vessel Turnaround Time:

Turn Around Time (TAT) for the Inland Navigation is the most critical analysis, involving many practical issues, linked with the Fairway constraints; Terminal Operational Constraints; Availability of Day / Night Navigation system; Vessel speed etc.

The navigable stretch of River Sharavati (NW-90), between Honnavar Port and up to D/s of Gerusoppa Dam, is 25.2 Kms. The table below shows the calculation and assumptions considered to arrive at Turn Around time for single vessel at defined 25.2 km stretch of River Sharavati (NW-90) carrying passengers.

TABLE 5-2 : Turn Around Time Calculation for Single Vessel

Sl No.	Parameters	Unit	Honnavar to Gerusoppa
1	NW-90 Stretch	Km.	25.2
2	Traffic Type Proposed	Type	Passengers & Tourists
3	Terminal Proposed	Type	Passenger upgradable for Ro-Pax

Sl No.	Parameters	Unit	Honnavar to Gerusoppa
4	Embark / Disembark (both side)	Mins	30
5	Total Handling Time	Mins	30
6	Average Sailing Speed	Knots	10
7	Sailing Time	Mins	80 (1 Hr 20 Mins)
8	**Total Turn-around Time (trip/voyage)**	**Mins**	**216 (3 Hrs. 36 Mins)**

Based on the above assumptions, a vessel loaded with passengers would take at least 3 hours to reach from one terminal to another. Vessel speed and operational time consumed at terminal and in transit are the primary influencing factor of turnaround time.

5.7. Traffic Requirements:

The number of vessels required to handle projected passenger and tourist traffic on the defined 25.2 km of NW-90. Below listed are the relevant factors are considered to arrive at the requirement of number of vessels.

- Nature and Type of Traffic
- Fairway Length (distance between proposed terminals)
- Physical Hindrances
- Vessel Capacity
- Permissible Speed
- Operational (Days & Hours), etc.

The table below shows the assumptions considered to arrive at vessel calls and number of vessels required to cater to the projected traffic till FY-45.

TABLE 5-3 : Assumptions for Calculating Vessel Requirement

Sl No.	Parameters	Unit	Honnavar to Gerusoppa
1	Operational Days	Days	300
2	Daily Operational	Hours.	8
3	Carrying Capacity	No.	30 Pax.
4	Vessel Speed	Nm. / km.	10 / 19
5	Loading and Unloading Time	Mins	30

Sl No.	Parameters	Unit	Honnavar to Gerusoppa
6	Chainage (Honnavar to Gerusoppa)	Km.	25.2
7	Total Turn Around Time (trip/voyage)	Mins	216 (3 Hrs. 36 Mins)

Based on the above assumptions, number vessels required on the NW-90 is represented in the table below. One vessel of 25 - 30 Pax carrying capacity is sufficient enough to accommodate the projected traffic on NW-90 from Honnavar to Gerusoppa.

TABLE 5-4 : Number of Vessel Requirement

Sr. No	Unit	FY23	FY25	FY30	FY35	FY40
Traffic (Tourist & Passengers)	No.	3,571	3,715	4,102	4,528	5,000
Annual Vessel Calls	No.	120	124	137	151	167
Daily Vessel Calls	No.	1	1	1	1	1
Vessels Requirement	No.	1	1	1	1	1

The above calculation concludes that 1 passenger ferry is adequate to handle projected passenger traffic on River Sharavati (NW-90) till FY45. Requirement for additional vessel would not arise in this period of time. As shown in the table above, proposed vessel will require to make single trip daily to cater to the projected traffic. It takes around 3 hours to complete one trip. If in future traffic increases beyond the projected, the proposed vessel can make up to 2 trips every day. The river is proposed to be developed for tourism, hence night navigation is not required.

5.8. Gangway

The gangway bridges the gap between the approach trestle/bank seat and the berthing pontoons. The gangway are aluminum truss elements formed with box sections and enclosed built-up sections. The terminal is provided with one gangway arrangement for access to the berthing pontoons.

The end points are hinged at one end and are provided with roller supports the other end. The roller supports allow the slope of linkspan to vary with the fluctuation of water level. Hence when the water level is at HFL (3.13m RL), the gangway are near horizontal and when the water level is at LWL (1.13m RL). A pictorial view is shown in the figure below.

FIGURE 5.4: The Artistic View of Pontoon and Gangway Arrangement

5.9. Bankseat

The bankseat is a pile supported deck structure that supports the gangway at the hinged end. The proposed bankseat structure is 6.6m wide and 4.0m long. The following figure shows typical arrangement of the bankseat structure.

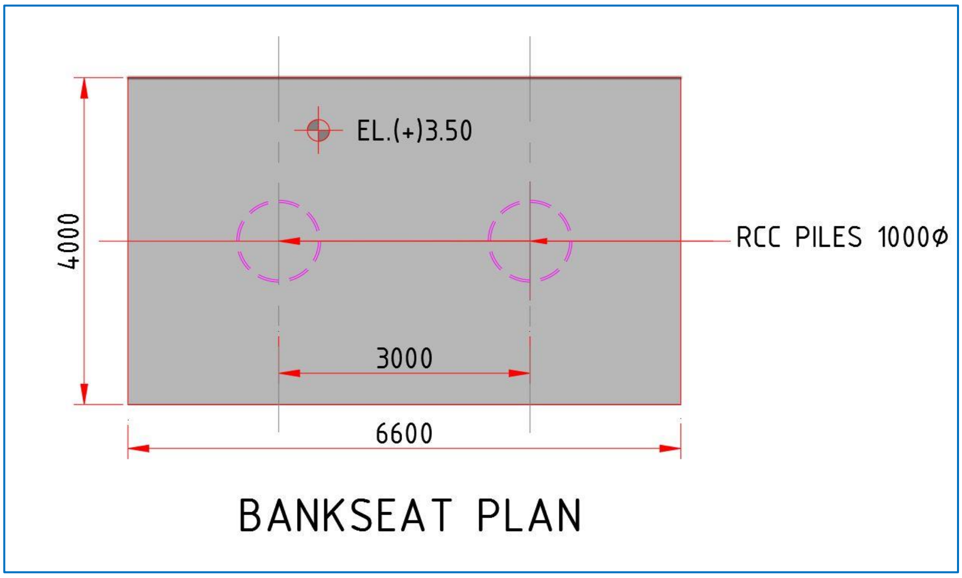


FIGURE 5.5: General arrangement of Bankseat

The pile forces and the proposed stiffnesses to resist the forces are the key factors for pile spacing and rake angle. Based on these factors the dimensions of deck structures of dolphins and Bankseat has been finalized.

5.10. Landside Terminal Infrastructure

Based on the traffic analysis and forecast in previous chapter, terminal building areas and infrastructure requirement will be finalised.

Typical elements/ Activities in terminal building are given below -

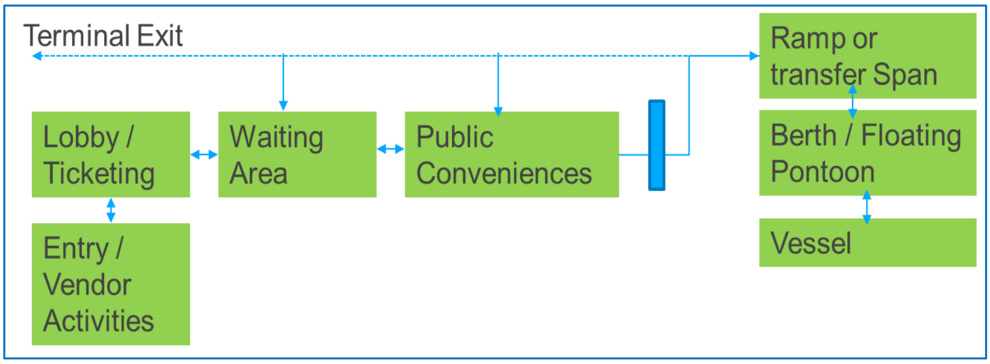


FIGURE 5.6: Typical element for terminal building

The broad components of terminal building are as under –

- Waiting areas for passengers
- Emergency service facilities
- Toilet facilities
- Security check areas
- Ticketing booths
- Parking areas
- Office and Meal Room
- Shops
- Open area
- Entry exit routes
- Access to ferry services by disabled persons
- Space for utilities / infrastructure requirements
- Control room for ferry services
- Storage Areas

Area Requirement for Pontoon Side Given Below –

TABLE 5-5 : Area requirement Pontoon Side

Terminal Land Area Requirement for the Waterway Sharavati - Gerusoppa Ferry Terminal (Lat-14°14'20.64"N & Long-74°38'59.16"E)

Sl No.	Facility	Nos.	Size	Area (in m²)
1	Open Mobility Area	1	-	75

Terminal Land Area Requirement for the Waterway Sharavati - Gerusoppa Ferry Terminal (Lat-14°14'20.64"N & Long-74°38'59.16"E)

Sl No.	Facility	Nos.	Size	Area (in m^2)
2	Area under internal Roads	1	3.75m x 40m	150
3	Main Terminal Building/ Administrative department/ Ticket Counter/ waiting Area/ First Aid etc.	1	25m x 20.0m	500
4	Security shed for watch and ward	1	4m x 3m	12
5	Electrical facility, Transformer etc.	1	4m x 3.5m	14
6	Fuel Bunkers	1	6m x 4m	24
7	Water Supply Room	1	3m x 4m	12
8	Fire and Safety support Room	1	3m x 3m	9
9	DGPS receiver & transmitter shed	1	4m x 3m	12
10	DG shed	1	5m x 5m	25
11	Sewerage Treatment Plant (STP)	1	15m x 15m	50
12	Overhead Tank	1	7.5m dia	44
13	Green Area	1	-	200
14	Boat Outlet, Accessories, Boar Repair & Boat Launching	1	-	400
14	Land required for Road Extension external approach road	1	-	200
14	Area under Mangroves clearance	1	-	200
		Total Area		**1927.18**

5.11. Planning for Terminal Building

Vision

“Rivers are a spatial system woven into the geographic fabric of the city” Cities have evolved in proximate of water bodies.

Water based transport most reliable means of Communication and transport for goods and passengers.

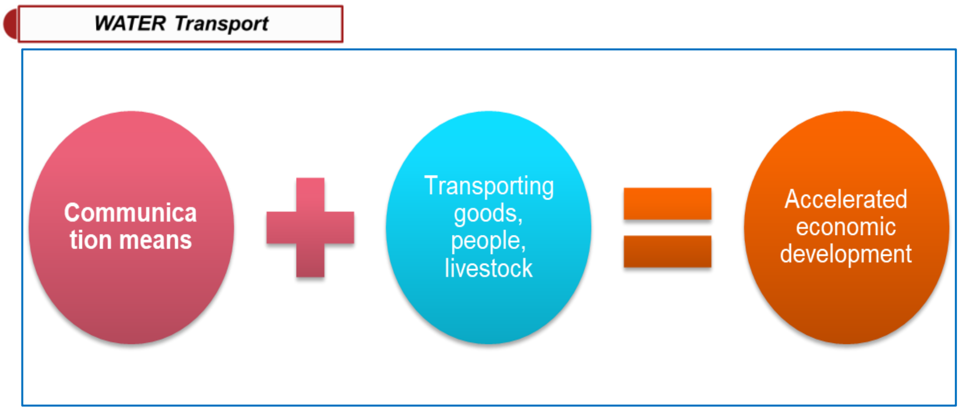


FIGURE 5.7: Water transport importance

and Ferry terminal is a building used for marine transportation of goods and people. Therefore, Vision for designing the terminal building is –

"To develop a self-sustainable building focused upon positive customer experience from embarking till last mile Connectivity".

Objective

to develop any ferry terminal building, following points should be taken care off

FIGURE 5.8: Design criteria for terminal building

For last mile connectivity The Land Side terminal building will be connected to the existing road by means of ramps for convenient entry and exit of passengers and vehicles.

5.12. Architecture Design of Terminal Building

Terminal design is driven by the following factors.

FUNCTIONALITY

The concept is an outcome of design philosophy, “Form follows function”. Landside development broadly comprises of the circulation space, parking lots, utility/substation zone and the main building with administration and waiting areas.

Spatial arrangement of various zones revolves around the main building mass which comprises of the basic amenities for all the users, pedestrians and passengers on vehicles. Customers coming by bikes and cars can park in the designated spaces and avail the public amenities in the waiting time, if they wish to. The beauty of the concept is its absence of complication combined with its clarity of functional and richness of cultural experience.

Functional zoning of the terminal building is explained below: -

FIGURE 5.9: Terminal building: - zoning plan

The form of terminal building is a modern interpretation of the vernacular architecture of the site. It is an amalgamation of state of the art and local materials. Reference Drawings of detail layout of Terminal have been displayed in the Volume-II Drawing No. **P.010256-W-20364-A06**.

SEGREGATION OF TRAFFIC MOVEMENT

Terminal design aims at creating separate routes for the vehicular and pedestrian movement to have least to no conflict in the two types of user movements.

SUSTAINABLE BUILDING

Parameters for sustainability adopted in terminal design are:

1. Minimum disturbance with natural scape
2. Use of local material
3. Proper shading
4. Proposal for roof top solar panels- Renewable energy

5. **Waste treatment –** Provision of STP to treat waste water and use the treated water for irrigation.
6. Use of Water saving equipment.

A single storied structure is proposed that respects and reflects the natural landscape of the site and does not stand out as an eye sore.

Sloping roofs on terminal building have been proposed as a climate responsive design and following the local architecture.

Use of local material for tiling of roads and sloped roofs has been adopted.

Proper shaded pathways and parking lots have been given by proving line of shade giving native trees and shrubs along the parking bays. It reduces heat island effect and provides a positive experience for the end users.

To provide for 10% of energy being consumed as renewable energy, roof top solar panels are proposed above the terminal building and over the concrete platform towards pontoon.

Particulars of Gerusoppa Ferry Terminal Ghat`

TERMINAL & INFRASTRUCTURE

The following main components are considered to form the basic infrastructure required at Ferry Terminal ghat at Gerusoppa:

- Ticketing Office
- Administration & Security
- Passenger waiting area
- Public Amenities: Toilet Facilities, Drinking water fountain, Vending area
- Vehicle parking area
- Roads / Turning Areas
- Utilities
- Green cover

Typical elevation of terminal building & the zoning plan is shown as below: -

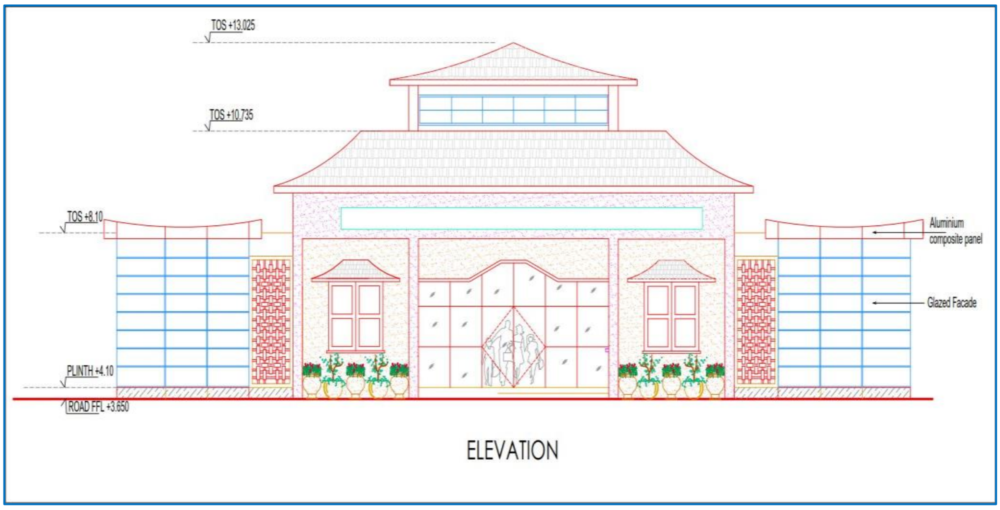


FIGURE 5.10: Terminal building: - Elevation

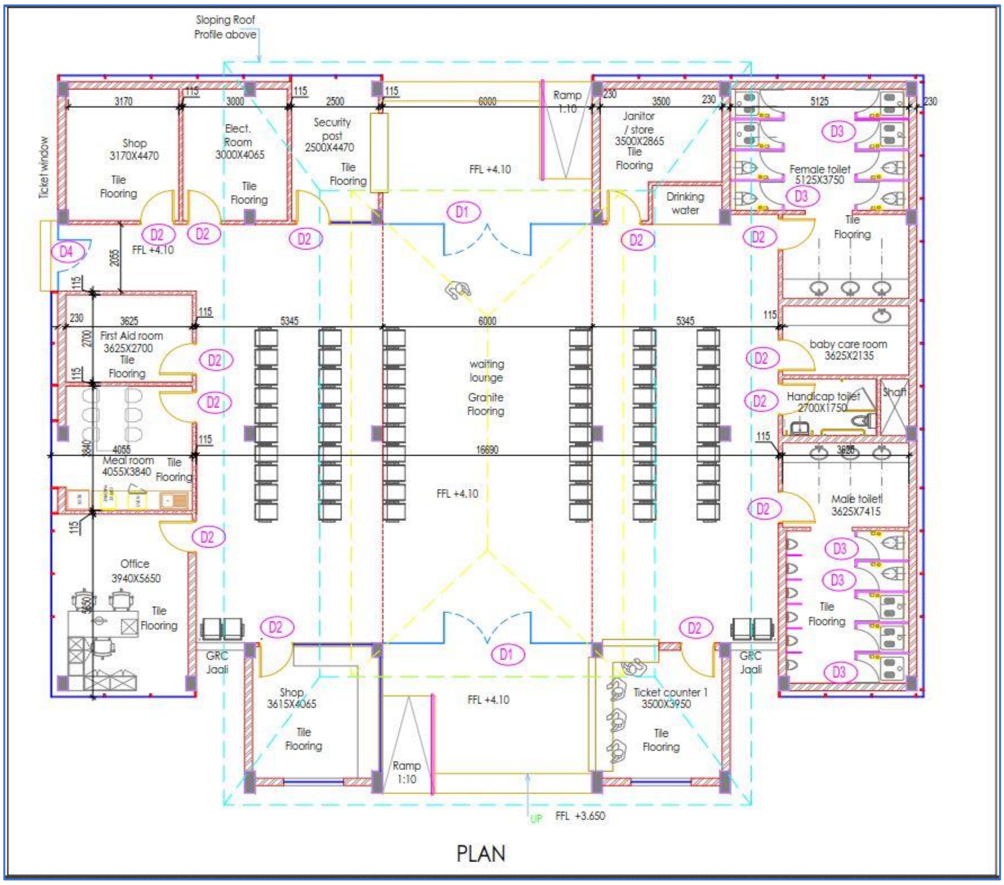


FIGURE 5.11: Terminal building: - Zoning Plan

5.13. Land Details

Apart from all the technical requirement for operation of ferry services, Land Availability is considered the main criteria for finalisation of terminal building. The connectivity to the proposed terminal location is through main road The Land area identified is as below:

TABLE 5-6 : Terminal Land Details

Coordinates (UTM) N/E	**1574194.5**	**462217.25**
Coordinates (DMS) N/E	14°14'20.64"N	74°38'59.16"E
Village	Saralagi	
Taluka	Gerusoppa	
District	Uttara Kannada	
State	Karnataka	
Nearest Town	Gerusoppa	
Distance of town (km)	1km	
Land use	Barren land	
Ownership	State Govt revenue Deptt land	
Water Distance	on edge	
Nearest Road	NH-206	
Road Distance (m)	500	
Nearest Railhead	Honnavar	
Railhead Distance	35km	
Nearby major Structure	none	
Terrain	-	
Soil/Subsurface strata	Gravely, bouldery sandy strata	
Surveyed Area (Approx)	50289	

5.14. Geotechnical Investigations

The project/selected site falls under Survey of India toposheet No 48J. The area is habited, and locality is having a spread with the villages of Molkad; Mandalaurve; Upponi and Gerusoppa. The study stretch has been observed with thick vegetation cover along with Mangroves to a mojor extent on the river bank, on both the sides.

Most of the surrounding area is occupied by overburden material comprising of mixed material like sand, gravels, boulders, concrete fragments, broken rock blocks (used for stone pitching) etc. The project/surrounding area has undulating topography having variations in elevation from 17m to 22m.

5.14.1. Regional Geology

The area is characterised by extensively developed laterites on both Archaean as well as Tertiaiy litho units. The area (Dakshina Kannada coastal tract) forms the westernmost part of the Western Ghat Belt (also termed, West Coast Belt) of Karnataka craton. The Western Ghat Belt could be divided into two divisions based both on physiography as well as geology: (1) the Western Ghat proper and (2) the coastal tract.

The Western Ghat proper is a mountain like terrain having a scarp of more than 1000 m facing the west. The folded rocks of Dharwar Supergroup consisting of mica schists, gametiferous mica schists and contemporaneous traps with subordinate quartzites (i.e. metavolcanics with interbedded quartzites over the basal oligomict quartz-pebble conglomerate) and hematite-magnetite-quartzites resting on the uneven surface ofthe Archaean granitoid gneisses, having the beds tilted to north are exposed Y (forming many terraces) along the scarp and highlands of the Ghat (Ramakrishnan and Harinanda Babu, 1981). The ironstones (hematite-magnetite-quartzites) of the Bababudan Group form some of the precipices of the Ghat. Domes/batholiths of Peninsular Gneiss form some ofthe foothills ofthe scarp.

In contrast, the coastal tract of Dakshina Kannada, between the shoreline and the Ghat scarp is devoid of Younger Greenstone cover and it mainly reveals extensively developed Peninsular Gneiss. The geological map of the area is given in Figure 5.12 and the stratigraphic sequence as Table 5.7.

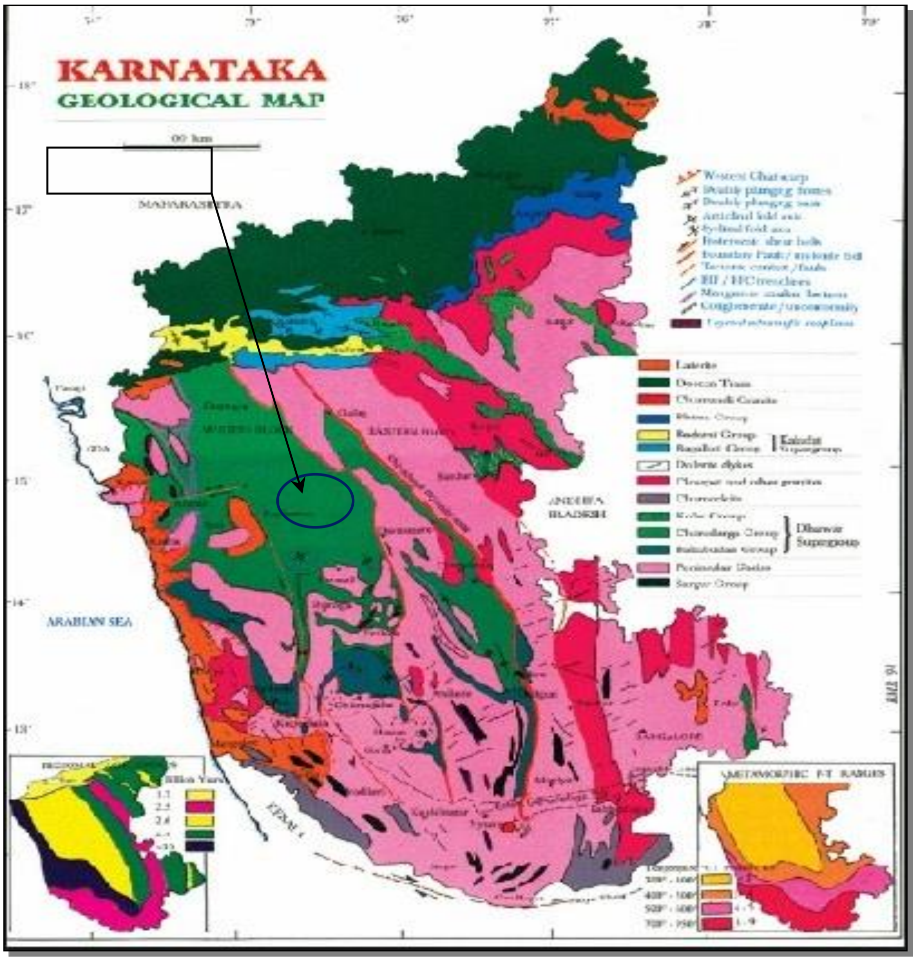


FIGURE 5.12: Geological Map of Karnataka

TABLE 5-7 : Stratigraphic Sequence of Karnataka Craton

Group	Litho units	Metamorphism
DECCAN TRAPS	Undifferentiated continental flood basalts.	
KALDGI GROUP	Conglomerates, quartzites, argillites, and limestone/ dolomites (in two prominent cycles of sedimentation).	Unmetamorphosed
YOUNGER GRANITES	Potash rich granites	
YOUNGER GREENSTONES	Manganiferous phyllites; Ankeritic limestones; Greywackes; Chloritic phyllites.	Least metamorphosed
	Agglomerates, tuffs, pillow lavas; Ferruginous and manganiferous cherts; Dolomites and limestones; Phyllites; Orthoquartzites; Conglomerates.	Green schist facies
	Banded magnetite quartzites; Argillites; Mafic lavas; Orthoquartzites; Conglomerates.	Green schist to lower amphibolite facies
PENINSULAR GNEISS	Granites & Gneisses; Granites and Granodiorites; Tonalites.	Migmatitic; lower amphibolite facies
OLDER GREENSTONES	Mafic and ultramafic flows; Anorthosites and anorthositic gabbros (comparable to low K-oceanic tholeiites).	Amphibolite facies
GORUR GNEISSES	Tonalitic-trondhjemitic gneisses	Migmatitic
ANCIENT SUPRA-CRUSTALS	Magnetite quartzites; Graphitic schists; Kyanite-staurolite schists; Cordierite granulites; Crystalline limestone and dolomites; Mafic and ultramafic flows; Anorthosite pods.	Upper amphibolite to lower granulite facies

5.14.2. Physical Condition and Drainage

The major physiographic divisions of Karnataka State are the Deccan plateau, the hill ranges and the coastal plain. Based on their geographic location, they are sub-divided into four regions viz., a) South Deccan plateau, b) Western Ghats, c) Eastern Ghats, and d) West coast plains. The South Deccan plateau covering an area of about 158 lakh ha. is divided into malnad and maidan regions. Malnad, a transitional zone between the Western Ghats and the maidan, is an area of rolling to undulating uplands with many valleys. It covers an area of about 62 lakh ha. in the districts of Belgaum, Uttara Kannada, Dharwad, Shimoga, Chikmagalur, Kodagu and Hassan. Maidan has a rolling surface with gentle slopes and occasional monadnocks. The highest surface is located in the South-Western part of the State and the lowest in the valleys of the Tungabhadra and Hagari rivers.

The study area is featuring marine, fluvio- marine, fluvial and denudational geomorphic unit. The eastern part forms the denudational hills of Western Ghats. The coastal lands form good aquifers and yield water in abundance.

Major morphometric/ morphotectonic units are coastal plains, a few small lateritic plateaus and the remaining areas are dotted with hillocks of both regional and structural types. Coastal plains covered with recently formed unconsolidated sand and clay are with high permeability and low in bearing capacity and poor in foundation characters, whereas crystalline rocks posses high to moderately high compressive strength and desirable foundation characteristics.

Sharavathi River is one of the west flowing rivers of Karnataka. The river basin comes under the two districts namely Shimoga and Karwar (called Uttara Kannada till recently). Two taluks in Shimoga district (*viz.,* Sagar, Hosanagara) and three taluks in Karwar district (*viz.,* Honnavar, Kumta, Siddapur) constitute the study area of the basin. The river rises at Ambuthirtha near Kavaledurga in Thirthahalli and flows in a northwesterly direction and receives Haridravathi river on the right (below Patterguppe) and Yenneholé on the left above Bharangi. Of a due course of 131 km in journey, the river receives a series if small tributaries like Nagodi, Kalkatte hole, Mavinahole, Hadinabal, Bhaskeri, Gudankatte hole, etc. Near the border of the Shimoga district, it bends to the west and hurls down near Jog from 255 m height. This river has a catchment area of approximately 2,784 sq. km. The river confluences the Arabian Sea at Honnavar in Uttara Kannada district.   The drainage pattern of the area is mainly dendritic, sub-dendritic and trellis (Figure 5.13).

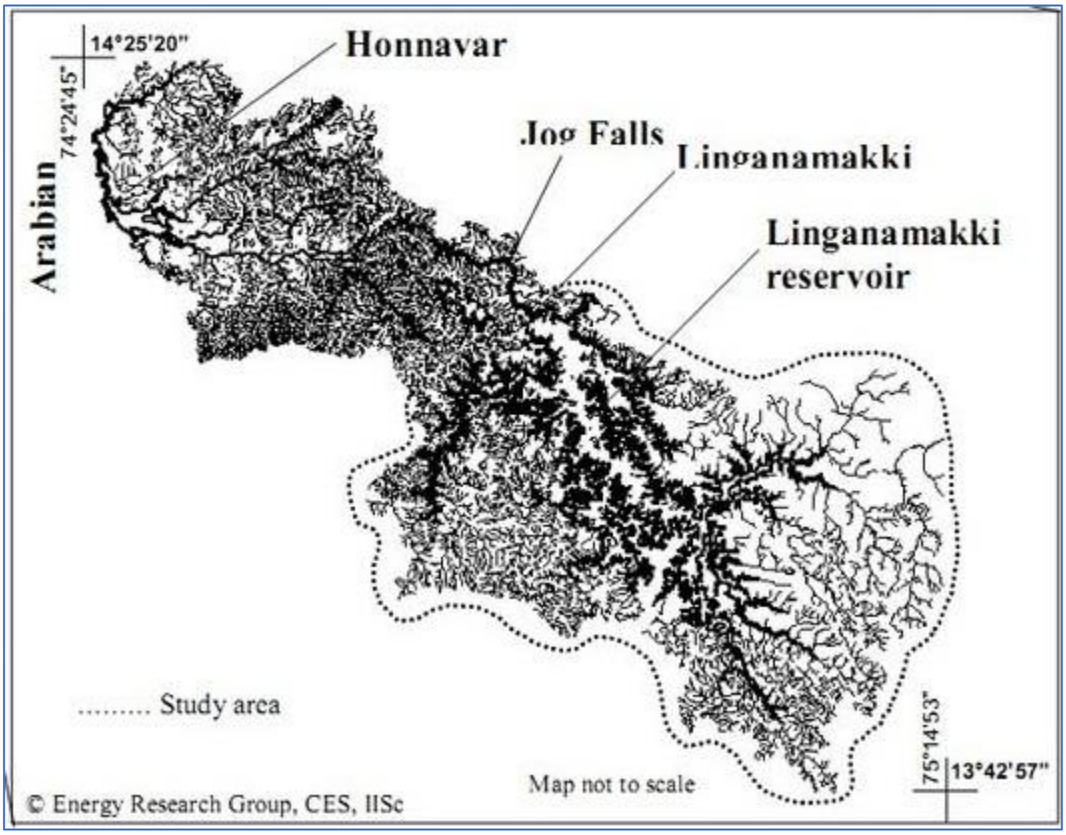


FIGURE 5.13: Drainage Network of River Sharavati

(Source: Sahyadri Conservation Series: 22, ENVIS Technical Report: 52, Nov. 2012)

5.14.3. General Geology and Stratigraphy

The rocks types of the district could be classified into (i) high grade schists of Sargur Group, (ii) migmatites, granites and gneisses of Peninsular Gneissic Complex and (iii) metal volcano-sedimentary sequence of Bababudan Group. Extensive lateritisation during the Tertiary Quaternary period has given rise to 15-20 m thick cappings of laterite on all the lithounits in the district. Coastal sands and "Teri" sands are seen in the coastal plains as parallel sand flats consisting of coarse sands mainly of quartz with limonite coating (Figure 5.14).

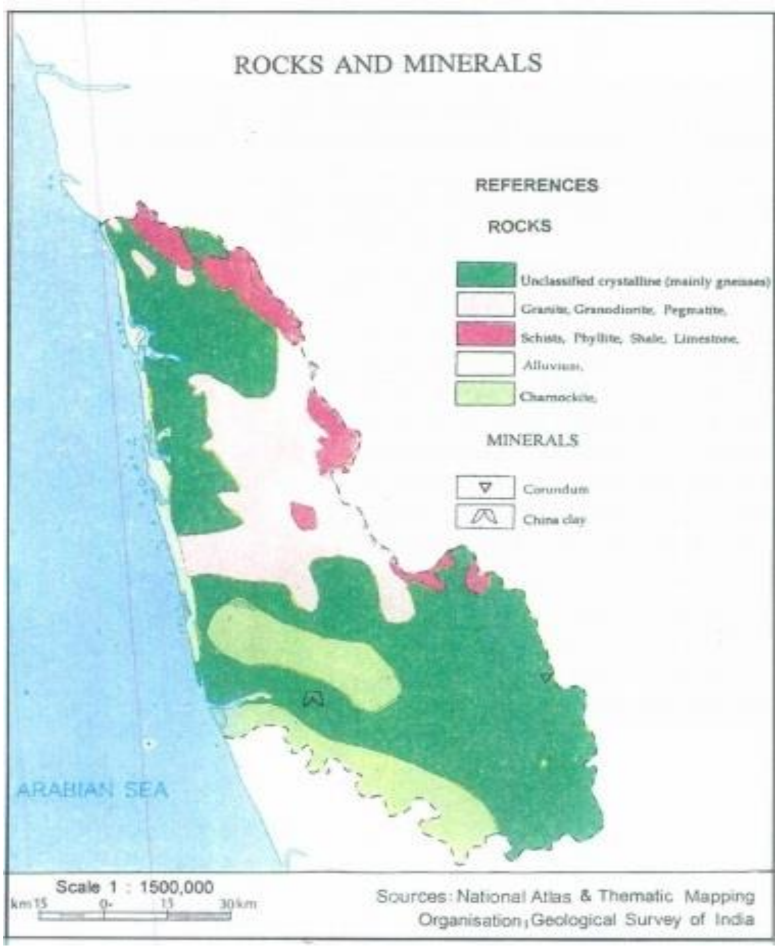


FIGURE 5.14: Rock and Mineral Map of Dakshin Kannada, Karnataka
(Source: National Atlas & Thematic Mapping Organisation, Geological Survey of India)

5.14.4. Sub-surface Investigations

TABLE 5-8 : Summary of Drill holes

Sl No.	Hole No.	Location	Drilled Depth (m)	Depth		Thickness (m)	Description of Strata	Remarks
				From (m)	To (m)			
1.	BSH-1	On Right bank of Sharavat River	18.00	0	10.35	10.35	Reddish silty Gravelly sand	
				10.35	14.95	4.6	Grayish Hard sandy clay	
				14.95	18.00	3.05	Grey, highly-moderately weathered Granite	

5.14.5. Geotechnical Results and Analysis

TABLE 5-9 : Summary of In-Situ Test Results

Sl. No.	Strata			SPT 'N' Value		CR %	RQD %
	Description	Depth					
		From	To	Observed	Corrected		
1	Reddish silty Gravelly sand	1.5	9.06	R	-		
2	Grayish Hard sandy clay	10.5	11.1	38	-		
		12.0	12.6	39	-		
		13.5	14.1	42	-		
3	Grey, highly-moderately weathered Granite	14.95	16.5	NA	NA	45	21
		16.5	18.0	NA	NA	67	22

5.15. Terminal Infrastructure including equipment

The land area for the proposed terminal infrastructure to be taken through Land acquisition. The land requirement with the requirement of facilities for the terminal has been worked out to 1928 Sq. m, which can be accommodated within the Land proposed to be taken on Acquisition.

Considering the Class IV waterway classification, Ferry facility shall be planned for the identified terminal location.

5.16. Berthing Structure

The berthing structures shall be designed such that they provide safe berthing of ferry/vessels without damaging the ferry/vessels as well as the structure. The requirements of the berth differ depending on the nature of traffic being handled at the berth. The size of the structure shall depend on the largest vessel likely to use the berth. The berth shall be designed for all possible loads that are likely to act on the structure as per BS 6349 & IS 4651. The total number of berths required for the proposed terminal shall be fixed based on tourist traffic, and water level variations.

- Deck Level

As per IS 4651 _IV, the deck level of the Ferry structure shall be fixed based on the variations in water levels during the monsoon and non monsoon season. Keeping this in view, the deck of ferry is maintained in a slope of 1:12, maintaining the deck level at the shore side at 1.0m above the MHWS /highest water level or to match with the existing ground elevations.

On the river side, the deck level is fixed maintaining under keel clearance of 0.5 m below the vessel. The position of vessel approaching the berth shall vary corresponding to the water depth available at site. The fixed ramp shall be submerged in water corresponding to the variations in water level available at site.

- Deck Dimensions

The dimensions of the berthing structure are decided on the basis of the dimensions of the largest vessel that are likely to use the terminal facilities as well as the function of the terminal. The sample vessel specification proposed for tourist mobility considered at the initial stage is as follows.

- For steel boat
  - i. Size (L x B x D) – 12m x 2m x 0.8m, 30pax
  - ii. Engine - 1 Marine Diesel Outboard Engines of 150 hp each.
- For FRP boat
  - iii. Size (L x B x D) – 12m x 2m x 0.5m, 30pax
  - iv. Engine - 1 Marine Diesel Outboard Engines of 120 hp each.

TABLE 5-10 : Salient Features of Berthing Pontoon

Description	Length(m)	Width (m)
Berthing Pontoon	30.0	8.0

The structural arrangement of the berthing pontoon including the preliminary design has been shown below in Figure 5.15.

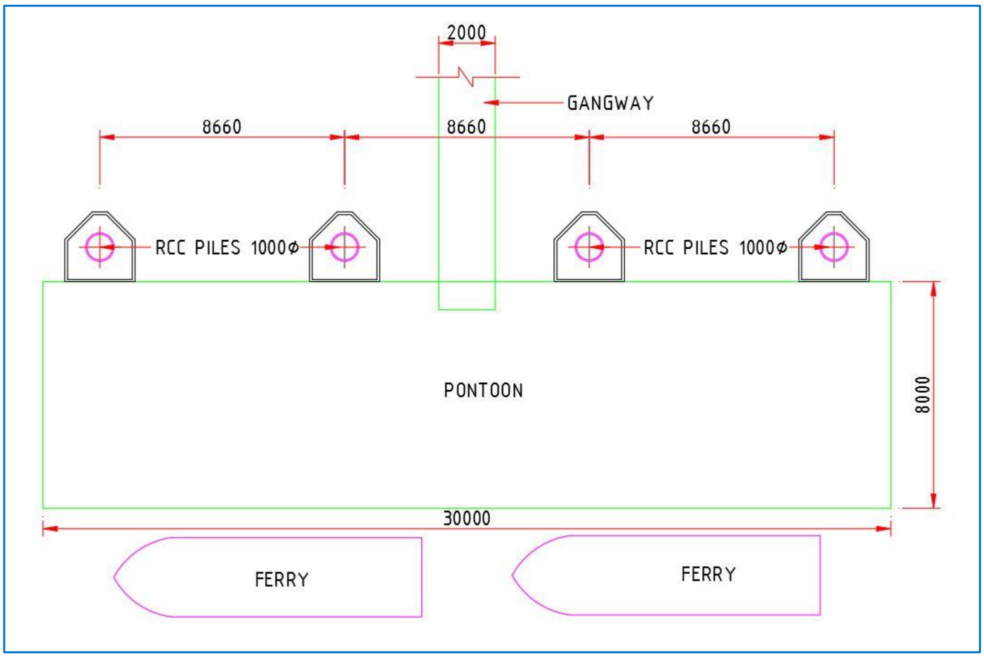


FIGURE 5.15: Structural Arrangement of Pontoon

The preliminary design has explained in the chapter 6. (Refer Volume-II Drawing No. P.010256-W-20309-A06)

Note: The above berthing structure has been considered based on the Preliminary Designs, as advised. Before taking up the work in the site, Detailed Engineering / Design are to be considered.

5.17. Terminal Costing

5.17.1. Capital Cost

The Capital Cost for the fairway has been considered in Chapter 11 along with the proposed development for Ferry Terminal facilities at the defined location. The Capital Cost of termainal works out to be about 8.95 Crores.

5.17.2. O&M Cost

The item wise Operation and Maintenance cost have been considered as per the circulated parameters, as defined by IWAI, which have been analyzed and considered. Some more assumptions have been considered appropriately, wherever required.

CHAPTER 6: PRELIMINARY ENGINEERING DESIGNS

6.1. River Training (including Barrages and Locks, if proposed)

River training covers those engineering works which are constructed on a river, so as to guide and confine the flow to the river channel. The river trainingworks may serve the objectives as below:

To prevent the river from changing its course and to avoid outflanking of structures like, weirs, aqueducts, etc.

To protect the riverbanks by diverting the river away from the attacked banks.

To ensure effective disposal of sediment load.

To provide minimum water depth required for navigation.

Barrages are the structures to be constructed to channelize the flow condition duly building up the water depths and controlling the flow according to the requirements in the downstream. For safe navigation with controlled discharges in the waterways, this ideology is applicable. However, the problem of difference in the depth due to the pondage etc., shall be considered by constructing a lock structure for safe passage of the vessels in this zone. This type of “Barrages & Locks” combination is a comparatively costly proposal and such proposals may not be found viable in normal conditions. If such construction has other concurrent advantages, may be economical. Further in the inevitable situation of crossing the deep depth variation, such crossings may be recommended.

6.1.1. River Training through Spurs

Spurs or Groynes are constructed transverse to the river flow extending from the bank into the river. This form of river training works performs one or more functions which includes training the river along the desired course to reduce the concentration of flow at the point of attack by deflecting high velocity flow away from the vulnerable bank. Effectively designed spur-dikes encourage sediment deposition between the spurs and consequently the re-establishment of an eroded bank line. Spurs structures restrict the width of a river channel in low flows, thereby improving its navigability. Different types of spurs are shown in the Figure.

Impermeable spurs do not permit appreciable flow through them whereas permeable ones permit restricted flow through them. Impermeable spurs are constructed of a core of sand or sand and gravel or soil as available in the river bed and protected on the sides and top by a strong armor of stone pitching or concrete blocks. Spur-dikes can be constructed from gabions mattresses which may be economical form of construction when the required stone sizes are available from the river bed.

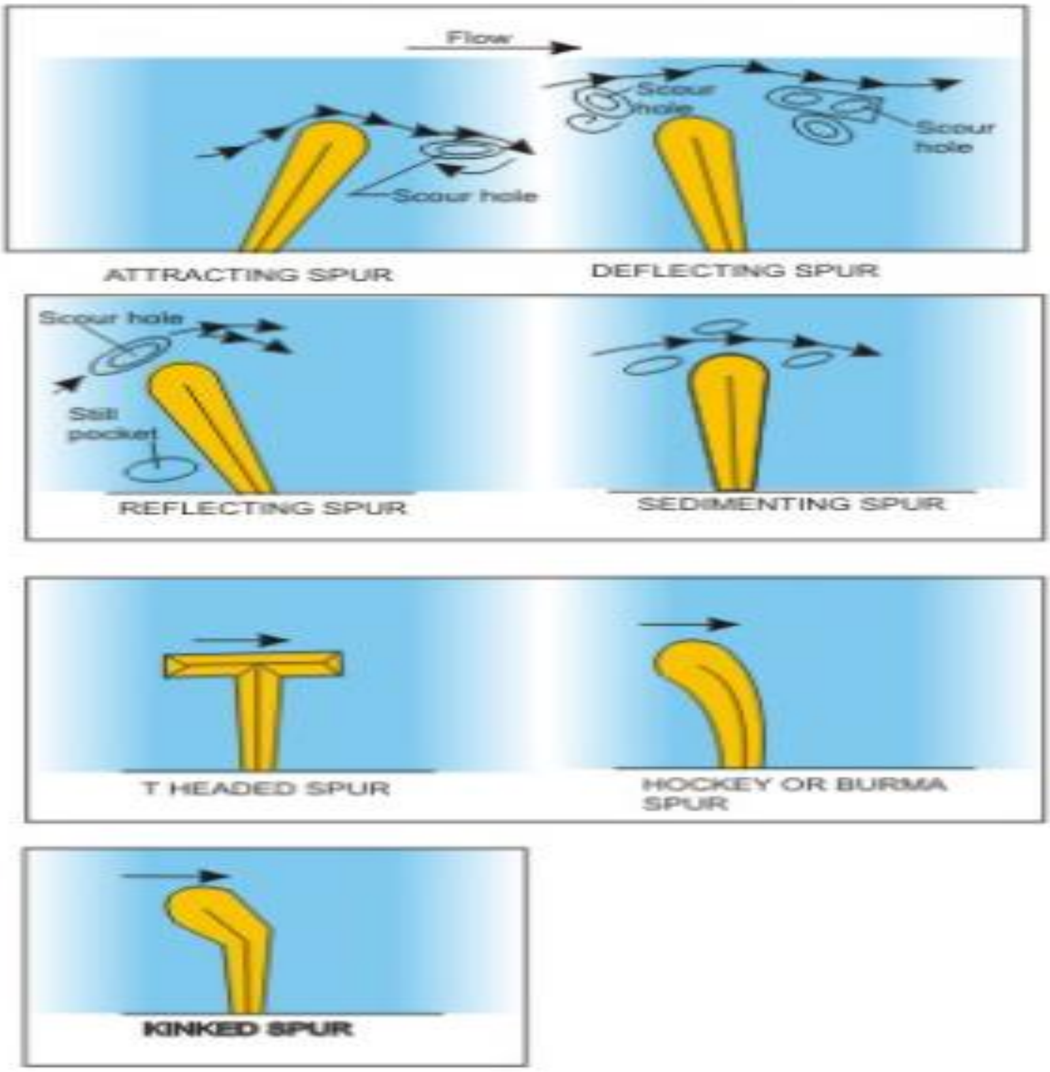


FIGURE 6.1: Different types of Spur

General Design Considerations

Layout of Spurs

Spurs are much more effective when constructed in series as they create a pool of nearly still water between them which resists the current and gradually accumulates silt forming a permanent bank line in course of time. In general, in the T-shaped spurs, greater length of the cross spurs projects upstream and a smaller portion downstream of the main spurs. Typical plan view of system of spur-dikes is shown in below Figure.

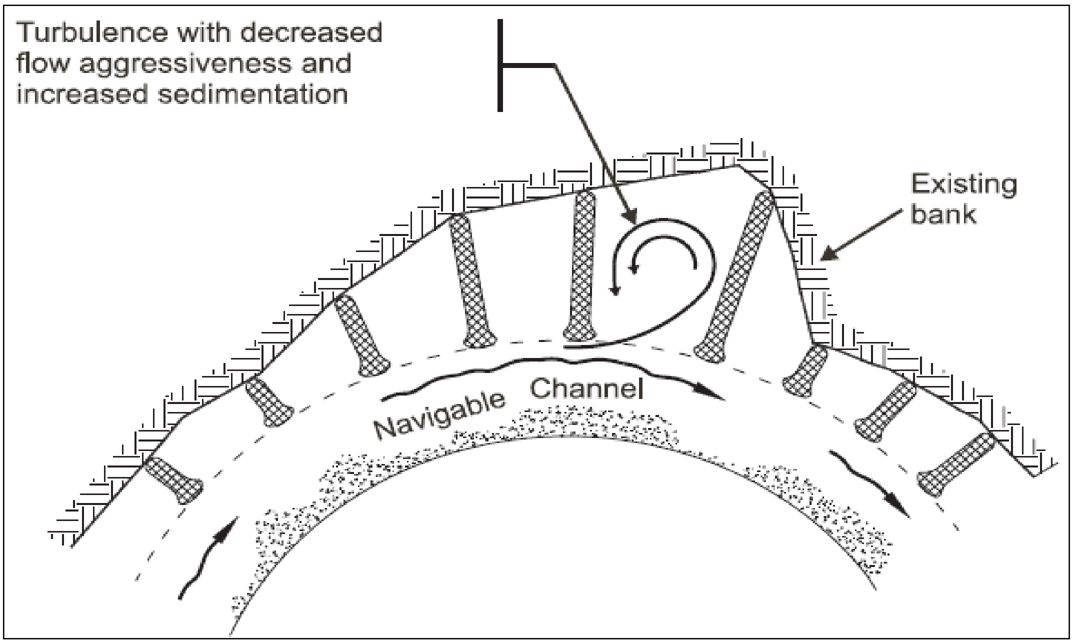


FIGURE 6.2: Plan view of system of spur-dikes constructed to control and stabilize the erosion of the outer band

Spacing

Each spur protects only a certain length. The stability of eddies is govern by the non-dimensional spur ratio, $e_{sp.}$, which is ratio of the head loss in the river between two spurs, $U^2 S_{SP} / (C^2 h)$ (m), to the velocity head $U^2 / (2g)$ (m) of the river.

Where,
U = depth-averaged velocity (m/s)
S_{SP} = spacing between spur-dikes (m)
C = Chezy coefficient of the river ($m^{0.5}$/s)
h = cross-sectional average water depth of the river (m)
$e_{SP} = (2g S_{SP}) / (C^2 h)$,
e_{SP} should never exceed 1.
For the navigational requirement
$S_{SP} / B = 0.5$ to 2
Where B= width of the constricted river (m) as shown in Figure below.

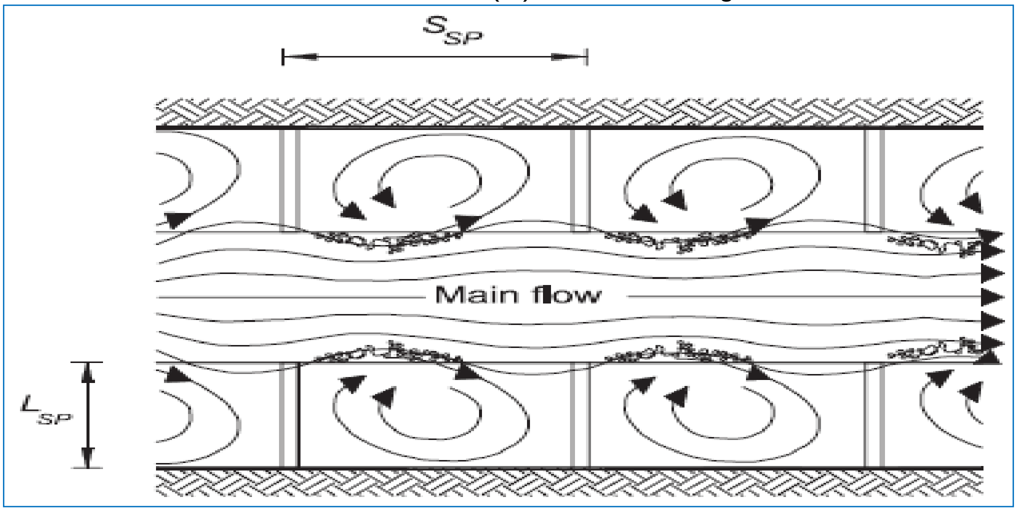


FIGURE 6.3: Diagram showing the length and spacing of the individual dikes with respect to the river width

In general, the prime factor for spur spacing between adjacent spurs is their lengths.

Generally, spur spacing adopted = 2 to 2.5 time the length of spur at convex banks and Spur spacing = Length of spur at concave banks

Length

The ratio of spacing of spur to its length (SSP / LSP) varies from 1 to 6.

Length of spurs depends upon the position of the original bank line and the designed normal line of the trained river channel. In erodible rivers, too long spurs may get damaged and cause failure. Hence, it is suggested / recommended to construct shorter ones in the beginning and extend them gradually, after due site observations.

Top width of spur

The top width of spur is kept as 3 to 6 m at formation level.

Free board

The top level of spur is kept with a free board of 1 to 1.5 m above the highest flood level for 1 in 500 years flood or anticipated highest flood level, whichever is more.

Side slope

Slope of upstream shank and nose is generally kept not steeper than 2:1. Downstream slope is kept which varies from 1.5:1 to 2:1.

Size of stone of pitching

Stones are placed over filters so that fines do not escape through the interstices of the pitching. For average velocity up to 2 m/s, burnt clay brick on edge are used as pitching material.

For average velocity of 3.5m/s, pitching of stone weighing from 40 to 70 km (0.3 to 0.4 m in diameter) and for higher velocities, cement concrete blocks of depth equal to the thickness of pitching can be used.

Thickness of pitching

Thickness of pitching is determined from the formula,

T = 0.06 Q 1/3,

Where, Q = design discharge in Cumecs.

Thickness of stone need not be provided the same through-out the entire length of spur. It can be progressively reduced from the nose.

Provision of filters

In general, Filters are provided below the pitching at nose and on the upstream face for a length of 30m to 45m from the nose. The thickness of the same may be 20 cm to 30cm. The thickness for the next 30m to 45 m on the upstream face may be reduced to about 15cm and beyond that, it can be omitted. However, may also refer the codal provisions, if available.

A typical layout of a spur is shown in Figure.

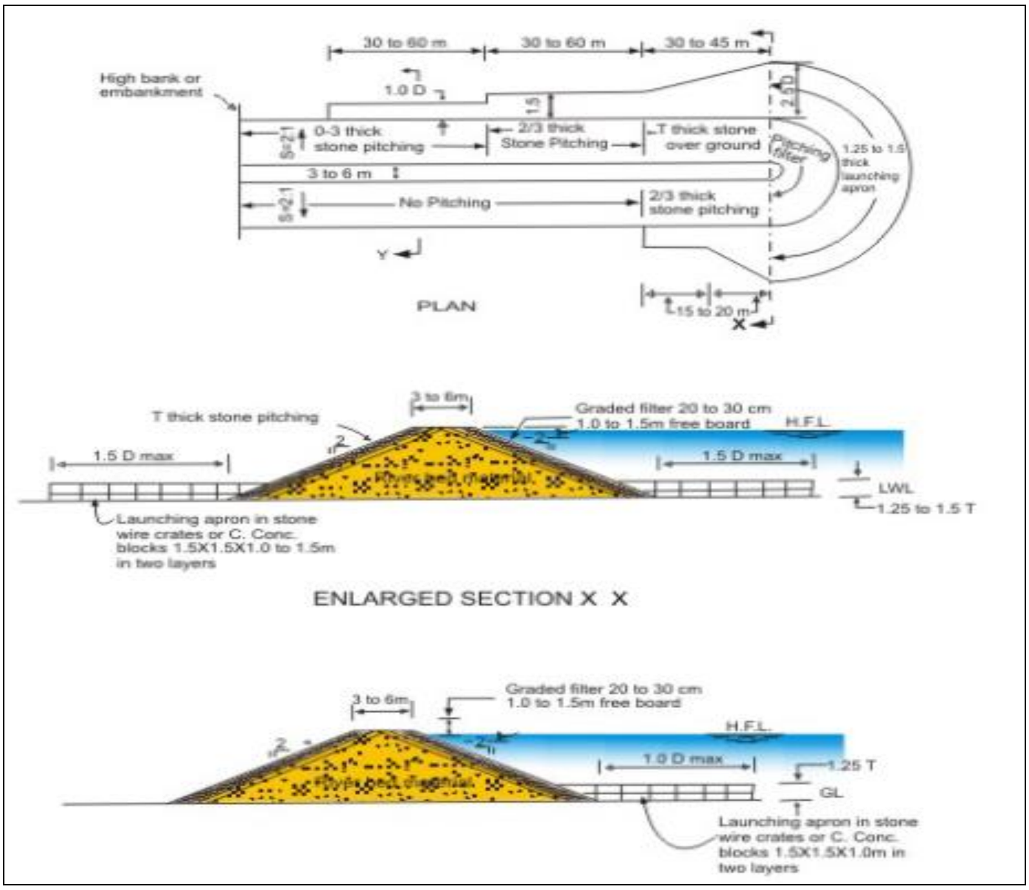
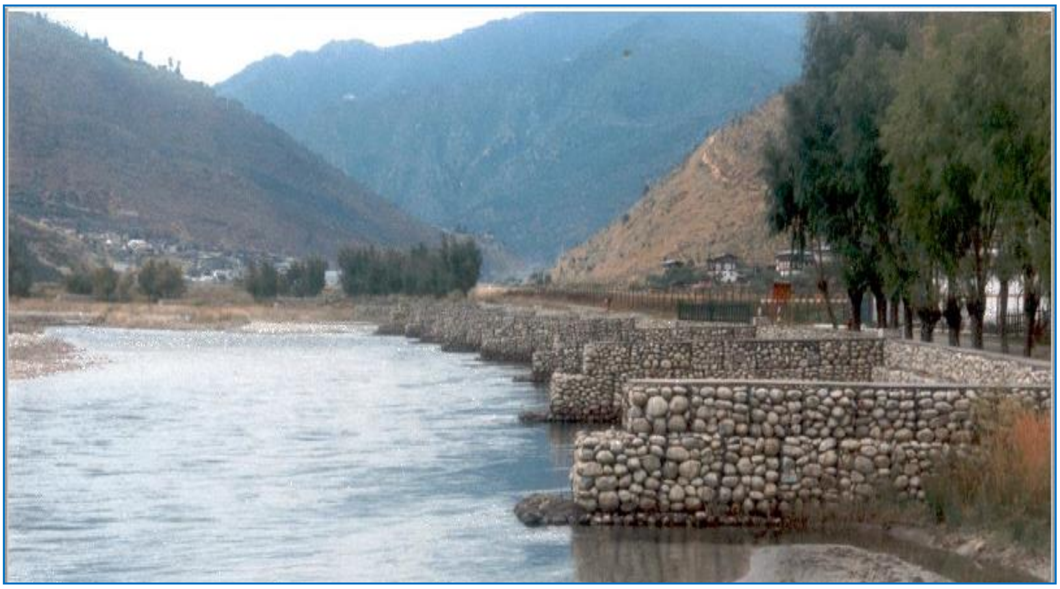


FIGURE 6.4: Typical layout and section of spur

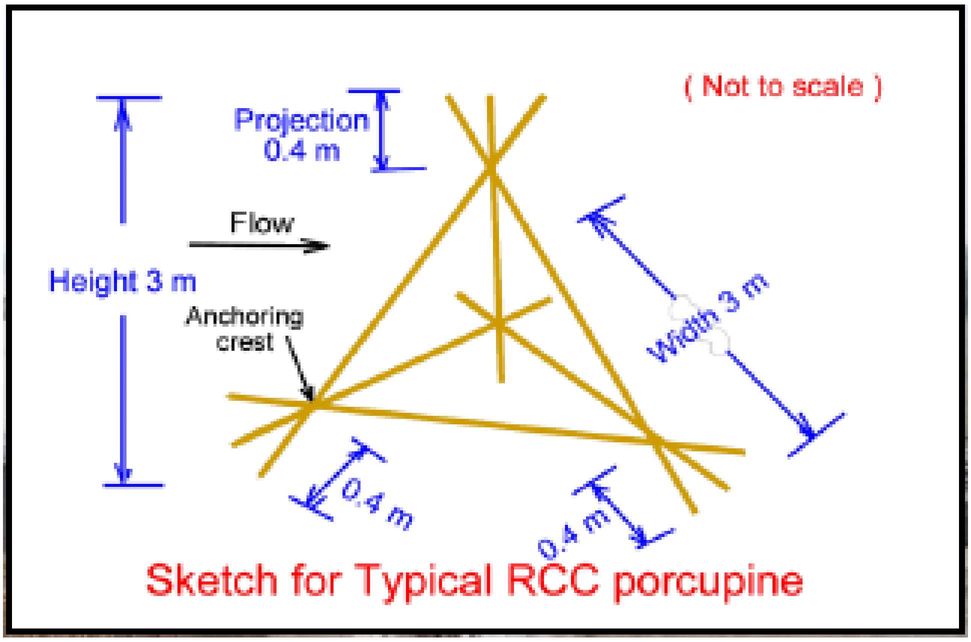
Impermeable spurs



Series of spurs

6.1.2. River Training through Porcupines

River Training through RCC Percupines are coming up nowadays and the same is under consideration on NW 1 for various activities including the Flood mitigation and taming of the river. Accordingly, the same also is under consideration for the study dtrech, wherein the Design and Photos are placed herewith.



6.2. Bank Protection

6.2.1. Basis of Design

The following specifies design principles, criteria and requirements to be taken into account for the design of the Bank Protection / Revetments.

All the banks are within a floodplain and made up by sand, silt and clay. This soil type may present different failure modes, such as scour, loss of fines, erosion, piping, etc. A special attention is to be paid to overall and local geotechnical failures. It is suggested to consider the required investigations at site and Detailed Engineering Designs etc., based on the soil parameters at the site.

There are many materials available in the market to be used for revetments, i.e., box gabions, block stone, cabled concrete blocks, dense stone asphalt, gabion mattresses, grouted stone, hand-pitched stone, in-situ poured concrete, loose concrete blocks, precast concrete slabs, open stone asphalt, soil reinforcement systems, etc. The selection of the type of material is based on a trade-off between hydraulic/geotechnical performances, construction related aspects (availability and supply, equipment and labor, access and infrastructure, etc.) and costs.

Gabion revetments at the site shall be considered in the present study stretch. As the gabions do not need special equipment nor high-skilled labour for execution, their maintenance is not cumbersome and further they are more durable and economical than geotubes or geobags.

A. Design Principles

Applicable Codes, Standards and Guidelines

The following national design guidelines shall be used while carrying out the design of the revetment and the embankment:

- IS1893 (Part1): 2002. Criteria for earthquakes resistant design of structures
- IS7894: 1975. Code of practice for stability analysis of earth dams
- IS8408:1992. Planning and design of groins in alluvial rivers
- IS10751:1994. Planning and design of guide banks for alluvial rivers
- IS12094:2000. Guidelines for planning and design of river embankments
- IS14262:1995. Planning and design of revetment guidelines
- IS11532:1995. Construction and maintenance of river embankments.
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London.

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180.

- PIANC (2014). Harbour approach channels design guidelines. Report no. 121.
- CIRIA, CUR, CETMEF (2007). The Rock Manual. The use of rock in hydraulic engineering (2nd

edition). C683, CIRIA, London.

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Francis Group, London & New York.

Lafleur, J. (1999). Selection of geotextiles to filter broadly graded cohesionless soils. Geotextiles and Geomembranes, 17(5), p. 299-312.

- BAW (1993). Code of practice - Use of geotextile filters on waterways. BAW, Karlsruhe.
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geotextiles for inland waterways.

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- EN 1997 Eurocode 7 – Geotechnical Design.
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race of manoeuvring ships. Publication no. 202, July 1978. Delft Hydraulics Laboratory.

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Brahmaputra at Jamuguri. *The Masterbuilder*, October 2013.

B. Design Vessel

Vessel features are important in the design because moving vessels induce waves and currents in the river, which are a hydraulic load on the bank and riverbed. These parameters will influence the design of the free board, the hydraulic stability of the structure and the size of the scour protection respectively for the revetments and the embankments.

C. Design requirements for Revetments

Gabions are wire mesh baskets filled with crushed rock. They are filled in situ, with locally available material and thus have a low capital cost. Because they are flexible and porous, they can absorb some wave and wind energy, thereby reducing the scour problems.

Gabions have been proposed as bank protection and shall be placed as sloping revetments with a preferable slope of 1:2.5.

(Refer Volume-II **Drawing No.P.010256-W-20303-X06** for details).

Subdivided into equal sized cells, standard gabion baskets are of thickness 1, 1.5 and 3 feet and are available in lengths of 6, 9 and 12 feet.

D. Filter

A geotextile filter is required to prevent the underline sand being washed out through the gabions.

E. Toe protection

To prevent the sliding and failure of the revetment on the slope, a toe protection is required.

F. Anchoring

Proper anchoring is required for keeping the revetment in place. For this purpose, the revetment will be extended both upstream and downstream.

Anchorage is required at the top of the submerged bank. It needs to be extended and anchored in the upper bank with a top key.

G. Hydraulic and Geotechnical Design

1) Revetment

a. Stone size

The minimum size of the stones should not be less than the ones specified in Figure. The figure is based on following assumptions:

- δ = friction angle between the geotextile bag surface and the subsoil, 20 degrees is recommended to be a conservative value;
- α = slope angle of the structure, because the slope angle is unknown, an assumption of 1V:2.5H is made;
- The specific gravity of the stones is 2.65.

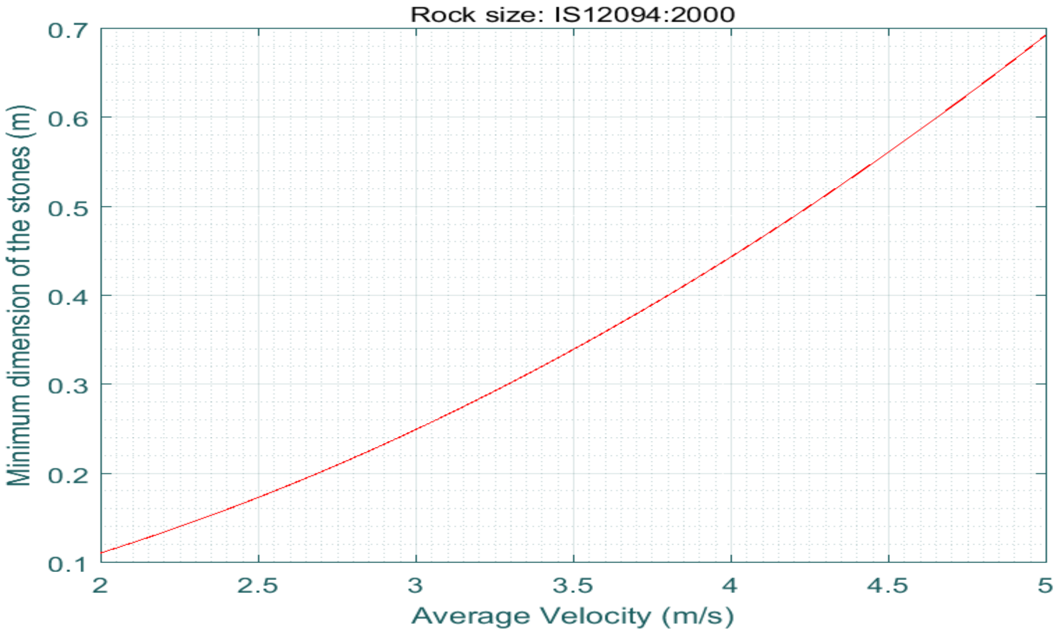


FIGURE 6.5: Minimum rock size according to the IS12094

From the above figure, it can be inferred that for average velocities higher than 3-4 m/s the rock size becomes very high. Under such circumstances small stones in crates or gabions are generally used. Therefore, the use of gabions is proposed as alternative for the revetment.

b. Gabion size

The formulation of Pilarczyk allows accounting for additional phenomena compared to the national codes (IS12094). This formulation is referred to standard guidelines such as PIANC. Therefore, it is proposed to use that formula to perform a sensitivity analysis and to include more local effects (like the turbulence expected in the bends, difference between continuous layer and edges/transitions and influence of the propeller jet). It should be kept in mind that near the terminal the river current and the propeller can act together, for that case the formulation can be expressed as:

$$\Delta D = \phi_{sc} \frac{0.035}{\psi_{cr}} k_s^{-1} \frac{(k_{h1} k_{t,r}^2 V_h^2 + k_{h2} k_{t,p}^2 V_r^2)}{2g}$$

Where:

- D = characteristic dimension/ thickness [m];
- Δ = relative density of the system (=1.17). According to the IS12094 the porosity for gabions can be computed as follows:

$$\Delta_t = (1-e)\cdot\frac{\rho_s-\rho_w}{\rho_w}$$

$$e = 0.245 + \frac{0.086}{D_{50}^{0.21}}$$

- D_{50}= mean diameter of the stones (= 0.30)
- *Sb* = Specific gravity of the stones, 2.65
- V_h = Maximum velocity of the propeller jet at the bottom [m/s];
- V_r = Maximum velocity of the currents at the bottom [m/s]
- ϕ = stability parameter, depending on the application (1, for gabions placed in edges or transitions and 0.75 for continuous top layer)
- Ψ = Shields parameter (0.07, gabions)
- $k_{t,r}^2$= turbulence factor of the river current (1.5 higher turbulence at river bends)
- $k_{t,p}^2$= turbulence factor of the propeller yet (3-4, load to the water jet)
- K_s = factor related to the slope angle

$$K_s = \sqrt{1-\left(\frac{\sin\alpha}{\sin\delta}\right)^2}$$

- *δ* = friction angle between the gabion surface and the subsoil, 20 degrees is recommended to be a conservative value (for rip-rap is equal to 40 degrees)
- *α* = slope angle of the structure, because the slope angle is unknown, an assumption of 1V:2H is made
- K_{h1} = factor related to the depth (1 for a very rough current). This factor translates the depth-averaged flow velocity into the flow velocity just above the bottom protection. The roughness of the gabion depends on the stone size and the height of the gabion, among other things. Therefore, a value of 1 is chosen as a very conservative value to account for uncertainties in the vertical velocity field distribution and the roughness of the gabion.
- K_{h2} = factor related to the depth. For propeller jet PIANC (2016) recommends using 1

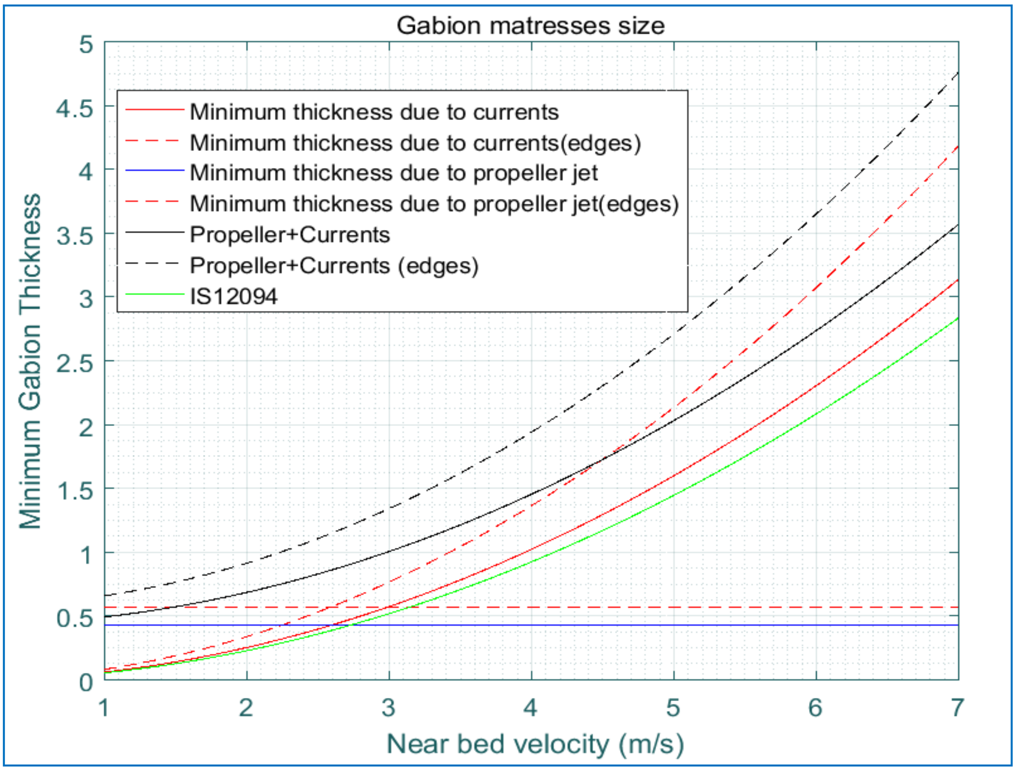


FIGURE 6.6: Minimum required thickness for revetment

The values given by Pilarczyk are chosen for the design since they allow for certain optimization. It should be noticed that, when changing slopes, the thickness of the gabion mattresses should be increased to account for the effects of the turbulence present on the transitions. The scour protection is considered as an edge of the revetment because high turbulence is also expected.

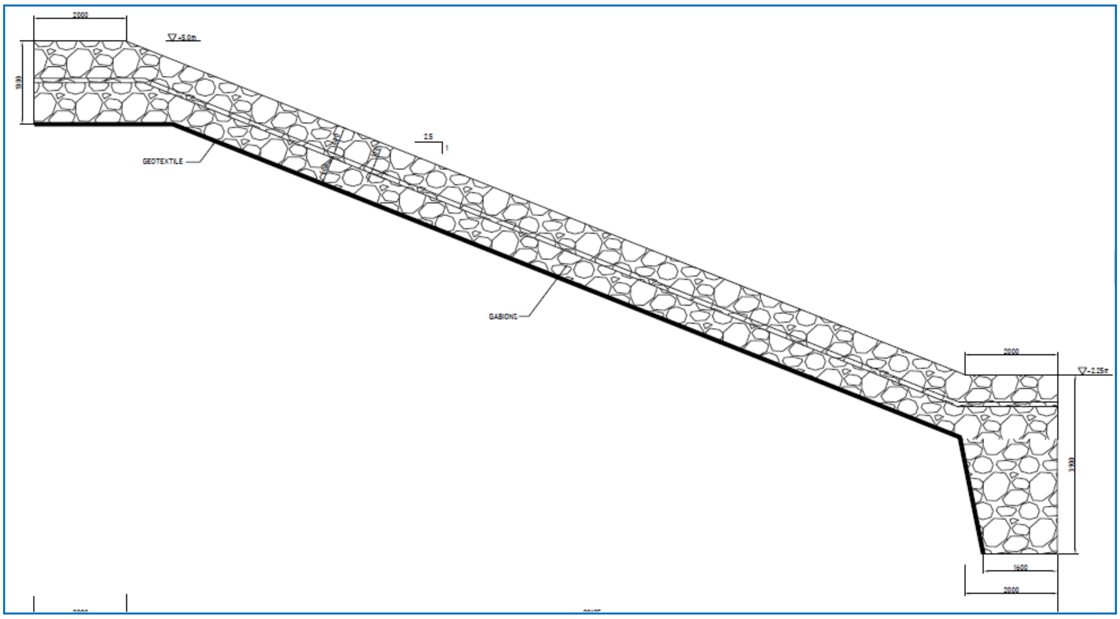
It is expected that the waves / currents calculated in section will not have any impact in the design. For revetments the required thickness to withstand wave / current loads can be worked out with next conservative formula (Klein & Pylarczyk, 1998):

$$\frac{H_s}{\Delta D} = \frac{9\cos(\alpha)}{\varepsilon_{op}^{2/3}}$$

- *D* = characteristic dimension/ thickness [m];
- Δ = relative density of the gabion
- *α* = slope angle of the structure, because the slope angle is unknown, an assumption of 1V:2.5H is made
- ε_{op}= Breaking parameter

$$\varepsilon_{op} = \frac{\tan(\alpha)}{\sqrt{\frac{H_s}{1.56Tp^2}}}$$

The proposed bank protection as derived from various design assumptios are shown in **Figure** below.



The maximum velocity during the high tide is recorded as 4.0m/s as mentioned in Table 2.5 and therefore the minimum proposed thickness of the Gabian is 1200 mm having two layers of rock each of 600mm to enhance the effectiveness overlain on a slope of 2.5H:1V. The whole arrangement is once again overlain on geotextile.

Geotextile filter layer shall prevent the underline sand & fine materials being washed out through the gabions. The minimum rock size for the gabions shall be 0.4m. Assumptions have been taken for the calculation of the velocity and turbulence factors applied for the river currents. Standard gabion baskets are of thickness 1, 1.5 and 3 feet and the length size of 6, 9 and 12 feet however these are intertwined with linking wire of the same material.

c. Rock specifications

It is proposed to use a light grading which is appropriate for amour layers produced in bulk, usually by crusher opening. The size of the stone should be such that its length, width and thickness should be more or less the same. Round stones or very flat stones having small thickness should be avoided.

Standard grading should be used whenever possible. Determination of the gradation of the granular material is important for a number of reasons: 1) the packing and the volumetric layer porosity depend on the overall slope of the grading curve, 2) phenomena such as filtering and piping are governed by the gradation.

In Table 6.1 Some assumption for the rock grading are shown according to EN13383. Different rock layers are required to fill a determined gabion. In this sense the same table provides guidance on the number of layers needed to fill a gabion.

TABLE 6-1: Typical Values for a grading of 10 to 60 Kg 1(following EN13383)

Grading (kg)	ELL	NLL	NUL	EUL	D_{n50}	D_{50}	Kt	nlayer	Ltmin
10-60	2	10	60	120	0.25	0.30	0.96	1	0.24
10-60	2	10	60	120	0.25	0.30	0.96	2	0.48
10-60	2	10	60	120	0.25	0.30	0.96	3	0.73
10-60	2	10	60	120	0.25	0.30	0.96	4	0.97
10-60	2	10	60	120	0.25	0.30	0.96	5	1.21
10-60	2	10	60	120	0.25	0.30	0.96	6	1.45

The major consideration in the design of gabion structures is the expected velocity at the gabion face. The gabion must be designed to withstand the force of the water in the stream. However, the median stone size for gabion mattresses has to be in such a way that movement of the filler stone in the mattresses is prevented. This eliminates deformation that can occur when stone sizes are not large enough to withstand the forces of the water. The result of mattress deformation is stress on the basket wire and increases the resistance to flow and the likelihood of basket failure. A recommended value of a d_{50} in function of the water depth depends on manufacturer experiences; however, some formulas are available in the literature (Gary E.F, J. Craig, 2000):

$$d_m = S_f C_s C_v d\left[\left(\frac{\gamma_w}{\gamma_s - \gamma_w}\right)^{0.5} \frac{V}{\sqrt{gdK_1}}\right]^{2.5}$$

Where:

- C_s = Stability coefficient (= 0.1), C_v = Velocity coefficient (= 1.25), S_f = safety factor (= 1.1)
- d_m = average rock diameter in gabions
- d = local flow depth at V
- V = depth average velocity (= 4 m/s)
- γ_s = unit weight of stone (2650 kg/m^3)
- γ_w = unit weight of the water (1000 kg/m^3)
- K_1 = side slope factor (= 0.98 for a slope of 1:3)

Figure below shows that for a medium stone diameter of 0.3 m and for the design velocity of 2.5 m / sec, the grading 10-60 kg is suitable.

[1] *G=Grading Denomination, ELL= the mass below which no more than 5 per cent passing by mass is permited, NLL= the mass below which no more than 10 per cent passing by mass is permited, NUL= the mass below which no more than 70 per cent passing by mass is permited, EUL= the mass below which no more than 97 per cent passing by mass is permited, Dn50=Maximum Foreseen medium nominal diameter, D50= mean stone diameter (D50=Dn50/0.84), Kt= Layer thickness coefficient, Lt= layer thickness*

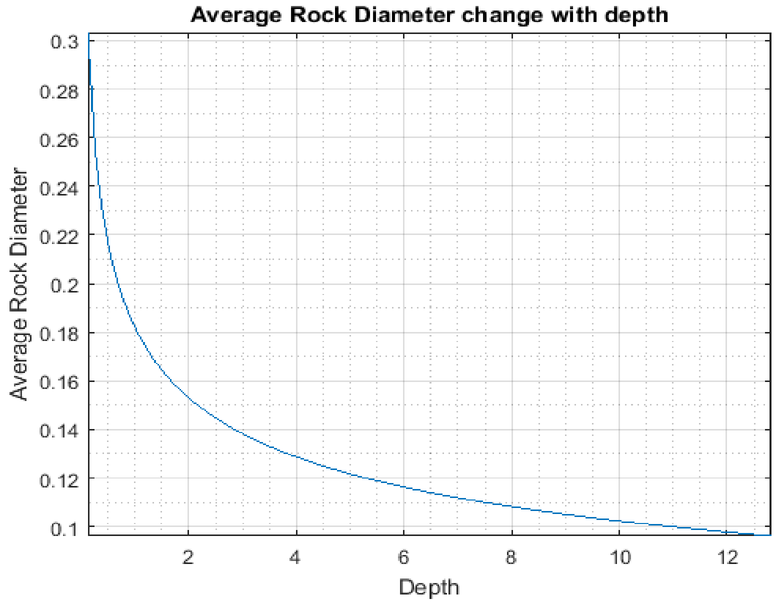


FIGURE 6.7: Minimum average rock diameter

The table below shows the properties from a well-known supplier (Maccaferri, 2014) for a durable stone fill for gabions:

TABLE 6-2: Technical specs for stone fill for gabions

Property	European standard references	Suggested requirements
Mechanical strength	Los Angeles, LA (EN 1097-2:1998) Fragmentability, FR (EN 1097-2:1998)	LA < 45 or LA > 45 and FR < 7
Resistance to attrition	Micro-Deval (EN 1097-1:1996) Fragmentability FR (EN 1097-2:1998)	MDE < 45 or MDE >45 and FR < 7
Resistance to freeze and thawing	EN 13383-1:2002	Category for FT_A (as assessed by loss of mass during testing): Loss of mass < 0.5%
Density of rock	EN 13383-2:2002	Apparent density > 2.2 t/m3
Amour stone grading	EN 13383-1:2002	CP90/180 or equivalent
Type of rock	Petrography	Calcareous, siliceous, metamorphic or igneous rock

d. Gabion specifications

The gabion basket is a double twisted wire mesh of variable sizes, uniformly partitioned in cells. A typical gabion has dimensions of 2 m length x 1 m width x 1 m height and comprises of a mesh type 80 mm x 100 mm. At the terminals, a mesh of 80 mm x 100 mm and a height of 1.4 m is proposed.

A gabion mattress consists of gabions with relatively small height dimensions compared to length and width and would usually be of a smaller mesh type. A typical gabion mattress would have dimensions of 6 m length x 2 m width x 0.6 m in height and comprise mesh type 60 mm x 80 mm. At the terminals, a mesh of 60 mm x 80 mm and a height of 1-1.4 m is proposed.

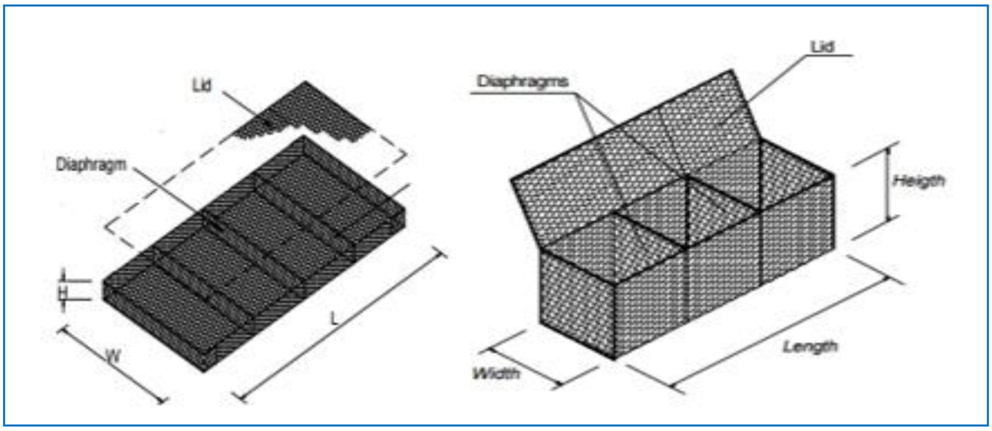


FIGURE 6.8: Example of a gabion mattress and gabion basket

According to IS14262:1995 gabions should be laid with the longer dimension along the slope of the bank. The size of the mesh of the crate should be smaller than the smallest stone in the crate. The mesh should be double knotted. Wire of minimum diameter of 4 mm should be used for crates. Crate units may be tied to each other by 5 mm wire.

A summary of the relevant European standards for gabions are given in table below, some suggestions are cited following the recommendations of the Rock Manual (CIRIA et al., 2007). Notice IS rules are stricter than EN for wire minimum diameter and those should be respected.

TABLE 6-3: European standards for the wire mesh

Wire Properties	European testing	Content
Steel wire compositio	EN 10218-2:1997	Steel composition, strength
Steel mesh composition	EN 10223-3:1998	Mesh 60 mm x 80 mm wire: d = 2.2 or 2.4 mm Selvedge wire= 2.7 mm Mesh 80 mm x 100 mm wire: d = 2.7 mm Selvedge wire = 3.40 mm
Corrosion protection (galvanising)	EN 10244-1:2001 EN 1024402:2001	Thickness of the coating conforms to class A, mass of coating mc, depends on wire diameter: d = 2.2or 2.4 mm, mc = 23- g/m^2 d = 2.7 mm, mc = 245 g/m^2
Corrosion protection (polymer coating)	EN 10245-1:2001 EN 10245-2:2001 EN 10245-3:2001	Requirements for organic coating, PVC or PE, thickness, composition, strength durability, flexibility
Tensile strength	EN 10223-3	60 mm x 80 mm: Tensile = 35 kN/m 80 mm x 100 mm: Tensile = 51 kN/m
Elongation	EN 10233-3	Elongation shall not be less than 10%

6.3. Ferry Terminal Design

6.4. Basic Design Criteria

Units

The international system of units (S.I.) shall be used for the design of all items unless specified otherwise.

Design Life

The design life of all the components of the riverine structures are described in Table 6.4 along with relevant maintenance criteria.

TABLE 6.4: DESIGN LIFE AND MAINTENANCE INTERVALS

Structural Component	**Design Life**
Reinforced concrete structures	50 years
Concrete Piles	50 years
Aluminum gangway	50 years
Berthing pontoon	25 years
Fenders and bollards	8-10 years
Buildings	50 years

Ferry Dimensions

Dimensions of the largest ferry considered in the planning and design of the infrastructure are given below:

- Length : 12.0 m
- Breadth : 2.0 m
- Laden Draft : 0.80 m

6.4.1. Water levels

Estimation of HFL at Gerusoppa Ferry Ghat

- HFL observed at downstream of Gerusoppa Reservoir is = 3.13 m

6.4.2. Levels for structures used in design are as follows:

Building Floor Level	+4.10 m RL
Top of Bank Sheet	+3.50 m RL
Gangway caters for differential flood levels in a slope of	1 in 12
Building levels	Refer drawing Volume-II Drawing No. **P.010256-W-20364-A06**

6.4.3. Current Speed

The velocity distribution near the terminal location is maximum in the range of 2.6 m/s, therefore, the design velocity has been taken accordingly.

6.4.4. Topography

Topographic survey has been carried out in the location of the proposed terminal. Average existing ground level in the terminal area varies from +2m RL (approx.) to +3.5mRL (approx.).

6.4.5. Bathymetry

The bathymetric survey in the terminal location depicts that the riverbed level varies from +2 m RL (approx.) at landfall point to +3.5 m RL (approx.) at berthing pontoon location.

6.4.6. Seismic loading

Earthquake loads shall be adopted as applicable for the site as per IS 1893 – 2002. The river falls under Zone III, as per the seismic map of India shown in IS 1893-2002. Design horizontal seismic coefficient shall be evaluated as per procedure detailed in IS 1893-2002. The horizontal seismic coefficients are as follows:

TABLE 6-4: Seismic Loading

Seismic zone	III
Design horizontal seismic coefficient, Ah	Z I (Sa/g)/ (2R)
Zone Factor Z	0.16
Importance factor, I	1.5
Response Reduction Factor, R	3 (for ordinary RC moment resisting frame)
Average response acceleration coefficien Sa/g	Depending on time period of structure

Time period of specified structures shall be evaluated by STAAD analysis considering Dead Load + 50% Live load.

6.4.7. Scour

The scour depth has been estimated as below:

Design discharge adopted Q = 5340 m3/s

Particle size, D50= 0.3 mm

Silt factor, f= 1.76 * Sqrt (D50) = 0.964

Lacey's regime scour depth = 0.473 * (Q/f) (1/3) = 8.34 m

Scour depth from HFL= 2*8.34= 16.68 m

HFL= 5.5 m (amsl)

Scour Level from Lacey Regime depth formula= 5.5 -16.68 = -11.18 m

Existing bed level close the location = +2 m

Scour level calculated from Lacey's regime depth formula = -11.18 m is adopted.

The design scour level = -11.18 m

The pile termination level is kept at -16.0m which will provide a 5.0m developmental length having socketing arrangement with surrounding rock.

6.5. Materials of Construction

6.5.1. Concrete

The reinforced concrete member sizes considered for all the components of the riverine and landside infrastructure works shall comply to minimum dimensions prescribed in Fig. 1 of IS 456-2000 for a fire resistance of 4 hours. The following grades of concrete shall be used for construction of precast / cast-in-situ concrete components:

Sr. No	Members / Components	Proposed Grade of concrete
1	Piles	M25
2	Beams & Deck slab for superstructure of approach bridge and dolphins	M25
3	Buildings	M20

Partial Safety Factor γ_m for Material Strength

- Concrete $\gamma_m = 1.50$
- Reinforcement $\gamma m = 1.15$

Reinforcement

Main reinforcement steel shall conform to [Fe 500 (IS 1786)] TMT, 500 S with low alloy steel grade. Strength parameters shall be as follows:

- Minimum yield stress (Main steel) : 500 N/mm²
- Elongation (min) : 18 %
- Secondary steel shall be HYSD : 500 N/mm2 (confirming to IS 1786)

Cover to Reinforcement

The nominal cover to reinforcement for all reinforced concrete members complies with Fig. 16A of IS 456-2000 for a fire resistance of 4 hours. Nominal cover to be followed are as shown below:

Riverine Structures:	Prescribed Parameter
Piles and Pile caps	75mm
Deck slab	50mm
Beams	50mm
Landside Structures:	
Superstructure	45mm
Substructure	50mm

Structural steel

The grade of structural steel considered for pontoons, linkspans and other superstructures shall conform to Grade 250 as per IS;2062 with a minimum yield strength of 250 N/mm^2. However, the structural steel shall conform to Grade E275BR as per IS: 2062 with minimum yield Strength of 275 N/mm^2 for steel tubular piles.

6.6. Design of Riverine Terminal Infrastructure

The layout and components of the riverine infrastructure have been planned and the structural design of these components follow the design basis described below with the methodology adopted for the analysis and design of each component of the riverine infrastructure based on the Preliminary Designs, as advised. Before taking up the work in the site, Detailed Engineering / Design are to be considered.

RCC bored piles with sacrificial MS liners installed vertically.

6.6.1. Berthing pontoons

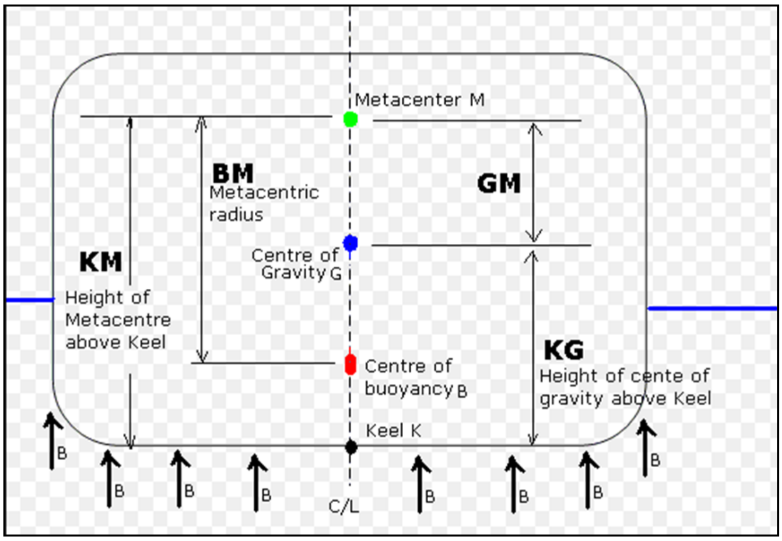
One berthing pontoon, has been planned at Gerusoppa terminal location having floating arrangement, shall be of structural steel with the following minimum requirements.

- 30m x 8m in plan
- Deck stiffened for uniformly distributed load of 5kN/m2.
- Deck of high yield steel plate of at least 10mm thickness.
- Pontoon to be divided into buoyancy chambers, all with sealed access hatches.
- Gangway to be placed to approach the Pontoon having vessel ramps to accommodate angle variations.
- As a result of current forces, Guide frames with piles to hold the pontoon
- Lifesaving equipment, safety ladders and fire control for small fire
- 1 No. Potable water hydrants.

• Water jet system to be installed beneath pontoon to prevent silt build up.
• 15year protective paint system to all steel-work.
• Fitted with sacrificial anodes (near low water mark) with 10yrs life
• 20lux lighting mast illumination
• The walking/bike lane surface preparation on top of gangway shall comprise of anti-skid high
• grade abrasion resistant polyurethane resin based designed to give strength, flexibility and long-
life durability of minimum 5 years duly approved by engineer in charge.
• Safety restraints to IRC guidelines
• Fresh water hydrants for Ferry and also for washing the pontoons.

The floating stability of the pontoon has been checked for 8m (width) and 30 m (length) of the pontoon. The loads including self-weight and live loads of 5 kN/m^2 have been considered in two load cases, with live loads on half the cross section (load case 1) and live loads fully loaded (load case 2). The metacentric height (> 0), the max angle of heel (10°) and minimum freeboard (>0.3 m) of the pontoon have been checked to be within the permissible limits.

The Metacentric height is a measure of the vessel's stability under small heeling also called the initial stability. The higher the value of GM, the better the vessel's initial stability. Thus, harder it is to get the vessel to heel.



Floatation Stability Calculations

A 3-D model of guiding pile for Berthing pontoon is prepared in STAAD-Pro software and linear elastic analysis is carried outfor the following loads:

- Dead load
- Live load
- Wind load
- Current load (on the structure and on the berthing pontoon)
- Seismic load
- Berthing reaction onto the pontoon

. Logical combinations of the above loads in line with the IS 4651 Part IV are used to obtain the results of the analysis.

The following figure shows the 3D analysis model prepared in STAAD-Pro.

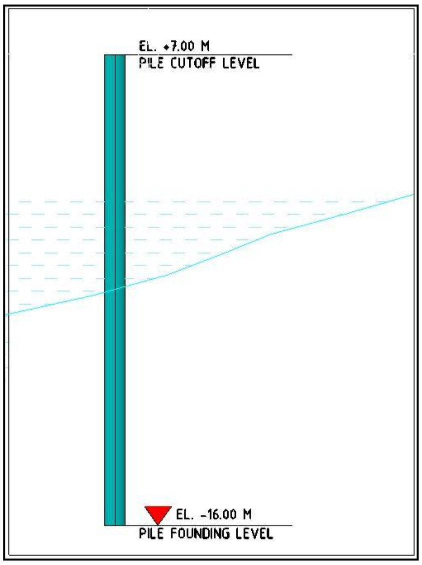


Figure 6-9: STAAD-Pro analysis model of pile for berthing pontoons

Reinforced concrete member sizing and design are carried out by Limit State approach as laid down in IS 456.

6.6.2. Gangway

The gangway bridges the gap between the two structures i.e. bankseat & berthing pontoon. The gangway shall be aluminum structure and shall cater for the differential level between the bankseat and berthing pontoon during high and low water levels, by adjusting in a slope of 1 in 12. Only one gangway spanning 26.0m is proposed for this riverine infrastructure development with detail as below.

Table 6-5: SALIENT FEATURES OF GANGWAY

Sl No.	Location	Span	Width
1	Gangway	26 m	2.0m

The gangway shall be of aluminum structure with the following minimum requirements.

- Aluminum gangway bridge having built up sections.
- Deck stiffened for a uniformly distributed load of 5 kN/m^2.

- The ends of gangway should be equipped with hinge and roller support at either ends to ensure that gangway bridge adjusts to a slope in case of lowering of berthing pontoon.
- The walking/bike lane surface preparation on top of gangway shall comprise of anti-skid high grade abrasion resistant polyurethane resin based designed to give strength, flexibility and long-life durability of minimum 5 years duly approved by engineer in charge.
- Service lines to run down link-span for potable water, electrical supply and communications.
- Safety restraints to IRC guidelines

The gangway bridge design allows for the movement of berthing pontoon and subsequent transfer of vertical, horizontal and rotational loads into the bridge through a pinned hinge with the others free to slide horizontally and pivot through the vertical. Based on the preliminary design specification the fabricated aluminium gangway will be supplied by the vendor.

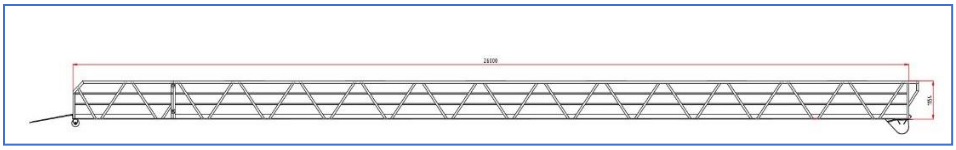


Figure 6-10: Elevation of Aluminium Gangway Span of 26.0m

The member section properties will be consider for fabrication of of the aluminium gangway is shown in thefigurebelow:

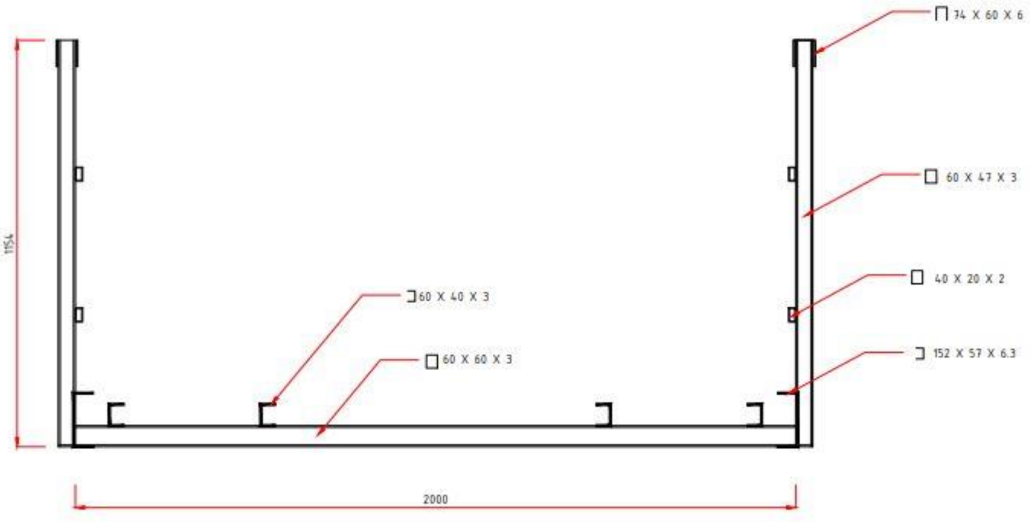


Figure 6-11: Section properties of member components of Aluminium Gangway

Table 6-5: Section properties of member components of aluminium gangway

SI No.	Type of Section	Section Property(mm)
1	Channel	60x40x3
2	Box	60x60x3
3	channel	152x57x6.3
4	Box	40x20x2
5	Box	60x47x3
6	Channel	74x60x6

6.7. Construction Schedule

Construction schedules of different structures will be discussed and elaborated as a part of the implementation schedule in the appropriate chapter.

CHAPTER 7: VESSEL DESIGN

7.1. General Review

There does not exist any opportunity for cargo transportation on river Sharavati due to unavailability of industrial development in the region. Development of River Sharavati (NW-90) may be considered for Tourist and Passengers. Passengers use ferry boat to cross over river. Ferry services along river for tourism and passengers have been proposed. Two terminals have been proposed for alongside movement of ferry boats at Honnavar and Gerusoppa. Gerusoppa terminal is proposed on the Right bank of river and Honnavar terminal (upcoming Hannovar Port shall serve the berthing terminal) is located on the left bank of the river.

Tourists would use IWT service for along the river movement i.e. between Honnavar and Gerusoppa. River Sharavati (NW-90) attracts tourists for its scenic beauty. The entire river stretch is surrounded by green hills and valleys covered with thick forests. Tourists would use proposed IWT service on River Sharavati (NW-90) for touring around and grab an opportunity to have a closer look at beauty of nature by sightseeing. There exist small ferry services at few locations for river crossing. Local residents would continue to use existing infrastructure, additional infrastructure development is not required for across the river movement. A well-developed road runs parallel to entire stretch of river.

The predominant factors in vessel designing are Fairway and Traffic i.e., the Fairway availability, Traffic Type and Volumes to be handled and transported. The Fairway details have been discussed in Chapter 03 and the IWT Traffic scenario has been discussed in Chapter 04. The present status on the vessels plying in the study stretch have been collected and placed in chapter 4.

7.2. Design Basis

Vessel design is usually influenced by the factors like traffic type and density, channel type and characteristics, flow current, operational and navigational factors, etc. The selection of vessels for River Sharavati (NW-90) has been made using traffic type and volume. Higher traffic / volumes and lower transport cost induce need for larger vessels or deployment of smaller vessels in several numbers.

Vessel Classification adopted in Indian Inland Waterway

Ministry of Shipping and Inland Waterways Authority of India has classified the Inland waterways into seven categories for rivers and canals for safe plying of self-propelled vessels (Ref: IWAI, Gazette Notification 2006). The classification criteria of waterways are mentioned in **Table 7.1** for Rivers.

TABLE 7-1: Classification of Inland Waterways for Rivers

Class of Waterways	Rivers				
	Min. Depth (m)	Bottom Width (m)	Bend Radius (m)	Vertical Clearance (m)	Horizontal Clearance (m)
I	1.2	30	300	4	30
II	1.4	40	500	5	40
III	1.7	50	700	7	50
IV	2.0	50	800	10	50
V	2.0	80	800	10	80
VI	2.75	80	900	10	80
VII	2.75	100	900	10	100

Vertical clearance for power cables or telephone lines or cables for any transmission purpose for all the classes of waterways mentioned shall be as follows:

- Low voltage transmission lines including telephone lines -16.5 metres
- High voltage transmission lines, not exceeding 110 kilo volt-19.0 metres
- High voltage transmission line, exceeding 110 kilovolt- 19.0 metres + 1 centimetre extra for each additional kilovolt.

7.3. Type of proposed Vessels

The most suitable river vessel is to be considered based on the following aspects viz., Fairway availability; Availability of Day / Night navigation system; Obstructions enroute like Locks; Navigational clearances free cross structures; Haulage distance; Type and Nature of Cargo; Terminal facilities etc. The study stretch of River Sharavati has been considered as Class IV. Class IV waterways can operate passenger carrying vessel. It has been suggested and recommended to have 2 Terminals in Sharavati River each at Gerusoppa Dam (Right Bank) and Honnavar Port area (Left Bank). This can be used with intermobility for the catchment of Honnavar Port as well.

Vessel Requirement for a waterway can be segregated mainly into two parts i.e., Waterway maintenance vessels and Cargo/Passenger vessels. There are many vessels required for maintenance of waterway viz., Dredgers; Tugs; Survey vessels; Navigational Equipment maintenance vessels; Patrol Boats; Pilot Boats; Inspection Vessels etc. Sharavati river due to its small stretch and limited commercial opportunity cannot have exclusive vessels for maintenance of waterway. All the vessels required for maintenance of waterways have been clubbed together for cluster 6 waterways and it has been discussed in the “Institutional Requirement”.

7.4. Proposed Vessel Size and Specifications

Targeted depth of River Sharavati (NW-90) is considered as 2 m. Vessels with draught less 2 m is proposed to be deployed in the river for passenger movement. The table below lists down the sample specifications of few passenger cum tourist vessel along with pictures that could be deployed in River Sharavati (NW-90).

TABLE 7-2: Specification of Vessels – Sample

Vessel Name	Length (m)	Beam (m)	Draught (m)	Capacity (Pax.)
India Bungy	11	3.8	0.6	20
Touring 32	9.8	2.5	0.5	23
25 Pax Transfer	9	3.8	0.5	25
Touring 36	**10.9**	**2.8**	**0.5**	**29**
Grandsea 12m Fibreglass	11.8	2.9	1.2	30
ODC Marine, Mono Pax	12.2	4.2	1.2	36
Wantaim 14m Fast Ferry	14	3.2	1.2	45

Source: Consultant’s Analysis

Note – Highlighted vessel is the recommended specification

Figure 7-1: India Bungy – 20 Pax Vessel

Figure 7-2: : Touring 36 – 29 Pax Vessel (similar recommended)

Figure 7-3: : Grandsea Fibreglass 30 Pax Water taxi / Passenger Boat

Figure 7-4: : Passenger Vessel 12m 36 Seats

Any passenger ferry with less than 1.8m draft is suitable for navigating in the defined stretch, as targeted depth of Sharavati is 2 m. The sample vessel specification proposed for tourist mobility considered at the initial stage is as follows.

(For Steel Boat)

- Size (L x B x D) – 12m x 2m x 0.8m
- Capacity – 30 Passengers (seating capacity)
- Engine - 1 Marine Diesel Outboard Engines of 150hp (approx.)
- Speed - 12 Knots (max.)

(For FRP Boat)

- Size (L x B x D) – 12m x 2m x 0.5m
- Capacity – 30 Passengers (seating capacity)
- Engine - 1 Marine Diesel Outboard Engines of 120hp (approx.)
- Speed – 12 Knots (max.)

7.5. Turn around Time

Turn Around Time (TAT) for the Inland Navigation is the most critical analysis, involving many practical issues, linked with the Fairway constraints; Terminal Operational Constraints; Availability of Day / Night Navigation system; Vessel speed etc.

The navigable stretch of River Sharavati (NW-90), between Honnavar Port and up to D/s of Gerusoppa Dam, is 25.2 Kms. The table below shows the calculation and assumptions considered to arrive at Turn Around time for single vessel at defined 25.2 km stretch of River Sharavati (NW-90) carrying passengers.

TABLE 7-3: Turn Around Time Calculation for Single Vessel

Sr. No.	Parameters	Unit	Honnavar to Gerusoppa
1	NW-90 Stretch	Km.	25.2
2	Traffic Type Proposed	Type	Passengers & Tourists
3	Terminal Proposed	Type	Passenger upgradable for Ro-Pax
4	Embark / Disembark (both side)	Mins	30
5	Total Handling Time	Mins	30
6	Average Sailing Speed	Knots	10
7	Sailing Time	Mins	80 mins (1 Hr 20

Sr. No.	Parameters	Unit	Honnavar to Gerusoppa
			Mins)
8	**Total Turn-around Time (trip/voyage)**	**Mins**	**216 min (3 Hrs.36 mins)**

Based on the above assumptions, a vessel loaded with passengers would take at least 3 hours to reach from one terminal to another. Vessel speed and operational time consumed at terminal and in transit are the primary influencing factor of turnaround time.

7.6. Number of Vessels Required

This section discusses the number of vessels required to handle projected passenger and tourist traffic on the defined 25.2 km of NW-90. Below listed are the relevant factors to be considered to arrive at the requirement of number of vessels.

- Nature and Type of Traffic
- Fairway Length (distance between proposed terminals)
- Physical Hindrances
- Vessel Capacity
- Permissible Speed
- Operational (Days & Hours), etc.

The table below shows the assumptions considered to arrive at vessel calls and number of vessels required to cater to the projected traffic till FY-45.

TABLE 7-4: Assumptions for Calculating Vessel Requirement

Sr. No.	Parameters	Unit	Honnavar to Gerusoppa
1	Operational Days	Days	300
2	Daily Operational	Hours.	8
3	Carrying Capacity	No.	30 Pax.
4	Vessel Speed	Nm. / km.	10 / 19
5	Loading and Unloading Time	Mins	30
6	Chainage (Honnavar to Gerusoppa)	Km.	25.2
7	Turn Around Time (trip/voyage)	Mins	216mins (3 Hrs. 36 Mins)

Based on the above assumptions, number vessels required on the NW-90 is represented in the table below. One vessel of 25 - 30 Pax carrying capacity is sufficient enough to accommodate the projected traffic on NW-90 from Honnavar to Gerusoppa.

TABLE 7-5: Number of Vessel Requirement

Sr. No	Unit	FY23	FY25	FY30	FY35	FY40
Traffic (Tourist & Passengers)	No.	3,571	3,715	4,102	4,528	5,000
Annual Vessel Calls	No.	120	124	137	151	167
Daily Vessel Calls	No.	1	1	1	1	1
Vessels Requirement	No.	1	1	1	1	1

The above calculation concludes that 1 passenger ferry is adequate to handle projected passenger traffic on River Sharavati (NW-90) till FY45. Requirement for additional vessel would not arise in this period of time. As shown in the table above, proposed vessel will require to make single trip daily to cater to the projected traffic.

It takes around 3 hours to complete one trip. If in future traffic increases beyond the projected, the proposed vessel can make up to 2 trips every day. The river is proposed to be developed for tourism, hence night navigation is not required.

7.7. Vessel Costing

7.7.1. Capital Cost

The deployment of ferry for tourism would be through 3rd party tour operators. IWAI would not make any investment in acquiring vessel or operating it. Hence, Capital Cost of the vessel is not part of financial analysis or project cost calculation. It has been noted that the Capital Vessel Building Subsidy is under consideration by IWAI / Administrative Ministry of Shipping, which is being recommended herewith to give boost to this sector. The indicative ferry acquisition cost, as ascertained from the Market, is being furnished herewith. The recommended specification of passenger ferry that can be deployed in River Sharavati (NW-90) for tourism and passenger movement is as follows.

- ✓ Market Price for steel boat – Approx. INR 120 Lakhs

- ✓ Size (L x B x D) – 12m x 2m x 0.8m, 30pax
- ✓ Engine - 1 Marine Diesel Outboard Engines of 150 hp each.
- ✓ Market Price for FRP boat – Approx. INR 75 Lakhs
- ✓ Size (L x B x D) – 12m x 2m x 0.5m, 30pax
- ✓ Engine - 1 Marine Diesel Outboard Engines of 120 hp each.

7.7.2. O&M Cost

The Operation & Maintenance cost (O & M Cost) for the Vessels being considered in the IWT project, in general, consists of Running Cost; Crew Cost; Repair Cost; Depreciation Cost; Insurance factor and Interest Factor. The vessel mobility is under consideration of 1 passenger ferry, for which working the O & M Costs will not have any bearing at this point of time. The following cost factors are only indicative.

1 Passenger Vessel (For 1 Year)

- 1 passenger vessel Running cost for 300 days operation with 3 Hrs mobility in a cycle and having 1 cyclic maximum operation in a day, cost per annum will be as detailed.
- 300 cycles x 3 Hrs x {0.16 Litre per hour x 1Engines x 150 Bhp} x INR 97 per Litre = **INR 24.44 Lakhs Per Annum**.
- 2 Nos. Crew on 1 passenger vessel @ **INR 0.50 Lakhs per month**.
- Crew cost for 12 months will be 12 x 2 x 0.5 = **INR 12 Lakhs Per Annum** per Unit.
- Repair Cost for **steel boat** is @ 2 % P. A of CAPEX i.e., 0.02 {1 x 120} = **INR 2.4 Lakhs Per Annum**
- Repair Cost for **FRP boat** is @ 1% P. A of CAPEX i.e., 0.01 {1 x 75} = **INR 0.75 Lakhs Per Annum**
- Depreciation is proposed by considering the life of vessels as 20 Yrs.
- Interest factor is proposed as per the industry norms.
- Insurance factor is proposed as per the industry norms.

CHAPTER 8: NAVIGATION AND COMMUNICATION SYSTEM

8.1. General Requirements

A fool proof communication system in the River Navigation is a most important requirement in order to maintain the safety of the entire system. Safety is one of the important parameters that has to be considered for the development of the inland navigation along with the protection of the environment and efficiency. In order to have undisturbed and uninterrupted development and maintenance of Inland navigation System, safe communication is most important.

Safety implies that navigation risks on the waterway stretch need to be at an acceptable level. In particular, the risks of:

- Ship-to-ship collisions;
- Ship-bridge collisions;
- Groundings;

need to be minimised, rather to be nullified. Accordingly, to accomplish, an adequate visual marking of the fairway has to be done. Even if more advanced and potentially more accurate systems are deployed, visual fairway markings are used to verify proper navigation and are also a necessary backup in case of system failures.

8.1.1. VHF / HF

Communication is essential for navigation in Inland Waterways. Due to the VHF the captains of the vessel can communicate with each other. The VHF communication can be recorded if the system will be equipped with VHF-transceiver. The recordings of the VHF can be used to investigate incidents or near-incidents to prevent future incidents.

8.1.2. GPS

The DGPS system provides the RIS-system with a correction value. This correction value increases the accuracy of the AIS transponders onboard of the vessels. The AIS base station transmits the correction signal through the designated AIS message or DGPS correction.

8.1.3. RIS / AIS / Radar / VTMS

RIS is a concept for harmonised information services which supports traffic and transport management in inland navigation, including interfaces to other transport modes.

The general technical solution is depicted in Figure below.

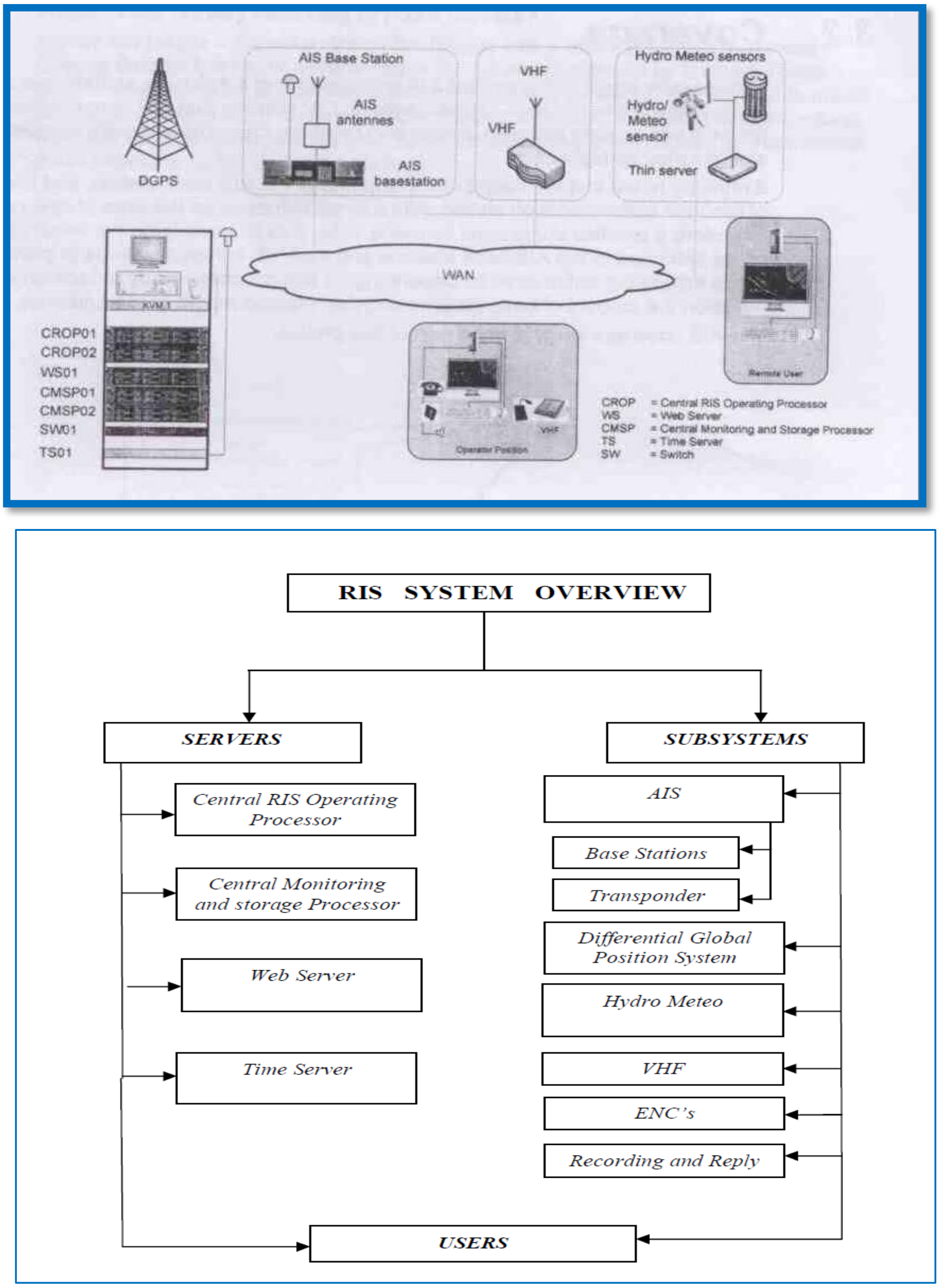


Figure 8-1: : Main components of the RIS system in flowchart

Servers

The system consists of several central servers (or processors). For availability reasons these servers should be duplicated. Duplication in two different locations requires a good Quality of service of the connection, on and a fair amount of bandwidth between these locations.

CROP (Central RIS Operating Processor)

The Central RIS Operating Processor (CROP) is the main unit of the RIS-system. It receives all the received ship reports from the AIS base stations. The CROP filters all duplicated AIS Ship reports and provides the operator with a real time over-view of the Traffic.

CMSP (Central Monitoring and Storage Processor)

The Central Monitoring and Storage Processor (CMSP) provide 2 basic functions for the RIS-system. These functions are the storage of all received data and the monitoring of the availability of the servers and the subsystems.

The data that will be stored by the CMSP will all be stored at the moment the data is received. The CMSP will fingerprint all received data. A notice will be given during replay in case the data is corrupt or has been changed. The data that will be stored by the CMSP are:

- Received AIS Data;
- Hydro and Meteo Data;
- VHF communications;
- Operator Actions;
- System Status (availability)
- WS (Web Server)
- The web server is used to provide a traffic image to third party users. These third-party users are the one that benefit from the data as provided by the RIS-system but who don’t have direct access to the RIS-servers. In this case the third parties are limited to a few responsible persons as mentioned below:
- Harbour master at Port;
- Logistic supply chain manager at Port;
- Harbour master at another Terminal;
- Logistic supply chain manager at another Terminal;
- Vessel operators (or owner).
- The benefits by using the web server are:
- Real time overview of the vessel position;
- Overview of the expected time of arrival (ETA) of each vessel;
- Delays in logistic deliveries (Coal) are known in due time;

- Optimisation in logistic deliveries.
- The functions of the web server are:
- Provide traffic image to the WS-users;
- WS user profile selection
- TS (Time Server)
- The time server is used to align all servers in the server centre to exactly the same time. This is important with respect to the registration, display and replay of data.
- Subsystems
- The subsystems and their anticipated function as used in the RIS-system are described as under.
- AIS (Automatic Identification System)
- There are two types of AIS i.e., Shore stations and the ships transponder.
- Base Stations
- The AIS base stations are the main sensor in the RIS-system. The AIS base station should comply with all regulations with respect to AIS.
- The function of the AIS base stations will be:
- Receipt of the ship reports
- Transmission of virtual buoys
- Transmission of Hydro and meteo information
- Transmission of DGPS correction message
- Transmission of AIS messages to skippers or certain areas
- Transponder
- The function of the AIS transponder on board of the vessel will be:
- Transmission of own position;
- Transmission of own configuration (in case of barges)
- Receipt of other ships positions equipped with an AIS transponder
- Receipt of hydro and meteo information
- Receipt of safety related messages
- On board of the vessels the AIS transponder should be integrated with the radar and with the display. VTMS i.e., Vessel Track Monitoring System is also to be integrated as a part of projection of visual features to identify the location with its real time pictures. This will be a cumbersome proposal.
- Hydro Meteo
- Knowing the accurate level of the water in the river is essential to be able to increase the efficiency of the logistic chain. The required data can be forwarded to the:
- RIS-operators
- Skippers;

- Logistic simply chain managers (a decreased depth might negatively influence the coal supply).
- ENC's

The RIS-system should be equipped with an ENC chart. This ENC chart can be displayed on the operator positions at the traffic centre and on the electronic chart display system onboard of the vessels.

Inland Waterways Authority of India (IWAI) is already in the process of development of Digitized Charts of all the National Waterways, which are the ENCs and these ENC charts are already being updated on a regular base. The updated ENC charts are adaptable to the virtual aids to navigation.

Recording and Replay

The system will be equipped with a recording and replay function. The recorded data will be fingerprinted, so one can check whether the data is correct or has been changed afterwards. The recordings can be stored on the CMSP-server. It is advised to have the data stored online for at least 30 days. After these 30 days the data can be stored on a medium like tape or on DVD.

The Recording and Replay function should also be equipped with a function to make a movie of the traffic image on DVD or other kind of storage device.

The recording and replay system can be used for:

- Registration of acquired data;
- Incident Evaluation;
- Near incident Evaluation;
- Check on procedures;
- Operational analysis (statistical).

Additional requirement

- The following infrastructure is required to operate the RIS-system:
- Fixed energy supply
- Uninterruptable Power Supply (UPS)
- Diesel generator
- Mast for antennas
- Shelter for equipment
- Foundation for shelter and Mast
- Lightning protection
- Fence to protect shelter and mast
- Wide Area Network (WAN) connection at each site
- Other infrastructure that might be required could be:
- Microwave link

- Air-conditioning
- Fire detection equipment
- Fire Fighting
- Burglar detection

Users

The RIS-system will have multiple users. These users will either have a different task. Depending on the task of the user the authorization on what the user can do or what data the user is allowed to see can change.

Depending on the specific needs of the IWAI, or its clients, these users can be expanded and/or changed.

The following users/ roles are:

- User management
- Traffic Operator
- Emergency response
- Incident evaluation
- Maintenance

8.1.4. Vessel / Hydrographic Survey equipment

The RIS-system also requires that certain systems are available and working on the used vessels. The system should be connected and integrated with each other. The required systems are:

- AIS transponder
- VHF
- Radar
- Hydro and meteo sensors
- Echo sounder
- Electronic chart displays capable of displaying virtual buoys

8.2. Existing System

IWAI is already having the communication system on NW 1 / NW 2 along with Day / Night Navigation system which may be developed as per requirement considering the AIS and DGPS stations. Further, the adaptable Digitized charts are already being used linked with Survey Equipments viz., Echo-sounders and GPS with a provision for updating the charts. Provision also is under consideration to link up with the Day / Night Navigation Buoys.

8.3. Additional requirement

The communication system technology is rapidly changing with Technology change. Accordingly, within a short gap of time, the existing system is leading to an obsolete scenario. Hence, development of a sustainable system is very difficult. However, an attempt has been made and a workable rather reliable system has been worked out and placed as Annexure 8.1. Further, the specification of AIS Base station Transponder is enclosed at Annexure 8.2 and AIS Embedded Server specifications are enclosed at Annexure 8.3. As observed, this system is not cost effective and left the details in this report, as an Academic data for consideration at later date, if found feasible.

Further to the above, an attempt has been made to ascertain the details on the alternative real time ship tracking system viz., Vessels Traffic Management System (VTMS). It was observed that the same is more costly than the RIS system and has not been discussed.

Subsequent to the discussions with the stakeholders, it was noticed that the Ministry of Shipping, Govt. Of India has already initiated the working about feasibility and implementation of “National Coastal Grid of VTMS”, in which a considerable distance of the Rivers joining the sea also is under consideration. This proposal is from the strategic safety point of view and is expected to take some more time. It is suggested to have a dialogue at later date by IWAI for a full proof communication / navigation system in the National Waterways joining the sea in both West / East coast.

At this stage, it is recommended to proceed ahead with the available Mobile Networking system and later on an amenable system can be adopted, subsequent to the considerable progress on “National Coastal Grid of VTMS”.

8.4. Costing

Regarding the Navigation & Communication System, it was observed that the same is not cost effective. Therefore, there will not be any Capital Cost and O & M Cost.

8.4.1. Capital Cost

Nil -

8.4.2. O&M Cost

Nil -

CHAPTER 9: ENVIRONMENTAL & SOCIAL ASPECTS

9.1. Objective of Environmental and Social Studies

The objective of the environmental and social studies is to assess the environmental and social impacts due to the proposed development works and suggest a suitable environmental management plan (EMP) to mitigate adverse impacts, if any, including its cost. In addition, Consultant has to identify the authorities who will give the clearance for EIA / EMP.

9.2. Environmental Setting in the Project Area

The proposed project is designated as national waterway no. 90 under the National Waterways Act 2016 and is located on Sharavati River in the Uttara Kannada district of Karnataka State. Out of the total length, about 29 km length of the river from Honnavar Port Sea Mouth at Lat 14°17'56"N, Long 74°25'27"E to link at highway at Gerusoppa Lat 14°14'15"N, Long 74°39'06"E has been declared as new national waterway.

The total catchment area of Sharavati is 3592 sq km.

The environmental setting in the project area is described in the sections that follow.

9.2.1. Physiography

Karnataka is situated on the western edge of the Deccan Peninsular region of India. It is located approximately between 11.5° North and 18.5° North latitudes and 74° East and 78.5° East longitudes. Karnataka comprises the Deccan Plateau, the Western Ghats Mountain Range and the Coastal Plains.

Physiographically, Karnataka is part of two well-defined regions of India: the Deccan Plateau and the Coastal plains and Islands.

The state can be divided into four physiographic landforms – the Northern Karnataka Plateau, the Central Karnataka Plateau, the Southern Karnataka Plateau and the Coastal Karnataka Region.

Northern Karnataka Plateau

The Northern Karnataka Plateau covers the districts of Belgaum, Bidar, Bijapur and Gulbarga. The area is mainly composed of the Deccan Trap. It represents an extensive deforested plateau landscape. The Northern Karnataka Plateau has an elevation of 300 metres to 600 metres from the sea level. The plateau slopes towards the east. The landscape is mainly covered with rich black cotton soils.

The vast expanse of treeless plateau is interspersed with river plains, watersheds, residual hills and ridges. The river plains are represented by those of River Bhima, River Ghataprabha, River Krishna and River Malaprabha.

Central Karnataka Plateau

The Central Karnataka Plateau is located between the Northern Karnataka Plateau and the Southern Karnataka Plateau. It consists of districts like Bellary, Chikmagalur, Chitradurga, Dharwad, Raichur and Shimoga. The elevation of the Central Karnataka Plateau varies between 450 metres and 700 metres. The general slope of this plateau is towards the east.

This region is the location of the Tungabhadra River basin.

Southern Karnataka Plateau

The Southern Karnataka Plateau includes the districts of Bangalore Urban, Bangalore Rural, Hassan, Kodagu, Kolar, Mandya, Mysore and Tumkur. This plateau region is covered by a high degree of slope. It is encircled by the Western Ghats on the west and the south. The Southern Karnataka Plateau has a general elevation of 600 metres to 900 metres. But the Biligirirangan hills of Mysore district and the Brahmagiri range of Kodagu district have residual heights ranging between 1,500 metres to 1,750 metres. The Cauvery River basin forms a significant part of this plateau.

Karnataka Coastal Region

The Karnataka coastal belt starts from the Western Ghats in the west and extends till the edge of the Karnataka Plateau in the east. The Karnataka Coastal Region includes the districts of Udupi, Uttara Kannada and Dakshina Kannada.

The terrain of this region consists of rivers, creeks, waterfalls, ranges of hills and peaks. The Karnataka Coastal Region can be divided into two main geographical divisions, known as the Western Ghats and the plains. The coastal belt has an average width of 50 km to 80 km. It covers a distance of around 267 km from north to south.

Uttara Kannada district is one of the three districts of the State located in the coastal region. The district is located in the mid-western part of the state. It lies between 13°.551 and 15°.311 north latitude and 74°.91 and 75°. 101 east longitudes. The total geographical area of Uttar Kannada district is 10,291 sq. kms, which is about 5.37% of the total area of the state. The district is hilly and most of its part is covered by thick forest. Somewhat broken and irregular Sahyadri range of central hills divide the district into two parts; a) the uplands or the regions above the ghat with an area of about 7898 sq km comprising 77% of the total area of the district which is 600-700 meters above the sea level, and b) the low lands covering around 3370 sq. km.

Uttar Kannada district has three main distinctive regions: (a) the coastal region (b) Malnad region (Western Ghat) (c) Semi-Malnad region.

The coastal region: The coastal area is well-developed and densely populated. It serves as a link between Goa, Mumbai and Mangalore. The coastal belt begins in the north from the village called Majali that lies on Goa border and continues in the south up to Dakshina- Kannada boundary. In this region, the taluks of Karwar, Ankola, Kumta, Honnavar and Bhatkal are situated.

The Malnad region (Western Ghat): The Malnad region consists of four taluks namely Joida, Yellapur, Sirsi and Siddapur. This region is mostly forested forming the valleys and the roads passing through the ghats have resulted in some kind of activities of economic significance. The western boundary of the region is represented by the edges of ghat, while eastern boundary roughly coincides with the limits of forested area, as well as agricultural land. It is the central belt of the district that consists of hills, valleys and eastern table land. About 75% of the area of the district consists of hills and valleys.

Semi-Malnad region: To the east of the Malnad is the semi-malnad of undulating plateau, where rainfall is moderate. The eastern belt consists of a narrow transitional zone of undulating lands and vast stretches of plains as one moves further eastwards. This is a transitional tract between the "Malnad" and the "maidan". Mundgod and Haliyal taluks fall in the upghat section. Geographical area of Mungod taluk is 668 sq. kms and Haliyal 847 sq. kms.

Karnataka has seven river systems and their tributaries flowing through the state. The river systems of Karnataka are:

- Cauvery
- Godavari
- Krishna
- North Pennar

- South Pennar
- Palar
- The West Flowing Rivers

There are four prominent rivers flowing in the Uttara Kannada district from the high range of mountains to the Arabian Sea, they are as follows:

a) Kali River: originates near the village called Diggi in the earlier Supa taluk that has been shifted to a newly formed Joida taluk, consequent upon the sub merger of the taluk. It has a total length of 184 km. After taking South-east course of about 64 km it takes sharp turn to the south-west and after a course of about 66 km till Kadra, a small village where a Power generation unit is commissioned by KPC Ltd., it flows towards east-west and falls into Arabian Sea at about 3 km north of Karwar. Konkan railway-bridge is constructed over the river at this point.
b) Aghanasini River: also called Tadri river rises at Manjaguni near Sirsi and after winding westerly course of about 70 km falls into the sea about 10 km south of the river. This river passes through Kumta taluk.
c) Gangavali River: is formed by the confluence of two streams namely, Shaimala and Bedti originating in Dharwad district flows through eight kms South-east to the border of Uttar Kannada at Magod, covering a length of 96 km.
d) Sharavati River: also called Gerusoppa River has its origin at Ambutirtha in Tirthalli taluk of Shimoga district. After a northerly course of about 64 km from Nagar, it forms the south-east boundary of Uttar Kannada for about 13 km and then passes about 32 km west to join the sea at Honnavar. Sharavati River which forms the famous jog falls, flows through Honnavar.

9.2.2. Geology and Seismicity

The geology of Karnataka is largely confined to the two oldest eras; the Archean and the Proterozoic. The rest of the great periods from Cambrian to recent are hardly represented but for minor sediments of recent age exposed along the coastal margin to the West. A substantial part of North Karnataka is covered by Deccan trap, representing phenomenal outburst of volcanic activity at the dawn of the Cenozoic era.

The oldest rocks in the State are from Gorur area, Hassan district, Karnataka dating back to about 3300 million years. The Precambrian craton of Karnataka is made up of western and eastern segments. The Precambrians of Karnataka have been divided into older Sargur supracrustals (about 3300 to 3000 million year old) and younger Dharwar supracrustals (about 3000 to 2600 million year old. The Dharwar supracrustals Supergroup has been further divided into older Bababudan Group (ca.3000 to 2700 million years) and younger Chitradurga Group (ca.2700 to 2500 million years). The schist belts of the Eastern craton, like Kolar, Hutti, Sandur etc., appear to be approximately equivalent to the Chitradurga Group.

The Karnataka craton has been extensively intruded by granites and granitoids of the ca. age2600 to 2500 million years. The eastern Karnataka abounds in these granites and granitoids. The northern part of Karnataka is made up of Kaladgi and Badami and Bhima Group of sediments, approximately of Proterozoic age. Further north the terrain is covered by extensive volcanic flows known as Deccan traps of Cretaceous -Tertiary age.

Geologically, the region of Uttara Kannada consists of rock of the Earth's crust. Archaeozoic rocks occur over the whole of the district. A system of ridges and plateau characterises the region with the plateau on the West descending rapidly creating between itself and the Arabean Sea a narrow strip of low land covered by alluvium. The low land is regarded as a creation of later period (of glacial and interglacial age) than the up-ghat regions. Formerly the sea had submerged the land up to an elevation of 200 rats. The Archaean formation comprises the earlier metamorphosed Dharwar system and later peninsular gneisses overlain by laterite cap. The ridge of hills in the western part of this district, sometimes rising to a height of 700 mts, nearly runs parallel to the coastline and consists of varied assemblage of granites and schists. These ridges separate the Sahyadris consisting of Deccan traps in the north from the Western Ghats consisting of Dharwar schists in the south. The eastern part of this district, being entirely hilly, consists of Dharwar and the peninsular gneisses, the latter being Found in low ground areas.

The Karnataka state is categorized as moderate to low seismic risk zone. The state of Karnataka has reported more than 500 earthquake tremors in the last three decades with most of them having low magnitude.

As per the seismic zoning map of India, the project area falls under seismic zone III (moderate damage risk zone).

9.2.3. Climate

The climate of Karnataka ranges from arid to semi-arid to humid tropical. Two annual monsoons bring rainfall to Karnataka: the North-East monsoon and the South-West monsoon. The mean annual rainfall in the State is around 1355 millimetres. The coastal region of Karnataka receives the maximum rainfall while parts of North Karnataka are among the major rainfall deficit areas of the state.

Karnataka experiences four seasons in a year. Summer starts from March and extends till May. Monsoon begins in June and lasts until September. During this season the state receives rainfall due to the southwest monsoon winds. Post-monsoon season extends from October to December. Winter stays in Karnataka during the months of January and February.

The climatic conditions of the different parts of the district vary greatly, normally humid, hot along the coast, cool in the ghat region and warm in the eastern ghat region. Average rainfall in the district is 2835 mm.

The coastal region receives annual rainfall varying between 2540 mm - 3556 mm in the southern part and between 1016 mm to 1524 mm in the northern transitional belt. The temperature of the district varies between 15°C in the winter to 34°C in the summer. Average climate is 33° Centigrade during the summer and 20°C during the winter at the sea level.

9.2.4. Soils

According to soil survey data, the soils of Karnataka can be divided under nine groups. These groups are:

- Red Sandy Soils
- Red Loamy Soils
- Shallow Black Soils
- Medium Black Soils
- Deep Black Soils
- Mixed Red and Black Soils
- Laterite Soils
- Laterite Gravelly Soils
- Coastal Alluvium

The soils of Uttara Kannada district are divided into two distinct zones based on topography; the coastal alluvial soil and the upghat lateritic and granitic soils.

Along the coast the costal alluvial soil is occurring on western most parts of the district. The most rugged hilly parts of the district are covered by hilly type soil and surrounded by the areas covered by lateritic soil having less rugged features. On eastern parts, the lateritic soils change to red loamy soils. Some parts on eastern most parts of of Mundgod taluk are covered by semi-black cotton soils.

9.2.5. Land Use Pattern

Land use is the surface utilization of all developed and vacant lands on a specific space at a given time. Lands are used for forest, pastures, transportation, settlement, industrial and commercial purposes. Uncultivable waste land, barren and fallow land are unused lands.

The Uttara kannada district has 813695 ha. of forest which constitutes 79 % of the total geographical area of the district. The land not available for cultivation is 50600 ha. i.e; 5 % of the total area. The fallow land in the district is around 16951 ha. The other uncultivated lands are 30156 ha.

Mixed land use is found on both sides of the waterway stretch comprising mangroves, agricultural land, forests and village settlements. Mangroves are observed on both the sides of the in the stretch of the river between Ch 0.00km to Ch 20.00 km).

The river channel under consideration is characterized by presence of shoals and islands. There is a major island formation in the between the ch 25 and ch 27.

9.2.6. Ambient Air and Noise Quality

The overall ambient air quality in the project area is found to be of acceptable standards. The impact on the existing ambient air and noise quality is largely limited to the emissions due to vehicular movement. The project area has a few settlements and some industries with emission norms regulated by the SPCB.

Primary data on ambient air quality monitoring in the project area may be collected at a later stage as required.

9.2.7. Ambient Water Quality

There are some industries are established on the banks of Sharavati river comprising the NW-90 stretch. However, discharge of effluents by these industries is regulated by the State Pollution Control Board and the Sharavati river water quality in the proposed stretch does not appear to be impacted adversely in any significant manner by industrial effluents.

Water quality samples have been collected and tested for four sample locations along the NW-90 stretch as part of the hydrographic survey carried out for preparation of the present DPR. The pH value of the four samples is found to be over 7, which indicates that water in the project area is alkaline in nature.

9.2.8. Susceptibility to Natural Hazards

Karnataka state is vulnerable to various natural hazards. The coastal districts namely

Dakshina Kannada, Udupi, Uttara Kannada with a coastal line of 322 km and coastal population of 43.64 Lakhs are under the direct threat of cyclones and severe cyclones originating in Arabian Sea and indirect attack of cyclones originating along the Eastern coastline.

Nearly all districts of Karnataka experience moderate to severe floods. Floods are associated with cloud bursts, cyclones or depressions in the Bay of Bengal and in the Arabian Sea.

Hilly regions of Western Ghats spread in the districts of Kodagu, Chikmagalur, Hassan,

Shimoga, Daksina Kannada and Uttara Kannada record a very high rainfall of 2000mm to 4000mm. Landslides are common in these districts.

Karnataka stands Second only to Rajasthan in terms of drought affected areas. The state is highly vulnerable to drought as compared to its neighbouring states. About 152.1 lakhs ha (80%) out of 190.238 lakh ha is affected by drought in Karnataka.

9.2.9. Estuary and Coastal Zone

The entire stretch of NW-90 falls under the tidal zone.

The Ministry of Environment and Forests, Govt. of India, under the provisions of the Environment (Protection) Act, 1986, had issued a notification in February, 1991, declaring an area of 500 m. from the high tide line along the sea coast, bays and estuaries and up to 100 m from the rivers and creeks as a Coastal Regulation Zone. The developments within this zone are required to be regulated in accordance with the provisions of the notification and the Coastal Zone Management Plan which the State Govt. is required to prepare for the area.

The CRZ Notification 1991 was later amended, and a new Notification was issued in 2011 namely CRZ Notification, 2011. The notification imposes certain restrictions on the setting up and expansion of industries, operations or processes and the like in the CRZ.

As per the CRZ categorization provided in the CRZ Notification, 2011, the entire stretch of NW-90 project area falls in CRZ – I. Accordingly, the proposed project will require clearance under the CRZ Notification 2011.

9.2.10. Archaeological and Heritage Locations

No structures of archaeological, cultural or historical importance will be impacted due to the proposed project.

9.2.11. Flora and Fauna

Nearly 22.6% of the State's total geographical area comprises forest area. Notified forests

comprise17.3% of the State's geographical area and include reserved, protected, village and private forests.

Based on Champion and Seth's system of classification (1968) the following major types of forests are recognised in Karnataka:

- Southern tropical wet evergreen forests;
- Southern tropical semi evergreen forests;
- South Indian tropical moist deciduous forests;
- Southern tropical dry deciduous forests;
- Southern tropical thorn forests;
- Subtropical broad leaved hill forests;
- Littoral and swamp forest.

The biodiversity of Karnataka is estimated to have more than 1.2 lakh known species including 4,500 flowering plants, 800 fishes, 600 birds, 160 reptiles, 120 mammals and 1,493 medicinal plants.

The Western Ghats support a diverse fauna. Among the vertebrates, birds represent the largest number of known species (508 species), followed by fishes (218), reptiles (157), mammals (137), and amphibians (126).

9.2.12. National Parks, Forests, Wildlife Sanctuaries and Reserves

The Karnataka state has five national parks and 27 wildlife sanctuaries covering 6,794 km2 of forest areas.

The Uttara Kannada district is rich in forest resources. Forest resources constitute one of the sources of revenue to the state government. 80% of the district is under forest. The total forest area is 8,14,455 hectares. The types of forests found in the district consists of 1) evergreen (2) semi-evergreen (3) moist deciduous (4) scrub and thorny and (5) un-wooded forests.

The general species in moist deciduous are Teak, Sissum (Rosewood), Nandi, Kindal, Jamba, Matti, Holedasal, Toon and Burga. The teak of Dandeli area is said to be the finest in the world. Medicinal plants are available in the vast thick forest.

The project is not located close to any protected area such as a national park or a wildlife sanctuary.

9.2.13. Socio-economic Profile

As per the 2011 census, the total population of the state is 1,437,169 comprising 726, 256 males and 710,913 females. The literacy of the state is 55.98%. Population density is 140 persons per sq km. The sex ratio is 979 females per 1000 males.

DISTRICT HIGHLIGHTS – 2011 CENSUS

- Uttara Kannada with a total population of 1,437,169 holds the 20th position in terms of total population in the State.
- The district holds the 19th rank in terms of rural population and 16th in terms of urban population.
- Uttara Kannada district accounts for 2.4 percent of the total population of the State.
- With the decadal growth rate of 6.2 percent, it ranks 22nd in the State in terms of decadal growth rate.
- The district with a Sex ratio of 979 holds 18th rank in the State.
- The district with a Sex ratio of 955 among the child population in the age-group 0-6 holds the rank of 12th in the State.
- The proportion of child population, (0-6 age-group) is 10.5 percent in the district and ranks 19th in the State.
- The district has a literacy rate of 84.1 percent and is placed at 4th rank in the State.

- The male literacy rate in the district is 89.6 percent and the female literacy rate is 78.4 percent.
- The male – female literacy gap in the district is 11.2 percentage points, which is less than the male – female literacy gap registered by the State (14.39 percentage points).
- The Scheduled Caste population contributes 8.1 percent to the total population of the district and the Scheduled Tribe population contributes 2.4 percent.
- The district has registered a work participation of 42.3 percent and stands at 28th rank in the State.
- The work participation rates for Male and Female population are 59.3 and 25.0 respectively in the district.
- Among the total workers in the district 81.9 percent are Main workers and 18.1 percent are Marginal workers.
- Major work force of 61.0 percent is engaged in other workers category and the district holds 5th rank in the State.
- Agricultural sector constitutes 37.4 percent of the total workers i.e., Cultivators (18.3 percent) and Agricultural Labourers (19.1 percent) and 1.6 percent of the total workers are engaged in Household Industry. About 57.7 percent of the total population in the district is Nonworkers.
- Uttara Kannada district with area figure of 10277 Sq-Km stands at 5th Position in the State in terms of area.
- The population density for this district is 140 and it is the third least dense district in the State.
- There are 1289 villages, 11 Statutory Towns and 7 Census Towns in the district.

Socio-economic features of the project area are further detailed out in Chapter 4 of the DPR.

9.3. Potential Environmental and Social Impacts of the Project

The proposed project involves the following major construction activities:

- Construction of terminal buildings
- Construction of access roads
- Dredging of the river
- River training works

- Bank protection works

These activities will involve mobilization of manpower and equipment at site, movement of vehicles, use of existing water resources and use of DG sets for construction power. The proposed construction period is of three years.

Taking into consideration the scale of construction and operation relating to the project, limited significant adverse impacts are anticipated on account of the project. Most of the impacts will be limited to the construction phase and can be suitably mitigated by following good industry practices.

The project envisages construction of one terminal. The land area required for construction of terminal is estimated to be 1928 sq m. Land identified for terminal construction is barren land. The land belongs to the State Revenue Department.

Impacts on air and noise, arising out of vehicular movement and fugitive dust emission, will be largely limited to the construction period.

Potential impacts on water quality of the river can be suitably mitigated by constructing the labour camps away from the river banks and by not allowing any debris to be thrown into the river during the construction and operation phases.

The project involves dredging for creation of a navigable channel maintaining a depth of 2.0m. It is estimated that a quantity of 4.21 lakh cu m of soil may have to be considered for dredging. All the dredged material is proposed to be disposed of within the flood banks of the river. As such there is no impact on the land environment due to disposal of dredged material.

The project also envisages river training and bank protection works. The impacts on aquatic ecology due to dredging, river training and bank protection works envisaged for the project shall have to be confirmed as part of the EIA study.

The positive impacts on the project will include improved waterway facilities and other allied infrastructure facilities for the local population. It will also generate some employment and small business opportunities for the local population.

9.4. EMP and Mitigation of Environmental Effects

As already stated, most of the potential impacts will be limited to the construction period.

The management measures required to mitigate the potential impacts of the project on the ambient air quality during construction period include suppression of fugitive dust by water sprinkling, transportation of construction debris in covered vehicles, maintaining the specified stack height of DG sets under use and ensuring that the vehicles and equipment used during the construction period are in well maintained condition. To ensure that the ambient air quality remains within the prescribed standards by the Central Pollution Control Board (CPCB), periodic monitoring of ambient air quality should be undertaken through an accredited laboratory. Suitable corrective measures should be implemented if the ambient air quality is found to exceed the prescribed limits.

The measures to ensure that there is no adverse impact on the water quality on account of the project during the construction period would include setting up of labour camps at a safe distance from the river banks. In addition, no construction debris should be allowed to flow or be thrown into the river. The batching pants and concrete mixing plants should be located away from the river banks and these should be set up and operated strictly in accordance with the conditions stipulated by the SPCB.

To mitigate land, air and water contamination by the construction workers, adequate fuel, water and sanitation facilities should be provided to the construction workers. Hunting or poaching of wildlife should be strictly prohibited by any of the construction workers or employees. Also, it should be ensured that no unauthorized tree / forest cutting is undertaken by anyone engaged on the project.

Minimum required land should be acquired for the project. The private land owners, if any, whose land is to be acquired for the project, should be compensated adequately in accordance with law.

The project should take care that the traditional fishing rights of the local population are not impacted adversely in any manner. Adequate consultation with the local population should be undertaken as required.

The project authorities should ensure that the contractors engaged on the project have an approved environment management plan in place and that this management plan forms a part of the contract document so as to ensure its effective implementation by the contractors.

9.5. Applicable Legal and Regulatory Framework

The Karnataka State Pollution Control Board (KSPCB) acts as the nodal agency for environmental management, prevention & control of pollution and for the enforcement of following important acts & rules:

- Water (Prevention & Control of Pollution) Act, 1974
- Water (Prevention & Control of Pollution) Cess Act, 1977
- Air (Prevention & Control of Pollution) Act, 1981
- Environment (Protection) Act, 1986
- Notifications issued under Environment (Protection) Act, 1986
- Noise Pollution (Regulation & Control) Rules, 2000
- Wildlife Protection Act, 1972

Key legal and regulatory provisions as applicable to the project are described below.

Consent to Establish and Consent to Operate

The project will require obtaining the Consent to Establish from the SPCB under the Air and Water Acts prior to commencement of construction. Prior to commencement of operation, it shall require obtaining the Consent to Operate from the SPCB under the same Acts.

CRZ Clearance

The project shall require obtaining clearance under the CRZ Notification 2011. The entire stretch of NW-90 falls in the coastal zone. Based on the categorization provided in CRZ Notification, 2011, the entire stretch of NW-90 project shall fall under CRZ – I.

The Ministry of Environment and Forests, Govt. of India, under the provision of Environment (Protection) Act, 1986, had issued a notification in February, 1991, declaring an area of 500 m. from the high tide line along the sea coast, bays and estuaries and up to 100 m from the rivers and creeks as a Coastal Regulation Zone. The developments within this zone are required to be regulated in accordance with the provisions of the notification and the Coastal Zone Management Plan which the State Govt. is required to prepare for the area.

The CRZ Notification 1991 was later amended and a new Notification was issued in 2011 namely CRZ Notification 2011.

The CRZ Notification, 2011 declares the following areas as CRZ:

i. the land area from High Tide Line (HTL) to 500 mts on the landward side along the sea front.

ii. the land area between HTL to 100 mts or width of the creek whichever is less on the landward side along the tidal influenced water bodies that are connected to the sea and the distance up to which development along such tidal influenced water bodies is to be regulated shall be governed by the distance up to which the tidal effects are experienced which shall be determined based on salinity concentration of 5 parts per thousand (ppt) measured during the driest period of the year and distance up to which tidal effects are experienced shall be clearly identified and demarcated accordingly in the Coastal Zone Management Plans (hereinafter referred to as the CZMPs).

    Explanation - For the purposes of this sub-paragraph the expression tidal influenced water bodies mean the water bodies influenced by tidal effects from sea, in the bays, estuaries, rivers, creeks, backwaters, lagoons, ponds connected to the sea or creeks and the like.

iii. the land area falling between the hazard line and 500mts from HTL on the landward side, in case of seafront and between the hazard line and 100mts line in case of tidal influenced water body the word 'hazard line' denotes the line demarcated by Ministry of Environment and Forests (MoEF) through the Survey of India (SoI) taking into account tides, waves, sea level rise and shoreline changes.

iv. the land area between HTL and Low Tide Line (LTL) which will be termed as the intertidal zone.

v. the water and the bed area between the LTL to the territorial water limit (12 Nm) in case of sea and the water and the bed area between LTL at the bank to the LTL on the opposite side of the bank, of tidal influenced water bodies.

The coastal zone is categorized for the purposes of regulation in the following categories:

(i) CRZ-I,–

A. The areas that are ecologically sensitive and the geomorphological features which play a role in the maintaining the integrity of the coast,-

(a) Mangroves, in case mangrove area is more than 1000 sq mts, a buffer of 50meters along the mangroves shall be provided;
(b) Corals and coral reefs and associated biodiversity;
(c) Sand Dunes;
(d) Mudflats which are biologically active;

(e) National parks, marine parks, sanctuaries, reserve forests, wildlife habitats and other protected areas under the provisions of Wild Life (Protection) Act, 1972 (53 of 1972), the Forest (Conservation) Act, 1980 (69 of 1980) or Environment (Protection) Act, 1986 (29 of 1986); including Biosphere Reserves;

(f) Salt Marshes;

(g) Turtle nesting grounds;

(h) Horse shoe crabs habitats;

(i) Sea grass beds;

(j) Nesting grounds of birds;

(k) Areas or structures of archaeological importance and heritage sites.

B. The area between Low Tide Line and High Tide Line;

(ii) CRZ-II,-

The areas that have been developed up to or close to the shoreline.

Explanation.- For the purposes of the expression "developed area" is referred to as that area within the existing municipal limits or in other existing legally designated urban areas which are substantially built-up and has been provided with drainage and approach roads and other infrastructural facilities, such as water supply and sewerage mains;

(iii) CRZ-III,-

Areas that are relatively undisturbed and those do not belong to either CRZ-I or II which include coastal zone in the rural areas (developed and undeveloped) and also areas within municipal limits or in other legally designated urban areas, which are not substantially built up.

(iv.) CRZ-IV,-

A. the water area from the Low Tide Line to twelve nautical miles on the seaward side;

B. shall include the water area of the tidal influenced water body from the mouth of the water body at the sea upto the influence of tide which is measured as five parts per thousand during the driest season of the year.

(v) Areas requiring special consideration for the purpose of protecting the critical coastal environment and difficulties faced by local communities, -

A. (i) CRZ area falling within municipal limits of Greater Mumbai;

(ii) the CRZ areas of Kerala including the backwaters and backwater islands;

(iii) CRZ areas of Goa.

B. Critically Vulnerable Coastal Areas (CVCA) such as Sunderbans region of West Bengal and other ecologically sensitive areas identified as under Environment (Protection) Act, 1986 and managed with the involvement of coastal communities including fisherfolk.

The development or construction activities in different categories of CRZ are regulated by the concerned Coastal Zone Management Authority (CZMA) in accordance with the norms as defined under the CRZ Notification 2011.

Forest Clearance

Forest Clearance from the MoEF shall be required if the project involves diversion of any forest land. The ownership of land identified for the project is barren land belonging to the State Revenue Department. Therefore, no forest clearance is envisaged for the project at this stage.

9.5.1. Need for Environmental Clearance

Inland waterways are not listed as an activity that requires prior environmental clearance under the EIA Notification 2006. However, the Notification, as amended in 2009, includes 'Dredging' as an activity for which prior environmental clearance is required. As such, the project will need to obtain Environmental Clearance from the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India.

The process of obtaining environmental clearance requires carrying out an Environmental Impact Assessment study in accordance with the Terms of Reference (ToR) approved by the MoEF. The Environmental Clearance is awarded upon approval of the EIA study report by the Expert Appraisal Committee of the MoEF.

9.5.2. Other Major Clearances / Approvals / Permits Applicable to the Project

No other major clearances / approvals / permits relating to environmental and social aspects are applicable to the project.

9.6. Cost Implications

A lump sum provision of 5% of the project cost has been made for environmental management and monitoring activities relating to the project. This does not involve the cost of land acquisition or cost of diversion of forest land.

CHAPTER 10: INSTITUTIONAL REQUIREMENTS

10.1. Organizational Set up / Establishment

The Inland Waterways Authority of India (IWAI) has been carved out duly taking over the responsibilities etc., of the erstwhile Inland Water Transport (IWT) directorate under Ministry of Surface Transport / Ministry of Shipping with a vision of more thrust on the IWT sector along with more Autonomy, by an Act of Parliament (IWAI Act 82 of 1985). Accordingly, IWAI is vested with the functions / duties and responsibilities connected to the safe navigation in the National Waterways and in the interconnected waterways, where IWT is considered for development. The Para 14 of IWAI ACT 82 of 1985 is provisioned with the Functions and Powers of authority, as detailed, which is self explanatory.

Functions and Powers of the authority:

14. (1) The Authority may-

(a) carry out surveys and investigations for the development, maintenance and better utilization of the national waterways and the appurtenant land for shipping and navigation and prepare schemes in this behalf; (b) provide or permit setting up of infrastructural facilities for national waterways;

(c) carry out conservancy measures and training works and do all other acts necessary for the safety and convenience of shipping and navigation and improvement of the national waterways;

(d) control activities such as throwing rubbish, dumping or removal of material, in or from the bed of the national waterways and appurtenant land, in so far as they may affect safe and efficient, shipping and navigation, maintenance of navigable channels, river training and conservancy measures;

(e) remove or alter any obstruction or impediment in the national waterways and the appurtenant land which may impede the safe navigation or endanger safety of infrastructural facilities or conservancy measures where such obstruction or impediment has been lawfully made or has become lawful by reason of long continuance of such obstruction or impediment or otherwise, after making compensation to person suffering damage by such removal or alteration;

(f) provide for the regulation of navigation and traffic (including the rule of the road) on national waterways; (g) regulate the construction or alteration of structures on across or under the national waterways;

(h) disseminate navigational meteorological information about national waterways;

(i) ensure co-ordination of inland water transport on national waterways with other modes of transport; and (j) establish and maintain pilotage on national waterways;

(k) enter into joint ventures concerning inland shipping by way of equity participation.

14. (2) The Authority may also-

(a) advise the Central Government on matters relating to inland water transport;

(b) study the transport requirement with a view to co-coordinating inland water transport with other modes of transport;

(c) carry out hydrographic surveys and publish river charts;

(d) assist, on such terms and conditions as may be mutually agreed upon, any State Government in formulation and implementation of scheme for inland water transport development;

(e) develop consultancy services and provide such services, on such terms and conditions as may be mutually agreed upon, in India and abroad in relation to planning and development of waterways for shipping and navigation or any facility there at;

(f) conduct research in matters relating to inland water transport including development of craft design mechanization of country crafts, technique of towage, landing and terminal facilities, port installations and survey techniques;

(g) lay down standards for classification of inland waterways;

(h) Arrange programme of technical training for inland water transport personnel within and outside the country; and

(i) Perform such other functions as may be necessary to carry out the provisions of this Act.

14. (3) Any dispute arising out of or concerning the compensation referred to in clause(e) of subsection (1) shall be determined according to the law relating to like disputes in the case of land required for public purposes.

14. (4) Every scheme, prepared by the Authority to carry out functions under sub-sections (1) and (2), involving capital expenditure exceeding the amount as may be prescribed, shall be submitted to the Central Government for approval.

14. (5) The Central Government may either approve the scheme submitted to it under sub-section (4) without modification or with such modifications as it may consider necessary or reject the scheme with directions to the Authority to prepare a fresh scheme according to such directions.

In order to consider a planned and systematic implementation with the assigned functions of the authority, a strong Institutional mechanism is required.

If we keenly observe the Institutional systems of similar administrations / establishment globally and the parallel administrations / establishments nationally, the key factor emerging out of the same is only the Policy and procedure of implementation of the assigned responsibilities. It is yet a debatable aspect i.e., whether to have a full pledged organization so as to undertake the works through contractual agencies or to have a mechanism of Out Sourcing the work along with supervision to different contractual agencies (Out Sourcing the work to an agency and the Project Management to other agency).

10.2. Man Power Requirement

It is suggested that the Outsourcing the work to a contractual agency is the best alternative for the subject study and accordingly, the Manpower requirement is under consideration

As ascertained, IWAI is having an Institution Mechanism consisting of a Board along with Functional Manpower having the inverted conical organization pattern. The major functional aspects have already been segregated as Project; Planning; Survey; Marine; Traffic; Finance and Administration. Hence, dislocation of the existing system is not suggested. The present requirement within the study stretch should be unique, which should be amenable to the existing system in the office of Policy making with Control.

Accordingly, the Controlling office (at NOIDA) has been depicted in the pictorial form and will have 1 Chief Engineer to look after the Central part of the country (Hyderabad) to deal with the Waterways / National Waterways in the states of Maharashtra; Goa; Karnataka; Orissa; Telangana; Andhra Pradesh; Tamilnadu & Kerala (including NW 3). Refer the Annexure 10.1.

The present study stretches of Cluster 6 having 6 National Waterways will be looked after by a Directorate (suggested / recommended) with an office within the Geographical zone, preferably accessible to all the Waterways / National Waterways. The Organizational requirement has been depicted in Annexure 10.2. A skeleton staff requirement of 3 Nos. also has been proposed as a support requirement to operate the project.

10.3. Training Requirement / Capacity Building

IWAI is having various disciplines within the organization viz., Civil Engineering; Mech. Marine Engineering; Hydrographic Survey; Traffic; Administration / Establishment; Finance etc.

It is suggested and recommended to have an intra discipline and inter discipline training for all the employees of the IWAI at entry level i.e., at Technical Assistant / Assistant Director; Junior Hydrographic Surveyor / Assistant Hydrographic Surveyor; Junior Accounts Officer / Accounts Officer; Section Officer / Assistant Secretary etc. The National Inland Navigation Institute (NINI) of IWAI at Patna premises can be used for such training. It is preferred to have such Trainings as onsite training, while the works are under progress.

10.4. Infrastructure

The Infrastructure for the Institution will not have much implication, except the Land for the Office premises, if at all to have the own building of IWAI. However, the infrastructure for functional aspects may be essential within the accessibility of the site controlling office viz., the office of the Director.

There are many accessories equipment required for functioning & maintenance of waterway viz., Dredgers; Tugs; Survey vessels; Navigational Equipment maintenance vessels; Patrol Boats; Pilot Boats; Inspection Vessels etc. Since the waterway shall cater to tourist activities, hence night navigation is not needed.

Sharavati river due to its small stretch and no commercial opportunity at this stage doesnot need an exclusive vessel for maintenance of waterway.

10.4.1. Immovable

The immovable asset, Land is not suggested at this point of time. In the Long run, even if identified the need of having own office, this will be considered at one of the Terminal Locations basically located in the terminal building, amenable with ease approach. Hence there is no suggestion/ recommendation of Land/ immovable asset under Institution.

10.4.2. Movable

As discussed above, the asset requirement for attending the functions and responsibilities catered will be considered for procurement. The details have been tabulated directly as a financial Implication with segregation of Capital Cost Implication and Monthly Cost Implication, including the Manpower monthly implication in the forth coming Paras. Keeping in view the Organization requirement, as derived, the implication has been worked out duly taking into consideration of the 7th Pay commission Pay system, so as to have an implementable approach.

10.5. Cost Implications

The cost implication for the apportioned project has been worked out and placed herewith.

TABLE 10-1: Manpower financial implication per month

Sl No.	Name of the Post	Nos. of the Post	Basic Pay (INR)	Implication per month @ 95 % extra (INR)	Remarks
1	Director	0	78800	0	25 % extra for statutory allowances and 20 % extra for perks have been taken into consideration.
2	Asst. Director Civil / Mechanical	0	56100	0	
3	Asst. Hy. Surveyor	0	56100	0	
4	Junior Hy. Surveyor	1	47600	92,820	
5	Junior Accounts Officer	1	47600	92,820	
6	Supervisor	0	35400	0	
7	Steno / P. A	0	35400	0	
8	Upper Divisional Clerk	0	25500	0	
9	Data Entry Operator	0	21700	0	
10	Driver	0	21700	0	
11	Attendant	1	21700	42,315	
	Total	**3**		**2,27,955**	

TABLE 10-2: Financial implication – Capital and Maintenance

Sl No.	Name of the Item	Capital Cost (INR)	Financial Implication per month (INR)	Remarks
1	Office premises	*	0	*Housed in Terminal Building
2	Furniture etc.,	20,00,000	0	One Time
3	Pay and Allowances for 4 Nos.	--	2,27,955	Refer Table 10.1
5	Computer Systems including UPS etc.,1Nos. @ 1 lakh each	1,00,000	10,000	---
6	Printers 1 Nos. @ 0.25 lakhs each	25,000	10,000	---
7	Alternate Uninterrupted Power Supply with D. G set 1 No @ 10 Lakhs per no.	2,50,000	50000	---
8	Other General Office maintenance including stationery, electricity bill, consumables etc.,	--	1,50,000	---
Total		**23,75,000**	**4,47,955**	

+ The Cost implications for segregated functions like Fairway Development Cost; Terminal Development Cost; Vessel maintenance Cost; Navigation and Communication system implementation cost etc., have been taken into consideration at the appropriate heads.

+ No cost apportionment has been considered in conjunction with 6 National Waterways this is considered as standalone development and the maintenance cost per month will be INR 4.47 Lakhs per month.

CHAPTER 11: PROJECT COSTING

11.1. General and Financial assumptions

Project Costing is an important aspect, which is to be worked out rationally to assess the apt requirement of the project with a reasonable costing structure so as to ascertain the end result of returns and also will play a vital role in decision making on the implementation of various project components.

It is also essential to define certain financial requirements, in terms of assumptions for the project, which are to be rational i.e., not to be irrational.

In this context, certain parameters, as defined, by IWAI have been analyzed and considered in the cost working and Return working. The circulated data has been placed at Annexure 11.1. However, the same may not suffice the requirements in working out the cost / returns and hence some more assumptions have been considered appropriately, wherever required.

11.2. Basis of Costing

In general, the costing used to be worked out based on the quantity requirements along with rate per unit quantity. The quantities for the subject project have been arrived at based on the actual item wise requirements. The estimated costs have been worked out based on the relevant Schedule of Rates (SoR) of the concerned region / state. Rates for the non available items have been proposed based on the Market Rates or based on the realistic budgetary quotations, to the extent possible.

11.3. Development Cost

The Sharavati River is having passenger mobility only near the mouth of the River, as on date and according to the estimation and forecast based on detail study, there is non-availability of cargo and the possibility of Ro-Ro operation doesnot appear feasible at this stage which may be reviewed with the passage of time only, till positive growth development, with its hinterland extending to Eastern Karnataka with its originating traffic at Honnavar Port area.

In view of the above, the costing has been considered as a nominal fairway development for ferry services and development of ferry terminal facility in one of the proposed IWAI Terminal location.

11.4. Capital Expenditure

As explained above, the Fairway related development has been worked out and placed herewith.

TABLE 11-1: Abstract of Cost for Sharavati Fairway Development for Ferry Operations

Sl. No.	Item Description	Amount (in Lakh Rs.)	Refernce in Annexure
A	**Fairway**		
1	Dredging		
(i)	General Soil	1031.45	11.2
(ii)	Hard Soil	0.00	
2	Low-Cost River Structures		
(i)	Bandaling	0.00	
(ii)	Bottom Paneling	0.00	
3	River Training Works		
(i)	Spurs		
(ii)	Bank Protection Works for river	0.00	11.3
(iii)	Porcupine		
4	Night Navigation		
(i)	Channel Marking Buoy, Mooring Gear & Lighting Equipments	0.00	11.4
5	Land Acquisition	0.00	
	Sub-total (A)	**1031.45**	
B	**Modification of Structures**		
(i)	Bridges	0.00	
(ii)	Cables	00.00	
(iii)	Dams	0.00	
(iv)	Barrages	0.00	
(v)	Locks	0.00	
(vi)	Others	0.00	
	Sub-total (B)	**0.00**	
C	**Communication System**		
(i)	RIS Centre	00.00	
(ii)	AIS Base Station	0.00	
(iii)	Vessels - Survey & Other Vessel	0.00	

Sl. No.	Item Description	Amount (in Lakh Rs.)	Refernce in Annexure
(iv)	Buoys	00.00	Chapter 8
	Sub-total (C)	**00.00**	
D	**Institutional Requirement**		Chapter 10
(i)	Office Development Cost	23.75	
(ii)			
	Sub-total (D)	**23.75**	
	Sub-total (A)+(B)+(C)+(D)	**1055.20**	
E	Enviornmental Management Plan Cost@5% of Prime cost	52.76	
F	Project Management & consultancy Charges @3% of Prime cost	31.66	
G	Contingencies and Unforseen Items of Works@3% of Prime cost	31.66	
	Project Total Hard Cost	**1171.27**	
		11.71 cr	

The requirements of ferry terminal facility have been worked out and placed herewith.

TABLE 11-2: Abstract of Cost for Sharavati Ferry Terminal Facility

Sl No.	Item Description	Amount (in Lakh Rs.)	Refernce in Annexure
A	**Terminals**		
	Terminal		
(i)	Land	24.76	11.5
(ii)	Riverine Components	342.60	11.6
(iii)	Infrastructure Components including internal roads	191.15	11.7
(iv)	Approach Road (External) Cost	11.00	11.8
(v)	Bank Protection Works for terminal	218.71	11.9
	Sub-total (A)	**788.21**	
B	**Vessels**		
(i)	Vessel Size	0.00	
(ii)	Vessel Capacity	0.00	
	Sub-total (B)	**0.00**	
C	**Equipments for Both Terminals**		

Sl No.	Item Description	Amount (in Lakh Rs.)	Refernce in Annexure
(i)	Ambulance - 1 no.	18.00	
(ii)	Dumper Trucks 16 T Capacity - 1 no.	0.00	
(iii)	Cranes with 50 T Capacity - 1 no.	0.00	
(iv)	Forklift trucks 20 T Capacity - 1 no.	0.00	
	Sub-total (C)	**18.00**	
	Sub-total (A)+(B)+(C)	**806.21**	
D	Enviornmental Management Plan Cost@5% of Prime cost	40.31	
E	Project Management & consultancy Charges @3% of Prime cost	24.19	
F	Contingencies and Unforseen Items of Works@3% of Prime cost	24.19	
	Project total Hard Cost (In Lakhs)	**894.89**	
		8.95 cr	

11.5. Operational and Maintenance Expenditure

The operation & Maintenance expenditure has been considered as at Annexure 11.1 and as per the industrial standards.

11.6. Phasing of Expenditure

As explained above, the project is proposed to be considered only based on the firming up of the requirement of development from the concerned departments' viz., Tourism Department & Environment & Forest Department. The project magnitude is very moderate, and the development is recommended in single phase only over a period of two years. The financial modules are being considered with a gap of about 10 yrs (approx).

CHAPTER 12: IMPLEMENTATION SCHEDULE

12.1. Time Frame

Project Costing is an important aspect, which is to be worked out rationally to assess the apt requirement of the project with a reasonable costing structure so as to ascertain the end result of returns and also will play a vital role in decision making on the implementation of various project components.

It is also essential to define certain financial requirements, in terms of assumptions for the project, which are to be rational i.e., not to be irrational.

In this context, certain parameters, as defined, by IWAI have been analyzed and considered in the cost working and Return working. The circulated data has been placed at Annexure 11.1. However, the same may not suffice the requirements in working out the cost / returns and hence some more assumptions have been considered appropriately, wherever required.

12.2. Phasing

The fairway development and Ferry Terminal development D/s Gerusoppa dam are proposed to be completed in 24 months, after obtaining clearances and approvals.

The Vessel requirement will be taken care by Entrepreneurs i.e., 1 passenger ferry for tourist mobility may be required at the for the entire project period.

12.3. Suggested Implementation Mechanism

The implementation will be considered through the Project Management Consultancy, as provisioned. However, it is suggested that the overall supervision will be under the control of the IWAI supervision mechanism.

CHAPTER 13: ECONOMIC AND FINANCIAL ANALYSIS

13.1. Introduction

Sharavati River (NW 90) development has been distinguished across two subsectors including Fairway and Terminals. This is depicted in the following Table 13 1:

TABLE 13-1 NW 90 Development

Sub-sector	FY23	FY24	FY25	FY30	FY35	FY40
Fairway	Development					
		Operational				
Terminal	Development					
		Operational				

Source: Tractebel; Consultant

Sharavati River development has been approached with the scope of handling tourist traffic along the River. In this view, the first objective is to develop the fairway to facilitate the projected traffic. The second objective is to develop a ferry terminal at Gerusoppa to cater to tourist traffic between Gerusoppa and Honnavar Port. Few locations on Sharavati river are already operational for passengers for river crossing, available infrastructure is sufficient to handle the future projected passenger traffic.

Hence, IWAI does not require to invest and develop any additional infrastructure at available passenger landing points. Sharavati River is proposed to handle tourist traffic, however one floating pontoon berthing platform shall be developed at Gerrusoppa terminal location that is capable of handling tourist traffic.

This platform will facilitate ferry berthing. In the beginning stage, ferry service and tourism infrastructure may be started with Public- Private Partnership (PPP) methodology while the institutional support in terms of infrastructure, safety, licensing to operate shall be provided by the implementing organization.

The state govt. has a very proactive role to play in such kind of development and if there is a positive development over the period of time, the infrastructural arrangements shall conveniently be upgraded for cargo or commercial use. IWAI would develop fairway for class IV waterways and terminals infrastructure. The recovery of investment for fairway development, maintenance of fairway and terminals would be from royalty generated from tourism operations.

Construction period for this project is considered for 2 years i.e. FY23 & FY24 and operation will get started by FY24 till FY40. IWAI prescribed tariffs (notified in 2011) have been assumed for vessel berthing and fairway usage. The table below shows the revenue generating sources considered in this financial study.

TABLE 13-2 Revenue Sources for IWAI

Sl. No	Source	Tariff	Description
1	**Royalty from Tour Operators**		
	Boat Ride	INR 500 / Pax	20% of ticket fee charged by Operator (Tourists INR 100/Pax)
2	**Vessel Berthing**	INR 1,000 / Day	By IWAI
3	**Fairway Usage**	INR 0.02 GRT-km	By IWAI
4	**Real Estate Leasing**	INR 500 / Day / Shop	04 Shops
Source: IWAI and Consultant			

Royalty from tour operators would be the primary revenue source for IWAI. The boat operators carrying tourists for along the river ride would pay IWAI a Royalty of 20% from the boat tariffs. The selection of operators could be made using tendering process whereas 20% royalty sharing to be made as reserve price. Any operator bidding higher/highest revenue sharing to be awarded tourism project. There could be one or multiple operators based on the interest from tourism industry.

IWAI would generate additional revenue from Vessels berthing, tariffs imposed from fairway uses, license fee and leasing of real estate space on the terminals.

13.2. Input Sheet

The following table lists all the assumptions and input values used in the financial modeling of Sharavati River. This includes financial analysis for the navigation infrastructure (fairways), and terminals operation:

TABLE 13-3 Input Sheet for NW 90

Description	Unit	Fairway	Terminal
Loan Tenure	Years	10	10
Moratorium Period (Years Construction)	Years	2	2
Rate of Interest	Annual	11%	11%
Corporate Tax	Annual	25%	25%
Revenue Escalation	Annual	6%	6%
Administrative Cost	of Revenue	3%	2%
Manpower Cost Escalation	Annual	5%	5%

Description	Unit	Fairway	Terminal
Dredging Costs Escalation	Annual	5%	
Other Costs Escalation	Annual		6%
Fairway Chainage	km	25.2	
Chainage (mouth of the river to Terminal)	Km		25.2
Operation & Maintenance			
Description	**Unit**	**Fairway**	**Terminal**
Civil Infrastructure	Cost		1%
Dredging		10%	
Machinery Infrastructure			5%
Insurance Cost	Capex	2%	2%
Assumptions for EIRR			
Parameters	**Unit**	**Value**	
Distance			
Road	Km	62	
IWT	Km	25.2	
Capacity			
Road	Pax. Per Vessel	29	
IWT	Pax. Per Bus	60	
Accidental Loss			
Road	Rs Lakhs/KM	7.6	
IWT	Rs Lakhs/KM	0.15	
Fuel price	Rs/Litre	94.0	
Operating Cost (OC)			
Road	Rs/Pax.-km	1	
IWT	Rs/Pax.-km	2.5	
Emission			
Road	Rs/Trip	650	
IWT	Rs/Trip	105.5	

Source: Consultant, Market standards

All the necessary assumptions for financial modeling are either market driven or provided by IWAI. Fairway and terminal tariff have been taken from IWAI. The chainage of 25.2 km is between both the proposed terminals. In EIRR, round-trip distance is considered in each of the sub-sector's economic viability evaluation.

13.2.1. Revenue

Revenue for the cumulative stretch of Sharavati River will be generated from the core operations, which include utilization of the fairways by the potential users, vessel berthing and royalty from tour operator. Secondary revenues sources, labeled "Ancillary Revenue", will be generated from sources like land leasing for commercial operations (tea-stall, coffee shops, inn, etc.). The revenue break-up and total revenue for IWAI on Sharavati River are presented in the table below:

TABLE 13-4 Revenue for NW 90 (INR Lakhs)

Particulars	FY23	FY24	FY25	FY30	FY35	FY40
Fairway	-	0.13	0.15	0.22	0.32	0.47
Terminal	6.0	11.6	12.4	17.3	24.3	34.3
Total	**6.0**	**11.7**	**12.5**	**17.5**	**24.7**	**34.7**

Source: Consultant

13.3. Costs

The following table shows these cost-heads for development of terminal and fairway:

TABLE 13-5 Project Cost (INR Lakh)

Description	Total	FY23	FY24
Fairway			
Fairway	1,031.5	515.7	515.7
Environmental Management Plan Cost as per chapter-9 of the DPR	51.6	25.8	25.8
30.9		15.5	15.5
Contingencies and Unforeseen Items of Works@ 3% of Prime cost	30.9	15.5	15.5
Total Project Cost	**1,144.9**	**572.5**	**572.5**
Terminals			
Terminal	788.2	394.1	394.1
Equipments	18.0	9.0	9.0
Institutional Requirement	23.8	11.9	11.9
Environmental Management Plan Cost as per chapter-9 of the DPR	41.5	20.7	20.7
Project Management & consultancy Charges @ 3% of Prime cost	24.9	12.4	12.4
Contingencies and Unforeseen Items of Works @ 3% of Prime cost	24.9	12.4	12.4
Total Project Cost	**921.3**	**460.6**	**460.6**

The onus of vessel acquisitions would be with the private operator and not IWAI. Hence, vessel costs will not be factored in to develop model for the proposed facility. All the tourism infrastructures would be created following PPP model. Hence, no vessel related investment has been assumed in the IWAI model.

13.4. Financial Analysis / FIRR

The financial indicators dictating FIRR for individual ventures, viz. fairways development and terminals construction have been presented tables below. These indicators help measure the financial return on investment, which will enable IWAI in taking an informed decision in regard to implementing the project. However, before presenting FIRR for the project, some major components such as Salary, Depreciation and P&L statement are provided in the following tables, respectively:

TABLE 13-6 Employment schedule and salary expenditure (INR Lakh)

Parameter	No.	CTC p.a. / person	FY23	FY24	FY25	FY30	FY35	FY40
Manpower Expenditure								
Junior Accounts Officer	1	11.1	-	11.7	12.3	15.7	20.0	25.5
Junior Hy. Surveyor	1	11.1	-	11.7	12.3	15.7	20.0	25.5
Attendant	1	5.1	-	5.3	5.6	7.1	9.1	11.6
Total Salary (INR Lakh)	**3**	**-**	**-**	**28.7**	**30.2**	**38.5**	**49.1**	**62.7**

Source: Consultant

Manpower cost has been considered in Total Project Cost under "Institutional Requirement". However, this investment component toward manpower will accommodate expenses only for the initial years, covering construction period. Manpower expenses in case of the terminal isn't necessarily directed towards IWAI. It will be borne by whosoever operates the terminal. The royalty received from tourist operators would act as a source of revenue for the operation of terminal and fairway. The cost of manpower to be recovered from the 20% royalty received from companies operating ferry.

TABLE 13-7 Depreciation (Using SLM Method) (INR Lakh)

Depreciation & Amortization	FY23	FY24	FY25	FY30	FY35	FY40
Fairway						
Gross Block	572.5	1,144.9	1,144.9	1,144.9	1,144.9	1,144.9
Depreciation & Amortization	-	88.0	88.0	65.3	65.3	-
Cumulative Depreciation & Amortization	-	88.0	176.0	570.5	896.9	1,144.9

Depreciation & Amortization	FY23	FY24	FY25	FY30	FY35	FY40
Net Block	**572.5**	**1,056.9**	**968.9**	**574.4**	**248.0**	**-**
Terminals						
Gross Block	460.6	921.3	921.3	921.3	921.3	921.3
Depreciation & Amortization	-	71.3	71.3	53.0	50.7	0.9
Cumulative Depreciation & Amortization	-	71.3	142.5	462.3	724.0	917.8
Net Block	**460.6**	**850.0**	**778.7**	**458.9**	**197.2**	**3.5**

Source: Consultant

Depreciation has been calculated using the Straight Line Method (SLM). Under this method, cost of asset is evenly distributed across its useful life. Gross Block in each case is sum of total hard cost and pre-operative expenses, which includes environmental management plan @ 5% of the Capex.

TABLE 13-8 P&L Statement (INR Lakh)

Parameter	FY23	FY24	FY25	FY30	FY35	FY40
Fairway						
Revenue	**0.0**	**0.1**	**0.1**	**0.2**	**0.3**	**0.5**
O&M Cost	**51.6**	**108.3**	**113.7**	**145.1**	**185.2**	**236.4**
PBDIT	**-51.6**	**-108.2**	**-113.6**	**-144.9**	**-184.9**	**-236.0**
Depreciation	0.0	88.0	88.0	65.3	65.3	0.0
Interest	40.9	81.9	72.2	23.9	0.0	0.0
PBT	**-92.5**	**-278.0**	**-273.8**	**-234.1**	**-250.2**	**-236.0**
Tax	0.0	0.0	0.0	0.0	0.0	0.0
PAT	**-92.5**	**-278.0**	**-273.8**	**-234.1**	**-250.2**	**-236.0**
Terminals						
Revenue	**6.0**	**11.6**	**12.4**	**17.3**	**24.3**	**34.3**
O&M Cost	**4.6**	**64.9**	**68.5**	**89.8**	**117.7**	**154.4**
PBDIT	**1.4**	**-53.4**	**-56.2**	**-72.4**	**-93.3**	**-120.1**
Depreciation	0.0	71.3	71.3	53.0	50.7	0.9
Interest	32.9	65.9	58.1	19.2	0.0	0.0
PBT	**-31.6**	**-190.5**	**-185.5**	**-144.7**	**-144.1**	**-120.9**
Tax	0.0	0.0	0.0	0.0	0.0	0.0
PAT	**-31.6**	**-190.5**	**-185.5**	**-144.7**	**-144.1**	**-120.9**

Source: Consultant

Terminal will start generating no positive operating profit till FY40, whereas fairway through out its operation period generates negative operating profit. The following table provides viability of project and calculates Financial Returns of the individual projects under the development of the Sharavati River:

TABLE 13-9 FIRR for NW 90 (INR Lakh)

Parameter	FY23	FY24	FY25	FY30	FY35	FY40
Fairway						
Project Cashflow (Pre-tax)	-624.0	-680.6	-113.6	-144.9	-184.9	-236.0
Project IRR(Pre-tax)	**Non-existent**					
Project Cashflow (Post-tax)	-624.0	-680.6	-113.6	-144.9	-184.9	-236.0
Project IRR(Post-tax)	**Non-existent**					
Terminals						
Project Cashflow (Pre-tax)	-459.3	-514.0	-56.2	-72.4	-93.3	-120.1
Project IRR (Pre-tax)	**Non-existent**					
Project Cashflow (Post-tax)	-459.3	-514.0	-56.2	-72.4	-93.3	-120.1
Project IRR (Post-tax)	**Non-existent**					

Source: Consultant

Revenue prospect for both the sectors generated no return. Based on the EIRR for both the sub-sectors, Viability Gap Funding (VGF) can be sought.

In contrast to the above project component-wise FIRR, the following table provides FIRR for the project as a whole:

TABLE 13-10 FIRR for NW 90 – Whole Project (INR Lakh)

Parameter	FY23	FY24	FY25	FY30	FY35	FY40
Whole Project						
Project Cashflow (Pre-tax)	-1,083.3	-1,287.7	-169.7	-217.4	-278.2	-356.0
Project IRR (Pre-tax)	**Non-existent**					
Project Cashflow(Post-tax)	-1,083.3	-1,287.7	-169.7	-217.4	-278.2	-356.0
Project IRR (Post-tax)	**Non-existent**					

Source: Consultant

Either on standalone basis like fairway and terminal separately or as a whole, this project does not give healthy returns.

13.5. Economic Analysis / EIRR

Economic Internal Rate of Return (EIRR) includes all the financial benefits of a project as well as the non-financial benefits of that project. Non-financial benefits would include reduction in CO2 emission, decreased health care interventions, reduced traffic, and other quantified benefits that a project can have on a region considered for a project. The EIRR looks at any investment decision from the perspective of improving the welfare of the society in general. The table below shows the estimated EIRR for each of these sub-sectors is presented in the table below:

TABLE 13-11 Project EIRR (INR Crores)

Parameters	FY23	FY24	FY25	FY30	FY35	FY40
Fairway						
Economic Cash Outflow	-6.2	-6.9	-1.2	-1.5	-1.9	-2.5
Net Cash Flow to Project	-3.6	-3.9	-0.5	-0.6	-0.8	-1.0
Project EIRR	**Non-existent**					
Terminals						
Economic Cash Outflow	-4.6	-5.3	-0.8	-1.0	-1.3	-1.6
Net Cash Flow to Project	-2.7	-2.9	-0.2	-0.2	-0.3	-0.3
Project EIRR	**Non-existent**					

Source: Consultant

Similar to calculating FIRR of the whole project, the following table shows the EIRR of the whole project:

TABLE 13-12 Project EIRR – Whole Project (INR Crores)

Parameters	FY23	FY24	FY25	FY30	FY35	FY40
Whole Project						
Economic Cash Outflow	-10.9	-12.1	-1.9	-2.4	-3.1	-4.0
Net Cash Flow to Project	-6.4	-6.8	-0.6	-0.8	-1.0	-1.2
Project EIRR	**Non-existent**					

Source: Consultant

The project as a whole produces no economic returns.

13.6. Sensitivity Analysis

Variations in tariff rates and project cost (+/- 10%) have been applied to measure the overall impact these could have on the project's earnings and profitability. Sensitivity Analysis for each of the sub-sectors is shown in the table below:

TABLE 13-13 Sensitivity Analysis (+10% Revenue, +10% Project Cost)

Revenue Source	FY23	FY25	FY30	FY35	FY40
Fairway					
Revenue	**0.0**	**0.2**	**0.2**	**0.4**	**0.5**
PAT	**-101.8**	**-301.1**	**-257.5**	**-275.2**	**-259.6**
Project IRR (Pre tax)	**Non-existent**				
Project IRR (Post tax)	**Non-existent**				
Terminals					
Revenue	6.0	12.9	18.2	25.6	36.1
PAT	-35.3	-198.9	-152.4	-149.7	-121.6
Project IRR (Pre tax)	**Non-existent**				
Project IRR (Post tax)	**Non-existent**				

Source: Consultant

TABLE 13-14 Sensitivity Analysis (+10% Revenue, -10% Project Cost)

Revenue Source	FY23	FY25	FY30	FY35	FY40
Fairway					
Revenue	0.0	0.2	0.2	0.4	0.5
PAT	-83.3	-246.4	-210.6	-225.1	-212.3
Project IRR (Pre tax)	**Non-existent**				
Project IRR (Post tax)	**Non-existent**				
Terminals					
Revenue	6.0	12.9	18.2	25.6	36.1
PAT	-27.8	-171.0	-135.3	-136.0	-116.7
Project IRR (Pre tax)	**Non-existent**				
Project IRR (Post tax)	**Non-existent**				

Source: Consultant

TABLE 13-15 Sensitivity Analysis (-10% Revenue, +10% Project Cost)

Revenue Source	FY23	FY25	FY30	FY35	FY40
Fairway					
Revenue	0.0	0.1	0.2	0.3	0.4
PAT	-101.8	-301.2	-257.5	-275.3	-259.6
Project IRR (Pre tax)	**Non-existent**				
Project IRR (Post tax)	**Non-existent**				
Terminals					
Revenue	6.0	11.8	16.5	23.1	32.5
PAT	-35.3	-200.0	-154.0	-152.1	-125.2
Project IRR	**Non-existent**				

Revenue Source	FY23	FY25	FY30	FY35	FY40
(Pre tax)					
Project IRR (Post tax)	**Non-existent**				

Source: Consultant

TABLE 13-16 Sensitivity Analysis (-10% Revenue, -10% Project Cost)

Revenue Source	**FY23**	**FY25**	**FY30**	**FY35**	**FY40**
			Fairway		
Revenue	0.0	0.1	0.2	0.3	0.4
PAT	-83.3	-246.4	-210.7	-225.2	-212.4
Project IRR (Pre tax)	**Non-existent**				
Project IRR (Post tax)	**Non-existent**				
			Terminals		
Revenue	6.0	11.8	16.5	23.1	32.5
PAT	-27.8	-172.1	-136.9	-138.4	-120.2
Project IRR (Pre tax)	**Non-existent**				
Project IRR (Post tax)	**Non-existent**				

Source: Consultant

Under no scenario fairway and terminal generates positive FIRR and this primarily because of tariff charged by IWAI i.e 0.02 GRT-km is too low to show any positive return. This means that even in imaginable optimistic conditions of higher revenue and lower cost, it is very highly unlikely that fairway would generate positive returns in the projected period up to FY40.

13.7. Risk Factors & Mitigation

Risk is a function of the probability of an event's occurrence and the impact it can have on the project. The major risk associated with the Project is the unwillingness of tourists to shift from existing mode of transportation i.e. roadways to proposed waterway. Opting for waterway for touring the local tourist spots by first using waterways and then roadways will be unreasonable to expect. The River is surrounded mostly by hills and valleys, covered with thick forests. Some tourist places are beyond the River's primary catchment area, which are better accessible by roads. Other risks typically impressing upon such a project are political, technical, environmental, and financial in nature.

13.8. Necessity of Govt. Support (VGF / PPP)

Difficulty in securing funds aside, some projects are not even considered to be financially viable, although they might be economically justified and indispensable. To take care of such projects and to carry them towards their successful completion, the government has designed Viability Gap Funding (VGF). Viability Gap Funding is the grant provided by the government towards financing projects that are termed financially unviable but are economically justified. The scheme and the projects are monitored by the Ministry of Finance and amount is allocated through annual budget. The usual grant given by the government is 20% of the total capital cost of the project, which can be supplemented by the state government through an additional 20% grant.

Fairway& Terminal both are commercially not viable and gives economically no returns, still VGF is applied to understand the outcome of return under 20% and 40% grant.

TABLE 13-17 Probable impact of VGF on project returns

Reduction in Project Cost	Fairway		Terminal	
	-20%	-40%	-20%	-40%
Project IRR (Pre Tax)	Non-existent	Non-existent	Non-existent	Non-existent
Project IRR (Post Tax)	Non-existent	Non-existent	Non-existent	Non-existent

Source: Consultant

Even at 40% of financial support from the government, the Fairway and Terminal does not produce the desired positive returns commercially.

13.9. Conclusion

The following table gives a snapshot of the project cost and viability indicators for all the sub-sector developments for NW 90:

TABLE 13-18 Critical indicators for the NW 90

No	Factors	Section	Unit	Outcome
1	Project Cost	Fairway	Cr.	11.45
		Terminals	Cr.	9.21
2	Tariff	Vessel Berthing	INR Vessel/Day	1,000
		Royalty	INR / Pax.	100 (20% of Ticket Fare)
		Fairway Usage	INR GRT-Km	0.02
2	Traffic	Tourists	In numbers	5,000

No	Factors	Section	Unit	Outcome
			(FY40)	
3	Revenue	Fairway (FY40)	Cr.	0.005
		Terminals (FY40)	Cr.	0.34
4	FIRR	Fairway	-	Non-existent
		Terminals	-	Non-existent
		Whole	-	Non-existent
5	EIRR	Fairway	-	Non-existent
		Terminals	-	Non-existent
		Whole	-	Non-existent

Source: Consultant

The project does not have cargo transportation hence this aspect has not been found commercially and economical viable. The development of the entire study stretches of Sharavati River of about 25.2 kms (D/s of Gerusoppa Dam to Hannovar Port) has been examined for tourist related movement with Class IV system of the NW standards however this is also not generating positive returns. The financial analysis undertaken for the project shows non-existent FIRR & EIRR. In the most optimistic scenario, development of river Sharavati (NW-90) may be considered only for the tourist services.

CHAPTER 14: CONCLUSIONS AND RECOMMENDATIONS

The study of Second Stage Detailed Project Report (DPR) for Development of Sharavati River (NW 90) of 28.674 kms from Lat 14°17'56.5621" N, Long 74°25'36.4534" E has been carried out as per the Terms of Reference (ToR).

A summary of the recommendations and conclusions as a result of the study is placed herewith:

- At the outset, it is to place that the study stretches of "Sharavati River" is up to the D/s of the Gerusoppa Dam and the entire srudy stretch is experiencing the Tidal effect.
- Based on the Detailed Hydrographic Survey carried out / Site data collected and subsequent to the Morphological analysis etc., the required developments in the Fairway along with interrelated activities have been identified.
- In order to provide a safe navigable fairway, in the stretch up to Gerusoppa Dam, along with the dredging to achieve a LAD of 2.0 m as the waterway depth (4.21 Lakhs Cu. M of ordinary soils); Day / Night Navigation (0 Nos of Buoy / Light – No Night Navigation); Bank Protection - None; Communication System (RIS / AIS / Locating the Vessels / Buoys); Institutional Requirements etc., have been considered. No need of Modification of structures, since there is no structure obstructing the IWT mobility. Since the waterway shall cater to tourist activities, hence night navigation is not needed.
- Honnavar port, in the mouth of Sharavati River, has been identified with the potential of handling the cargo Steel; Sugar; Fertilizer; Coal; Iron Ore; Molasses & Edible Oil. The development is expected shortly and will have connectivity through Sharavati. Keeping in view the Passenger & Tourism Traffic, ferry mobility service is suggested using the terminal facility of Hannovar port.
- Ferry IWT Terminal has been proposed taking into the consideration of the origin and destination and fairway. The most probable location identified is D/s of the Gerusoppa Dam, on the right side of the river, Lat 14°14'20.64"Nand Long 74°38'59.16"E. This location is having good accessibility to the road and the tentative Land requirement has been arrived at with 1928 Sq. M in the Saralagi Village; Gerusoppa Taluka; Uttara Kannada District of Karnataka state.
- Terminal Infrastructure has been considered to suit to the Ferry operation with the length of the berthing pontoon structure as 30.0 m and width as 8.00 m.

- Passenger ferry with less than 1.8m draft is suitable for navigating in the defined stretch, as targeted depth of Sharavati is 2 m. The sample vessel specification proposed for tourist mobility considered at the initial stage is as follows. The indicative cost & other specification are summarized below.
  - Market Price for **steel boat** – Approx. INR 120 Lakhs
  - Size (L x B x D) – 12m x 2m x 0.8m, 30pax
  - Engine - 1 Marine Diesel Outboard Engines of 150 hp each.
  - Market Price for **FRP boat** – Approx. INR 75 Lakhs
  - Size (L x B x D) – 12m x 2m x 0.5m, 30pax
  - Engine - 1 Marine Diesel Outboard Engines of 120 hp each.
- The cost estimates have been worked out and segregated into Fairway Module with capital cost of 11.71 Cr. followed with floating pontoon & terminal building at a capital cost of 8.95 Cr. (approx). The total cost is 20.66 Cr. All the capital assets will be provisioned in 24 months.
- The Revenue factor however, is to be considered along with the development of Fairway in Sharavati River and also the Ferry Terminal at the other end in Sharavati River near Gerusoppa dam.
- The FIRR and EIRR have been worked out and the details are placed.

Project Modules	FIRR	EIRR
Fairway	Non-Existent	NA
Ferry Terminal	Non-Existent	NA
Vessel	Non-Existent	NA

CHAPTER 15: TEMPLATES

15.1. Environmental & 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			To be confirmed
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	✓		EIA Notification 2006 CRZ Notification 2011

Screening Question	Yes	No	Details / Remarks
Order/ Policy relevant / relating to the site?			Water Act, 1974 Air Act 1981
5. Is the project involved clearance of existing land, vegetation and buildings?	✓		Only for construction of terminal buildings
6. Is the project involved dredging?	✓		
7. Is the project area susceptible to natural hazard (earthquakes, subsidence, erosion, flooding, cyclone or extreme or adverse climatic conditions)	✓		
8. Is the project located in whole or part within the Coastal Regulation Zone?	✓		The entire stretch falls under CRZ – I.
9. Is the project involved any demolition of existing structure?			To be confirmed
10. Is the project activity require acquisition of private land?			To be confirmed
11. Is the proposed project activity result in loss of direct livelihood / employment?			To be confirmed
12. Is the proposed project activity affect schedule tribe/ caste communities?			To be confirmed

Sl No.	Result of Screening Exercise	(Yes / No)
1.	Environment Impact Assessment is Required	Yes
2.	CRZ Clearance is Required	Yes
3.	Environmental Clearance is Required	Yes (for dredging)
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	Only as part of EIA study
8.	Abbreviated RAP is required	No
9.	Full RAP is required	No
10.	Any other clearance is required	No

15.2. Traffic Template

15.2.1. Catchment Baseline

- Local Economic Geography- Sharavati river originates at Ambuthirtha in Thirthahalli taluka, Shivamogga district and flows north-west through the Western Ghats. It forms the famous Jog Falls before joining the Arabian Sea at Honnavar in Uttara Kannada district.
- Catchment Area - Honnavar, Bhatkal & Kumta talukas in Uttara Kannada district.
- Population – As per census 2011, total population of Uttara Kannada is about 14,36,847.
- Total population residing in Honnavar taluka is 1,66,390, Bhatkal taluka is 1,61,577 and Kumta taluka is 1,54,515.
- Economic Activites- Paddy, Maize and Jowar come under Agriculture activities. The chief plantation and horticultural crops grown are mango, cashew nut, banana and coconut. Marine & Inland Fishing is done in the catchment area. In Mining, Iron and Manganese are the major minerals, while Limestone, Bauxite, Quartz, Silica, Lime shells and Sand are the other important minerals. Uttara Kannada's contribution in terms of registered manufacturing is negligible. Tourism's contribution in the district's economy is significant.
- Major Industries – There exist many micro & small enterprises and artisan units in the district. There is no large industry in the catchment area of Sharavati river. The river is surrounded by hilly & forest areas and wildlife sanctuaries, which make it difficult to establish any industry here.

- Connectivity
  - ✓ Major roads – NH 66, NH 206, NH 69, NH 4A, SH 144 are the major highways. NH 66 passes through Uttara Kannada district and connects Panvel near Mumbai to Kerala state.
  - ✓ Major railway – Uttar Kannada has railway stations at Kumta & Karwar, which are well connected with Konkan Railway. Konkan railway connects Mangalore and Mumbai via Karwar. Kumta is about 72 km from Karwar and 58 km north of Bhatkal.
- Specific Developments
  - ✓ Government of Karnataka has proposed to develop Honnavar Port, along with other ports of Karnataka.
  - ✓ Haigund Island Bridge is under construction, which connects famous tourist place Haigund Island with Heragaddi village in Honnavar taluka. Once this bridge becomes operational, Haigund Island would be easily accessible by locals and tourists.
- Catchment area Map

15.2.2. Navigation Baseline

- Existing Waterway Usage
  - ✓ No existing cargo movement on the river at present; river is mostly used by fishing vessels and country boats.

- ✓ There exist two non-major ports in the primary catchment area of Sharavati river, namely Honnavar Port and Bhatkal Port. Honnavar Port is located on the right bank of the river. The state government has ambitious plan for the development of Honnavar Port, which would further provide opportuniuty for the proposed waterway in future. Bhatkal Port is also near from the river. At present, it is used by fishing vessels.
- ✓ There exist fishing and passenger jetties along Sharavati river. Country boats and motorboats for passengers and tourists are used in the river. Passenger ferries ply across the river, between Upponi and Samshi village. There is Mavinhole dock also which is near Upponi- Samshi Suspension Bridge; this dock is used by passengers. Country boats are used to cross the river from Idagunji and Gerusoppa points also.

15.2.3. Market Baseline

- Potential Market

  - ✓ At present, there is no cargo potential for Sharavati river, as there does not exist any large industry in the catchment area. Minerals in the region would also not provide opportunity as they are less in volume.
  - ✓ Passengers would not provide opportunity because locals use existing ferry service to cross the river. They would not use IWT terminals for along the river movement.
  - ✓ Tourism would provide opportunity for the proposed ferry services with development of terminal at downstream of Gerusoppa dam on Sharavati river as tourists could visit tourist spots located near the river and enjoy the scenic beauty of hills and forests by availing the ferry services.

15.2.4. Forecasting Years

- IWT Share

  - ✓ As per the study on Development of IWT in Karnataka carried out by Directorate of Ports and IWT & Rites Ltd., a total of 2,500 tourists visited the tourist region of Sharavati River in 2005. Hence, number of tourists 2,500 has been considered as base data for future traffic projection.

15.2.5. Forecasting Years & Presentation of Forecast

Sr. No	Name of Cargo	Type of Cargo	Origin	Origin Terminal on NW	Co-ordinates	Final Destination	Destination Terminal on NW	Co-ordinates	Unit p.a	FY 16	FY 20	FY 25	FY 30	FY 35	FY 40
Existing Terminals on River (across the river movement for locals)															
1	Passenger Traffic	N.A.	Samshi, Idagunji, Gerusoppa & nearby villages	Samshi, Idagunji, Gerusoppa	14°14'8.06"N, 74°36'25.33"E/ 14°14'46.39"N, 74°30'18.62"E/ 14°14'15.98"N, 74°39'5.35"E	Uponni, Jalwali, Gerusoppa & nearby villages	Uponni, Jalwali, Gerusoppa	14°14'14.16"N, 74°36'22.23"E/ 14°14'12.23"N, 74°39'7.66"E	('000 Number)	39.0	42.2	46.6	51.5	56.8	62.7
Proposed Terminal on River (Opportunity for IWAI)															
1	Tourist Traffic	N.A.	Indian states & Foreign countries	Kasarkod (Near NH 66)	14°16'8.00"N, 74°26'9.00"E	Shivamogga	Gerusoppa	14°14'20.64"N, 74°38'59.16"E	('000 Number)	3.2	3.4	3.7	4.1	4.5	5.0

15.2.6. Market Success Factors

As such there is no considerable cargo mobility observed in the study stretch.

However, there is every possibility of growth factor in Passenger / Tourism Traffic, which may pave way for Cargo mobility in coming years. Only in that case Ro-Ro services may be put in operation by developing the suitable facility.

15.2.7. Forecasting Methodology

- ✓ As per the study on Development of IWT in Karnataka carried out by Directorate of Ports and IWT & Rites Ltd., a total of 2,500 tourists visited the tourist spots near Sharavati River in 2005.
- ✓ Due to unavailability of data for the marked tourist places, it could be estimated that around 2,500 tourists visit the catchment area.
- ✓ Also expected the growth trend to 5,000 Tourists.

15.3. Project Costing Template

Cost type	Cost categories	Components to be itemized
Capital costs	Waterway Infrastructure	□ Land, compensation and resettlement: No □ Capital dredging: 4.21 lakhs cu.m Ordinary soil–10.31cr □ River training/bank protection: None □ Locks: No □ Barrages: No □ Channel marker: No □ Other: Communication system – No
Ferry Terminal Infrastructure		Ferry facility □ Fixed infrastructure: berths, moorings, hard-standing etc. (itemized) □ Loading/uploading and other equipment (itemized) - None □ Buildings : Considered in infrastructure □ Other : - Considered

Cost type	Cost categories	Components to be itemized	
Operation and maintenance (O & M) costs	Waterways	Maintenance dredging Markings and nav.-aids Bank maintenance Other	Considered as per standard
	Terminals	Terminal operations Terminal maintenance Other	Considered as per standard
	Vessel: One vessel of 25-30 Pax carrying capacity	Crew Fuel Maintenance Registration & insurance Fees and charges Vessel capital amortization (or leasing cost equivalent) Total costs (Cost/Pax for use in evaluation)	Considered as per standard
Recurrent costs		Periodic major capital costs that may occur over life of assets: Considered as per standard	
Price levels		All costs to be expressed at 2021 price levels. Costs derived from other years to be indexed to 2021 price levels & considered accordingly.	
Value engineering		Not all investments will be necessary in all projects. Value engineering should be applied to project scoping and specification to avoid “gold-plating” of costs and undermining viability of project: -	
Cost verification		Costs that are estimated on a “bottom-up” basis should be verified or tested for reasonableness against actual costs for such activities evidenced in the market place: Considered as per standard	

15.4. Economic Evaluation Template

Item	Requirements
Objective	To assess economic internal rates of return (EIRR) on a consistent basis between different river projects.
Economic evaluation approach	Economic evaluation of each river upgrading project may include: **Capital Cost:** (a) Navigation infrastructure – INR 11.45 crore (b) Ferry Terminal Cost - INR 9.21 crore **O & M costs:** (a) Navigation infrastructure – INR 2.36 crore (b) Terminal Cost - INR 1.54 crore Savings in transport resource costs between IWT and rail and/or road transport **Saving on Fuel:** (a) Navigation infrastructure – INR -0.10 crore (b) Terminal Cost - INR -0.10 crore **Saving on Vehicle Operating Cost:** (a) Navigation infrastructure – INR 0.05 crore (b) Terminal Cost - INR 0.05 crore **Savings in accident costs:** (a) Navigation infrastructure – INR 0.002 crore (b) Terminal Cost - INR 0.002 crore **Saving in carbon emissions:** (a) Navigation infrastructure – INR 0.004 crore (b) Terminal Cost - INR 0.004 crore
Standard values	To ensure consistency between evaluations of different waterways the following has been used: Vehicle operating Cost Road : INR 1.0 Person-km IWT: INR 2.5 Person-km Road accident Loss: INR 7.6 Lakhs/km

Item	Requirements
	□ IWT accident Loss: INR 0.15 Lakhs/km
Other benefits	Other significant economic benefits such as direct employment creation has also been considered in the evaluation. Employment cost has been taken as INR 2.5 Lakhs per annum.
Cash flows in real terms	Economic cost has been considered as 85% of actual values without any escalation.
Resource cost adjustments	Market prices has been taken on 2021 price level as equivalent to resource costs for the purposes of the economic evaluation.
Evaluation period	Waterway utilization is assumed to start from FY24 till FY40, with development of navigational infrastructure and terminal (development period of 2 years, FY23-FY24).
EIRR	Development of Sharavati as an alternate mode for transportation for tourism is likely to generate employment. The waterway would decongest the roads by traffic diversion and likely to save fuel used in road transportation along with reduction in environment pollution. The reduction of vehicular operating cost due to use of Sharavati is also likely to generate overall benefits to the project. Economic IRR of Navigational Structure and Ferry Terminal during FY24-FY40 comes at Non-Existent
Checking and Replicability	Systematic checks of spreadsheets and logic trail have been done keeping in mind the input data, assumptions and calculations.

15.5. Financial Evaluation Template

Consultants shall adhere to the following standard approaches in estimating financial internal rate of return (FIRR) and payback period.	
Item	**Requirements**

Objective	To assess financial internal rates of return and financial payback periods of Sharavati River.
Financial evaluation approach	Financial evaluation of each river upgrading project should estimate and present actual cash flows (cost and revenues) at market prices within the inland waterway sector consisting of the two sub-segments: (a) navigation infrastructure; (b) terminal operation. **Returns for Navigation infrastructure are:** Total Revenue: INR 0.005 cr. in FY40 O&M Cost: INR cr. 2.36 in FY40 Tax: NIL in FY40 (@ 30% on EBITDA) EBIDA: INR –2.36 cr. In FY40 Project Capital Cost (with escalation): INR 11.45 cr. Net Cash Flow: INR -2.36 cr. In FY40 **Returns for Ferry Terminal operations are:** Total Revenue: INR 0.34 cr. in FY40 O&M Cost: INR cr. 1.54 in FY40 Tax: NIL in FY40 (@ 30% on EBITDA) EBIDA: INR -1.20 cr. In FY40 Project Capital Cost (with escalation): INR 9.21 cr. Net Cash Flow: INR -1.20 cr. In FY40
Disaggregation	Cash flow streams and FIRRs have been attached as annexures in Financial Evaluation chapter 13 for Navigation Structure and Ferry terminal separately. It is not considered as a whole. Payback is also considered separately for all 2 facilities. **Returns for Navigation infrastructure are:** Total Revenue: INR 0.005 cr. in FY40 O&M Cost: INR cr. 2.36 in FY40 Tax: NIL in FY40 (@ 30% on EBITDA) EBIDA: INR –2.36 cr. In FY40 Project Capital Cost (with escalation): INR 11.45 cr. Net Cash Flow: INR -2.36 cr. In FY40 **Returns for Ferry Terminal operations are:** Total Revenue: INR 0.34 cr. in FY40

	O&M Cost: INR cr. 1.54 in FY40 Tax: NIL in FY40 (@ 30% on EBITDA) EBIDA: INR -1.20 cr. In FY40 Project Capital Cost (with escalation): INR 9.21 cr. Net Cash Flow: INR -1.20 cr. In FY40
Evaluation period	Waterway utilization is assumed to start from FY24 till FY40, with development of navigational infrastructure and 1 ferry terminal (development period of 2 years, FY23-FY24).
FIRR and payback period	Estimate both FIRR (sector and sub-sectors) and overall sector payback period, the latter being the year in which the cumulative sector each flow gives positive return: Described in financial evaluation
Ramp-up period	Unless good reasons otherwise, assume 4 years ramp-up period from first operational year to long-term trend levels of traffic: 5 years ramp up period considered
Commentary on FIRR	Explain overall sector FIRR results and distribution between sub-sectors. Identify main drivers of the results and sensitivity to assumptions: Factors influencing healthy financial returns of the project are: Financial rate of return does not exist for Development of Fairway and Ferry Terminal.
Risks to financial out-turn	Identify main risks to the estimated project out-turn or viability and their underlying causes e.g. market risks (traffic, tariffs, and competition), hydrology risks, engineering risks, operational risks etc.: Honnavar to Gerusoppa stretch would attract only those tourists that are coming from coastal region. People from central region have direct road connectivity to Gerusoppa to access nearby tourist spots. Therefore, good road connectivity restricts the utilization of River stretch. Tourist moving along the river would find no strong reason to divert to waterways, mainly

	because waterways tend to be more time consuming than road mode.
Checking and Replicability	Systematic checks of spreadsheets and logic trail have been done keeping in mind the input data, assumptions and calculations.

ANNEXURES

ANNEXURE 1.1 – TOR OF THE AGREEMENT

SECTION-6 TERMS OF REFERENCE

1.0 OBJECTIVE OF THE STUDY:

Government of India intends to explore the potential of additional waterways across the country for year round commercial navigation, for this it is planned to conduct a Feasibility Study and recommending thereafter the possibility of Composite and Integrated development of proposed waterways to achieve navigation and to develop water transport facilities across India. After carrying out the feasibility study if there is scope for navigation and potential to develop waterway transport facility, a Detailed Project Report needs to be prepared for those waterways which would include detailed hydrographic surveys and investigation, traffic survey, proposed location for terminals and cost assessment etc.

The study would consist of 2 stages:

1. **Stage-1**
2. **Stage-2**

1.1 STAGE-1

Stage-I is only for feasibility of the waterway for navigation, which may have the potential for year round navigation or at least for a few months in a year.

Stage-1 would consist of the following activities:

1A. Reconnaissance Survey

1B. Collection and review of available data

1C. Feasibility Report

1.1.1 Reconnaissance Survey

The detailed field reconnaissance survey may be taken up immediately after the analysis of available data. The primary tasks to be accomplished during the reconnaissance surveys include:

i- Single line longitudinal survey (Bathymetric survey or Topographic survey) in the deepest depths or lowest height lands, with the help of DGPS using Automatic Hydrographic Survey System. Bathymetric surveys in the proposed waterways are to be carried out in the deepest route. Deepest route can be accessed by taking two or three longitudinal line soundings at equal interval. Topographic survey, if required, is to be taken up at lowest ground levels, which can be decided on visual assessment.

ii- Details (horizontal and vertical clearances above High Flood Level of bridges, aqueducts, electric lines, telephone lines, pipe lines, cables en-route are to be collected and indicated on the chart and also included in the report along with their co-ordinates and location. Details about Barrages, Dams, Locks enroute are also to be collected. horizontal and vertical clearance is to be given as approximate on visual assessment. Photographs are required to be submitted in the report.

iii- Topographical features of the proposed Inland Waterways.

iv- Typical physical features along the alignment i.e. land use pattern:

v- Preliminary identification of stretches having year round flow and critical depth for navigational purpose.

vi- Preliminary Traffic identification on the proposed Inland Waterways.

vii- Inventory of major aspects including proposed Inland Waterway width, Terrain, Bridges and structures across the proposed Inland Waterways (Type, size and location), urban areas (location extent). Geologically sensitive areas environmental features. Hydrological features

viii- Critical areas requiring detailed investigations and

ix- Requirements for carrying out supplementary investigations

x- Soil (textural classifications) (only visual inspection at every 10km) and drainage conditions.

xi- Type and extent of existing utility services along the alignment.

xii- Identification of various agencies of the govt. from whom the concerned project clearances for implementation are to be sought.

The data derived from the reconnaissance surveys may be utilized for planning and programming the detailed surveys and investigations. All field studies including the traffic surveys should be taken up on the basis of information derived from the reconnaissance surveys. For the critical locations, River cross sections survey needs to be carried out.

1.1.2 Collection and Review of Available Data

A review has to be done based on the existing data available with the State Agencies and Central Water Commission for the proposed Inland Waterways for determining the nature, extent, adequacy, validity of the available data and identifying the data gaps. Consultant has to collect available data for the proposed Inland Waterways from the State Agencies and Central Water Commission. An introductory letter will be issued by IWAI for collecting information from State / Central Government.

An inception report has to be prepared which would consist of the findings based on the analysis of the existing data and reconnaissance surveys.

1.1.3 Feasibility Report

The Consultant has to prepare Feasibility Report for the proposed waterways based on the available data and reconnaissance survey. It must include the following prospects:

1. **Introductory considerations:**
   The Consultant shall provide an introduction, describing the scope of the assignment, its methodology in fulfilling the assignment and the expected outcome of the assignment.

2. **Analysis of present state of affairs:**
   The Consultant shall provide a quantitative and qualitative description of the current utilization of proposed inland waterways. In addition, the Consultant shall describe the status of goods transport, including utilization of road and transport, as well as river facilities.

3. **Market Analysis:**
   The consultant shall analyze the market and potential usage of proposed Inland Waterways. This analysis shall examine both the existing market and the potential future market. Contractor has to collect the details of available Industries along the waterway, type of production in these industries, ferry services, type of crop along the waterway, previous history of movement of cargo in the waterway etc. Above is to be collected after discussion with local village people while conducting reconnaissance survey etc. and also after interaction with State Govt. Officials, Irrigation / Water Resources departments.

4. **Reconnaissance Survey:**
   Analysis of the data collected in the reconnaissance survey should reflect the possibility of year round flow in the proposed Inland Waterways to achieve the commercial navigation. It should also consist the map of proposed Inland Waterways indicating existing cross structures viz. bridges, dams etc. Navigability of the waterway (for the periods) is to correlate with CWC/Irrigation water level data.

The Consultant has to submit the Feasibility Report for proposed Inland Waterways. Consultant also has to emphasize that which stretches of proposed inland waterways has potential of possible navigation. Only for those stretches of proposed inland waterways, which have potential of possible navigation, Stage 2 has to be carried out.

After obtaining approval from IWAI for identified stretches, Consultant may proceed for Stage - 2. Based on the feasibility report, IWAI will accord the approval for Stage-II, and stretch for DPR will be based on feasibility study.

1.2 STAGE-2

For Stage-2, Consultant has to carry out detailed hydrographic survey, topographic survey, traffic survey and selection of terminal locations.

Stage-2 would consist of the following activities:

1A. Hydrographic Survey & hydro-morphological survey

1B. Traffic Survey & Techno economic feasibility

1C. Preparation of Detailed Project Report

1.2.1 HYDROGRAPHIC SURVEY & HYDROMORPHOLOGICAL SURVEY

Based on the recommendation after reconnaissance survey of proposed Inland Waterways, Hydrographic survey may be carried out as per the International Standards including the following for finding the potential of proposed Inland Waterways for inland navigation:-

(i) The detailed hydrographic survey is to be carried out in WGS'84 datum.

(ii) The horizontal control is to be made using DGPS with minimum 24 hours observations at some platform/base.

The vertical control is to be established with respect to the chart datum / sounding datum from the following methods:-

i. Chart datum/ sounding datum already established by Port Authorities (Chart Datum), Central Water Commission (Average of last six years minimum Water Level) / State Irrigation Department (Full Supply Level (FSL)) and at their gauge stations along the river/canal. Secrecy undertaking forms etc. will be provided by IWAI for collection of CWC data. Introductory letter will be issued to the successful Consultant for collection of other required information from State Departments.

ii. Standard method shall be adopted for transfer of datum in rivers/canals. For tidal reaches standard transfer of datum as per Admiralty Manual shall be adopted.

iii. **By erection of tide gauges – at every 10km interval and also at upstream and downstream of Locks, Sluice gates, Barrages, Dams etc.**

Other Terms of Reference for the survey work shall be as given below: -

1.2.1.1 BENCH MARK PILLARS

a. Construct Bench Mark Pillars of dimension 0.3m x 0.3m x 1.5m (0.6m above GL) RCC pillar with 6mm thick 50mm dia GI pipe inserted (as per construction drawing of Survey Pillar in the tender document), at every 10km interval. Detailed description of the bench mark along with its position and value to be given in the report for future recovery.

1.2.1.2 WATER LEVEL GAUGES

i. Water level gauges are to be erected at every 10 km interval along the canal/river **and also at upstream and downstream of Locks, Sluice gates, Barrages, Dams etc. simultaneously.** Readings are to be taken at 1 hr interval for 12 hours (6 AM to 6 PM) or for the entire period of survey. The gauges are to be connected to a nearest Bench Mark by leveling and its datum value shall be established w.r.to MSL & CD. Water level gauges are to be installed temporarily during the survey period.

ii. At least 2 gauges (one U/s and one D/s at 10 Km apart) shall be read simultaneously and soundings to be carried out within the gauge stations. Soundings are to be reduced for datum of a gauge for 5km length of the canal/river on both side of a gauge.

1.2.1.3 BATHYMETRIC AND TOPOGRAPHICAL SURVEY

Sl. No.	Name of the River / Canal	Description of Inland Waterway
CLUSTER-2		
1	DHANSIRI / CHATHE	110 km length of the river from Bridge near Morongi T.E. village Lat 26°24'40.65"N, Lon 93°53'46.75"E to Numaligarh Lat 26°42'1.20"N, Lon 93°35'15.42"E
2	LOHIT RIVER	100 km length of the river from Parasuram Kund Lat 27°52'40.06"N, Lon 96°21'39.70"E to Saikhowa Ghat, Sadiya Lat 27°47'49.14"N, Lon 95°38'13.84"E

3	SUBANSIRI RIVER	111 km length of the river from Gerukamukh Lat 27°27'3.14"N, Lon 94°15'16.12"E to Brahmaputra confluence at Lat 26°52'24.93"N, Lon 93°54'31.26"E
4	TIZU and ZUNGKI RIVERS	42 km length of the river from Longmatra at Lat 25°46'11.98"N, Lon 94°44'35.04"E to Avanghku at Myanmar border Lat 25°35'2.94"N, Lon 94°53'6.12"E and in Zungki river from bridge at Lat 25°48'26.10"N, Lon 94°46'35.96"E to confluence of Zungki and Tizu rivers at Lat 25°46'58.03"N, Lon 94°45'20.51"E
	CLUSTER-3	
1	BIDYA RIVER	55 km length of the river from Lot No. 124 at Lat 21°54'42.88"N, Lon 88°41'8.48"E to near Uttar Danga at Lat 22°11'47.93"N, Lon 88°51'54.93"E
2	CHHOTA KALAGACHI (CHHOTO KALERGACHI) RIVER	15 km length of the river from near Rajani ferry ghat Lat 22°19'57.49"N, Lon 88°54'21.40"E to near Nazat at Lat 22°26'5.40"N, Lon 88°50'11.69"E
3	DVC CANAL	130 km length of the canal from Durgapur Barrage Lat 23°28'47.36"N, Lon 87°18'19.04"E to Confluence point of DVC canal with Hooghly river near Tribeni Lat 23° 0'30.95"N, Lon 88°24'54.72"E
4	GOMAR RIVER	7 km length of the river from near Ramkrishnapur Lat 22°11'53.35"N, Lon 88°44'41.97"E to near Gosaba Kheya ghat at Lat 22°10'5.44"N, Lon 88°47'37.17"E
5	HARIBHANGA RIVER	16 km length of the river from Bangladesh Border Lat 21°53'18.81"N, Lon 89° 1'23.61"E to confluence with Jhila river at Lat 21°58'17.66"N, Lon 88°55'8.38"E
6	HOGLA (HOGAL)-PATHANKHALI RIVER	37 km length of the river from near Parandar Lat 22°12'22.05"N, Lon 88°40'42.77"E to near Sandeshkhai Ferry Ghat at Lat 22°21'12.26"N, Lon 88°52'47.99"E
7	KALINDI (KALANDI) RIVER	8 km length of the river from Bangladesh Border at Hingalganj Lat 22°28'8.48"N, Lon 88°59'46.19"E to Bangladesh Border near Khosbash at Lat 22°24'41.40"N, Lon 88°58'20.68"E
8	KATAKHALI RIVER	23 km length of the river from Bangladesh Border near Barunhat Lat 22°30'31.44"N, Lon 88°58'24.53"E to Lebukhali ferry at Lat 22°21'45.36"N, Lon 88°57'30.27"E
9	MATLA RIVER	98 km length of the river from Bay of Bengal at Lat 21°33'4.13"N, Lon 88°38'25.65"E to Canning ferry ghat at Lat 22°18'38.87"N, Lon 88°40'42.65"E
10	MURI GANGA (BARATALA) RIVER	27 km length of the river from Bay of Bengal near Bisalakshmipur Lat 21°37'51.94"N, Lon 88°10'0.24"E to near Kakdwip at Lat 21°52'17.39"N, Lon 88° 9'7.52"E
11	RAIMANGAL RIVER	52 km length of the river from Hemnagar at Lat 22°11'40.58"N, Lon 88°58'1.08"E to Rajnagar at Lat 22°33'56.95"N, Lon 88°56'16.64"E
12	SAHIBKHALI (SAHEBKHALI) RIVER	14 km length of the river from near Ramapur Lat 22°17'52.04"N, Lon 88°56'34.78"E to Bangladesh Border near Khosbash at Lat 22°24'41.40"N, Lon 88°58'20.68"E
13	SAPTAMUKHI RIVER	37 km length of the river from Bay of Bengal at Henry Island Lat 21°34'57.35"N, Lon 88°19'8.47"E to near Chintamanipur at Lat 21°51'14.01"N, Lon 88°18'40.50"E
14	THAKURRAN RIVER	64 km length of the river from Bay of Bengal at Lat 21°33'31.95"N, Lon 88°27'45.40"E to Madhabpur at Lat 22° 2'52.19"N, Lon 88°33'27.96"E
	CLUSTER-4	
1	BAITARNI RIVER:	49 kms length of the river from Dattapur village at Lat 20°51'44.61"N, Long 86°33'30.45"E to confluence with Dhamra river near Laxmiprasad Dia at Lat 20°45'13.32"N, Long 86°49'15.36"E

2	BIRUPA / BADI GENGUTI / BRAHMANI RIVER SYSTEM:	102 kms length of the river from Birupa Barrage at Choudwar at Lat 20°30'49.00"N, Long 85°55'20.17"E to confluence of Birupa & Brahmani rivers near Upperkai Pada village at Lat 20°37'36.25"N, Long 86°24'19.13"E including alternative route of 25 kms from Samaspur village at Lat 20°35'40.59"N, Long 86° 6'31.50"E to near Kharagpur village at Lat 20°38'27.77"N, Long 86°17'31.81"E and additional 54 kms length of Brahmani river from confluence of Birupa & Brahmani rivers near Upperkai Pada village at Lat 20°37'36.25"N, Long 86°24'19.13"E to Brahmani river at Katana Lat 20°39'26.28"N, Long 86°44'52.86"E
3	BUDHA BALANGA:	56 kms length of the river from Barrage (approx 300m from Patalipura village) at Lat 21°38'12.96"N, Long 86°50'53.17"E to confluence of Budha Balanga river with Bay of Bengal at Chandipur Fishing Port Lat 21°28'12.14"N, Long 87° 4'11.60"E
4	MAHANADI RIVER:	425 kms length of the river from Sambalpur Barrage at Lat 21°27'34.33"N, Long 83°57'49.80"E to Paradip at Lat 20°19'38.12"N, Long 86°40'16.96"E
CLUSTER-5		
1	PENNAR RIVER:	29 kms length of the river from Penna Barrage, Pothireddypalem at Lat 14°28'8.38"N, Long 79°59'9.31"E to confluence with Bay of Bengal near Kudithipalem at Lat 14°35'36.75"N, Long 80°11'30.61"E
2	KAVERI / KOLLIDAM RIVER:	364 kms length of the river from Uratchikottai Barrage at Lat 11°29'3.09"N, Long 77°42'13.68"E to confluence with Bay of Bengal at Pazhaiyar Lat 11°21'37.97"N, Long 79°49'53.23"E
3	PALAR RIVER:	141 kms length of the river from rail bridge at Virudampattu, Vellore Lat 12°56'14.07"N, Long 79° 7'29.70"E to confluence with Bay of Bengal at Sadurangapattinam Lat 12°27'52.16"N, Long 80° 9'13.47"E
4	PAZHYAR RIVER:	20 kms length of the river from Bridge near Veeranarayana Mangalam village at Lat 8°13'48.97"N, Long 77°26'27.34"E to confluence with Arabian Sea at Manakudi at Lat 8° 5'15.01"N, Long 77°29'7.61"E
5	PONNIYAR RIVER	125 km length of the river from Sathanur Dam at Lat 12°11'0.06"N, Lon 78°51'1.25"E to Cuddalore at confluence of Bay of Bengal at Lat 11°46'21.76"N, Lon 79°47'41.70"E
6	TAMARAPARANI RIVER:	64 kms length of the river from Sulochana Mudalir bridge, Tirunelveli at Lat 8°43'43.17"N, Long 77°42'53.94"E to confluence with Bay of Bengal near Punnaikayal at Lat 8°38'24.90"N, Long 78° 7'37.85"E
CLUSTER-6		
1	West Coast Canal	160 kms length of the canal as extension of NW-3 towards north of Kottapuram - from Kottapuram at Lat 10°11'38.32"N, Long 76°12'4.39"E to Kozhikode at Lat 11°13'38.83"N, Long 75°46'43.90"E
2	ALAPPUZHA-CHANGANASSERY CANAL	28 km from Boat jetty, Alappuzha at Lat 9°30'2.85"N, Lon 76°20'37.05"E to Changanassery Jetty at Lat 9°26'41.61"N, Lon 76°31'41.76"E
3	ALAPPUZHA- KOTTAYAM – ATHIRAMPUZHA CANAL	38 km from Boat jetty, Alappuzha at Lat 9°30'2.85"N, Lon 76°20'37.05"E to Athirampuzha market Lat 9°40'04"N, Lon 76°31'54"E
4	KOTTAYAM-VAIKOM CANAL	28 km from Kottayam, near Kodimatha at Lat 9°34'38.67"N, Lon 76°31'7.67"E to Vechoor joining National Waterway no. 3 at Lat 9°40'0.19"N, Lon 76°24'10.65"E
5	GURUPUR RIVER	10 km length of the river from confluence of Netravathi river at Lat 12°50'44.04"N, Lon 74°49'44.51"E to confluence of Mangalore Port Bridge at Lat 12°55'34.81"N, Lon 74°49'37.34"E

6	KABINI RIVER	23 km length of the river from Kabini Dam Lat 11°58'24.52"N, Lon 76°21'9.69"E to Beeramballi at Lat 11°56'9.55"N, Lon 76°14'17.58"E
7	KALI RIVER	54 km length of the river from Kodasalli Dam Lat 14°55'8.24"N, Lon 74°32'6.90"E to confluence of Kali river with Arabian Sea near Sadashivgad bridge at Lat 14°50'30.95"N, Lon 74° 7'21.32"E
8	NETRAVATHI RIVER	78 km length of the river from Netravathi Dam, Dharmsthala Lat 12°57'55.23"N, Lon 75°22'10.19"E to confluence with Arabian sea at Bengre Lat 12°50'42.73"N, Lon 74°49'28.86"E
9	PANCHAGANGAVALI (PANCHAGANGOLI) RIVER	23 km length of the river from Gangoli Port at Lat 13°38'1.30"N, Lon 74°40'8.43"E to Bridge at Badakere at Lat 13°44'50.01"N, Lon 74°39'15.13"E
10	SHARAVATI RIVER	29 km length of the river from Honnavar Port Sea Mouth at Lat 14°17'56.23"N, Lon 74°25'27.04"E to link at highway at Gersoppa Lat 14°14'14.73"N, Lon 74°39'6.15"E
11	UDAYAVARA RIVER	16 km length of the river from Arabian Sea Mouth at Malpe Lat 13°20'57.24"N, Lon 74°41'28.22"E to Bridge near Manipura Lat 13°17'32.70"N, Lon 74°46'25.56"E
	CLUSTER-7	
1	CHAPORA RIVER	33 kms length of the river from Bridge at State highway # 124 (1Km from Maneri village) Lat 15°42'47.31"N, Long 73°57'23.38"E to Confluence of Chapora river with Arabian Sea at Morjim Lat 15°36'33.27"N, Long 73°44'0.93"E
2	MAPUSA / MOIDE RIVER	27 kms length of the river (including Moide river) from bridge on NH17 at Mapusa Lat 15°35'20.79"N, Long 73°49'17.20"E to confluence point of Mapuca & Mandovi rivers at Porvorim Lat 15°30'20.01"N, Long 73°50'42.09"E
3	SAL RIVER	14 kms length of the river from Orlim Deusa Bridge at Lat 15°13'11.41"N, Long 73°57'29.77"E to confluence with Arabian Sea at Mobor Lat 15° 8'31.93"N, Long 73°56'59.89"E
4	AMBA RIVER	45 kms length of the river from Arabian Sea, Dharamtaar creek near village Revas at Lat 18°50'15.14"N, Long 72°56'31.22"E to a Bridge near Nagothane ST Stand at Lat 18°32'19.82"N, Long 73° 8'0.29"E
5	DABHOL CREEK/VASHISHTI RIVER	45 km length of the river from Arabian Sea at Dabhol Lat 17°34'51.33"N, Lon 73° 9'17.83"E to bridge at Pedhe Lat 17°32'39.45"N, Lon 73°30'35.56"E
6	KALYAN-THANE-MUMBAI WATERWAY, VASAI CREEK AND ULHAS RIVER	145 km length of the waterway from Arabian Sea at Navi Mumbai Lat 18°55'49.78"N, Lon 72°53'21.67"E via Ulhas river to bridge on State Highway No.76 near Malegaon T. Waredi Lat 19° 2'38.20"N, Lon 73°19'53.79"E Bridge on Kalyan-Badlapur road near Kalyan railway yard at Kalyan Lat 19°14'6.39"N, Lon 73° 8'49.13"E to Kalyan Lat 19°15'35.03"N, Lon 73° 9'27.77"E Vasai Creek from Lat 19°18'53.50"N to Lon 72°47'30.18"E to Kasheli at Lat 19°13'22.84"N, Lon 73° 0'21.44"E
7	RAJPURI CREEK	31 km length of the river from Arabian Sea at Rajpuri Lat 18°18'3.15"N, Lon 72°56'42.94"E to Mhasala at Lat 18° 8'15.37"N, Lon 73° 6'45.35"E
8	REVADANDA CREEK / KUNDALIKA RIVER	31 km length of the river from Arabian Sea at Revadanda Lat 18°32'19.85"N, Lon 72°55'32.80"E to bridge on Roha-Astami Road near Roha Nagar Lat 18°26'31.50"N, Lon 73° 7'10.74"E
9	SAVITRI RIVER (BANKOT CREEK)	44 kms length of the river from Bridge near Sape at Lat 18° 5'54.11"N, Long 73°20'8.81"E to Arabian Sea at Harihareswar Lat 17°58'47.10"N, Long 73° 2'15.01"E
10	SHASTRI RIVER / JAIGAD CREEK	52 kms length of the river from Sangmeshwar at Lat 17°11'15.83"N, Long 73°33'2.57"E to confluence with Arabian Sea at Jaigad Lat 17°19'11.92"N, Long 73°12'39.30"E

CLUSTER-8		
1	MAHI RIVER:	248 kms length of the river from Kadana Dam at Lat 23°18'22.35"N, Long 73°49'37.45"E to confluence with Gulf of Khambhat near Kavi railway station at Lat 22°10'34.71"N, Long 72°30'36.31"E
2	NARMADA RIVER	227 km length of the river from Pandhariya at Lat 21°57'10.37"N, Lon 74° 8'27.46"E to confluence of Narmada with Arabian Sea at Gulf of Khambhat Lat 21°38'26.81"N, Lon 72°33'28.24"E
3	SABARMATI RIVER:	212 kms length of the river from Barrage near Sadoliya at Lat 23°26'49.66"N, Long 72°48'34.85"E to confluence with Gulf of Khambhat near Khambhat at Lat 22° 9'17.99"N, Long 72°27'27.81"E
4	TAPI RIVER:	436 kms length of the river from Hatnur Dam near Mangalwadi at Lat 21° 4'21.99"N, Long 75°56'44.88"E to confluence with Gulf of Khambhat (Arabian Sea) at Lat 21° 2'15.51"N, Long 72°39'29.63"E

#	River/Canal	State	Length (km)	Spacing (m)	Ave. width (m)
CLUSTER-2					
1	Dhansiri / Chathe	Assam	110	150	150
2	Lohit	Assam & Arunachal Pradesh	100	200	1000
3	Subansiri	Assam	111	200	1000
4	Tizu and Zungki	Nagaland	42	50	100
			363		
CLUSTER-3					
1	BIDYA RIVER	West Bengal	55	200	1500
2	CHHOTA KALAGACHI (CHHOTO KALERGACHI) RIVER	West Bengal	15	200	500
3	DVC CANAL	West Bengal	130	100	100
4	GOMAR RIVER	West Bengal	7	200	400
5	HARIBHANGA RIVER	West Bengal	16	200	2000
6	HOGLA (HOGAL)-PATHANKHALI RIVER	West Bengal	37	200	300
7	KALINDI (KALANDI) RIVER	West Bengal	8	200	500
8	KATAKHALI RIVER	West Bengal	23	200	200
9	MATLA RIVER	West Bengal	98	200	2000
10	MURI GANGA (BARATALA) RIVER	West Bengal	27	200	3000
11	RAIMANGAL RIVER	West Bengal	52	200	800
12	SAHIBKHALI (SAHEBKHALI) RIVER	West Bengal	14	200	300
13	SAPTAMUKHI RIVER	West Bengal	37	200	700
14	THAKURRAN RIVER	West Bengal	64	200	1000
			583		
CLUSTER-4					
1	Baitarni	Odisha	49	100	100
2	Birupa / Badi Genguti / Brahmani	Odisha	156	100	200
3	Budha Balanga	Odisha	56	100	100
4	Mahanadi	Odisha	425	200	500
			686		

		CLUSTER-5			
1	Pennar	Andhra Pradesh	29	100	400
2	Kaveri / Kollidam	Tamil Nadu	364	200	400
3	Palar	Tamil Nadu	141	200	500
4	Pazhyar	Tamil Nadu	20	50	100
5	PONNIYAR	Tamil Nadu	125	200	300
6	Tamaraparani	Tamil Nadu	64	150	300
			743		
		CLUSTER-6			
1	West Coast Canal	Kerala	160	50	100
2	ALAPPUZHA- CHANGANASSERY CANAL	Kerala	28	50	100
3	ALAPPUZHA- KOTTAYAM – ATHIRAMPUZHA CANAL	Kerala	38	50	100
4	KOTTAYAM-VAIKOM CANAL	Kerala	28	50	100
5	GURUPUR RIVER	Karnataka	10	100	400
6	KABINI RIVER	Karnataka	23	200	500
7	Kali	Karnataka	54	150	450
8	Netravathi	Karnataka	78	100	300
9	PANCHAGANGAVALI (PANCHAGANGOLI) RIVER	Karnataka	23	150	600
10	SHARAVATI RIVER	Karnataka	29	150	400
11	UDAYAVARA RIVER	Karnataka	16	100	250
			487		
		CLUSTER-7			
1	CHAPORA RIVER	Goa	33	100	250
2	MAPUSA / MOIDE RIVER	Goa	27	50	100
3	SAL RIVER	Goa	14	50	100
4	AMBA RIVER	Maharashtra	45	150	300
5	DABHOL CREEK/VASHISHTI RIVER	Maharashtra	45	150	400
6	KALYAN-THANE-MUMBAI WATERWAY, VASAI CREEK AND ULHAS RIVER	Maharashtra	145	150	350
7	RAJPURI CREEK	Maharashtra	31	150	1000
8	REVADANDA CREEK / KUNDALIKA RIVER	Maharashtra	31	150	400
9	SAVITRI RIVER (BANKOT CREEK)	Maharashtra	46	150	400
10	SHASTRI RIVER / JAIGAD CREEK	Maharashtra	52	150	300
			469		
		CLUSTER-8			
1	MAHI RIVER	Gujarat	248	200	400
2	NARMADA RIVER	Maharashtra & Gujarat	227	200	500
3	SABARMATI RIVER	Gujarat	212	200	150
4	TAPI RIVER	Maharashtra & Gujarat	436	200	350
			1123		

Note:- Bathymetric and Topographical survey of specified Waterways is to be conducted for average width specified in above table. Average width of the Waterways is the average of narrow and wider portions of the river. For reservoir / ponding areas, only bathymetric survey of maximum 500m width in the deepest channel is to be carried out. Minimum 100m wide corridor is to be surveyed (only for rivers / canals having less than

60m water width). 100m wide corridor includes width of proposed Waterways. Bathymetric and topographic survey is to be carried out for 50m width on both side from the centre line of the channel.

a. Bathymetric and Topographical survey of proposed Inland Waterways is to be conducted for width specified in above table. Minimum 100m wide corridor is to be surveyed to assess the extent of land acquisition required for 100m wide corridor (100m wide corridor includes width of proposed Inland Waterways).
b. Cross-section sounding lines / leveling are to be run from bank to bank at spacing specified in above table, to identify the navigable channel.
c. Continuous soundings are to be taken by running the sounding boat at constant speed on the cross-section so as to get smooth contours. Intermediate line is to be run at bends, if the line spacing is more than the specified above.
d. For cross-sectional bathymetric survey more than 60m in proposed Inland Waterways, spot levels at line spacing x 20m length grid, on both banks should be taken. If Island or sandchur exist in the middle of the waterway, spot levels on the same spacing should also be taken and indicated in the charts along the same cross-section line.
e. If bathymetry cross-section is limited up to 60 mts width in waterway, then Consultant has to cover 100m corridor including spot levels in line spacing x 20m length grid on both banks.
f. If bathymetry cross-sectional is limited up to 20 mts width in waterway, then Consultant has to run three (03) nos. longitudinal lines. One in centre and one each at equal interval (near the edges of water).
g. If bathymetry cross-sectional is limited up to 10 mts width in waterway, then Consultant has to run one (01) no. longitudinal line at centre only.
h. If Island or sandchur exist in the middle of the river, spot levels on the same spacing should also be taken and indicated in the charts along the same cross-section line.
i. Surveys in non-approachable areas are to be informed by the Consultant and joint inspection (Consultant's representative & Engineer-In-Charge or his representative) will be held to confirm the non-approachable areas.
j. The survey area may consist of canal sections, rivers, sea openings of different dimensions. Hence, Consultant has to inspect the area to be surveyed and satisfy themselves with respect to site conditions before submission of bid. However, variation in quantity will be considered only for length of the river/canal (longitudinal length).
k. The soundings are to be reduced to the chart datum/ sounding datum established at every gauge stations.

1.2.1.4 CURRENT VELOCITY AND DISCHARGE MEASUREMENT

a. The current velocity and discharge at every 10 km interval shall be observed once in a day during the survey period. Current velocity and discharge at every 10 km interval are to be measured only once at different depths while carrying out survey in that region.
b. Current meter measurement should be taken at 1m below water surface or 0.5d (if depth is less than 1m), where d is measured depth of water & values indicated in the report along with position.
c. Measurements at different depths may be taken by single equipment over three different time spans.
d. Measurement of current velocity at different depth is to be measured for at least 15

minutes or as per listed calibration period of the equipment, under use for this project.

e. Current velocity and discharge can also be measured with the help of ADCP during survey, at every 10km interval. Discharge can be measured either by ADCP or standard formulas.

1.2.1.5 <u>WATER AND BOTTOM SAMPLES</u>

a. Water and bottom samples are to be collected from the deepest route at every 10 km interval and are to be tested and the results/characteristics of the soil and the water are to be incorporated in the report. Soil sample can be collected by a grab and water sample at 0.5d (d-measured depth of water) by any approved systems. The following tests are to be carried out for Bottom samples:-

i) Grain size distribution
ii) Specific gravity,
iii) PH value
iv) Cu, Cc
v) Clay silt%
and Sediment concentration for Water Samples.

1.2.1.5 <u>COLLECTION OF TOPOGRAPHICAL FEATURES</u>

a. Photographs of the prominent features are to be taken and included in the report along with its position.
b. Permanent structures located within this corridor are also required to be indicated on the report & charts.
c. All prominent shore features (locks, bridges, aqueducts, survey pillars if available etc) and other conspicuous objects are to be fixed and indicated on the chart and included in the report.
d. Identify cross structures which are obstructing navigation.
e. Details (horizontal and vertical clearances above High Flood Level in non-tidal area and High Tide Level in tidal area) of bridges, aqueducts, electric lines, telephone lines, pipe lines, cables en-route are to be collected and indicated on the chart and also included in the report along with their co-ordinates and location.
f. Details of water intake/ structures are to be collected and shown on the charts and include in the report.
g. Availability of berthing place, existing jetty, ferry ghats, approach roads etc. are to be indicated on the charts and include in the report.
h. During the survey, conditions of the banks are also required to be collected. It is to be noted that banks are pitched (protected) or not protected. Estimate the length of bank protection, where banks erosion is taking place.
i. Positions and levels of corners of permanent structures within the corridor are to be physically surveyed and marked on survey charts.
j. Approachable roads / rails / places outside the corridor may be incorporated from Toposheets/Google Map/Google Earth.

1.2.1.6 <u>SURVEY CHART PREPARATION</u>

a. The survey chart is to be prepared on a scale of 1:1,000 for Waterways width less than 100m. On a scale of 1:2,000 for Waterways width between 100m to 300m. On a scale of 1:5,000 for Waterways width between 300m to 500m and On a scale of 1:10,000 for Waterways width more than 500m.

b. Contours of 0m, 1m, 2m, 3 m, 5m and 10 m are to be indicated on the charts with respect to Chart Datum / Sounding Datum.
c. Reduced spot levels w.r.to MSL to be indicted on the charts. Spot level values are to be given w.r.t. Mean Sea Level (MSL) & Soundings w.r.t. Chart Datum / Sounding Datum. A separate file (xyz) (soft copy only) is also to be created for spot levels w.r.t. Chart Datum / Sounding Datum for dredging calculation purpose.
d. On completion of the cross-sections, dredge channel is to be identified/ established by linking deepest soundings on the cross-sections. Dredging quantity is to be estimated for developing a navigational channel of
   i. dimension of 32m x 1.8m, with side slope of 1:5, w.r.t. chart datum/sounding datum (if channel width is less than or equal to 100m).
   ii. dimension of 45m x 2.0m, with side slope of 1:5, w.r.t. chart datum/sounding datum (if channel width is more than 100m).
e. Dredging quantity is to be indicated in the report for per km length of the waterway.
f. Minimum & maximum reduced depth and length of shoal for per km length of the waterway is also to be indicated in the report.
g. Current meter measurement values shall be indicated in the report along with position.
h. The results/characteristics of the soil and the water are to be incorporated in the report.
i. Shallow patches /shoal and submerged sand-chur having less than 1.0 m depth, rocky outcrops, rapids and other navigational impediments are to be indicated on the charts.
j. A brief write up on condition of the locks, Sluice gates, Barrages, Dams etc. (if available) are also to be included in the report. Brief write up based on visual observation, photographs and information from State Irrigation Deptt. and local sources.
k. The chart shall also be suitably updated with prominent land features from the Topo-sheets/site. Available Survey of India (SOI) Topographic sheet will be shared with successful Consultant on receipt of Undertaking. Satellite imageries are not available with IWAI for the designated area. Route map and survey plan will be provided by IWAI to the successful Consultant.
l. All raw data and processed data of Automatic Hydrographic Survey System are required to be submitted. Standard procedure is to be adopted for data processing. All RAW, EDIT, SORT and field data are required to be submitted by the Contractor.
m. All surveyed field data including leveling data (csv file) are required to be submitted.
n. All position data of ground features, waterway structures are to be submitted in both hard copies and soft copies.

1.2.2 TRAFFIC SURVEY & TECHNO ECONOMIC FEASIBILITY

This is a detailed study to make a forecast of the traffic prospects to facilitate the projection of the most promising route for waterway transport and to assess the quantum of traffic of vessels/cargo on that route. This survey is to be under-taken in conjunction with Reconnaissance and Hydrographic surveys so that the Techno Economic feasibility and costs of the alternative proposals can be taken into account while formulating the recommendations.

Modality of conducting traffic survey shall be based on industrial surveys and a traffic projection for a horizon period (say 5, 10, 15 and 20 years) has to be forecasted based on standard methods. Divertible traffic to IWT is also to be assessed.

1.2.3 DETAILED PROJECT REPORT

The scope of works is as follows:

a. Assessment of the morphological, hydrological, hydrographical conditions, and operation and maintenance requirements of the proposed waterways to identify works in sufficient details that are required in respect of:
   - River conservancy including river training, bank protection, dredging etc. needed for shipping and navigation.
   - Navigational aids and communication facilities.
   - Improvements with reference to horizontal and vertical clearances required on the existing or proposed cross structures such as bridges, power cables, locks etc.

b. Geo-tech investigation will be carried out by the consultant as per standard guidelines of Geological Survey of India, Government of India.

c. To conduct necessary investigations for the preliminary design, to ensure a coordinated development to cover waterways engineering works and structures, waterway crossing, navigational structures, riverine ports and terminals, land and rail access.

d. Prepare preliminary engineering designs, drawings and estimates for the optimum structure of river training and bank protection measures and navigational aids to develop and maintain a navigable channel for the waterway system in an EPC mode.

e. For preliminary engineering designs, the data about soil characteristics shall be collected from the local sources based on the structures constructed nearby. In case of critical structures, consultant can suggest that detailed soil investigation including borehole tests etc.

f. River training/bank protection works particularly for those stretches where either the channel is narrow and needs to be widened by dredging or where it is anticipated that the bank can erode due to continuous movement of barges.

g. Identify the location and carry out preliminary designs of cargo terminals and river ports to handle the anticipated cargo as duly updated.

h. Prepare a realistic construction schedule for the whole project indicating the priority of different components of the project. The phasing of expenditure is also to be worked. Also suggest phased programs of construction including riverine terminals and ports which shall be fully integrated with the existing and planned irrigation and hydropower facilities.

i. Prepare cost estimate for various possible alternatives for the entire proposed infrastructure, handling, and other allied facilities. While comparing the different alternatives, the cost and economy factors shall also be evaluated. The most suitable alternative recommended shall have detailed costing for all the components of the project. The Consultant is to propose the River conservancy including river training, bank protection, dredging etc. needed for shipping and navigation. Alternate possible methods for water augmentation are also to be suggested in detail. FIRR, EIRR, NPV and SWOT analysis are also to be carried out by the Consultant.

j. Assess the environmental impacts due to these development works and suggest suitable environmental management plan (EMP) to mitigate the adverse impacts, if any, including its cost. Flood Plain specialist will be responsible to assess the Environmental Impact and preparation of EMP. Consultant has to identify the Authorities who will give the clearances for EIA/EMP. Consultant will not be required to take clearances from these identified Authorities.

k. Suggest horizontal and vertical clearances to be provided on cross structure such as bridges, power cables, locks etc. for commercial viable navigation in present as well as in future. For this, IWAI guidelines Section-IV, may also be referred to.

2.0 PERIOD OF SERVICES

Consultant may associate with sub Consultant(s) to enhance their expertise. The applicant shall submit a Memorandum of Understanding (MOU) with the Sub Consultant regarding the role and responsibilities of the Associate Company along with the proposal.

2.1 TIME SCHEDULE/SUBMISSION OF REPORTS:

(a) The time of completion of various sub-stages of the assignment will be as given below:

			Cluster -2	Cluster -3	Cluster -4	Cluster -5	Cluster -6	Cluster -7	Cluster -8
	Sl. No	**Activity**	**Time in weeks****						
Stage-I	a)	Mobilization of the Team and submission of Inception Report (2 copies)	6	9	10	11	8	8	15
Stage-I	b)	Submission of Draft Feasibility Report (3 copies)	9	12	13	14	11	11	18
Stage-I	c)	Comments from IWAI	11	14	15	16	13	13	20
Stage-I	d)	Presentation and Submission of Final Pre-feasibility Report (3 copies)	13	16	17	18	15	15	22
Stage-II	a)	Acceptance of Stage-I report and go ahead for Stage-II by IWAI	15	18	19	20	17	17	24
Stage-II	b)	Submission of Hydrographic Survey Charts and report (3 copies)	23	30	29	31	24	26	38
Stage-II	c)	Submission of Draft Detailed Project Report (3 copies)	31	38	37	39	32	34	46
Stage-II	d)	Receipt of comments of IWAI on Draft DPR.	33	40	39	41	34	36	48
Stage-II	e)	Submission of Final Detailed Project Report (10 copies) after incorporating final comments of IWAI.	39	46	45	47	40	42	54
****reckoned from the date of signing of Contract or 15 days from the date of issuance of work order, whichever is earlier.**									

NOTE: - The consultants are required to submit the following outputs in Stage-II for all the clusters in the enclosed standard templates:-

vi) Traffic Template: at Annex-IV
vii) Project Costing Template: at Annex-V
viii) Financial Evaluation Template: at Annex-VI
ix) Economic Evaluation Template: at Annex-VII
x) Environmental & Social Screening Template: at Annex-VIII

3.0 Minimum Qualification of Key Professionals

Sl. No	Key Professionals	Qualification Criteria
1.	**Waterway Expert (Team Leader)**	**Educational Qualification:** • Should be Graduate in Civil Engineering. Higher professional qualification in Port and Harbor Engineering/Structural Engineering/Geo-technical Engineering will be preferred. **Professional Qualification:** • Minimum 15 years' experience in planning, design, construction, preparing Feasibility Report/Detailed Project Report for various waterway/port/river front development/river training works, terminals, trade facilitations and other infrastructures in different natural and operational conditions with at least 5 years in a reputed firm of consultants.
2.	**Port planning & Infrastructure Specialist**	**Educational Qualification:** • Should be Graduate in Civil Engineering. Postgraduate training/ studies in Port & Harbor Engineering will be preferred. **Professional Qualification:** • Minimum 10 years' experience in Port planning, Port infrastructure Planning and development of physical facilities for port operations. Should be well conversant with different types of port structures and other physical facilities required for the provision of various port services efficiently. Should preferably have experience/ exposure of constructing several modern ports.
3.	**Remote Sensing/GIS Expert**	**Educational Qualification:** • Should be Graduate in Engineering/Geology. Higher professional qualification in Remote Sensing/ Geoinformatics will be preferred. **Professional Qualification:** • Minimum 10 years' experience in waterway/port/river mapping and a demonstrated proficiency in using the GIS software. Working knowledge of spatial data formats and related metadata issues. Working knowledge of web mapping applications, such as Google Earth/Bhuvan.
4.	**Floodplain Specialist**	**Educational Qualification:** • Should be Graduate in Civil/Environmental Engineering. Higher professional qualification in Floodplain Management/ Hydrology/Water Resource Engineering will be preferred. **Professional Qualification:** • Minimum 10 years' experience in Floodplain Management. Working

Sl. No	Key Professionals	Qualification Criteria
		knowledge of water and/or wastewater modeling is desirable.
5.	**Hydrographic Expert**	**Educational Qualification:** • Should be ITI in Survey/Diploma in Civil Engineering. Higher qualification in relevant field will be preferred. **Professional Qualification:** • Minimum 8 years' experience in conducting hydrographic surveys, investigations and measurements, bathymetric surveys/Topographic Survey in a variety of geographical locations and natural.
6.	**Soil Engineer/ Foundation Engineer**	**Educational Qualification:** • Should be Graduate in Civil/Environmental Engineering. Higher qualification in Marine Structure/Geotechnical Engineering will be preferred. **Professional Qualification:** • Minimum 10 years' experience in related field. He should have experience of the soil investigation, reclamation work, soil improvement and will be associated in foundation design. He will also be responsible for preparation of cost estimates/BOQ.
7.	**Traffic Surveyor**	**Educational Qualification:** • Should be Graduate in Engineering. Higher qualification in relevant field will be preferred. **Professional Qualification:** • Minimum 10 years' experience in related field. He should have experience of traffic survey of waterways/river/canal or similar facilities.
8.	**Transport Economist**	**Educational Qualification:** • Should be Graduate in transport planning management, transport economics, transport/road/rail/Civil engineering/MBA or equivalent qualifications. Higher qualification in relevant field will be preferred. **Professional Qualification:** • Minimum 10 years' experience in related field. He should have experience of estimating transport investments and implementing transport programs.

NOTE 1:- If the Key Personnel proposed in the CV does not fulfill the minimum academic qualification, the overall score of his CV will be evaluated as zero. All such Key Personnel (whose CV scores less than 75% or who does not fulfill the minimum qualification) will have to be replaced by the firm. H-1 firm will be intimated for replacement of such personnel and work will be awarded after receipt of CV's fulfilling the tender criteria.

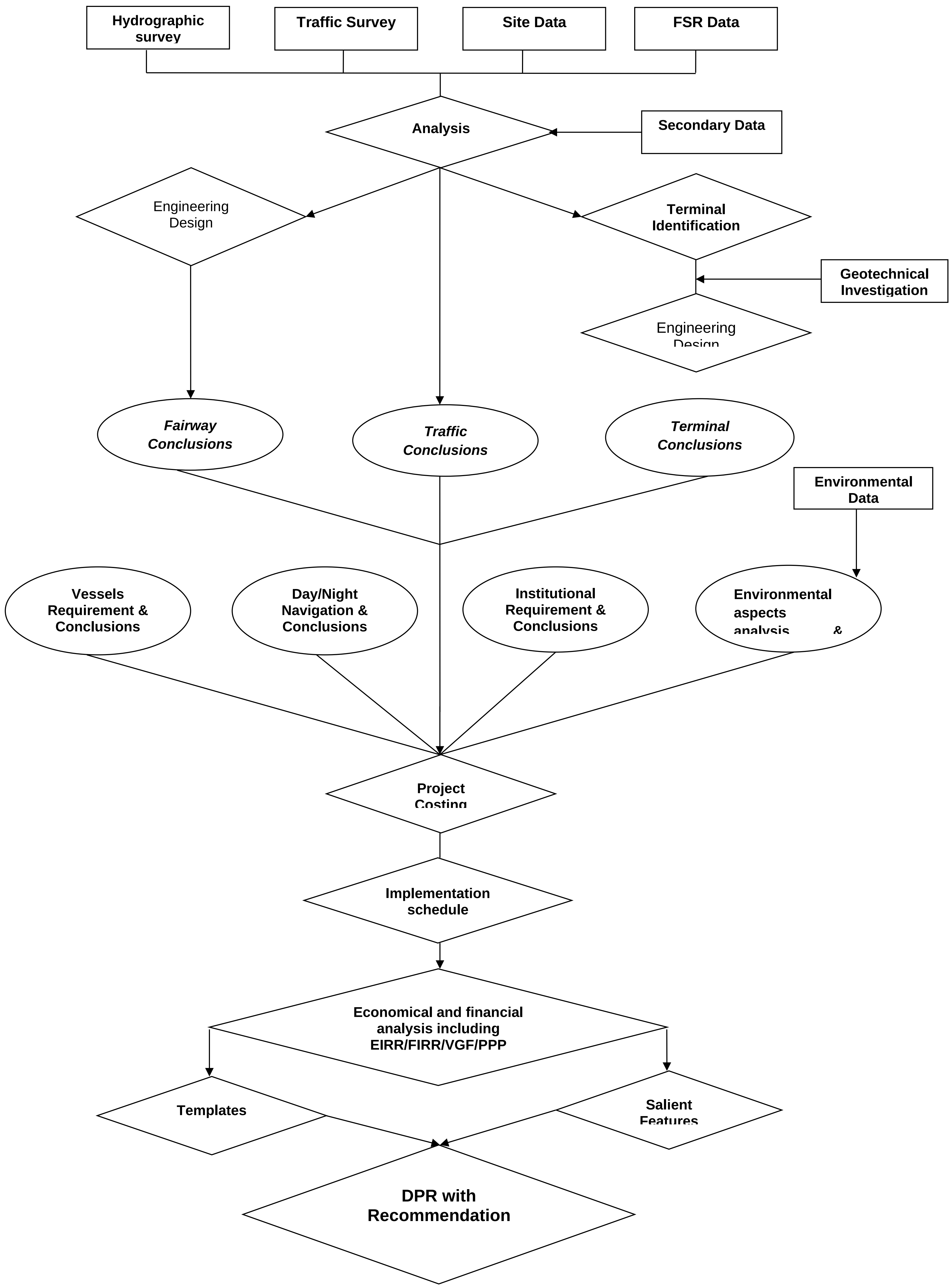
Note 2:- IWAI may call each key personnel of the preferred Consultant at the time of award of work, at the cost of Consultant.

Note 3: - In case during interaction with the key personnel, it is found that the key personnel proposed is un-suitable for the assignment position, his replacement by equivalent or better shall be provided by the consultant. The key personnel with such un-suitable CV shall not be considered in any future bids for that position for two years. No deduction for such replacement, who are not found suitable during interaction shall be made.

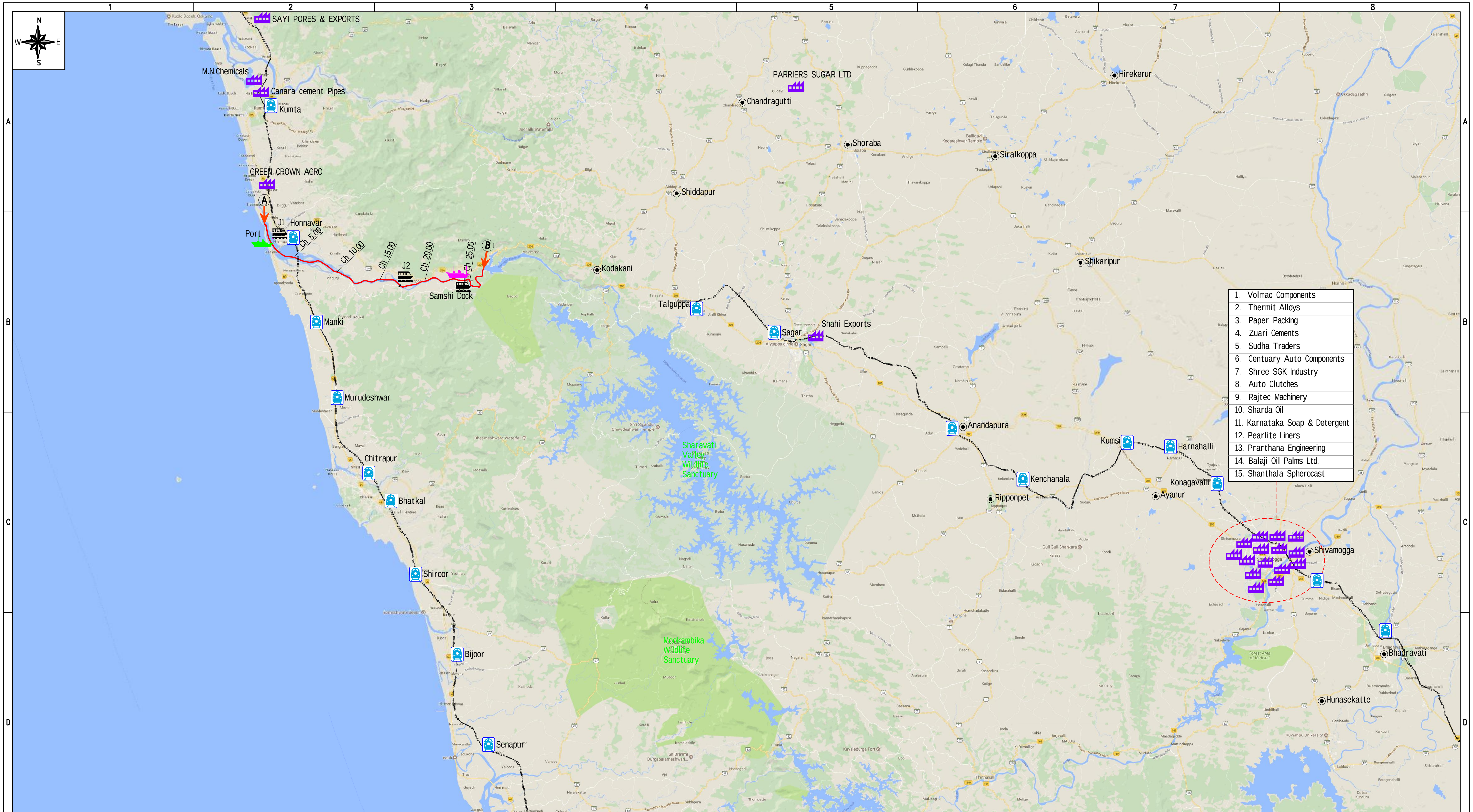
Note 4:- Since two clusters only will be awarded to one bidder, the same CVs cannot be proposed for at least two clusters. The same CV's can be proposed if the bidder is bidding for more than two Clusters.

Note 5:- Role and responsibilities of the Key Professional shall be as per the requirement of the project and Terms of Reference of the tender document and the same has to be access by prospective bidder.

ANNEXURE 1.2 – SEQUENTIAL APPROACH TO THE PROJECT IN SCHEMATIC FORM



ANNEXURE 4.1 – LAYOUT MAP SHOWING EXISTING JETTIES AND INDUSTRIES IN THE VICINITY OF SHARAVATI RIVER



LEGEND

BARRAGE	FERRY LINE
PROPOSED TERMINAL	STUDY STRETCH
PORT	RAILWAY LINE
BRIDGE	ROAD
INDUSTRY	NALA/CREEK/SMALL RIVER
PLACE NAME	
JETTY	
RAILWAY STATION	
BUS STOP	
NATIONAL/STATE HIGHWAY (Hwy)	

(A) START POINT FROM HONNAVAR PORT SEA MOUTH AT
LAT. 14°17'56.5621" N
LONG. 74°25'36.4534" E

(B) END POINT LINK AT HIGHWAY AT GERSOPPA
LAT. 14°14'14.32" N
LONG. 74°39'08.16" E

TOTAL WATERWAY LENGTH FROM POINT 'A' TO POINT 'B' 28.674Km

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

TITLE
LAYOUT MAP SHOWING EXISTING JETTIES & INDUSTRIES IN VICINITY OF SHARAVATI RIVER NW-90, (KARNATAKA)

CLIENT
INLAND WATERWAYS AUTHORITY OF INDIA
MINISTRY OF SHIPPING

PROJECT
CONSULTANCY SERVICES FOR PREPARATION OF SECOND STAGE DPR OF CLUSTER -6 OF NATIONAL WATERWAYS

PROJECT NO.
P.0010256

TRACTEBEL ENGIE

ANNEXURE - 4.1

ANNEXURE 4.2 – SUMMARY OF INTERVIEWS

Industry/Port	Contact Person	Designation
M.N. Chemicals Ltd.	Shreedhar Patil	Director Marketing
Karnataka Soap & Detergent	G. Mohan Kumar	Director
Pearlite Liners	Raghudatt	General Manager
Shahi Exports	Vinayak Hegde	HR
	Vinay Bharti	AGM
Karwar Port	Suresh S.	Traffic Manager
Honnavar Port	Ferry Owners	-
	Local People	-
Sharavati River	Ferry Owners	-
	Local People	-

Honnavar Port

Name: Mr. Suresh S

Designation: Traffic Manager, Karwar Port

- Mr. Suresh S, Taffic Manager of Karwar Port, provided information about the upcoming infrastructure development of Honnavar Port. He works with the members of Honnavar Port and an active participant for proposal of Honnavar port development. Mr. Suresh also shared the information that land has been sanctioned by the government to develop Honnavar port.
- Ferry owners in Honnavar port and harbour provided the information about Fishing and exports. They gave information that fish catch isexported to nearby districts by roadways. Fish are transported in lorries from Fishing Harbour of Honnavar.
- Local people of Honnavar gave the information that Tile industry had significant role in the economy of the region, but now all the major four factories of Honnavar had shut down their plants, due to unavailabilty of raw material and lack of market potential.

Sharavati River

- The ferry owners at Upponi, Samshi provided the information about the facilities and rail/ road connectivity.
- Local people of the villages on the bank of Sharavti river gave the information that their main occupation is fishing and agriculture.

- There is a Motor boat facility for passengers at Idgunjito cross the river. It is beside Honnavar – Nagarabastikeri road. This facility is not used extensively so far as only locals use this facility for occupational reasons. A plain land is available near the motor boat landing point. Small Roads are also been constructed to meet the Main Roads.
- At present, passenger ferries operate at Upponi to carry passengers on the other side of the river that is Samshi Village. The Ferry operator gave information that ferry charge is INR 10 per passenger and INR 20-30 per vehicle.

Industries

M.N. Chemicals Ltd.

Name: Mr. Shreedhar Patil

Designation: Director Marketing

M. N. Chemicals manufacturers and supplies bulk drugs, fine chemicals, sodium chloride etc. According to Mr. Patil, M.N. Chemicals's total annual capacity is 200 tonnes and it exports to Thailnad through New Mangalore Port. At present this company is using Roadways to transport its cargo to New Mangalore Port. When Sharavati river would be developed, the company is willing to move its cargo through waterways to New Mangalore Port.

Karnataka Soap & Detergent

Name: Mr. G. Mohan Kumar

Designation: Director

According to Mr. Mohan, at present Karnataka Soap & Detergent uses Chennai Port for export. The company exports its products to countries like UAE, USA, Canada, Singapore, Kuwait, Malaysia, South Africa, European Countries, Australia, China & Taiwan.The company's sandlwood oil divison is located at Shivamogga and its headquarter is at Bangalore. The company is not willing to shift its cargo to waterways because the distance from Chennai Port and waterways is same for them, so they don't want to divert their cargo to river.

Pearlite Liners:

Name: Mr. Raghudatt

Designation: General Manager

Mr. Raghudatt shared the information that Peralite Liners procure raw material from Bhadravti and Hospet by using roadways. According to him, the company would not use the waterways on Sharavati river because it is not convenient and economically feasible for them. Bhadravati is only 70 km away from their plant and using roadways is a better option.

Shahi Exports

Name: Mr. Vinay Bharti/ Mr. Vinayak Hegde

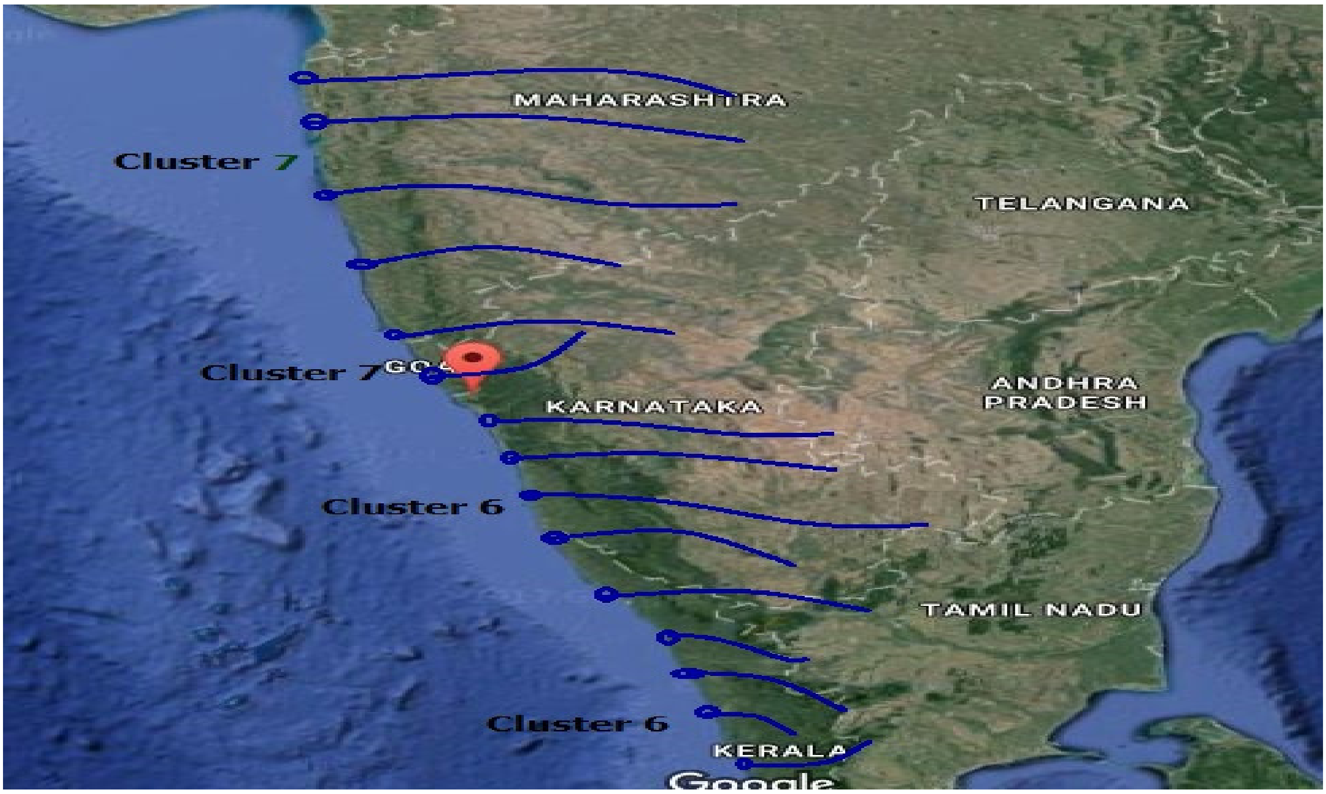
Designation: AGM/ HR

Shahi Exports Pvt. Ltd. is engaged in the manufacture and export of readymade garments in the International market. According to Mr. Hegde, the plant in Sagar only produces garments and uses Tuticorin Port for export. If waterway develops in Sharavati river, Shahi Exports' Sagar Plant would use the waterways.

ANNEXURE 8.1– RIS / AIS

RIVER VESSEL TRACKING INFORMATION SYSTEM

- RIS Objective
- Proposed AIS Base Station
- RIS Key Technologies
  - (a) Vessel Tracking & Tracking
  - (b) Onshore Facilities
- AIS Base Station Set up
- AIS Station Tower Design
- AIS Station VHF Range
- AIS Onboard Device
- Onboard ECDIS Interface
- RIS Centre
- Communication Segments
- Bill of Material



Services for skippers

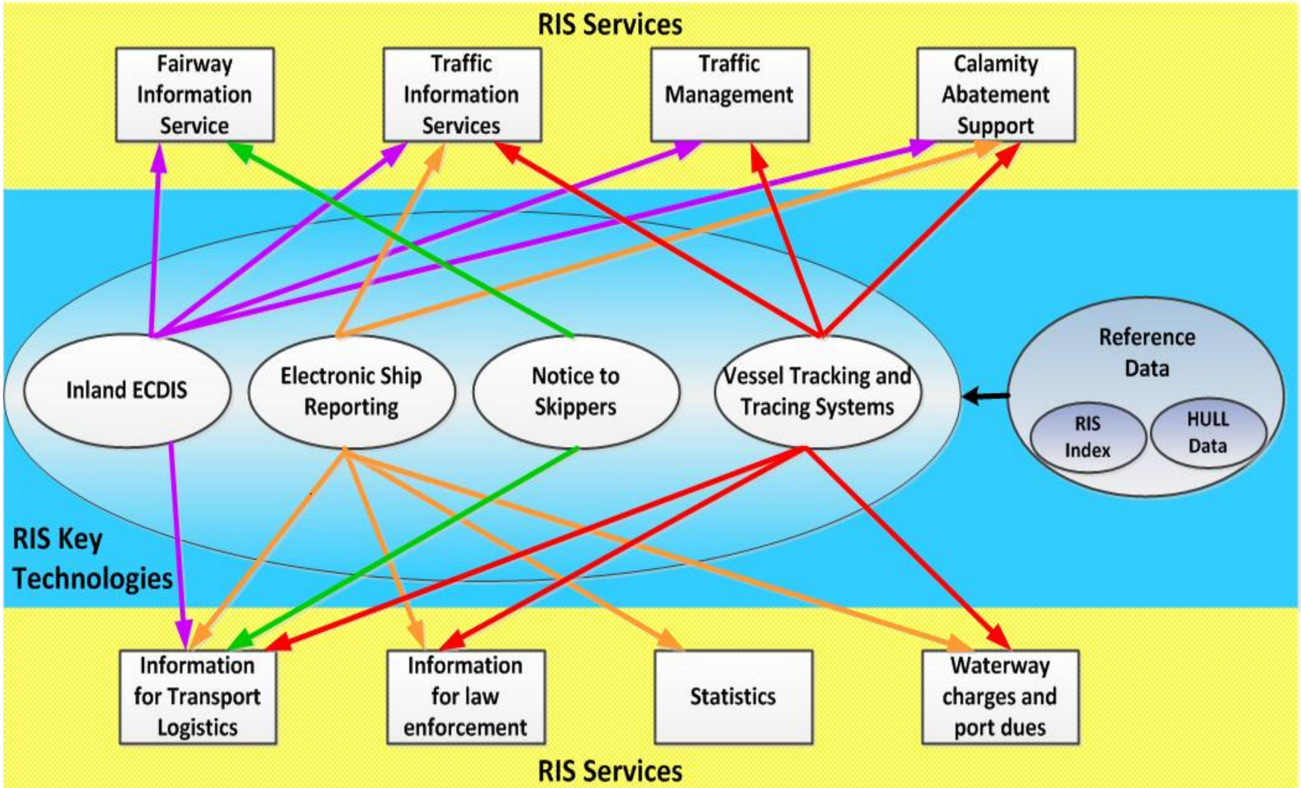
- Electronic Navigational Charts / Inland ECDIS
- Information on nautical conditions (fairway, obstructions, water level, etc.)
- Real time traffic information
- Electronic reporting of cargo and voyage
- Electronic pre-announcement at locks and harbours

Services for authorities

- Real time traffic monitoring (tracking and tracing)
- Analysis of accidents
- Exchange of safety related messages
- Electronic vessel register
- Electronic lock management
- Reception of electronic cargo reports
- Border surveillance

Services for logistic users

- Electronic cargo documents
- Data for fleet management
- Data for voyage planning
- Fairway conditions
- Water level forecast
- Availability of locks
- Calculations of arrival times

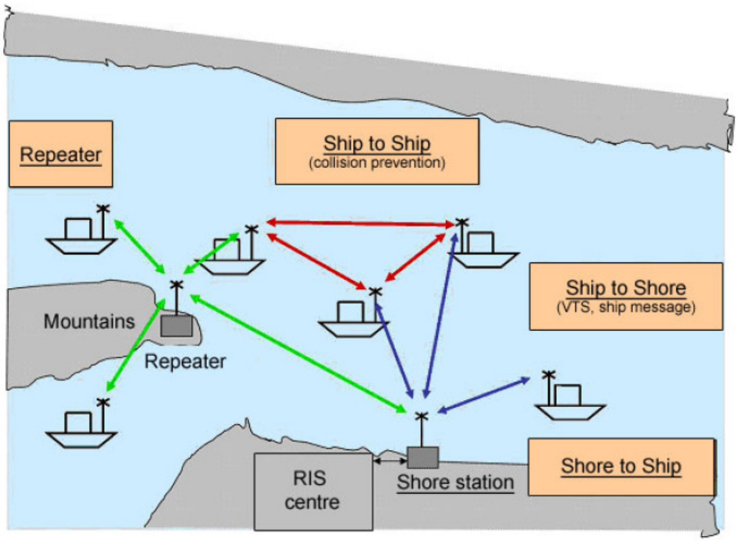


The key technologies of RIS are

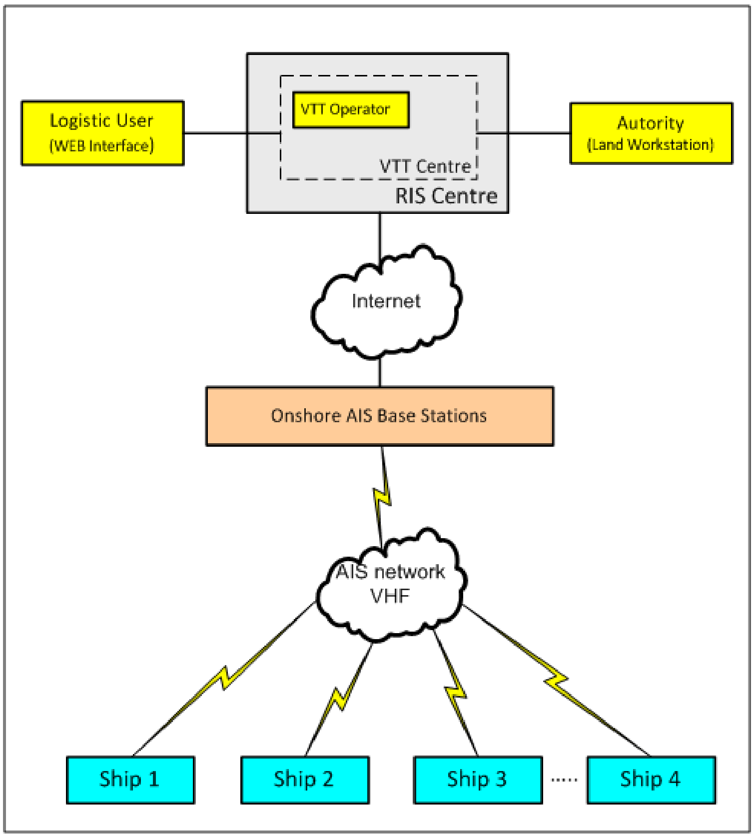
- VTT (Vessels Tracking and Tracing)
- ECDIS (Electronic Charts)
- NtS (Notice To Skippers)
- ERI (Electronic Reporting International)
- HULL Database
- LMS (Lock Management System)

Some technologies needs to be adapted to the local laws and operating procedures.

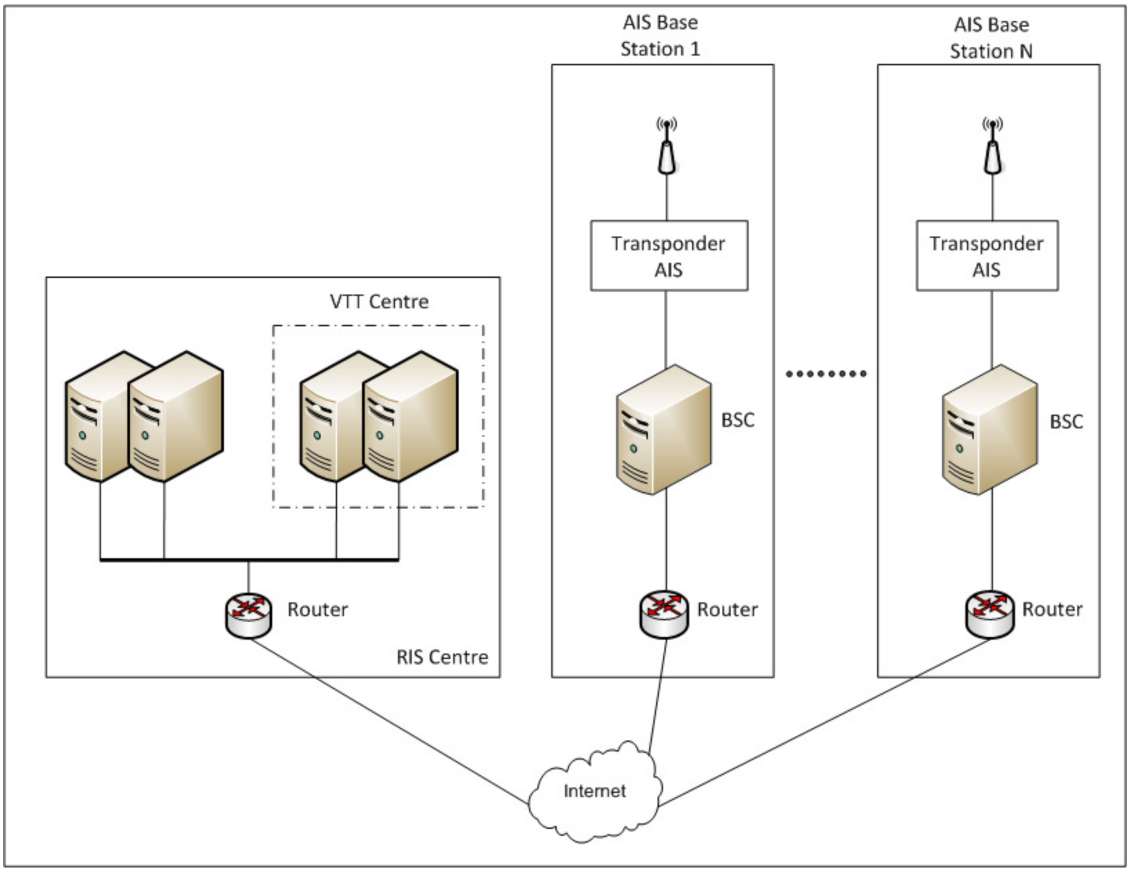
System to get a Strategic and Tactical Traffic Image using AIS technology with INLAND extension



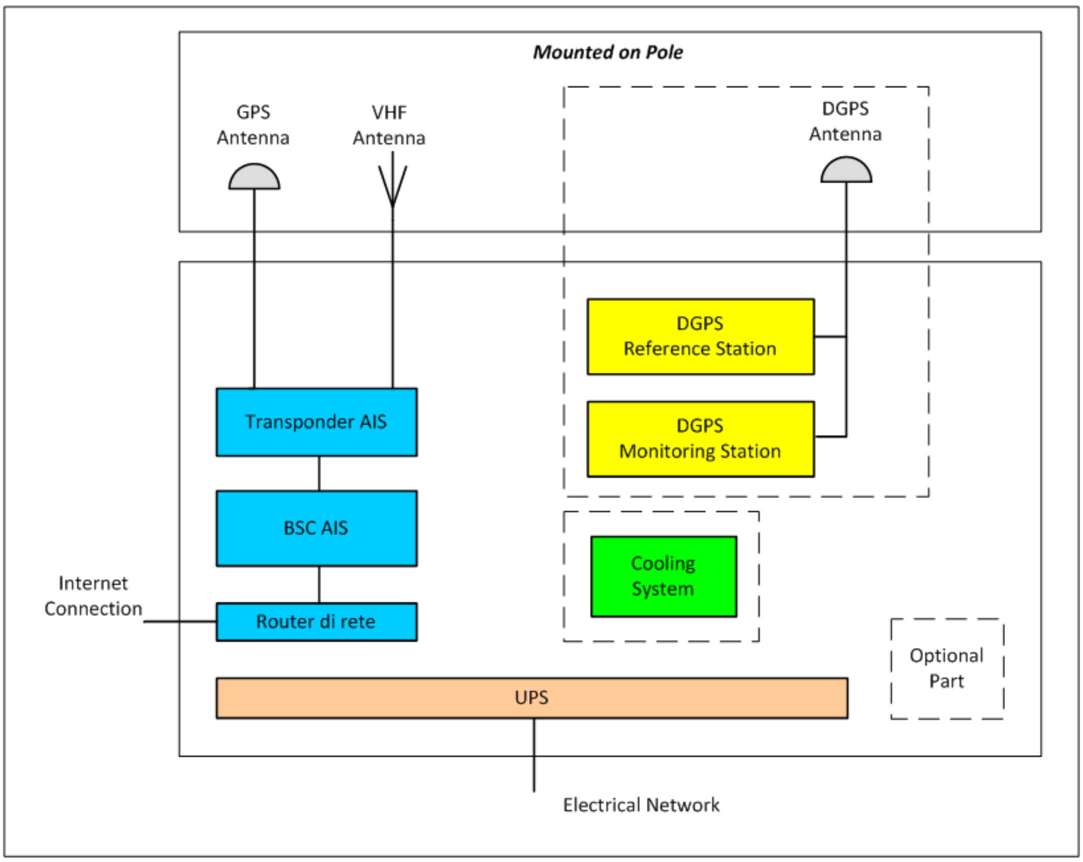
Onboard AIS devices transmit the identity of the vessel, its position and other data at regular intervals. By receiving these transmissions, AIS shore stations or ships fitted with AIS can automatically recognize, identify and track vessels equipped with AIS on a suitable screen, such as an inland ECDIS display. AIS systems are meant to boost the safety of navigation by use from vessel-to-vessel alongside onshore Vessel Traffic Services (VTS) to trace and track vessels and to assist in calamity abatement.



AIS BASE STATION & RIS CENTRE ONSHORE FACILITIES

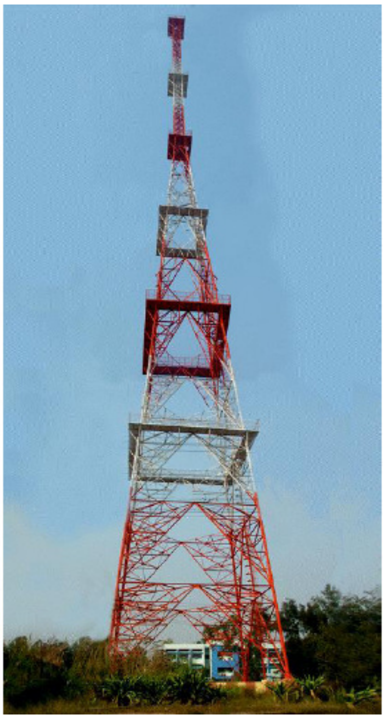


AIS BASE STATION



AIS STATION TOWER DESIGN

The type of tower depends upon the environment & also capable to carry Radar. Some of the examples are shown in the pictures

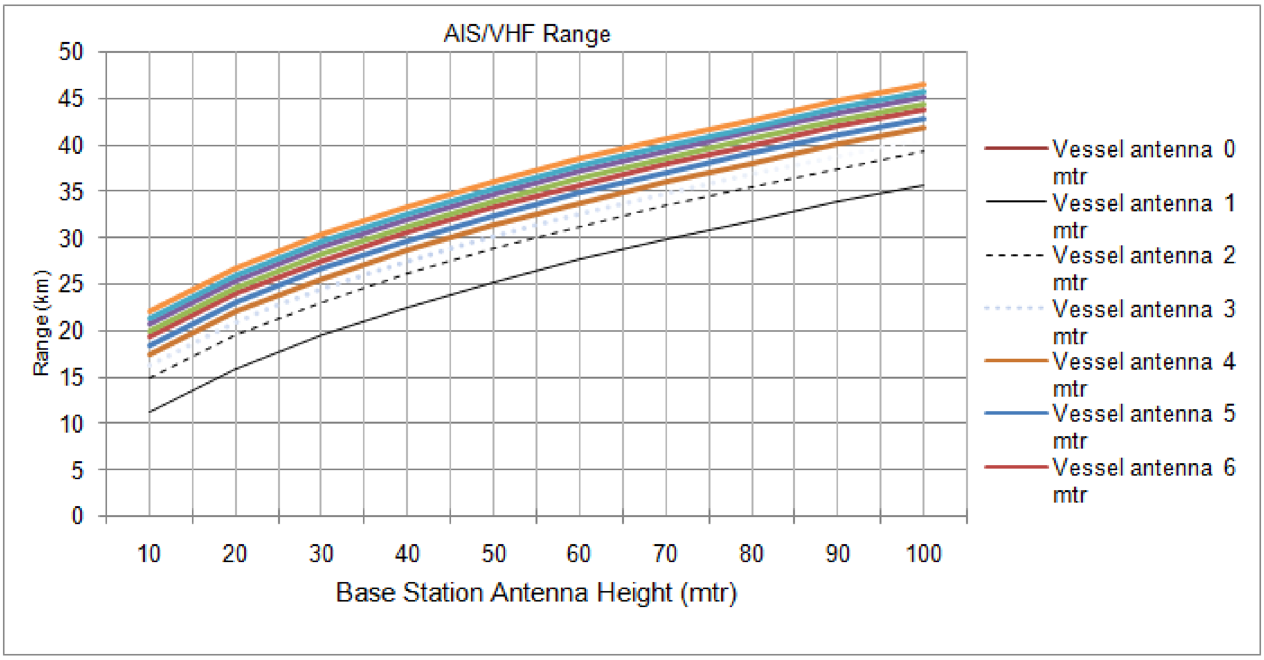


AIS STATION VHF RANGE

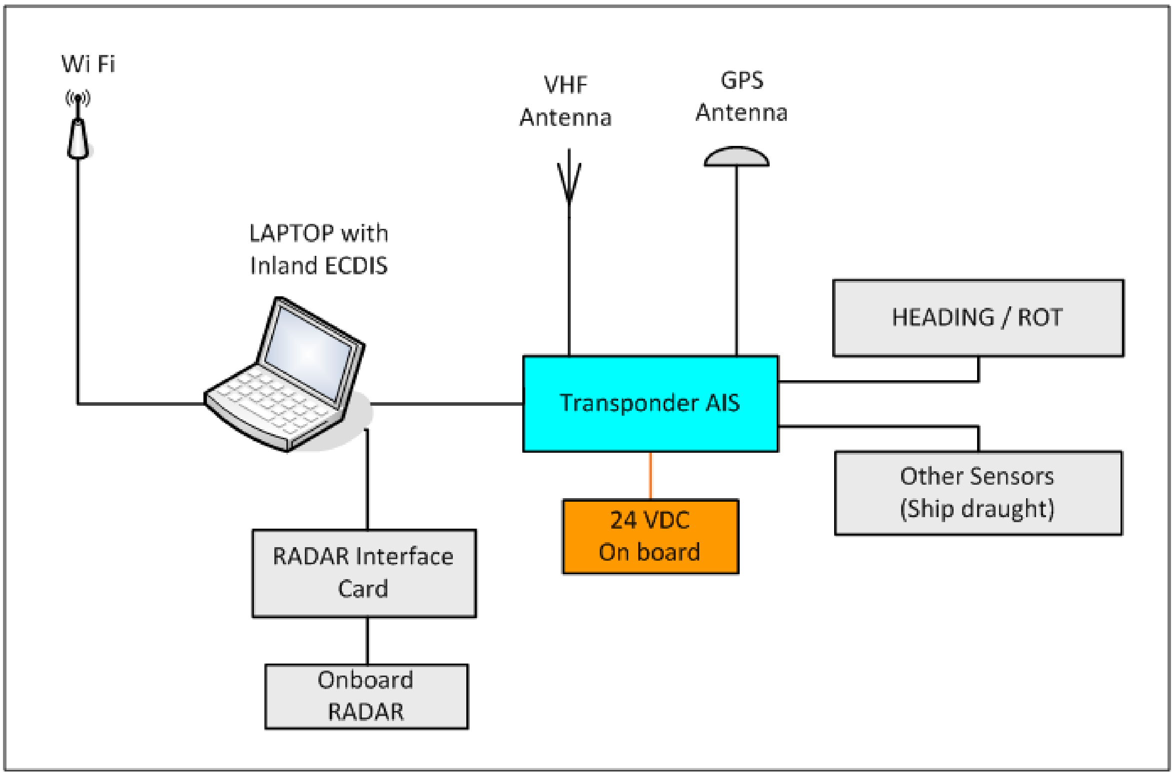
AIS/VHF Range

Base Station antenna Height (mtr.)	Vessel Antenna Height	0	1	2	3	4	5	6	7	8	9	10
10		11.3	14.9	16.3	17.5	18.4	19.3	20	20.7	21.4	22	22.6
20		16	19.5	21	22.1	23.1	23.9	24.7	25.4	26.1	26.7	27.3
30		19.6	23.1	24.6	25.7	26.7	27.5	28.3	29	29.7	30.3	30.8
40		22.6	26.1	27.6	28.8	29.7	30.6	31.3	32	32.7	33.3	33.9
50	Range (km)	25.2	28.8	30.3	31.4	32.4	33.2	34	34.7	35.3	36	36.5
60		27.7	31.2	32.7	33.8	34.8	35.6	36.4	37.1	37.8	38.4	38.9
70		29.9	33.4	34.9	36.1	37	37.9	38.6	39.3	40	40.6	41.2
80		31.9	35.5	37	38.1	39.1	39.9	40.7	41.4	42	42.6	43.2
90		33.9	37.4	38.9	40.1	41	41.9	42.6	43.3	44	44.6	45.2
100		35.7	39.3	40.8	41.9	42.8	43.7	44.4	45.1	45.8	46.4	47

AIS STATION VHF RANGE

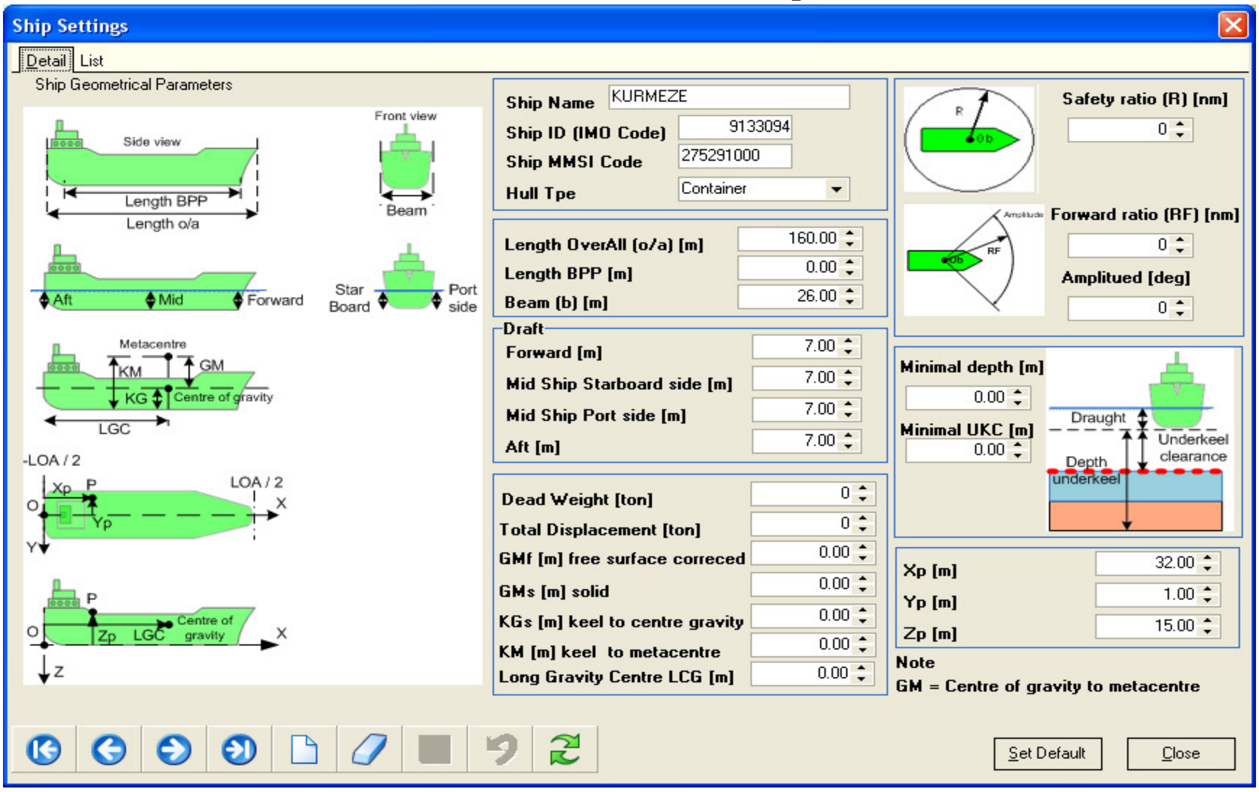


AIS ON BOARD DEVICE



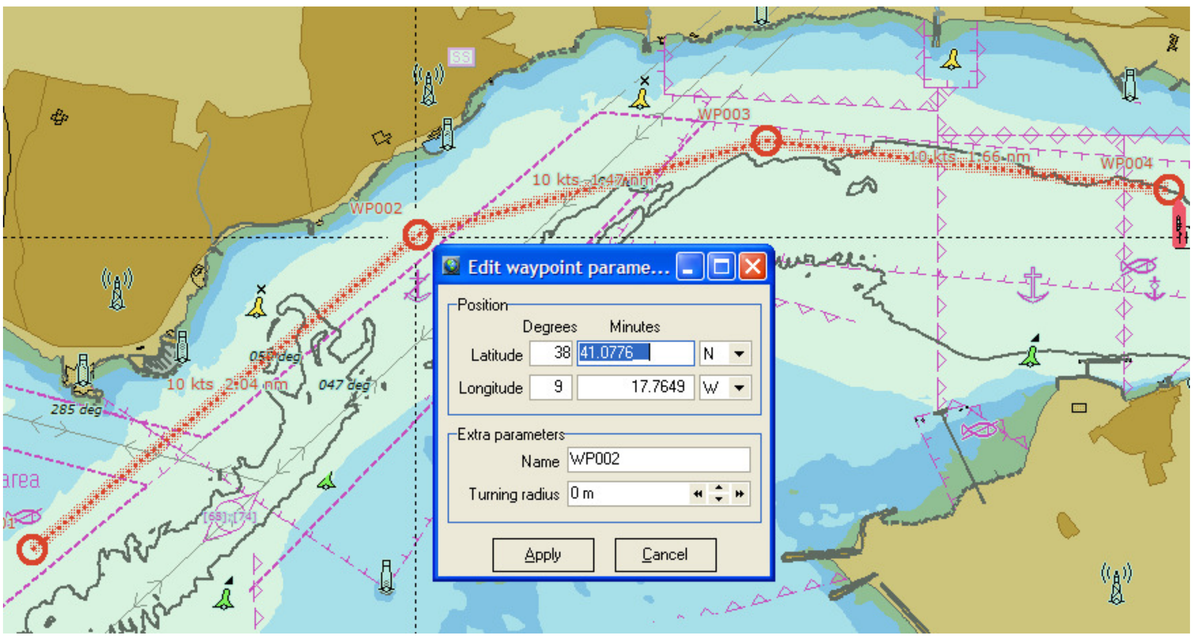
ONBOARD ECDIS INTERFACE

Interface to insert ship data

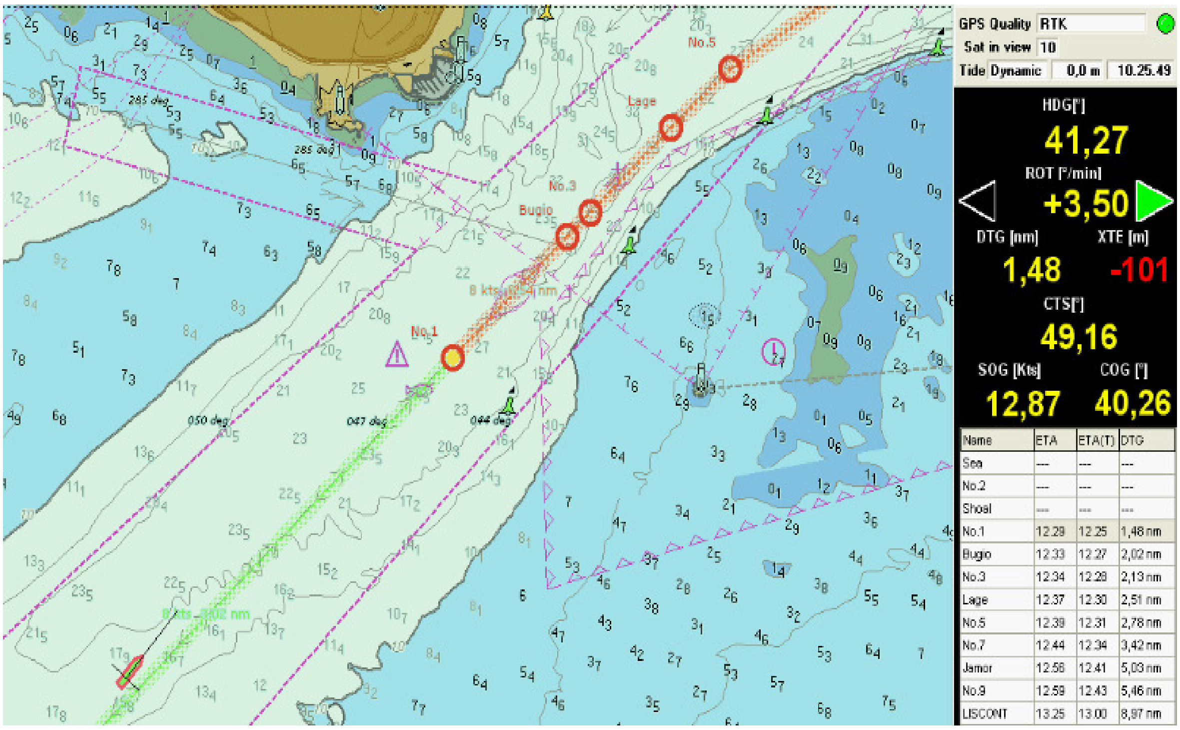


ONBOARD INTERFACE

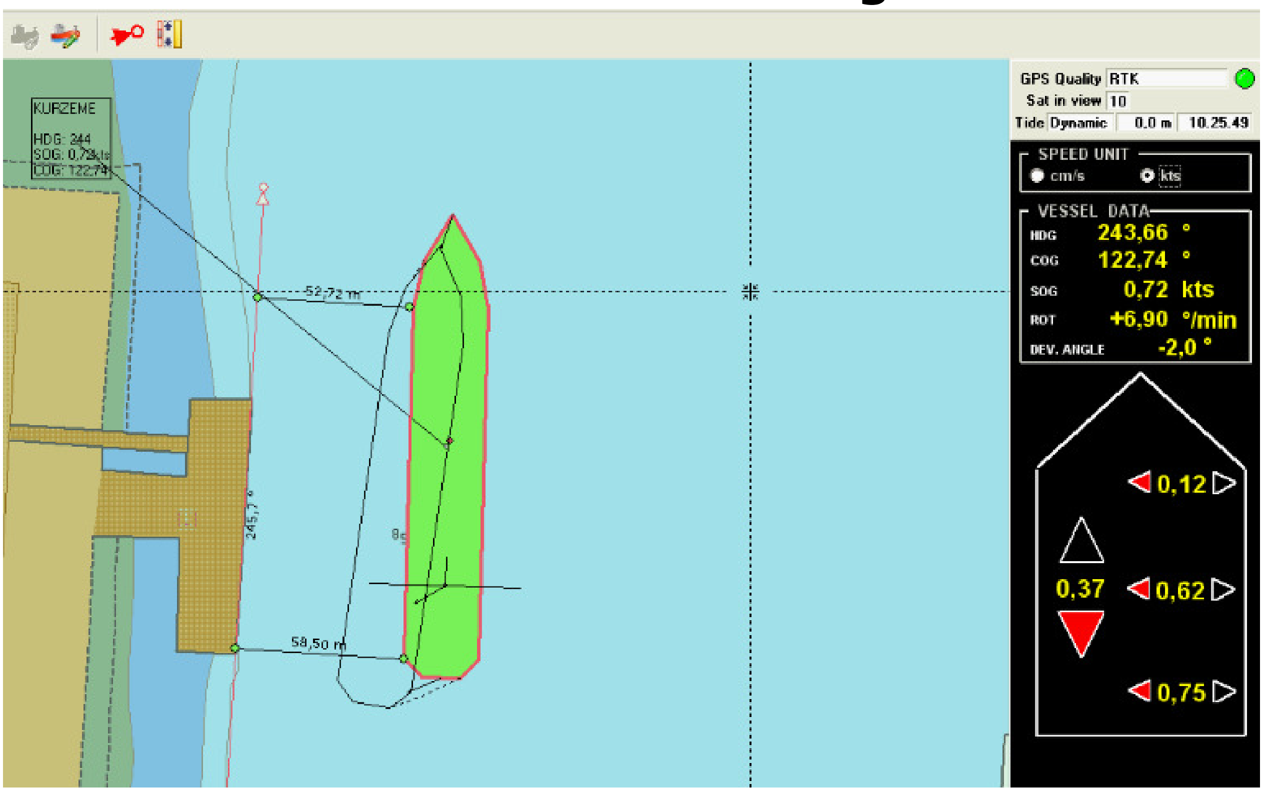
Interface to for voyage planning



Interface in navigation mode

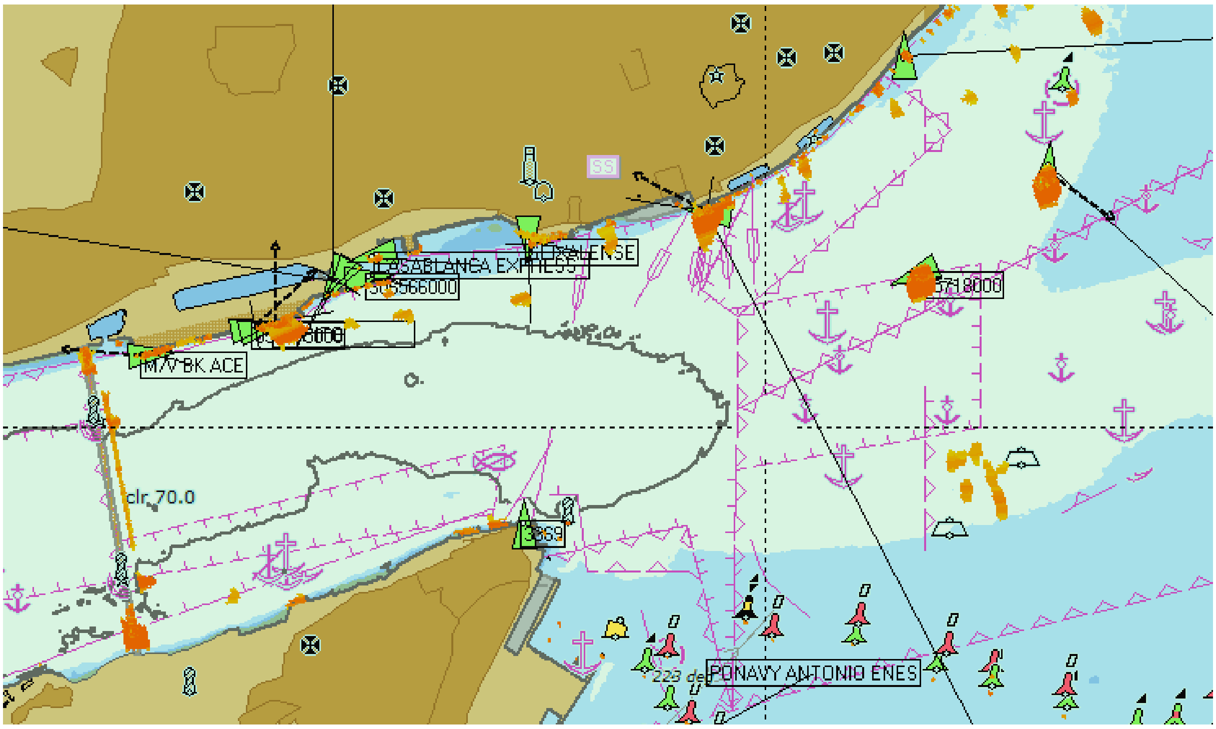


Interface for docking

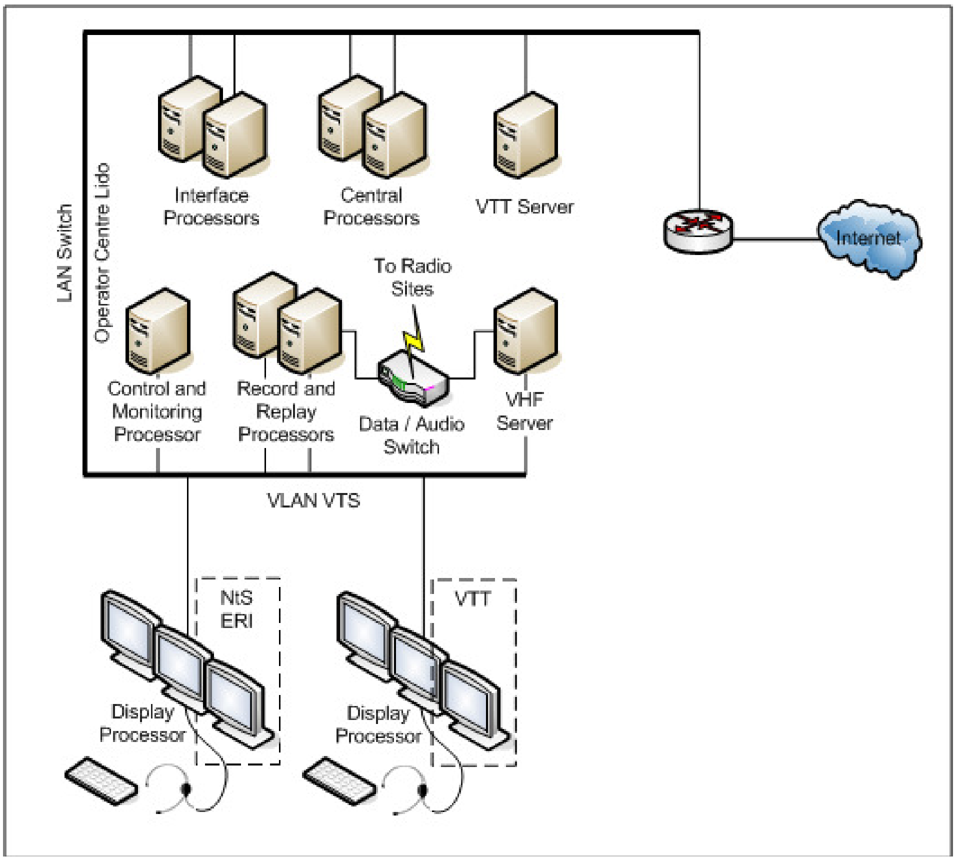


ONBOARD INTERFACE

Tactical Traffic Image + RADAR

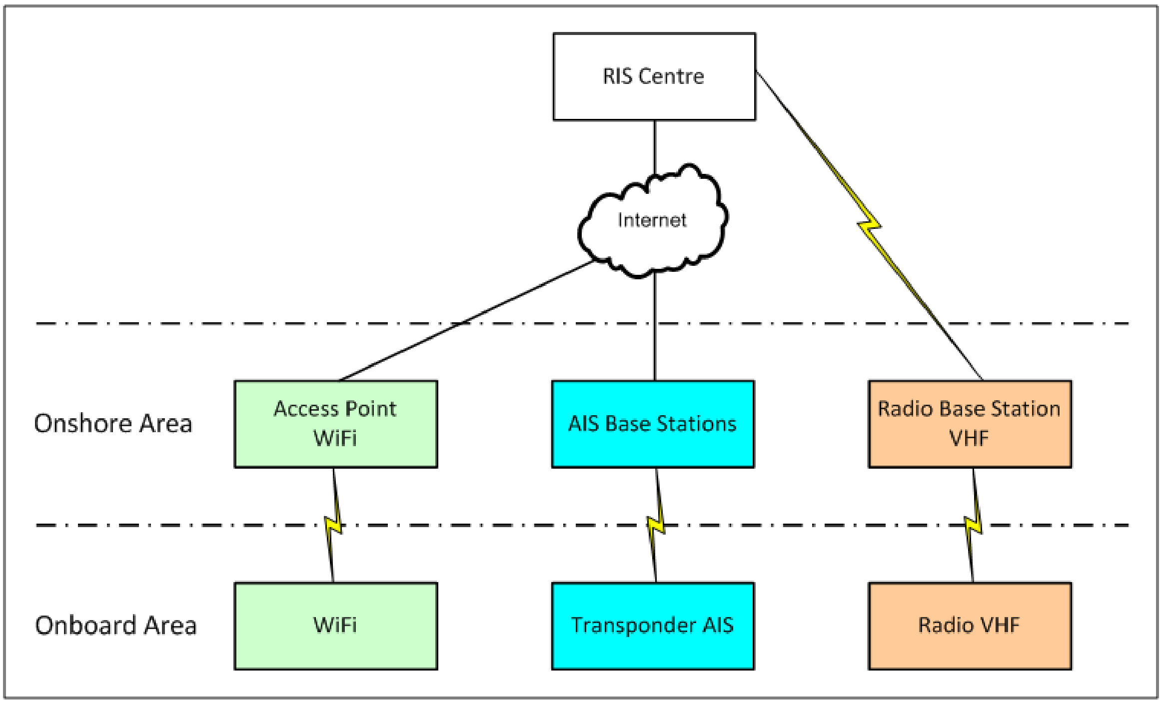


RIS CENTRE



COMMUNICATION SEGMENTS

- **Voice**
- **AIS**
- **WiFi for Charts Update and WEB Interface**



MAIN ACTIVITIES

- VHF/WiFi Coverage Study of the Inland Area
- Identification of Location for WiFi Access Point
- Identification of Location of VHF voice base stations
- Detailed definition of Main VTT Functionalities
- Notice To Skipper for River Levels
- Instrumentation with Inland AIS class A of each ship
- Creation of Inland ECDIS-S57 Chart
- DGPG integration in AIS Base Stations for 10cm precision in ships location (RTCM via AIS Msg. 17)
- Integration with Local Level and Meteo Monitoring Systems ?
- Lock/Bridge/Terminal Management ?

BILL OF MATERIAL

Onboard Vessel composed of

- AIS Transponder+ VHF

Onshore Area composed of

- AIS Base Stations + Controller + radio base VHF (voice)

1 RIS Centre Composed of

- Workstations with Data management software

ANNEXURE 8.2– AIS BASE STATION SPECIFICATIONS

AIS BASE STATION TRANSPONDER ABT-1103

AIS mod. ABT-1103
BASE STATION TRANSPONDER

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AIS BASE STATION TRANSPONDER
mod. ABT-1103

According to IMO recommendations, the AIS system is employed by Authorities to improve monitoring of maritime traffic and VTS (Vessel Traffic Services) operations. This technology, based on the use of GPS (Global Positioning System) receivers, enables transmission of position information in an automated, safe, and accurate fashion. Moreover, the AIS integrates position information with static and dynamic data enabling full identification of vessels.

The ABT-1103 has been designed to implement an independent AIS base station according to the relevant international regulations (ITU-R M.1371 and IEC 62320-1), and compliance with these standards has been certified by BSH.

The ABT-1103 can be easily integrated in a regional monitoring system according to the IALA Recommendation A-124. The exchange of data between the base station and the monitoring system is carried out through the embedded Presentation Interface (PI) ports (RS232 or RS422), or via TCP communications using a PCU (Physical shore station Control Unit) like the BCS-1135, or BCD-1135. The operating mode of the transponder can be configured through the same PI ports, using the embedded web server of the Elman PCU, or by means of a dedicated management software.

The ABT-1103 includes an internal GPS receiver used to acquire position and time information; this information can be forwarded in order to synchronize other units. Alternatively, the ABT-1103 can accept time and position information from external devices. Furthermore, the ABT-1103 features a dedicated RTCM port to input DGNSS messages to the unit, enabling corrections to be forwarded to the internal GPS and/or transmitted to remote stations.

The ABT-1103 can also be equipped, upon request, with additional functionalities that can be adapted, and specifically developed to the customer's needs. The Secure mode functions, for example, can be used to stop the standard broadcasting of AIS messages and/or enable encrypted communications with selected AIS stations (e.g. WAIS equipped vessels).

GENERAL CHARACTERISTICS

- 2 or 3 VHF receivers and 1 VHF transmitter
- Transmission/reception of text messages
- User Interface (ECDIS, ECS)
- Internal DGPS receiver
- Standard 19" form factor
- Internal BIIT (Built In Integrated Test)
- Optional Secure mode functions (WAIS)

ORDERING GUIDE

Model	Description
ABT-1103	Base Station unit compliant to IEC 62320-1 standard, 2 receivers installed
ABT-1103-W	Base Station unit compliant to IEC 62320-1 standard, 2 receivers installed , WAIS support
ABT-1103-WR3	Base Station unit compliant to IEC 62320-1 standard, 3 receivers installed , WAIS support, dedicated channel for WAIS transmissions

TECHNICAL SPECIFICATIONS

Physical characteristics

Dimensions	482 x 220 x 88 mm
Weight	5 kg

Environmental specifications

Operating temperature	-20 ÷ +55 °C
Storage temperature	-40 ÷ +70 °C
Relative humidity	95% @ +25° ÷ +55° C
Vibration	Compliant with NAV-30-A002 regulations
Shock	Compliant with NAV-30-A001, level B, class II regulations

Power

Input	115/220 VAC 24 V DC
Power consumption	20 W (50 W peak)

VHF transponder

Frequency Band	156.025 ÷ 162.025 MHz
Channel width	25 kHz
RF Power output	2 or 12.5 W (nominal)
Modulation	GMSK/FM
Bit rate	9600 bps
Sensitivity	-112 dBm @ 20% PER

GPS receiver

Receiver	Differential, 16 channel
Accuracy (2D)	5 m (95%) - GPS 1.5 m (95%) - DGPS

Interfaces

Input	3 x IEC 61162-1 / 2 1 x ITU 823-2 1 x PPS input pin 1 x TX INHIBIT input pin
Bidirectional	4 x IEC 61162-2 1 x RS232
Output	1 x ITU 823-2 / IEC 61162-1 / 2 1 x NC/NO Contact 1 x PPS output pin 1 x BIIT output pin
RF	1 x BNC for VHF antenna 1 x TNC for GPS antenna

Position and time sources

External synchronization supported	Yes
Fallback algorithms for time synchronization	Yes
External position sensor supported	Yes
Fallback algorithms for position sensor	Yes
GPS output port DGNSS corrections output port	Yes
DGNSS corrections dedicated input port	Yes

Operation modes

Dependent mode	Yes
Independent mode	Yes
RATDMA	Yes

Processing capacity

FATDMA message memory	Up to 100 messages at the same time
RATDMA message memory	Up to 100 messages at the same time
AIS internal directory	Up to 2048 remote stations

Optional message transmission

Station name (Message 24A) Yes

Standards

IMO MSC.74(69) Annex 3	ITU-R M.1371-4,
ITU-R M.1084-4,	EN 301 489-1, V 1.8.1,
EN 55022:2006 + A1,	EN 60950-1,
EN 55022:2006 + A1,	EN 61000-3-2,
EN 61000-3-3 + A1 + A2,	EN 61000-4-2,
EN 61000-4-3,	EN 61000-4-4,
EN 61000-4-5,	EN 61000-4-6,
EN 61000-4-11,	IEC 61162-1 / 2,
IEC 61108-1,	IEC 62320-1

Type approvals

Statement of Conformity nr. BSH/46162/4321801/11
R&TTE Directive 1999/5

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ANNEXURE 8.3– AIS EMBEDDED SERVER SPECIFICATIONS

AIS EMBEDDED SERVER

FOR PHYSICAL SHORE STATIONS

Mod. BCS-1135, BCD-1135

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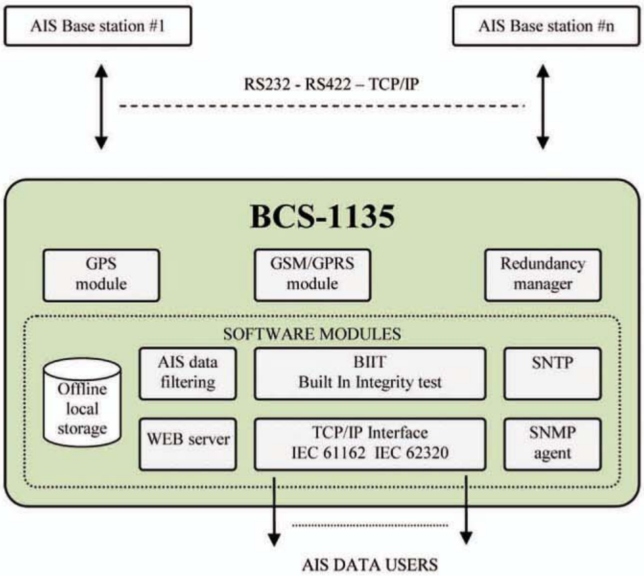
AIS EMBEDDED SERVER
Mod. BCS-1135, BCD-1135

The BCS-1135 AIS Embedded Server is designed to interface multiple AIS Physical Shore Stations (PSS) and to allow their management from shore systems. The BCS-1135 can be easily integrated in an AIS network acting as a PSS Controlling Unit (PCU) according to the IALA Recommendation A-124.
The BCS-1135 is designed to withstand harsh environments including industrial range components and solutions normally employed in military products like solid state technology, fanless approach etc.

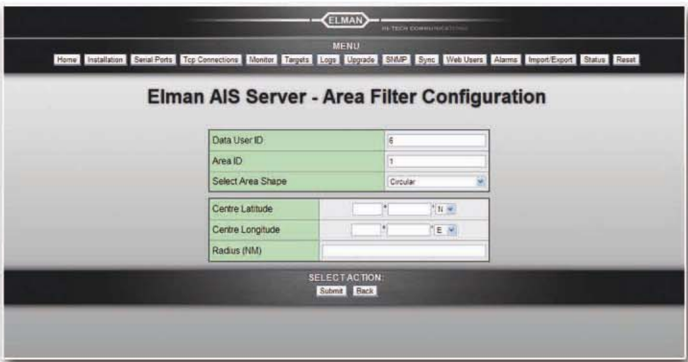


USER INTERFACE

The BCS-1135 features an embedded web server which allows configuring and monitoring both the BCS-1135 and the connected AIS Base Stations, through a Web User Interface (WUI) removing the need of additional software. Authorized operators can log-in the web interface to configure and monitor every aspect of the BCS-1135, its ports and connections and the linked devices and users. A TFTP client allows easy firmware upgrades.

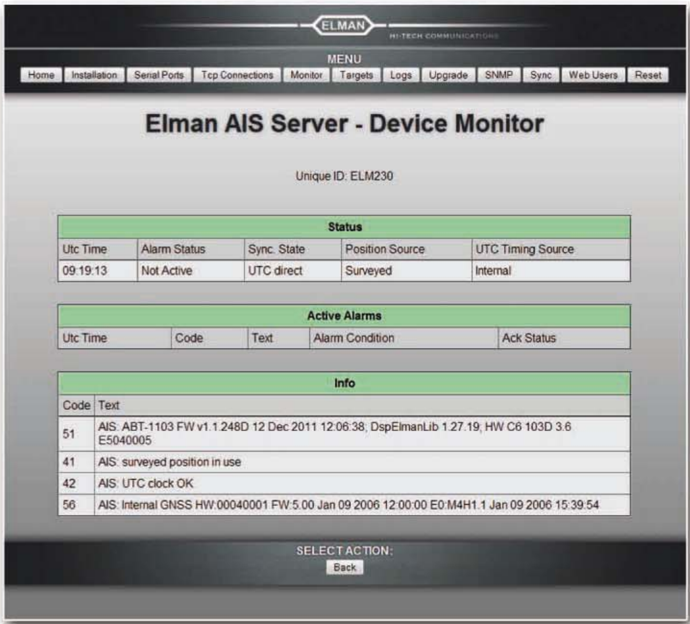
AIS DATA MANAGEMENT

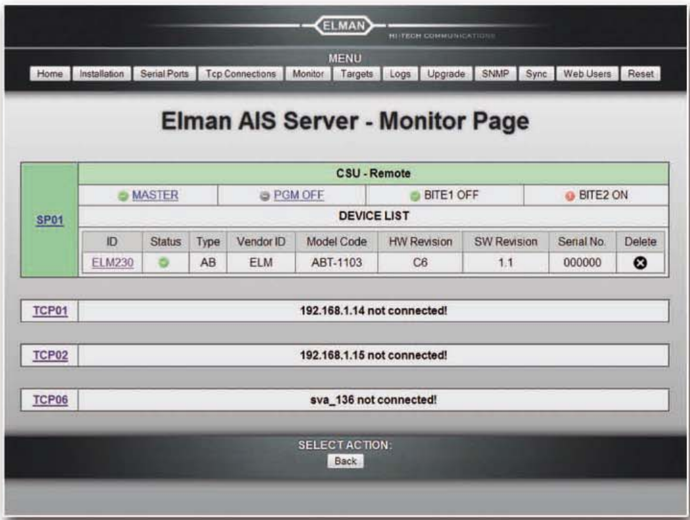
The BCS-1135 can acquire AIS data from the serial ports and from TCP connections according to the specified configuration. In the same way the collected AIS data are made available to serial ports and TCP connections. Moreover, it is possible to configure the data forwarding for each port (serial and/or TCP) applying filters on the AIS data like duplicate removal, down-sampling, area filters and type of ITU messages.
Received AIS targets can be displayed on the BCS-1135 WUI or exported using the included Kml Service.
Optionally, the BCS-1135 includes a memory card which provides persistent local AIS data storage, thus avoiding loss of data when the link to a data centre is temporarily broken.



ALARM AND STATUS MONITORING

The BCS-1135 includes modules dedicated to monitor the status and detect alarms generated from internal circuitry and the connected Base Stations. Alarm and status information can be displayed and managed using WEB interface. Moreover the featured SNMP agent allows for remote centralized monitoring.





BASE STATION MANAGEMENT

The BCS-1135 is also capable of addressing the connected AIS Base Stations, allowing the remote configuration and monitoring. The standard IEC 61162 protocol is used for all the real time data communications; the comment block extension as per IEC 62320-1 is also supported, providing a standard and convenient way to address data users and devices and to attach a timestamp to the AIS data. All the Base Stations compliant with the IEC 62320-1 standard should work seamlessly with the BCS-1135; however the BCS-1135 also supports Elman proprietary sentences to manage the advanced functionalities of the ABT-1103, such as Warship-AIS configuration.

OPTIONAL MODULES

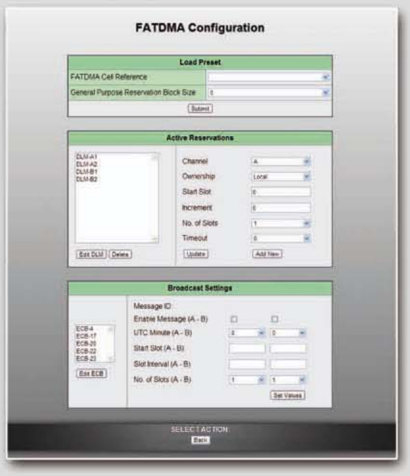
The BCS-1135 can be optionally equipped with an internal GPS receiver which can be used as position and time source both for the BCS-1135 itself and for the connected AIS Base Stations, simplifying the installation where more than one Base Station is required. Time synchronization can also be achieved through the embedded SNTP client.

An optional internal GSM/GPRS module can be installed and used as primary connection to an external AIS data user, fallback connection or service link to monitor the status of the BCS-1135 and connected devices.

Moreover, the BCS-1135 can also be used as a switching unit for Base Stations in redundant installations in active/passive configuration; VHF antenna switch can be used to feed the active Base Station only, thus reducing the number of required antennas.

BCD-1135

The BCD-1135 is the dual version of the BCS-1135; it includes all the functionalities featured by the BCS-1135. In addition, the BCD-1135 features two separate processing modules and Ethernet interfaces supporting internal redundancy or the simultaneous interface to two different TCP networks (Serial Router).



GENERAL CHARACTERISTICS

- Serial to IP conversion
- Up to 5 serial ports for direct interface to AIS Base Stations
- User configurable up to 10 TCP/IP connections
- Collected data available on serial and TCP/IP ports
- User customizable message filters
- Configuration and monitoring via WEB interface
- Multiple AIS base station configuration and monitoring via WEB interface
- Support for secure mode functions (Warship-AIS)
- Internal BIIT (Built In Integrated Test)
- KML Service to display AIS targets on external application like Google Earth
- Embedded SNMP agent
- Time synchronization via SNTP
- Automatic firmware upgrade via TFTP
- Optional internal DGPS receiver
- Optional GSM/GPRS module
- Optional VHF antenna switch
- Dual processing module and Ethernet interface (BCD -1135 only)
- PoE (Power over Ethernet) support
- Standard 19” form factor

TECHNICAL SPECIFICATIONS

Physical characteristics

Dimensions	482 x 230 x 44 mm
Weight	3 kg

Environmental specifications

Operating temperature	-20 ÷ +55 °C
Storage temperature	-40 ÷ +70 °C
Relative humidity	95% @ +25° ÷ +55° C°

Power

Input	115/220 VAC 18÷48 VDC
Power consumption	5 W (BCS-1135) 10 W (BCD-1135)

GPS receiver

Receiver	Differential, 50 channel
Accuracy (2D)	5 m (95%) - GPS 1.5 m (95%) - DGPS

Interfaces

Ethernet	2 x RJ45 (BCS-1135) 4 x RJ45 (BCD-1135)
Serial ports	Up to 5 x DB9 connectors Each port is configurable as: • RS232 DTE (DB9 male) • RS422 (DB9 female) • ABT-1103 PI (DB9 female)
Maintenance ports	1 x RJ12 (BCS-1135) 2 x RJ12 (BCD-1135)
RF	1 x N-Female for VHF antenna in 2 x BNC-Female for VHF antenna out 1 x TNC-Female for GPS antenna 1 x GSM/GPRS antenna

Standards

IALA Rec. A-124,
ITU-R M.1371-4,
IEC 61162-1 / 2,
IEC 62320-1,
IEC 61108-1

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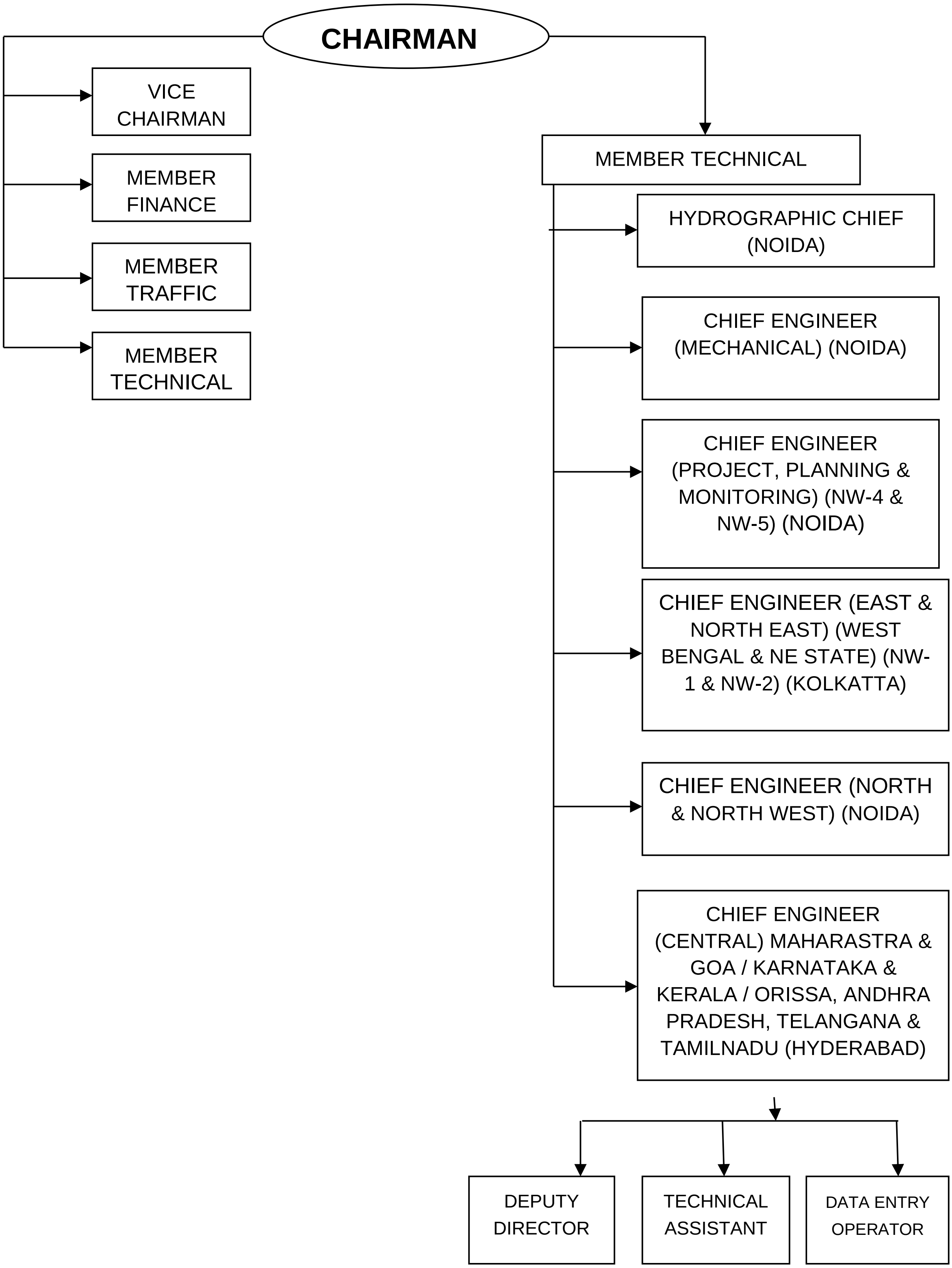
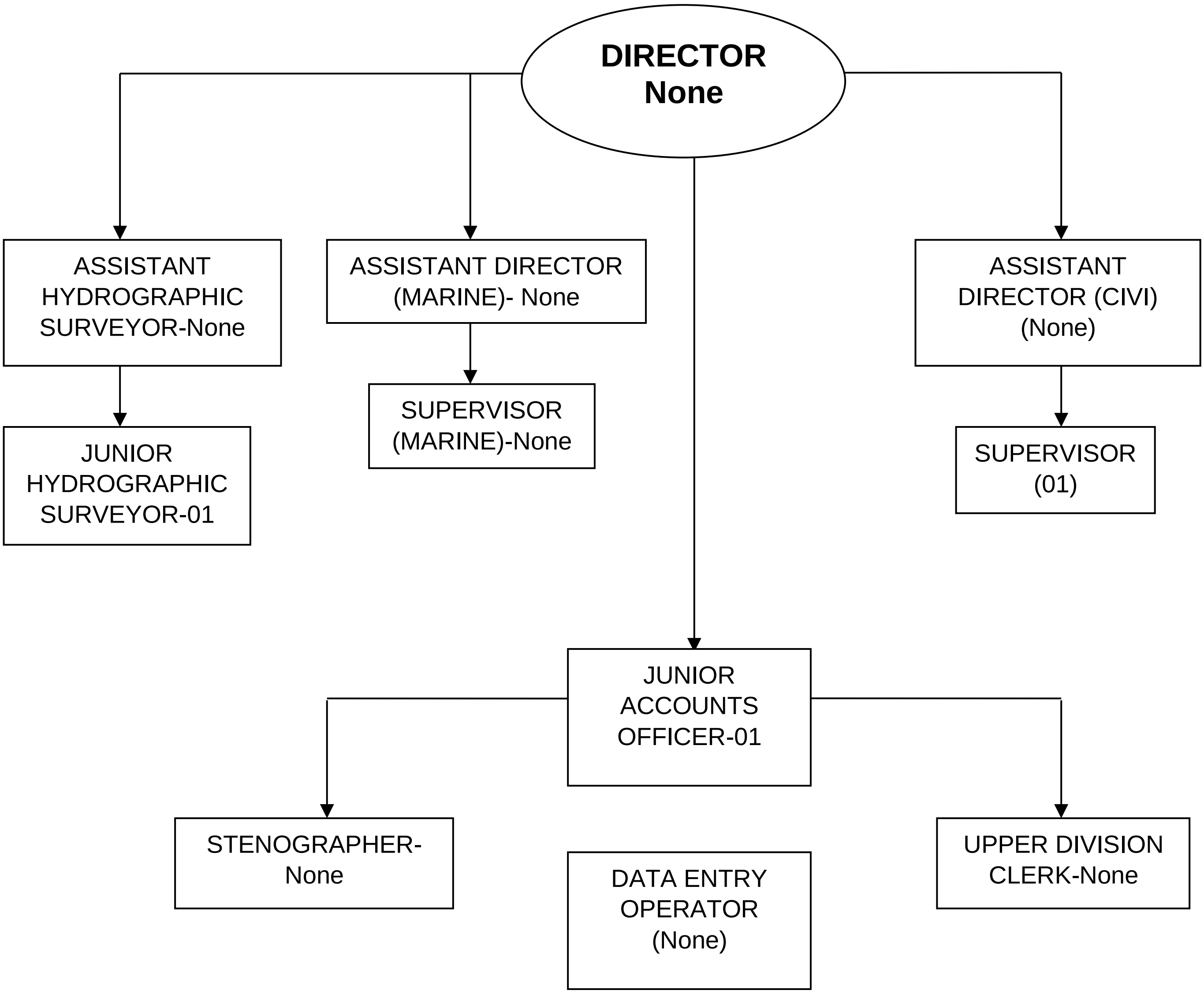
ANNEXURE 10.1– INSTITUTIONAL REQUIREMENT HEAD OFFICE COMPONENTS



ANNEXURE 10.2– INSTITUTIONAL REQUIREMENT IN KARNATAKA AND KERALA (EXCLUDING THE EXISTING



NW-3 & NW-8/9/59)

ANNEXURE 11.1 – COSTING/FINANCIAL ASSUMPTIONS

FINANCIAL ANALYSIS

Broad Assumptions

Based on Financial Analysis as per DPR of NW5

Abstract

Broadly identified assumptions in order to facilitate financial analysis of Category II shortlisted waterways development

Inland Waterways Authority of India

FINANCIAL ANALYSIS BROAD ASSUMPTIONS[1]:

Capital Expenditure:

Elements to be covered (based on planned infrastructure requirement for respective rivers)

Suitable assumptions with relevant justification shall be made for any missing items.

CAPEX HEAD	TOTAL COST (INR CRORE)
Land Acquisition	Cost initially to be considered for acquisition of land for land side development of floating jetty
Dredging	**Normal Condition** Standard dredging rate of Rs. 200/cum to be considered. Suitable adjustments shall be made (with proper justification) for change in quality of dredge material/any special requirement for disposal of dredge material
Barrages with Navigational Locks	Based on requirement standard charges as per Planned Infrastructure of respective rivers.
Raising Banks	
Protection Measures	
Environmental Monitoring	
Navigational Aids	
Bridges	
Cross Drainage Works	
Facilities to Local People	
Terminals	Initially while calculating CAPEX terminal cost shall include cost for development of required numbers of floating jetty along respective waterways, cost of equipment, manpower required for terminal operation
Total Capital Expenditure	**Sum of all parameters mentioned above**
DC, PMC, IE Services, Loan Fees	10% of Total CAPEX
Overall Contingency	3% of Total CAPEX
Escalation	1.5% of Total CAPEX
Total Hard Capex	
Interest During Construction	
Total Project Cost	

Operations & Maintenance Expenditure:

(Pick up the cost items relevant to your study and planned infrastructure components)

Suitable assumptions with relevant justification shall be made for any missing items.

Annual Escalation shall be assumed @ 5.0%.

[1] These assumptions are to facilitate consultants in giving a sense of direction in which they shall move to make the reporting of final outcome consistent. Any missing information shall be assumed suitably (with valid justification) by the consultants in order to provide desired end result.

Cost Items	% of CAPEX
Dredging	5%
Cross Drainage	2%
Locks	2%
Bridges	1%
Terminals	2%
Navigation Aids	2%
Protection Measures	2%
Raising Banks	2%
Facility to Local People for Ferry Services	2%
Environmental Monitoring	2%
Cost of Barrages with Navigation Locks	2%
Total Waterway O&M Costs	

Revenue Estimation:

For estimating the revenue, the tariff structure proposed by IWAI (Levy & Collection of fees and charges) Regulations, 2011 shall be used as a reference.

Existing Tariff Structure & Charges by IWAI (Shall be verified from the latest published Tariffs)

Suitable assumptions with relevant justification shall be made for any missing items.

Tariff Heads	Charge unit	Charges (INR)
(A) Usage Charges		
Movement of Vessels	GRT/km	0.02
(B) Vessel related charges		
Berthing charges	Vessel	1000.00
Towage	Vessel/hour	600.00
Pilotage	Day	750.00
(C) Cargo related charges		
(i) Terminal Charges		
Dry Cargo	Ton (or part thereof)	1.00
Liquid Cargo	Ton (or part thereof)	1.00
Containerised Cargo	TEU	50.00
(ii) Transit shed charges		
First 3 days	MT per day	
First 7 days	MT per day	
7-21 days	MT per day	5.00
22-35 days	MT per day	10.00
After 35 days	MT per day	40.00
(iii) Open storage charges		
Hard Stand		
First 3 days	MT per day	
First 7 days	MT per day	0.00
7-21 days	MT per day	2.00
22-35 days	MT per day	4.00
After 35 days	MT per day	16.00
On Open Area		
First 3 days	MT per day	

Tariff Heads	Charge unit	Charges (INR)
First 7 days	MT per day	0.00
7-21 days	MT per day	1.00
22-35 days	MT per day	2.00
After 35 days	MT per day	8.00
(D) Composite Charges		
Movement of Over Dimensional Cargo	Per MT per km	1.50
Customs clearance convenience charges	Per MT	40.00
(E) Miscellaneous charges		
Crane, fork lift, bunkering of fuel, water supply, etc.	Of total revenue	
Crane (including Pontoon crane)		
5 MT capacity Crane	Per shift of 8 hrs	800.00
20 MT capacity Crane	Per shift of 8 hrs	2000.00
>20 MT capacity Crane	Per shift of 8 hrs	2500.00
Container Crane	Per hr	1100.00
Fork Lift (3MT capacity)	Per shift of 8 hrs	600.00
Electricity supply to Vessels		As per Electricity Board
Bunkering of fuel/ Petroleum Oil Lubricants		As per Market Rates
Water Supply	Per km	300.00
Sewage Disposal	Per km	100.00
Weighing scale	Per MT	5.00

In order to estimate the effective charge that the end users are expected to face, it is assumed that the margin charged by barge operators is Rs. 1.20 per MT per km.

FINANCING

The financing parameters considered for the study are as follows:

Suitable assumptions with relevant justification shall be made for any missing items.

Item	Unit	Value
Leverage Ratio	% Debt	70%
Moratorium	Quarters	2
Door-to-door Tenor	Years	15
Interest Rate	%	8%
Debt Drawal Start Quarter	No.	1
Debt Repayment Start Quarter	No.	22
Debt Repayment End Quarter	No.	60
Discount Rate (For NPV calculations)	%	16%

OTHER ASSUMPTIONS

Suitable assumptions with relevant justification shall be made for any missing items.

Tax Rate Assumptions

Type of Tax	Rate
Corporate Income Tax Rate	34.61%
Minimum Alternate Tax Rate	21.34%

Final IRR Reporting:

The consultant shall report the Project FIRR & EIRR considering different scenarios. Broadly the sensitivity shall include (but not limited to) following parameters as variable:

- Traffic (15-20% ± of projected divertible cargo, as at this stage the divertible cargo potential)
- Development Cost (15-20% ± of planned cost)
- Leverage Ratio (70:30 in base case, 10-15% ± in optimistic & pessimistic scenarios)

ANNEXURE 11.2 –COST OF DREDGING

S.No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
1	Dredging in General Soil	Cum	4,21,000	245	1031.45
2	Dredging in Hard Soil	Cum	0	900	0.00
	Total Cost of Dredging				**1031.45**

ANNEXURE 11.3 –COST OF BANK PROTECTION WORKS

Cost of Bank Protection Works at River						
Sl No.	**Item Description**	**Unit**	**Estimated Quantity**	**Rate (in Rs.)**	**Amount (in Lakh Rs.)**	**Remarks**
1	Providing and laying gabion for erosion control, river training works and protection works as per technical specifications	Cum	0	3759.57	0.00	DSR 2018, Cl.no.5.22.4 - The rate has been updated with Wpi (3.02%) in 2019 & Wpi (1.062%) till Dec 2020 & 1.069 till June 2021. The combined effect is 1.11%.
2	Providing and laying geotextile as per technical specifications	Sqm	0	135.42	0.00	
3	Providing and fixing in position of perforated PVC pipe /filter of dia 100 mm including materials and labour etc. complete @ 100 m c/c	m	0	555	0.00	
4	Boundary wall 250 mm thk brick masonary (1:6)	Cum	0	2830.5	0.00	
	Cost of Bank Protection Works for 300 m				0.00	
	Cost of Bank Protection Works for 1 m				0.00	
	Cost of Bank Protection Works for 1800 m for 6 locations				**0.00**	

ANNEXURE 11.4 –COST OF NIGHT NAVIGATION WORKS

S.No.	Item Description	Unit	*Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
1	Providing and laying 1.8 m dia. Polythene Buoy, Mooring Gear & fixing Lighting Equipments	No.	0	3,69,875	0.00
	Cost of of Night Navigation Works including GST				**0.00**

* Since the waterway shall cater to tourist activities, hence night navigation is not needed at this stage and this cost has been removed from the cost sheet.

ANNEXURE 11.5 –COST OF LAND FOR FERRY TERMINAL

Sl no.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
A	**Terminal (T)**				
1	Land Area Cost				
(i)	Land inside the terminal area	m^2	1927.18	1103.31	21.26
(ii)	Land required for Road Extension or construction of external approach road	m^2	0.00	1103.31	0.00
(iii)	Area under Mangrooves clearance	m^2	0.00	1103.31	0.00
3	Land Cutting/Excavation for 2.0 m depth Excavation for foundation in soft rock with-out blasting including 2.2. boulders upto 0.6 m diameter (0.113 cum) for dam, spillway, intake structure, surface power house and other appurtenant works and placing the excavated material neatly in specified dump area or disposing off the same as directed including cost of all materials, machinert, labour etc., complete with lead upto 1 km and all lifts. SOR Karnataka Item no.2.2 page 34 SOR 2018-19 (WPI-11% added)	m^3	2890.77	121.00	3.50
	Total Cost of Land & its Development				**24.76**

ANNEXURE 11.6 –COST OF RIVERRINE STRUCTURES AT SHARAVAI FERRY FACILITY AT TERMINAL

Sl no.	Description of work	SOR Ref	Units	Total Qty.	Rate (INR)	Amount	Tax Component		Total Amount (incl. CESS & GST)
							Labour cess	GST	
							(1%)	(12%)	
1	**Piling Works**								
1.1	Shifting and setting up of piling plant and equipment using jackup rig, tripods, winch / rile driving rig, rotary drilling rig, bailers, chisellers etc (as per the methodology of work) at each pile location for pontoon piles for providing of 1000mm vertical MS steel liner for boring work and for concreting the piles including fabrication and erection of pile driving plant, staging with various steel plates, girders, angles, channels etc., including cost of steel items, welding charges, strutting and fixing in position at each location, cost of mobilization and demobilization of all equipment, transportation charges of all materials to worksite, all labour charges and tools etc. complete.								
a	Pontoon Piles in River		No	4	12,500	50,000		6,000	56,000
b	Bankseat - Land piles		No	2	8,000	16,000		1,920	17,920

Sl no.	Description of work	SOR Ref	Units	Total Qty.	Rate (INR)	Amount	Tax Component		Total Amount (incl. CESS & GST)
							Labour cess	GST	
							(1%)	(12%)	
1.2	Providing, Fabricating and delivering of 8mm thick MS liner with 8 mm thick stiffeners at bottom of liners, as per drawing, for 1000mm dia vertical cast-in-situ RCC pile for each pile in Pontoon guide piles and bankseat piles including cost of supply of steel plates confirming to IS: 2062, Grade E250, cost of all other materials, transportation charges of structural steel plate to Work Site, all labour charges, hire charges, tools, rolling, cutting, welding etc., complete.								
a	Pontoon Piles in River	5.8 Karnataka SOR	MT	12	1,01,400	11,92,679		1,43,122	13,35,801
b	Bankseat - Land piles		MT	6	1,01,400	5,96,340		71,561	6,67,900
1.3	Boring / drilling through all types of soil and including soil removal for vertical piles from the existing river bed level/Ground Level to founding level (firm stratum) including cost of winch / Pile driving rig, rotary drilling machine								
a	Pontoon Piles in River	Karnataka SOR-4.35	M	100	21,008	21,00,800		2,52,096	23,52,896
b	Bankseat - Land piles	Karnataka SOR-4.35	M	60	21,008	12,60,480		1,51,258	14,11,738

Sl no.	Description of work	SOR Ref	Units	Total Qty.	Rate (INR)	Amount	Tax Component		Total Amount (incl. CESS & GST)
							Labour cess	GST	
							(1%)	(12%)	
1.4	Providing and laying design mix concrete of RCC M40 grade in accordance with IS 456 (Latest Edition) using coarse aggregate, sand and 53 grade Ordinary Portland cement confirming to IS 455 for RCC piles by using tremie with hopper arrangements, excluding cost of fabrication, fixing of reinforcement, which will be paid separately but including cost of cement, stone chips, sand, cost of all labour charges, centering and shuttering, mixing, conveying, placing, consolidation, screening and washing of coarse aggregate and sand, transportation charges of all materials to the Work Site, hire charges and running charges of batching plant, vibrator, consumables and all other equipment, cost of tools etc. complete. (The design mix shall be provided by the contractor from the approved laboratory of Govt. of India/ IITs/ NITs/ NABL Accredited Labs).								
a	Pontoon Piles in River	DSR-20.5.6	CUM	94	12,537	11,81,627		1,41,795	13,23,422
b	Bankseat - Land piles	DSR-20.5.6	CUM	47	12,537	5,90,813		70,898	6,61,711
c	Bankseat - Pile cap platform	DSR-20.5.6	CUM	36	12,537	4,51,348		54,162	5,05,510

Sl no.	Description of work	SOR Ref	Units	Total Qty.	Rate (INR)	Amount	Tax Component		Total Amount (incl. CESS & GST)
							Labour cess	GST	
							(1%)	(12%)	
1.5	Supply, deliver and transportation of reinforcement steel with a minimum yield strength of 500 N/mm2 and minimum elongation of 16% or equivalent confirming to IS 1786 with corrosion resistant element for Fabrication and fixing of reinforcement cages as per drawing for cast-in-situ piles including cost of fabrication, fixing dowels, shear ties, cutting, bending, tying, lapping and welding in position wherever necessary with black 18 SWG annealed binding wire, all labour charges, transportation charges of all materials to Work Site, cost of binding wires, all other items required for the work and tools etc. complete.								
a	Pontoon Piles in River	Karnataka-WRD-2.13	MT	19	70,225	13,23,710		1,58,845	14,82,555
b	Bankseat - Land piles		MT	7	70,225	4,96,391		59,567	5,55,958
c	Bankseat - Pile cap platform		MT	5	70,225	3,79,215		45,506	4,24,721
2	**PONTOON**								
	Procure, supply , fabricate ,install & commissioning of Pontoon with structural steel work (structural steel Fy 250MPa) welded in built up sections, framed	Karnataka 18.2.3							

Sl no.	Description of work	SOR Ref	Units	Total Qty.	Rate (INR)	Amount	Tax Component Labour cess	Tax Component GST	Total Amount (incl. CESS & GST)
							(1%)	(12%)	
	work including cutting, hoisting and fixing in positions and applying priming coat of red-lead paint including drilling holes, supplying, fitting and fixing with bolts and nuts or welding, if necessary as directed								
	Berthing Pontoon size - 30 m X 8 m	Karnataka 6.12	KG	1,70,893	97	1,65,59,564		19,87,148	1,85,46,712
3	**Gangway**								
a	Procure, supply, install and commission of the Aluminium Gangway as per the length and width shown in drawings including the hinge and roller support accessories.		SQM	68	52,500	35,70,000		4,28,400	39,98,400
4	**Guide Pile - Brackets, Rollers**								
a	Procure, supply, install and commission of the pontoon guide pile steel bracket, rollers and fixtures.		LS	4	80,000	3,20,000		38,400	3,58,400
5	**Pontoon Fixtures**								
a	Procure, supply, install and commission of the pontoon fixtures Fenders, Bollards, Life saving Equipment and Handrails		LS	1	5,00,000	5,00,000		60,000	5,60,000
							Total=		**3,42,59,644**

ANNEXURE 11.7 –COST OF STRUCTURES AT TERMINAL

Sl no.	Facility	Nos.	Size	Area (in m^2)	Rate (in Rs.)	Amount (in Lakh Rs.)
1	Open Mobility Area	1	-	75	8,754	6.57
2	Area under internal Roads	1	3.75m x 40m	150	16650	6.66
3	Main Terminal Building/ Administrative department/ Ticket Counter/ waiting Area/ First Aid etc.	1	25m x 20.0m	500	27,157	135.78
4	Security shed for watch and ward	1	4m x 3m	12	9,435	1.13
5	Electrical facility, Transformer etc.	1	4m x 3.5m	14	30,525	4.27
6	Fuel Bunkers	1	6m x 4m	24	6,167	1.48
7	Water Supply Room	1	3m x 4m	12	30,618	3.67
8	Fire and Safety support Room	1	3m x 3m	9	35,243	3.17
9	DGPS receiver & transmitter shed	1	4m x 3m	12	19,225	2.31
10	DG shed	1	5m x 5m	25	14,819	3.70
11	Sewerage Treatment Plant (STP)	1	15m x 15m	50	28,694	14.35
12	Overhead Tank	1	7.5m dia	44	2,135	0.94
13	Green Area	1	-	200	888	1.78
14	Boat Outlet, Accessories, Boar Repair & Boat Launching	1	-	400	666	2.66
15	Land required for Road Extension external approach road	1	-	200	666	1.33
16	Area under Mangroves clearance	1	-	200	666	1.33
	Total Area			**1927.18**	**Sq-m**	
	Total cost of Other Components inclusive of GST					**191.15**

ANNEXURE 11.8 –COST OF APPROACH (EXTERNAL) ROADS

Sl no.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
A	**Terminal (T)**				
1	External Roads				
(i)	Pacca Road (7.5m wide road)	m	50.00	15000	7.50
2	Pipe Culvert on External Road			LS	3.50
	Sub-total 1				**11.00**
	Total Cost of Approach Roads inclusive GST				**11.00**

ANNEXURE 11.9 –COST OF BANK PROTECTION WORKS AT TERMINAL

Sl No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)	Remarks/ reference
A	**Terminal (T)**					
1	Providing and laying gabion for erosion control, river training works and protection works as per technical specifications	Cum	4758	3942.90	187.60	DSR 2018, Cl. no. 5.22.4 - The rate has been updated with Wpi (3.02%) in 2019 & Wpi (1.062%) till Dec 2020 & 1.069 till June 2021. The combined effect is 1.11%.
2	Providing and laying geotextile as per technical specifications	Sqm	3225	134.2	4.33	
3	Providing and fixing in position of perforated PVC pipe /filter of dia 100 mm including materials and labour etc. complete @ 100 m c/c	m	11	550	0.06	
4	Brick masonry wall in CM 1:4 proportion . by volume for walls using burnt bricks from approved source including cost of all materials, machinery, labour, scaffolding, ramps, cleaning, batching and mixing mortar, packing mortar into joints, finishing, curing etc., complete with lead upto 50 m and lift upto 1.5 m. & additional lift beyond 1.5 m add Boundary wall 250 mm thk brick masonary surrounding the entire terminal on 3 sides except Ferry terminal side. as per 5.22 of SOR, Karnataka	m^3	168.75	6763.9	11.41	
5	Providing 12 mm thick cement mortar plastering in CM 1:3 proportion . by volume including cost of all materials, machinery, labour, scaffolding, cleaning joints, smooth finishing, curing etc., complete with initial lead upto 50 m and all lifts. & Providing and applying two coats of water proof cement paint of as per item 5.29.1 of SOR approved quality and colour including cost of all materials, labour, scraping and cleaning surface, scaffolding, curing etc., complete with all leads and lifts. as per item 5.27 of SOR, Karnataka -2018	m^2	1350	361.90	4.89	
6	Carriage of Material @ 5% of the cost				10.41	
	Sub-total 1				**218.71**	
	Cost of Bank Protection Works inclusive of GST				**218.71**	

ANNEXURE 12.1 –IMPLEMENTATION SCHEDULE

SHARAVATI RIVER

Sl.No.	Items	Months																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
A	**Fairway**																								
	1. Dredging																								
	Ordinary/Hard Soils (Approvals & Tendering)																								
	Ordinary Soils (Execution of 4,21,000 Cu.M)																								
	2. Low Cost Riverine Structures																								
	3. River Training Works																								
	Bank Protection (Approvals and Tendering)																								
	Bank Protection (Execution of 1800m at 6 Locations)																								
	4. Night Navigation																								
	Day / Night Navigation Buoys / Lights (Approval & Tendering)																								
	Day / Night Navigation Buoys / Lights (0 Nos Procurement)																								
	Day / Night Navigation Buoys / Lights (0 Nos. Deployment)																								
B	**Modification of Structures**																								
C	**Communication System**																								
	RIS / AIS / Vessel / Buoy (Approval & Tendering)																								
D	**Institutional Requirement**																								
	Office / Manpower (Establishment & Recruittment)																								
	Office / Manpower (Deployment)																								
E	**Environmental Management Plan**																								

Note: The project schedule is being considered for 24 months

The initial confirmation and approval are to be obtained prior to the project commencement.

ANNEXURE 12.2 –IMPLEMENTATION SCHEDULE RO-RO

SHARAVATI RIVER

Sl.No.	Items	Months																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	Ferry Terminal																								
	Land Acquisition																								
	Riverine Components																								
	Infrastructure Components including internal roads																								
	Approach Road																								
	Bank Protection Works for terminal																								
	Vessels																								
	Environmental Management Plan																								

Ferry vessels Procurement to be arranged as per the project commencement.
Land Acquisition shall be the prerequisite for the commencement of the project.

LIST OF DRAWINGS

Sl.No	DRAWING NAME	DRAWING NUMBER
1.	LAYOUT PLAN OF SHARAVATI RIVER (4 SHEETS)	P.010256-W-20301-A06
2.	TERMINAL LOCATION MAP OF SHARAVATI RIVER (1SHEET)	P.010256-W-20351-X06
3.	TERMINAL LAYOUT PLAN OF SHARAVATI RIVER (1SHEET)	P.010256-W-20311-A06
4.	SHARAVATI RIVER GERUSOPPA FEERY GHAT DETAI (5 SHEETS)	P.010256-W-20309-A06
5.	SHARAVATI RIVER TERMINAL BUILDING DETAIL (2 SHEETS)	P.010256-W-20364-A06

LIST OF VOLUMES

VOLUME-I MAIN REPORT

VOLUME-II DRAWINGS

VOLUME-IIIA HYDROGRAPHIC SURVEY REPORT

VOLUME-IIIB HYDROGRAPHIC SURVEY CHARTS

VOLUME-IV GEO-TECHNICAL INVESTIGATION REPORT

Tractebel is a global engineering company delivering game-changing solutions for a carbon-neutral future. Insights gathered during our more than 150 years of experience in energy, urban, nuclear and water projects combined with local expertise allow us to tackle complex future-oriented projects. By connecting strategy, design, engineering and project management, our community of 5,000 imaginative experts helps companies and public authorities create positive impact towards a sustainable world, where people, planet and profit collectively thrive. With offices in Europe, Africa, Asia, the Middle East and Latin America, the company registered a turnover of 581 million Euros in 2020. Tractebel is part of the ENGIE Group, a global reference in low-carbon energy and services.

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