CONSULTANCY SERVICES FOR PREPARATION OF SECOND STAGE DPR OF CLUSTER-6 : (KARNATAKA) - RIVER KABINI- NW 51

DETAILED PROJECT REPORT-KABINI RIVER (23.171KM)-(NW-51)
VOLUME-I MAIN REPORT
Document No. P.010256-W-10305-003

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

RESTRICTED

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REPORT
Rev 03

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DPR – KABINI RIVER (23.171KM) NW-51

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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 – KABINI RIVER (23.171km) NW-51**

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(B C Jha)

Tractebel Engineering Pvt Ltd

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LIST OF ABBREVIATIONS

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
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
SPV	Self Propelled Vessel
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	Kabini Dam		Beerambali
	Latitude	11°58'25"N		11°55'52.94"N
	Longitude	76°21'10"E		76°14'12.11"E
B	**TECHNICAL**			
1	***Waterway***			
a	National Waterway Number	NW-51		
b	Class	III (up to 23.171km)		
c	Type (Tidal/Non-Tidal)	Non-Tidal		
	Length (Km.)	**Total**	**Tidal**	**Non-Tidal**
		23.171km	---	23.171km
d	Average Tidal Variation, if applicable	NA		
e	Chart Datum	The study stretch is in the foreshore of the Kabini Dam and accordingly, the water depths have been derived with respect to the Minimum Draw Down Level (MDDL) of the Kabini Dam at RL 690.68m and Full Reservoir Level (FRL) at RL 696.16m, which is 5.48m above MDDL.		
	Description/Basis	--		
	Value (from Zero of Gauge)	---		
f	LAD Status (w.r.t. CD)			
		Stretch-1 (km)	**Stretch-2 (km)**	**Total (km)**
	Stretch (From…...To……)	0.00 – 10.00	10.00-23.60	**(0 - 23.60)**
	Length with LAD < 1.2 m	0.0	3.8	**3.8**
	With LAD from 1.2-1.4 m	0.0	0.0	0.0
	With LAD from 1.5-1.7 m	0.2	0.0	0.2
	With LAD from 1.8-2.0 m	0.2	1.96	2.16
	With LAD > 2.0 m	9.60	7.80	**17.40**
	Total	10.0	13.56	**23.56**
g	Target Depth of Proposed Fairway (m)	1.70m upto Ch 23.171km		
h	Conservancy Works Required			
	Type of Work	**Stretch-1**		**Stretch-2**
		(0.00-10.00)		(10.00-23.171)
	Dredging Required (M. Cum.)	0		161877.66
	Bandalling	Nil		Nil

#	Particulars	Details			
	Barrages & Locks	Nil			Nil
	River Training/Bank Protection (Km.)	None			None
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.	Nil	Nil	Nil	Nil
	Bridges	Nil	Nil	Nil	Nil
	HT/Tele-communication lines	Nil	Nil	Nil	Nil
	Pipelines, underwater cables, etc.	Nil	Nil	Nil	Nil
2	***Traffic***				
a	Present IWT Operations (type of services)	No existing cargo movement on the river.			
b	Major industries in the hinterland (i.e. within 25 km. on either side)	No industries found in the catchment area of river			
c	Connectivity of major industries with Rail/Road network (Distances/ Nearest Railway Stations etc.)	✓ Major roads – SH 33 is the only major road which runs parallel to river. Apart from that there are internal village roads (Kachha rodas). ✓ Major railway – No rail connectivity found in the primary catchment area. Nearest railway station is located more than 45 km away from river.			
d	Commodities	**NA**			
	Proposed IWAI Terminal on Kabini River				
1	Tourism	--			
3	***Terminals/Jetties***				
a	Terminal/Jetty - 1	Passenger Ferry Terminal			
	Location (Bank/city/district)	11°59'22.22"N & 076°20'55.94"E near Beechanahalli			
	Passenger Ferry Terminal	Passenger Ferry Terminal			
	Location (Bank/city/district)	11°56'5.46"N & 076°15'13.36"E near Beeramballi			
	Type/Services	Passenger / Tourism Traffic			
	Facilities	Ambulance is provisioned			
	Approach	Road is available			
	Land Ownership				
	Area (ha.)	**Govt.**			**Private**
		0.169			NIL
4	***Design Vessel***				
a	Type	Passenger Ferry Vessels			
b	No. & Size	2 Nos Ferry Vessel **(For Mono Hull Steel Boat)** • Size (L x B x D) – 20 m x 2.2 m x 1 m • Capacity – 50 Passengers (seating capacity) • Engine – 2 Marine Outboard Engines of 75hp (approx.)			

#	Particulars	Details		
		(For FRP Boat) • Size (L x B x D) – 20 m x 2.2 m x 0.8 m • Capacity – 50 Passengers (seating capacity) • Engine – 2 Marine Outboard Engines of 60hp (approx.)		
c	Loaded Draft	<1.7m		
d	Capacity	50 Pax		
5	***Navigation Aids***			
a	Type	NIL		
b	Nos.	NIL		
b	Communication Facilities	Through local system		
C	**FINANCIAL**			
1	***Project Cost***			
a	Capital Cost	Fairway and Passenger Ferry Terminal		
	Fairway	5.06 Crore		
	Passenger Ferry Terminal (02 Nos.)	13.31 Crore		
3	***Financial Internal Rate of Return (%)***	Fairway	Ferry Terminal	Vessel
A	For IWAI	---	8%	-
4	***Economic Internal Rate of Return (%)***	Fairway	Ferry	Vessel
		---	23.9%	-
5	***Any other Important Feature***	---		

EXECUTIVE SUMMARY

Kabini River is one of the waterways declared as National Waterway in March, 2016 as NW 51. The Kabini River is a right bank tributary of River Kaveri. The River originates in the Pakramthalam hills (Western Ghat). Out of the total length of 230 km of Kabini River, the stretch from Kabini Dam at Lat 11°58'25"N, Long 076°21'10"E to Beeramballi at 11°56'10"N, Long 076°14'18"E has been declared as new national waterway and proposed to undertake the two stage DPR. 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 Kabini River in the Dam submersion of 23.171 Kms from Lat 11°56'0.9311"N, Long 076°14'17.5004"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 index map of Kabini River showing proposed waterway stretch, topographic features and road networks are shown in **Figure1.1**. The study stretch of the Kabini River for the Detailed Project Report (DPR) is presented in **Drawing No. P. 010256-W-20301-A03 (Sheet – 1)**. Kabini River originates from the Pakramthalam hills (Western Ghat) in Wayanad district of Kerala state at an altitude of about 2140m. It flows eastward to join the Kaveri River at Tirumakudalu Narasipura in Karnataka and the Kaveri river then empties into the Bay of Bengal at Poompuhar in Mayiladuthurai district. The total length of the river is about 195.50 km from origin up to the dam site. Kabini River has a relatively larger catchment area, and its tributaries are small feeder streams and canals. River Kabini has no tidal effect. The total catchment area of Kabini River is 2142 sq-km.

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. Further, this analysis may not have any impact, since the study stretch is in the submergence of the Kabini Dam. (Foreshore submersion).

Detailed Hydrographic Survey has been carried out so as to assess the required developments in the Fairway along with inter related activities. Based on the Hydrographic Survey data the stretch up to Ch. 20 km is having a water depth of 1.7 m (LAD). It has been noticed that no Bridges are located, and no HT Lines are crossing the study area. No pipe line is crossing the study area. No Dams / Barrages / Locks / Weirs / Anicuts / Aqueducts are located. 5 Nos. Bend locations have been identified in the study stretch.

No cargo mobility is existing. Even in the forecast, no cargo is anticipated. There is an estimated Tourism potential, which can be considered with the permission / consent / approvals from the concerned state departments. It has been proposed to consider the development for Tourism connecting both the ends to facilitate mobility through waterway, duly avoiding the forest area.

Currently, Kabini waterway is proposed to be developed for tourism purpose and two birthing pontoons shall be developed each at Beechanahalli (T1) & Beeramballi (T2) which is capable of handling passenger ferry services. 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.

Detailed study suggested one number of 30.0m (long) and 8.0m (wide) berthing pontoons for the ferry terminal. The sizing of the berthing structure at two locations are shown below:

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

The fairway between these two terminals shall be dredged in conformity with class-III waterway and the dredging quantity is 1.78 Lakh cum for provision of safe navigable fairway.

No Bridges and cross structures are present in the study reach and hence no modifications are needed. No Bend criteria while considering the channel and hence no suggestion on this aspect. Since the Dam area is bound by forest, only day mobility is suggested and hence no provision has been catered for marking. (Also keeping in view the submergence). Nominal provisions have been suggested towards Communication System and Institutional Requirements.

A tentative Land has been worked out which is based on requirement for tourism development and arrived at 1691.68 Sq. M at Beechanahalli and 1691.68 Sq. M at Beeramballi.

The Land Survey was considered at Beechanahalli and Land Details of the location has been firmed up. It is in the Vadkhal Village; Heggadadevenakote Taluka; Mysore District of Karnataka. Geotechnical Investigations have been completed along with the laboratory tests.

The selfpropelled vessel as described in the document is indicative only and no such deployment has been suggested in the DPR. Targeted depth of River Kabini (NW-51) is considered as 1.7 m. Vessels with draught less 1.7 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 that could be possibly deployed in River Kabini (NW-51).

TABLE 0-1: Specification of Vessels – Sample

Vessel Name	Length (m)	Beam (m)	Draught (m)	Capacity (Pax.)
Wantaim 14m Fast Ferry	**14**	**3.2**	**1.2**	**45**
Wavelength 6	**19.9**	**6.5**	**1.05**	**57**
Fibreglass 67 Passenger Vessel	**15.86**	**4.6**	**1.3**	**67**
Aquacat	**17.3**	**6**	**0.95**	**62**
15m 50ft 75 seats Catamaran	**15.0**	**4.5**	**0.8**	**75**
ODC Marine - Vedette	**18**	**4.7**	**1.25**	**84**
Aresa 1650 FCAT	**16.5**	**6.4**	**1.4**	**90**
Ferry 75	**22.9**	**6.5**	**0.8**	**100**

Source: Consultant's Analysis

The sample vessel specification proposed for tourist mobility considered at the initial stage is as follows.

(For Mono Hull Steel Boat)

- Size (L x B x D) – 20 m x 2.2 m x 1 m
- Capacity – 50 Passengers (seating capacity)
- Engine – 2 Marine Outboard Engines of 75hp (approx.)

(For FRP Boat)

- Size (L x B x D) – 20 m x 2.2 m x 0.8 m
- Capacity – 50 Passengers (seating capacity)
- Engine – 2 Marine Outboard Engines of 60hp (approx.)

In the beginning stage, ferry service 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.

Preliminary Designs have been worked out for Spurs; Bank Protection with Gabions; Navigational Aids for which a lumpsum money of Twenty Lakhs has been provisioned.
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.

Since there is no cargo and no cargo operation is being mooted in the project except the development of ferry terminals to facilitate tourism operation with its fullest safety & security, therefore INR 23.75 Lakhs is provisioned for one time expense and maintenance cost per month will be around (approx) INR 5.01 Lakhs. So, the institutional cost shall be 23.75 lakhs & the O&M cost is 5.01 lakhs per month.

The cost estimates have been worked out and segregated into 2 Modules i.e., Fairway Module which is working out to 506.27 lakhs (approx) and development of two ferry terminals at a cost of 1331.48 Lakhs. All the capital assets will be provisioned in 24 months commencing from FY: 2023-24 after ascertaining the required confirmations and approvals from the concerned departments. The FIRR and EIRR have been worked out and the details are placed as tabulated below.

Sl No	Factors	Section	Unit	Outcome
1	Project Cost	Fairway	Cr.	5.06
		Terminals	Cr.	13.31
2	Tariff	Vessel Berthing	INR Vessel/Day	1,000
		Royalty	20% of Tickets	Floating Restaurant - 120, Boat Ride - 20
		Fairway Usage	INR GRT-Km	0.00
2	Traffic	Passengers	In '000 (FY40)	686.01
3	Revenue	Fairway (FY40)	Cr.	0.00
		Terminals (FY40)	Cr.	7.79
4	FIRR	Fairway	-	-
		Terminals	-	8.0%
		Whole	-	1.1%
5	EIRR	Fairway	-	-
		Terminals	-	23.9%
		Whole	-	13.1%

The project does not have cargo transportation hence this aspect has not been found commercially and economically viable. The development of the study stretch of Kabini river is recommended for tourism traffic in the submergence area of the Dam from Beechanahalli to Beerambhalli for about 23.17 Kms with Class III system of the NW standards.

The development shall kickstart a structured facility which will attract and promote tourism activities. In the most optimistic scenario, development of river Kabini (NW-51) may be considered only for the tourist and passenger services.

The state govt. has proactive role to play in such kind of development and likely to promote tourism in this reason which is already an identified location by the state Govt.

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 meager 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 (Tamilnadu) 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 Kabini River (NW 51) 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 and quantum of cargo, 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, 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.

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 Kabini River – NW 51 (also known as Kapila) is a right bank tributary of River Kaveri. The detail description of the Kabini River has been compiled in below Table.

TABLE 1-3: Description of Kabini River (NW-51)

Sl. No.	Introductory Consideration	Description of the River
1.	Name of the river / canal	Kabini River (NW-51)
2.	State/ District through which river passes	The Kabini River passes through the Wayanad District of Kerala State and Mysore Distrcit of Karnataka State.
3	Length of the river / canal	The Kabini River is a right bank tributary of River Kaveri. The River originates in the Pakramthalam hills (Western Ghat). Out of the total length of 230 km of Kabini River, 23.171 km of the stretch from Kabini Dam Lat 11°56' 0.9311"N, Lon 076°14'17.5004"E has been declared as new national waterway and proposed to undertake the two stage DPR.
4	Map	The index map of Kabini River showing proposed waterway stretch, topographic features and road networks are shown in **Figure1.1**. The study stretch of the Kabini River for the Detailed Project Report (DPR) is presented in **Drawing No. P. 010256-W-20301-A03 (Sheet – 1)**.
Characteristic of River		
5	River Course	Kabini River originates from the Pakramthalam hills (Western Ghat) in Wayanad district of Kerala state at an altitude of about 2140m. It flows eastward to join the Kaveri River at Tirumakudalu Narasipura in Karnataka and the Kaveri river then empties into the Bay of Bengal. The total length of the river is about 195.50 km from origin up to the dam site.
6	Tributaries / Network of Rivers / Basin.	Kabini River has a relatively larger catchment area, and its tributaries are small feeder streams and canals. River Kabini has no tidal effect.
7	Catchment Area.	The total catchment area of Kabini River is 2142 sq-km.

FIGURE 1.1 : INDEX MAP

CHAPTER 2: WATERWAY / DETAILED HYDROGRAPHIC SURVEY

2.1. Hydrographic Survey

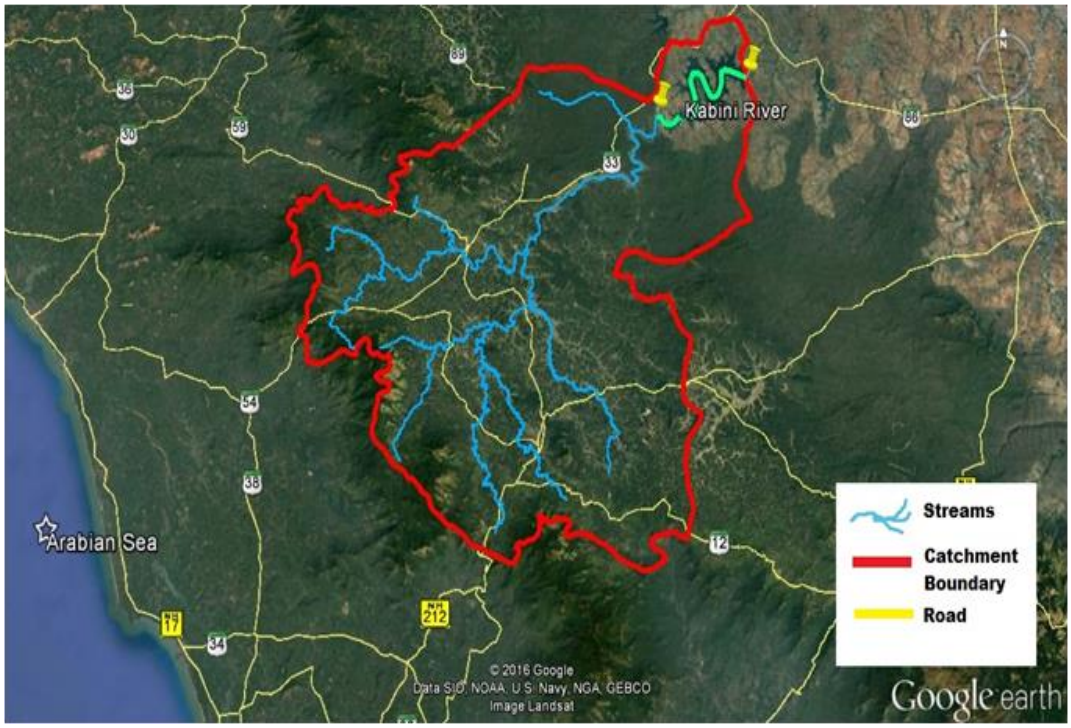
Hydrographic survey is the science of measurement of Water depths and description of features which affect maritime navigation, marine construction, dredging, offshore oil exploration / offshore oil drilling and related activities. Hydrographic survey is being carried out for one or more of the following activities like measurement of tides for sea coast works (e.g. construction of sea defense works, harbors 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 Kabini, also called Kapila, originates in the Wayanad District of Kerala state as a result of the confluence of the Panamaram River and the Mananthavady River in southern India. It flows eastward to join the Kaveri River at Tirumakudalu Narasipura in Karnataka. The Kaveri River then irrigates Tamilnadu and it is major drinking water source before emptying into the Bay of Bengal near kaveripoompattinam. Close to the town of Sargur it forms the huge Kabani Reservoir.

The Kabini River is bounded by Hosahalli, N. Begur, Kalasuru, Beerkabinilli and Kanakanahalli in the upper stretch, Singapatna, Katawalu, Nanjanathapura, Sagahalli, Machare and Jeeyare in the middle stretch and Kandegala, Agathur, Nerale, Magadilu and Beechanahalli in the lower stretch. The present study focusses on 23.171 km.



(Source: Google Earth)

FIGURE 2.1: Catchment Area Map of Kabini River

The catchment receives an average annual rainfall of about 2400mm. The length of the Kabini mainstream in the catchment from the origin up to dam site is about 195.50km.

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 river bed is observed that red soil is present in most parts of 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 river bed 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 river bed 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

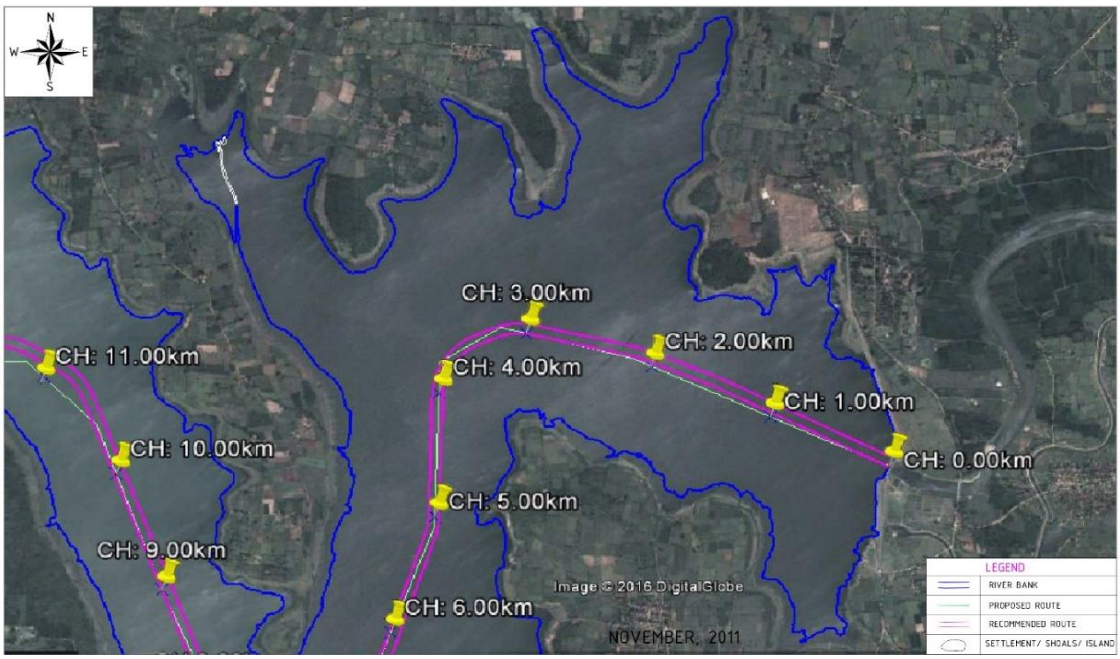
According to the classification of the waterway from class I to class VII, the minimum width required and minimum depth required has been given as 100 m and 1.7 m for two way navigation. Though the river Kabini was classified as class III for the entire stretch i.e. up to Ch 23.555 km at the FSR stage, the present analysis has been relooked with the possibilities for 100 m width and 1.7 m depth.

Kabini 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 (November, 2003; December, 2005; April, 2011 and October, 2016).

(Source: Google Earth)

FIGURE 2.2 : River stretch from Ch 0.00km to 5.00km in March, 2005)



(Source: Google Earth)

FIGURE 2.3 : River stretch from Ch 0.00km to 5.00km in November, 2011

(Source: Google Earth)

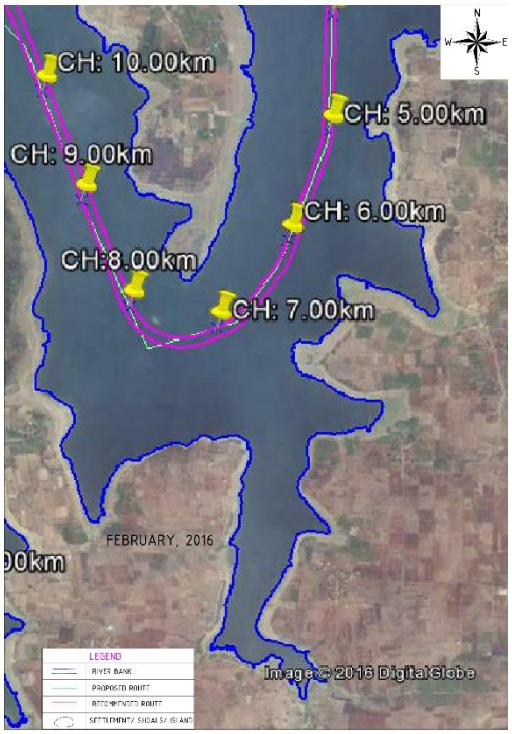
FIGURE 2.4 : River stretch from Ch 0.00km to 5.00km in February, 2016

(Source: Google Earth)

FIGURE 2.5 : River stretch from Ch 6.00km to 10.00km in March, 2005

(Source: Google Earth)

FIGURE 2.6 : River stretch from Ch 6.00km to 10.00km in November, 2011



(Source: Google Earth)

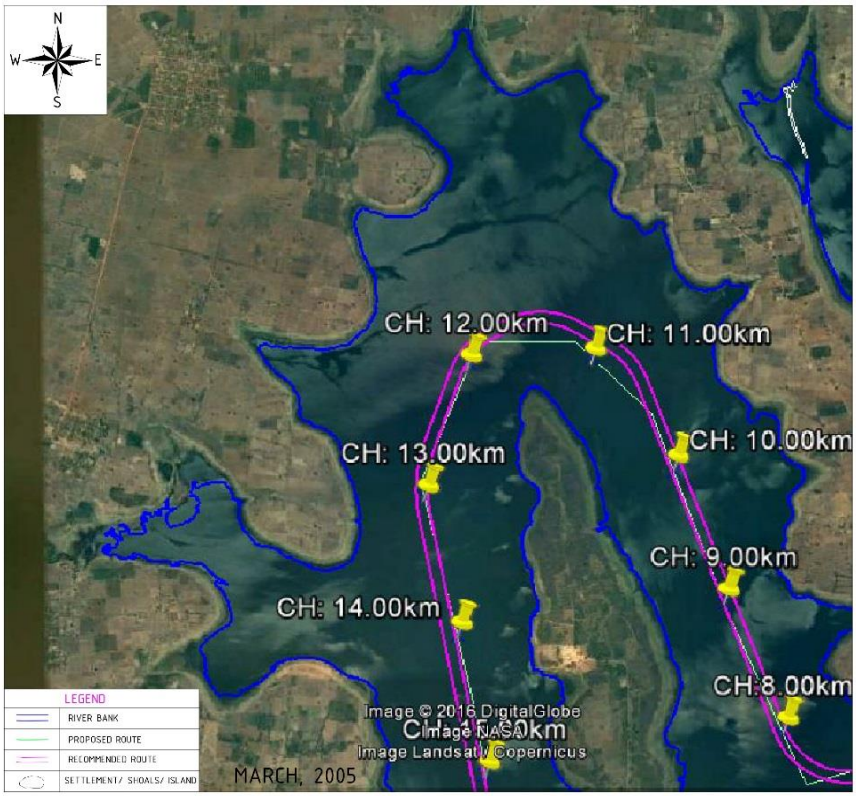
FIGURE 2.7 : River stretch from Ch 6.00km to 10.00km in February, 2016

The water depth is observed to be shallow in some portions of the stretch in March, 2005. Minor effect of accretion is seen during this time period. However, in November, 2011, predominant effect of accretion is observed.

Comparing all the images major change is seen in the left bank up to Ch 5.00 km. Some change in the right bank near Ch 6.00 km and Ch 7.00 km. It can be concluded that over the time period there has been siltation near the river banks.

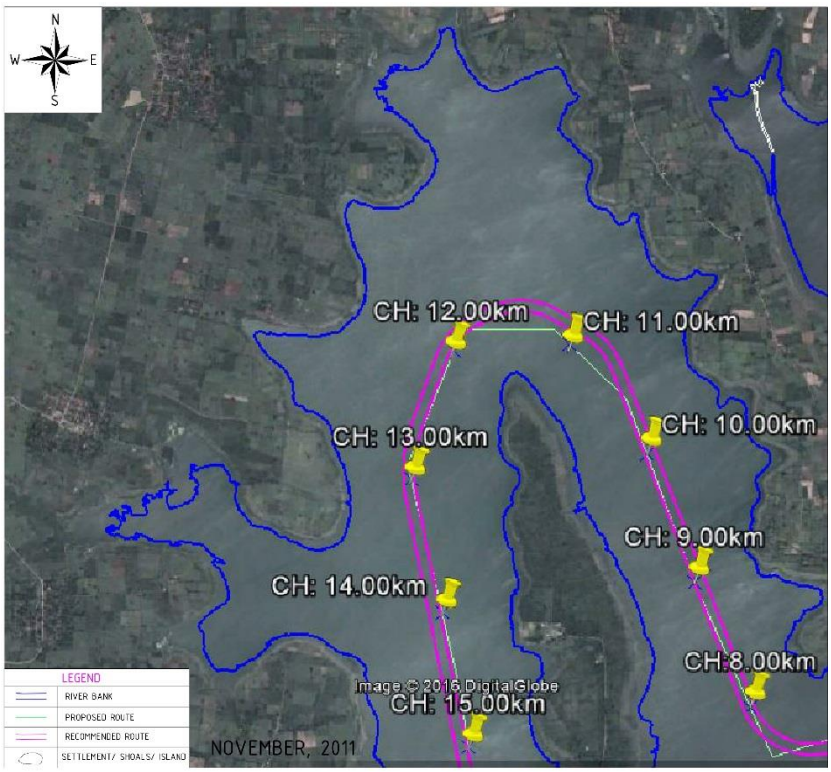
Kabini River (Ch 10.00 km - Ch 23.171 km)

The satellite images for the stretch of next 13.171 km for three time periods have been placed (March, 2005, November, 2011 and February, 2016).



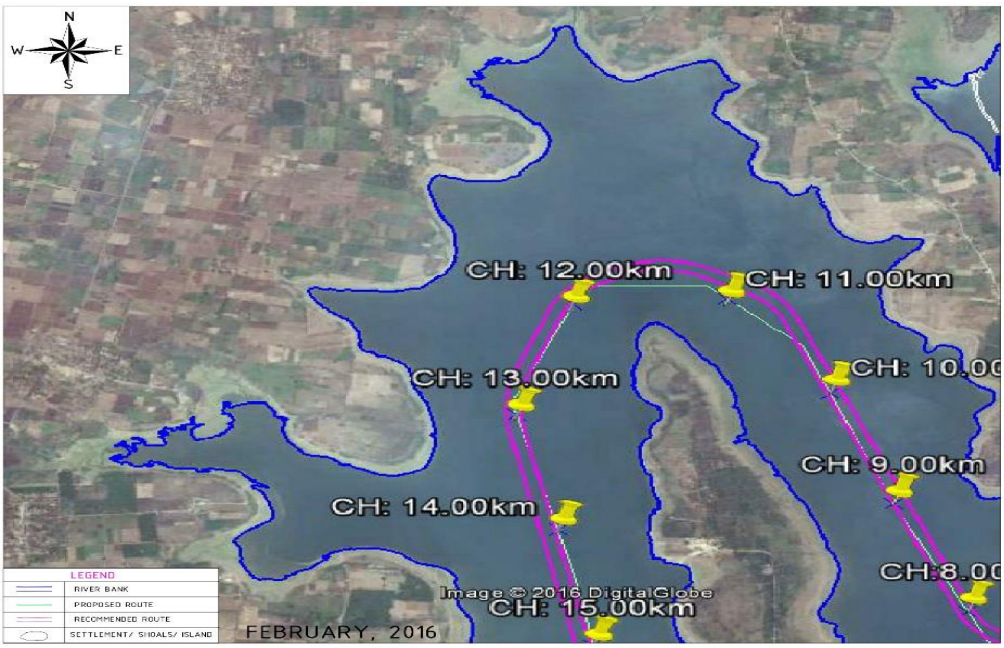
(Source: Google Earth)

FIGURE 2.8 : River stretch from Ch 11.00km to 15.00km in March, 2005



(Source: Google Earth)

FIGURE 2.9 : River stretch from Ch 11.00km to 15.00km in November, 2011)

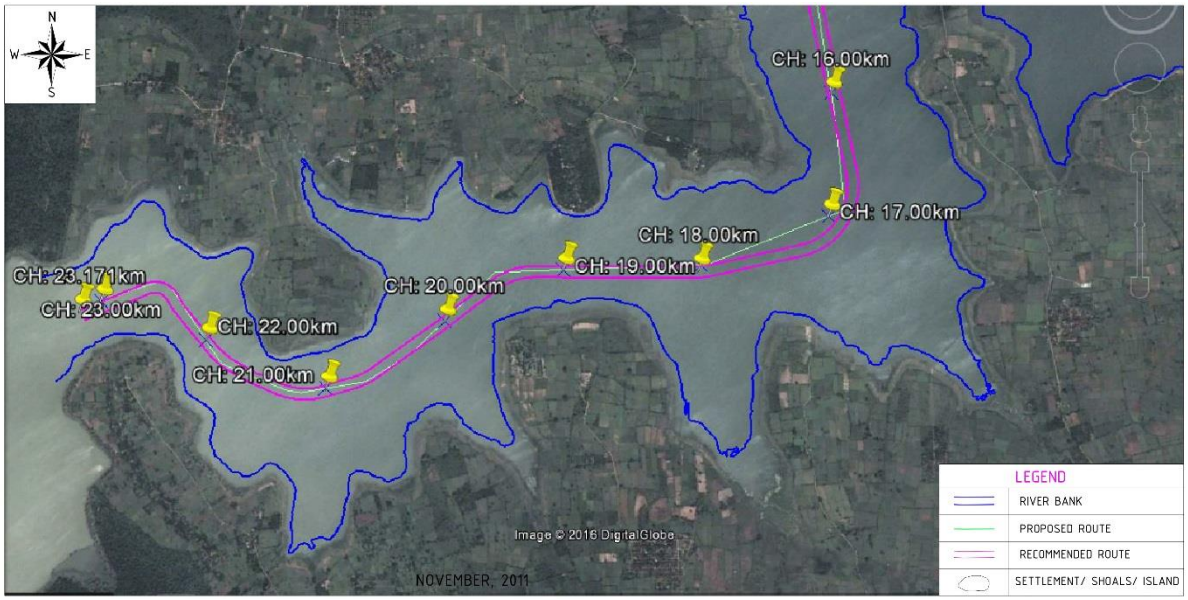


(Source: Google Earth)

FIGURE 2.10 : River stretch from Ch 11.00km to 15.00km in February, 2016

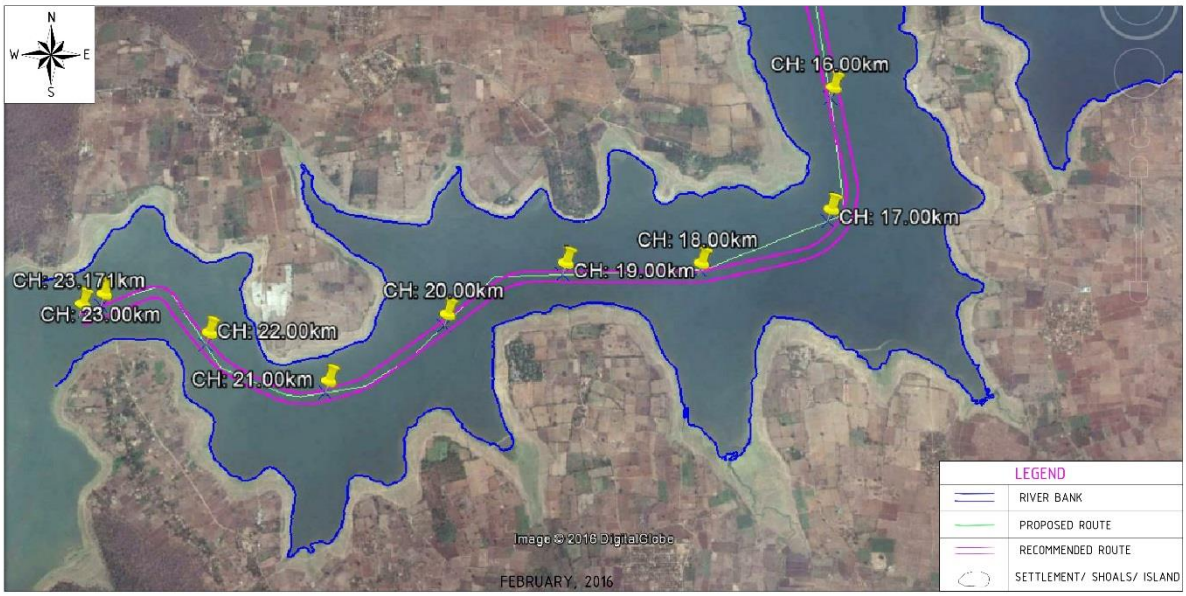
(Source: Google Earth)

FIGURE 2.11 : River stretch from Ch 16.00km to 23.171 km in March, 2005



(Source: Google Earth)

FIGURE 2.12 : River stretch from Ch 16.00km to 23.171 km in November, 2011



(Source: Google Earth)

FIGURE 2.13 : River stretch from Ch 16.00km to 23.171 km in February, 2016

The water depth is observed to be shallow in some portions of the stretch in March, 2005. Minor effect of accretion is seen during this time period. However, in November, 2011, predominant effect of accretion is observed.

Comparing all the images major change is seen in the left bank up to Ch 15.00 km. Some change in the right bank near Ch 18.00 km and Ch 20.00 km. It can be concluded that over the time period there has been siltation near the river banks.

Conclusion

From the satellite images of the above-mentioned time periods, it is seen that river bank line experiences some shift over the time period as mentioned above.

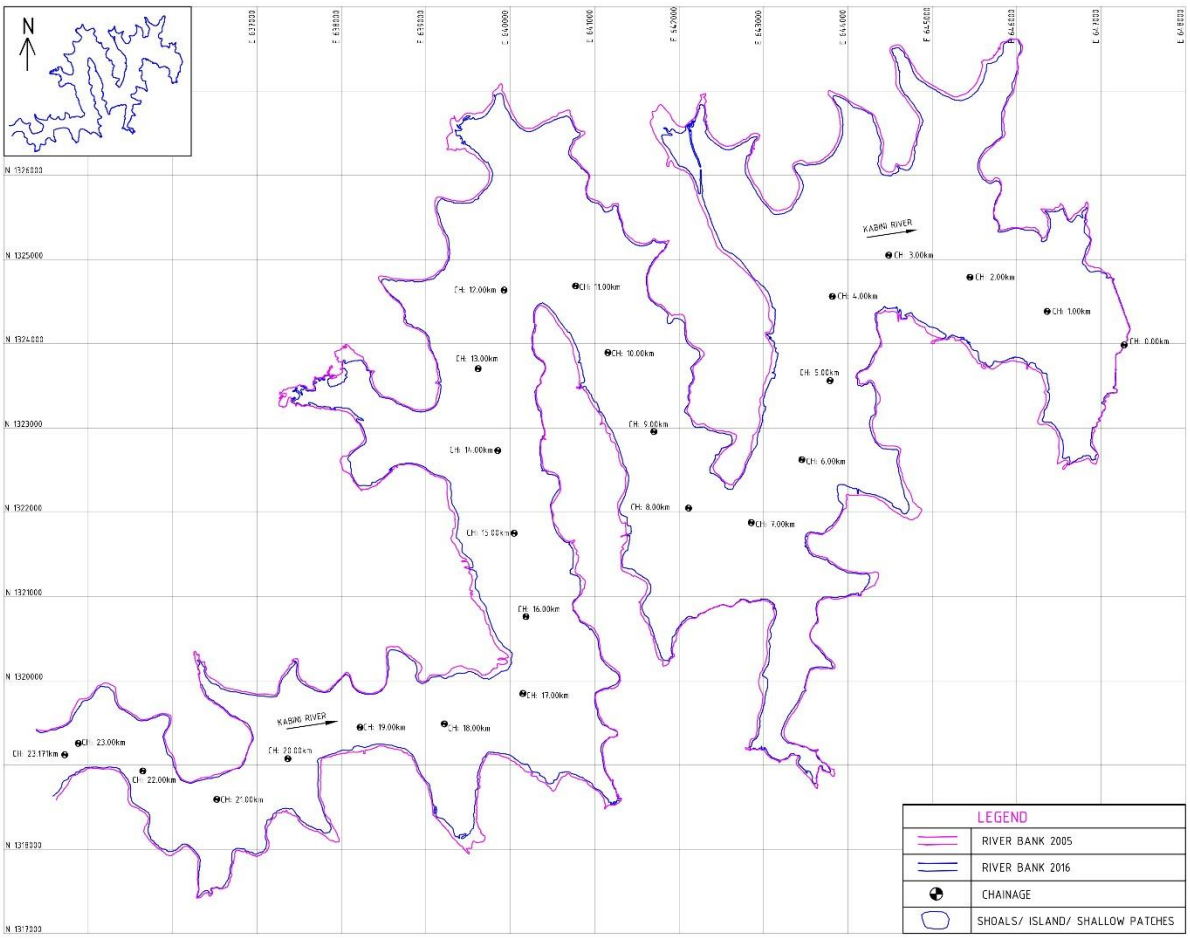


FIGURE 2.14: River bank in 2005 and 2016

2.1.2. Existing Hydrological / Topographical Reference levels

GTS benchmark which is ued as reference level is located near Kabini Dam.

Bench mark position and MSL heights are mentioned below: -

GTS BM	Lat: 11°58’27.5150”N,	Long:-076°21’11.2777”E
	Northing: 1324073.844N	Easting: 647327.328E

RL value Above MSL: 682.095 Mtrs.

2.1.3. Chart Datum / Sounding Datum

Kabini River is a non-tidal river. The study stretch is in the foreshore of the reservoir created upstream of Kabini Dam and accordingly, the water depths have been derived with respect to the Minimum Draw Down Level (MDDL) of the Kabini Dam at RL 690.68m and Full Reservoir Level (FRL) at RL 696.16m, which is 5.48m above MDDL.

2.2. Existing Waterway Structures

2.2.1. Bridges

There are no bridges present in the entire survey stretch of Kabini River.

2.2.2. Electric Lines / Communication Lines

There is no high-tension lines present in the entire survey stretch of Kabini River.

2.2.3. Pipe Lines / Cables

There is no Pipelines, under water cable present in the entire survey stretch of Kabini River.

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

There are no Dams, barrages, weirs, anicut, Locks etc. in Kabini River in the entire survey stretch. However, Kabini Dam is located before the starting point of waterway stretch. This may not create any obstruction for the movement of vessels. The details of Kabini Dam existing in the Kabini River are given below in Table.

TABLE 2-1: Details of Dam w.r.t. MSL

Structure Name	Chainage (km)	Location	Position (Lat Long)		Position (UTM)		Length (m)	Width (m)	Height w.r.t. --- (msl)	Present condition
			Left Bank	Right Bank	Left Bank	Right Bank				
Kabini Dam	00.00	Kabini	Lat-11º58'20.6832" Long-076º21'07.5865"	Lat-11º58'27.5016" Long-076º21'11.5253"	Easting-647216.7 Northing-1323863.4	Easting-647334.82 Northing-1324073.5	250.0	06.90	Elevation Hgt. 763.0m	In Use

2.3. Bends

On the proposed waterway route, there are many bends in Kabini River, which are given below in Table.

TABLE 2-2: River Bend Radius in Kabini River

Sl No.	Chainage (Km)	Radius
1	3.64	(R-480m)
2	7.43	(R-682m)
3	11.52	(R-770m)
4	17.44	(R-470m)
5	21.87	(R-580m)

2.4. Velocity and Discharge Details

The study of waterway streatch comes in the reservoir located upstream of Kabini Dam. The waterflow is regulated by Dam operation and hence the measurement of discharge details using current meter may not be more relevant for the present project study.

The details of velocity and discharge in the Kabini River are given below in Table, as observed. Since, the river under the study stretch comes under the Kabini reservoir, the velocity observed as 0.0 m/s.

TABLE 2-3: Current meter deployment locations and discharge details

Stretch No.	Chainage (km)	Latitude Longitude	Northing N (m) Easting E (m)	Obs. Depth (m) (D)	Velocity (m/s) 0.5 D	Avg. Vel. (m/s)	X-Sectional area (m2)	Discharge (m3/s)
1	2.350	11°55'23.734"N 76°15'17.348"E	1318377.01N 636647.030E	11.0	0.0	0.0	-	Discharge is as per dam authority.
2	10.000	11°05'0.12.07"N 76°17'4.7790"E	1324431.172N 641079.145E	6.0	0.0	0.0	-	
3	20.000	11°58'2.1251"N 76°20'46.3930"E	1324519.045N 646572.397E	6.0	0.0	0.0	-	

2.5. Waterway description

Kabini River (Ch 0.00km – Ch 10.00km)

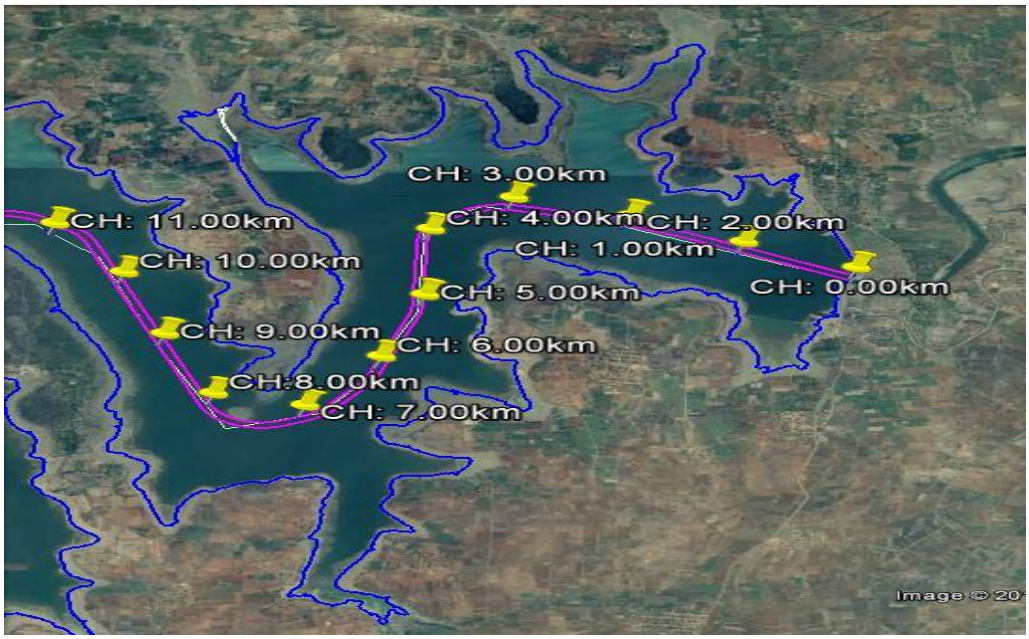


FIGURE 2.15: Kabini River from Ch 0.00km to Ch 10.00km

TABLE 2-4: Reduced depth from Ch 0.00km to Ch 10.00km

Chainage (km)		Reduced depth with respect to Sounding Datum				
		Reduced Depth (m)		Length of Shoals (m)	Dredging Qty	Cumulative Qty.
From	To	Min	Max			
0	1	5.0	14.2	0	0	0
1	2	5.3	7.0	0	0	0
2	3	3.4	5.5	0	0	0
3	4	3.7	10.5	0	0	0
4	5	3.1	5.6	0	0	0
5	6	3.0	9.0	0	0	0
6	7	2.6	10.5	0	0	0
7	8	1.7	4.0	0	0	0
8	9	2.0	4.2	0	0	0
9	10	4.3	10.8	0	0	0

The maximum and minimum LAD for the above-mentioned stretch is given in the above table (as per class III). The starting point of survey was Kabini dam. On both the sides of the river Agriculture land has been noted. As observed from the charts, the bed slope is 1 in 8000 in this stretch. The stretch is bounded by places like Agathur, Beechanahalli, Nerale, Jeeyare, Machare, Kandegala and Nanjanathapura. From the obtained information it can be concluded that the stretch has potential for navigation.

Kabini River (Ch 10.00km – Ch 23.171km)

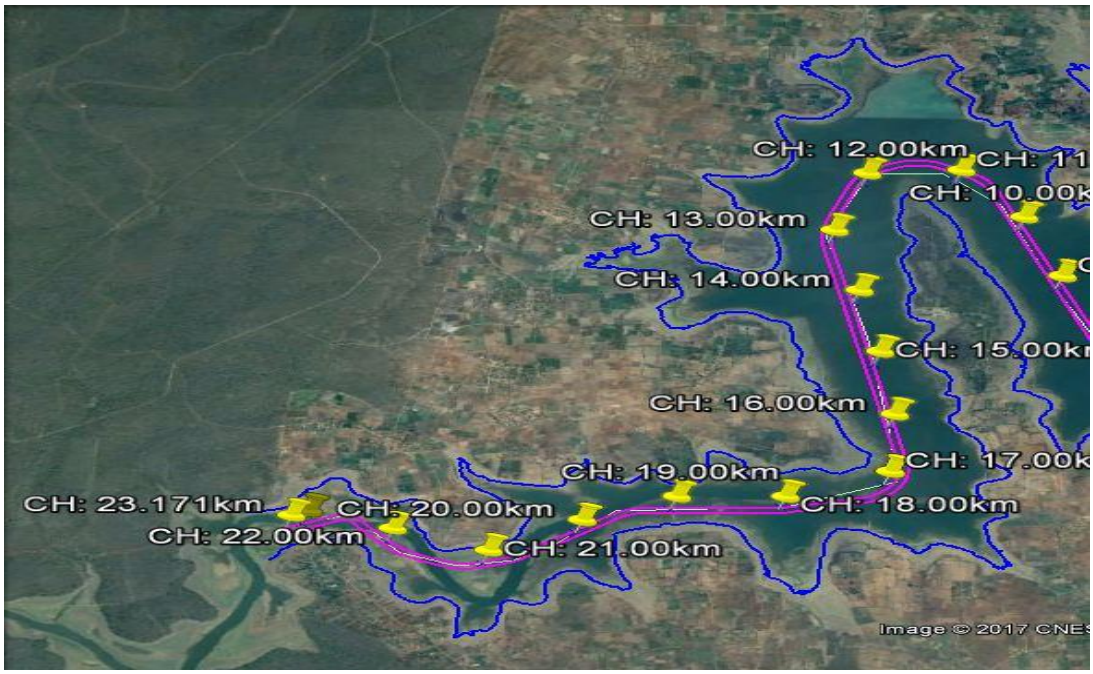


FIGURE 2.16: Kabini River from Ch 10.00km to Ch 23.171km

TABLE 2-5: Reduced depth from Ch 10.00km to Ch 23.56km

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	2.1	11.4	0	0	0
11	12	1.0	4.9	1000	9075.94	9075.94
12	13	2.6	9.5	0	0	0
13	14	2.1	9.2	0	0	0
14	15	3.0	8.8	0	0	0
15	16	0.6	9.1	600	12341.96	21417.90
16	17	0.2	2.3	1000	46495.36	67913.26
17	18	-0.4	8.7	200	10870.95	78784.21
18	19	5.1	8.4	0	0	78784.21
19	20	3.3	8.5	0	0	78784.21
20	21	2.8	7.8	0	0	78784.21
21	22	-1.4	6.3	1000	80152.54	158936.75
22	23	1.8	6.7	200	2940.91	161877.66
23	23.56	1.7	5.6	0	0	161877.66

The maximum and minimum LAD for the above-mentioned stretch is given in the above table (as per class III). On the right side of the river, there is Agriculture land. As observed from the charts, the bed slope is 1 in 5333 in this stretch. The stretch is bounded by places like Sogahalli, Kalasuru, N. Begur, Machare, Krishnarajapura, Gundattur and Hoshalli. From the obtained information it can be concluded that the stretch has potential for navigation with some dredging.

2.6. Water and Soil Samples analysis and Results

TABLE 2-6: Water sample results

SAMPLE NO.	Easting	Northing	WATER SAMPLES	
			Sediment concentration (ppm)	pH
Kabini-0	636647.030	1318377.019	57	7.61
Kabini-1	641079.145	1324431.172	93	7.51
Kabini-2	646572.397	1324519.045	48	7.42

The river water is slightly basic in nature with average pH being 7.56.
The river water is slightly basic in nature with average pH being 7.53.

TABLE 2-7:Soil sample results

Sl No.	Sample No.	Specific Gravity	Latitude	Longitude	Grain size analysis (%)				Cu	Cc
					Mechanical analysis		Hydrometer analysis			
					Gravel	sand	Silt	Clay		
1	Kabini-0	2.65	11º55'23.7340"	76º15'17.3484"	8	85	7		236.1	1.696
2	Kabini-1	2.67	11º05'40.1207"	76º17'44.7790"	6	87	7		84.72	1.052
3	Kabini-2	2.65	11º58'42.1251"	76º20'46.3930"	8	86	6		79.36	0.975

From the above table the riverbed can be concluded to be Loamy sand 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 and charts have been referred. As per the data available, the study stretch of the waterway is amenable for up to class VII of the waterway from the Fairway point of view.

Since the study stretch of Kabini River is in the Dam / Reservoir submergence, which is nothing but the controlled flow, the depth profiles will be oscillating between Minimum Draw down Level (MDDL) and Full Reservoir Level (FRL). According to the IWT traffic analysis, there is no cargo mobility in this region and the same is not expected in future also. Accordingly, the study stretch can be considered for development for Tourism Traffic within the reservoir submergence.

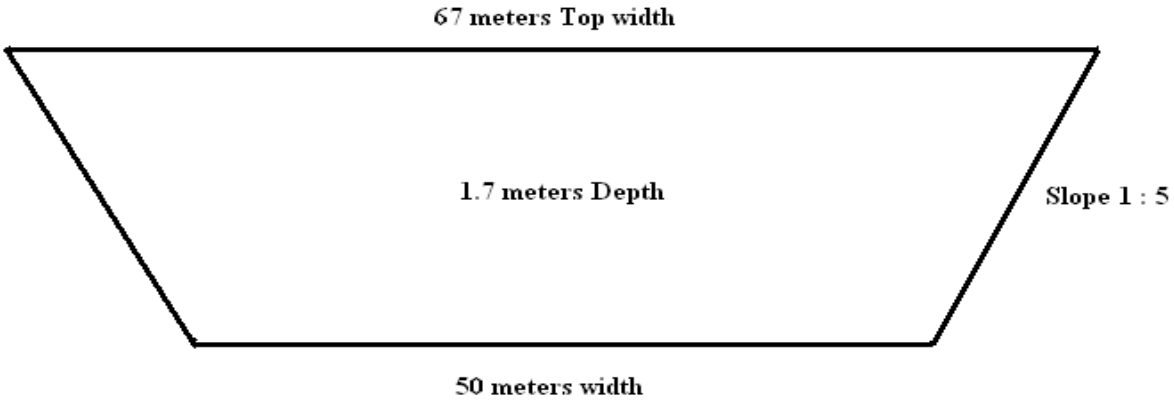
Keeping in view the above, the most amenable class will be Class III waterway to facilitate the passenger ferry services for tourism.

Tthe present study stretch in the Reservoir submersion area can be limited to ***Class III*** waterway, however, ***suggested*** any development in this stretch, only after ascertaining the confirmations about the Tourism Traffic assurance by the concerned department.

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

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

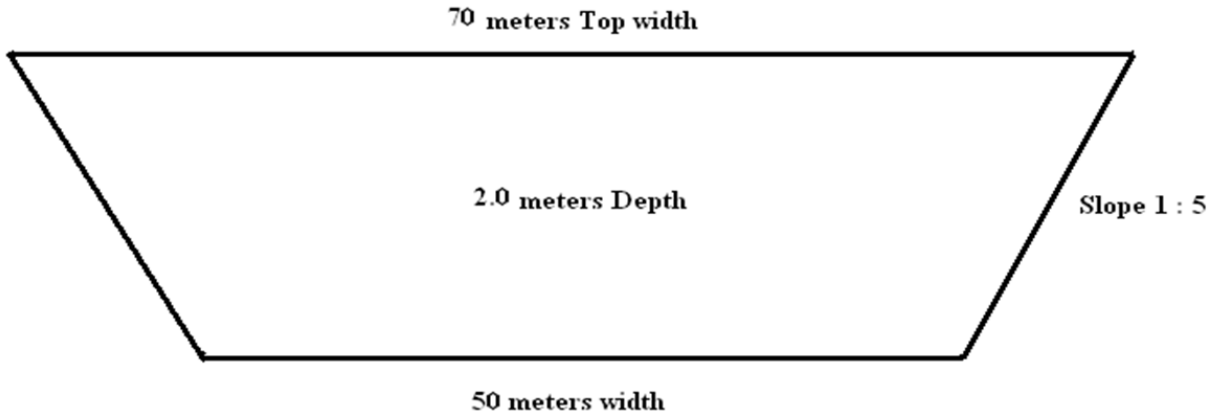
CLASS 3



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	NON-TIDAL ZONE				14.2	1.7	0.0	0.0
10.00	23.56					11.4	-1.4	4000	161877.66
Total								**4000**	**161877.66**

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		Per km drg
0.0	10.00	NON-TIDAL ZONE				14.2	1.7	0.00	0.00
10.00	23.56					11.4	-1.4	4400.00	210561.77
Total								**4400.00**	**210561.77**

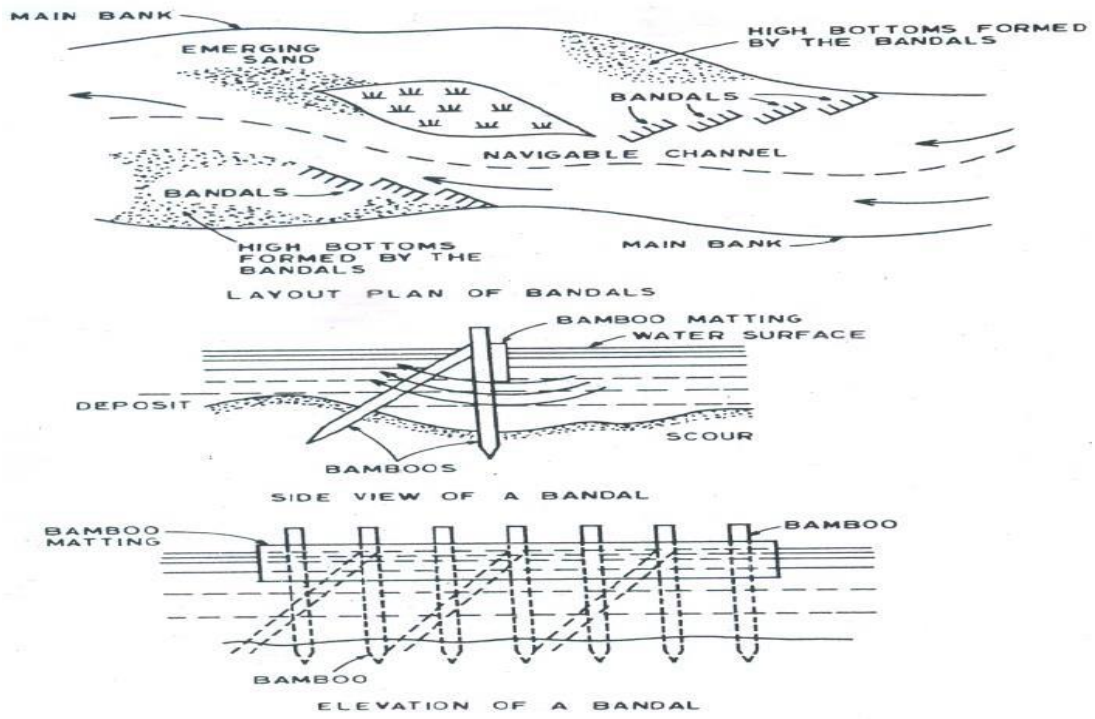
Proposed Conservancy Activities

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 lowcost 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 may 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, harbors, 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 harbors). 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, some marginal dredging has been identified. According to the vessel size, since this is limited to "Tourism Operations" possibility the Class III standard has been only considered. The shoal length for Class III is 4000 m with an estimated quantity of dredging as 161877.66 Cu. M, whereas the shoal length for Class IV is 4400 m with an estimated quantity of Dredging as 210561.77 Cu. M. By allowing 10 % excess volume for depth variation / fairway dimensional allowances, the total dredging quantity has been worked out to 1.78 Lakhs in NW 51; Hence a provision of 1,78,000.00 Cu. M of dredging has been taken into account for cost consideration.

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.

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.

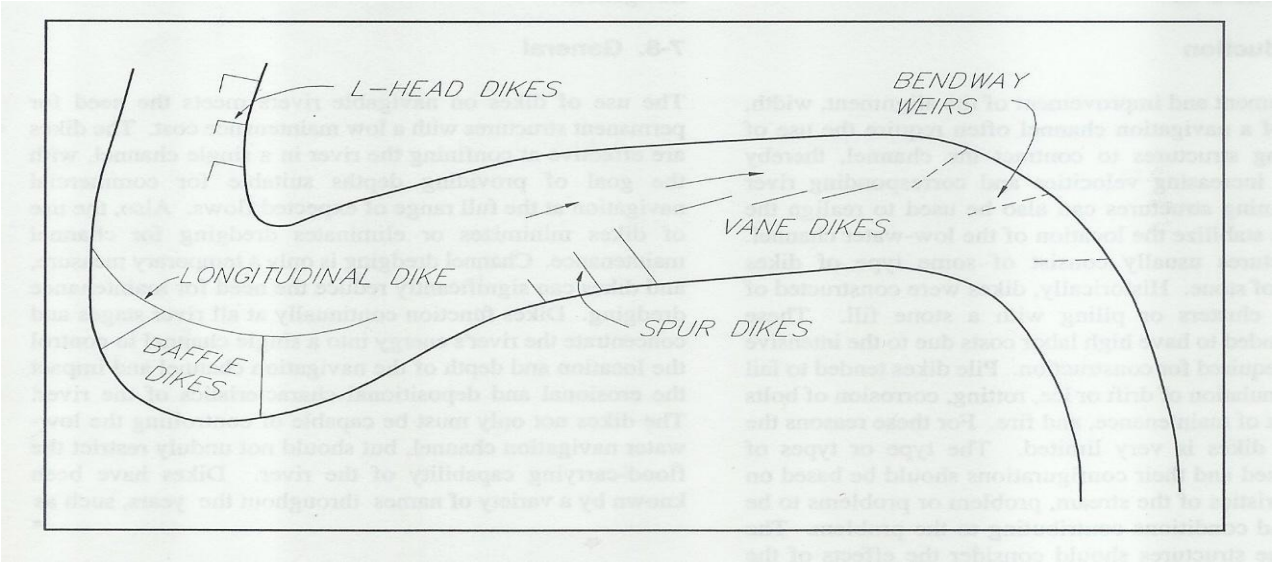


FIGURE 3.1: Types of dike structures

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.

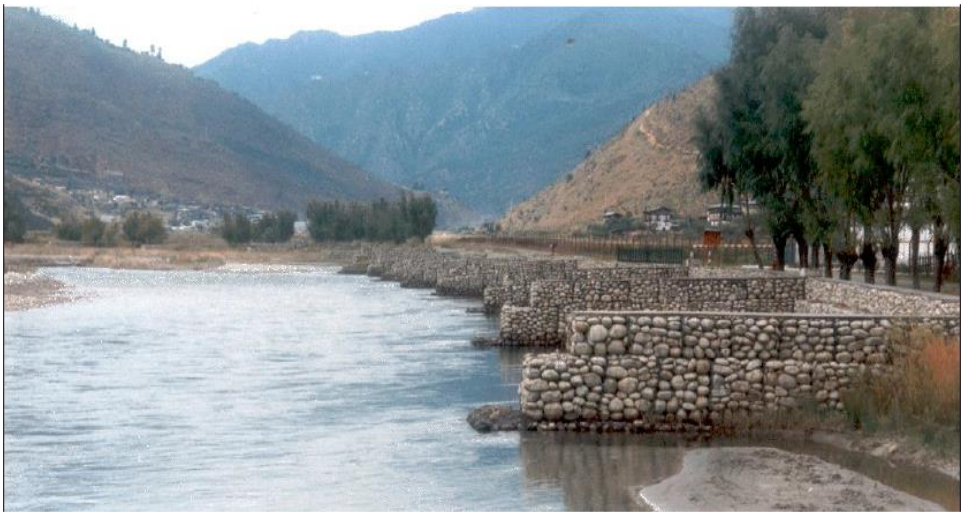


FIGURE 3.2: Spurs with Gabions & Boulder

FIGURE 3.3: Bamboo Porcupines

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.

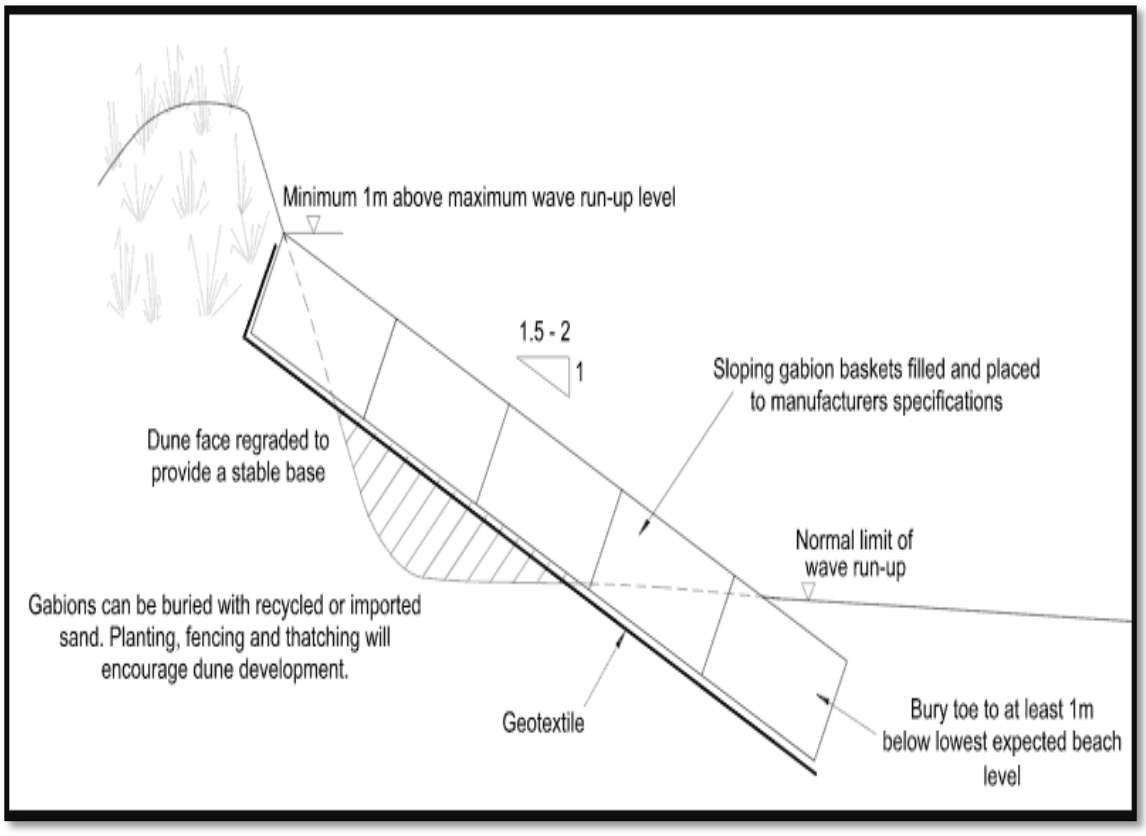


FIGURE 3.4: Typical Bank Protection

It has been proposed to consider the Bank Protection in the vulnerable locations. In the stretch, up to ch 19.64 km, there is no such location with any Bank Protection requirement. However,

the proposed dredging activity may have nominal morphological disturbance, which in turn may lead to the vulnerability of bank erosion.

In the present study stretch, there is no need of any Bank Protection requirements other than the terminal location.

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.

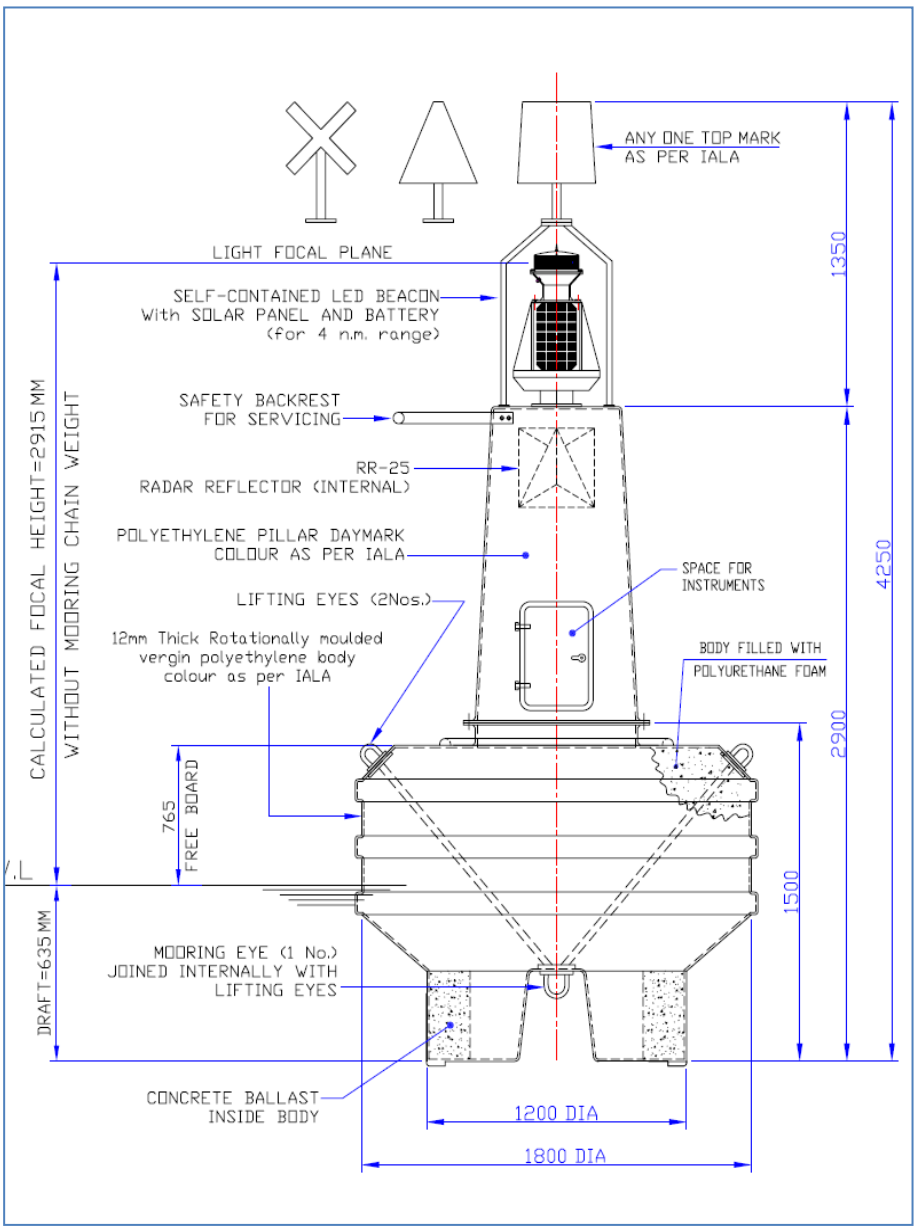


FIGURE 3.5: Buoy & Light Arrangement

POLYETHYLELENE CHANNEL MARKING BUOYS: (PORT HAND) 1 No. - PEB/1 800 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).

1 Set - Mooring gear – Each set comprised of the following:

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.

Note: 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.

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:

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).

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

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.

In the present study stretch, there is no need of any Night Navigation requirements, since this stretch is considered for a limited Tourism Navigation, which can be handled through “Pilots”, if required.

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

In the present study stretch, no Bridges are there.

In the present study stretch, no Power Cable is there.

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.

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.

CHAPTER 4: TRAFFIC STUDY

4.1. General

Kabini river of Karnataka originates in Kerala and then merges with Kaveri river in Tirumakudalu Narasipura village of Karnataka. Total stretch of the river is 23.35 km, which starts from Kabini Dam to Beeramballi. However navigable length of the river is only 19 km. Kabini river takes a zigzag route. Heggadadevankote Taluka is the only taluka in which this river flows. This taluka comes in Mysuru district. Mysuru land area is elevated, fertile and has good source of water from nearby rivers. There are dams and canals built on the river. Kabini River is 60kms away from 'Mysuru' city. Beechanahalli, Kenchanahalli, Nanjanthapura, Kittur, Biddarahalli are major areas besides river.

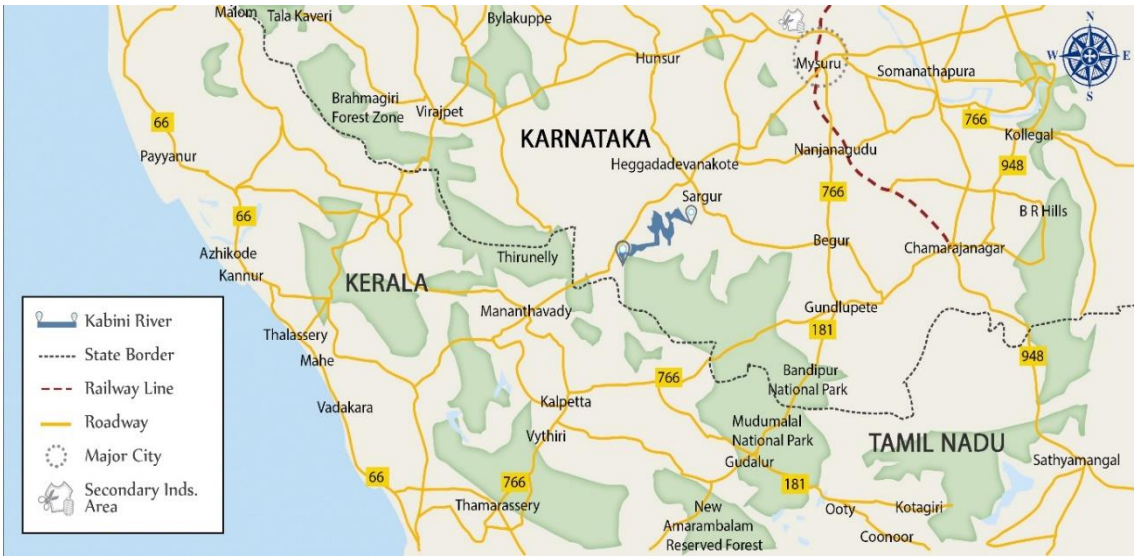


FIGURE 4.1: Kabini river overview

Source: Mantrana Maritime Advisory Pvt Ltd

4.2. Hinterland Analysis

Berambadi forest area is in the south direction of the river, Part of the west direction of the river goes into the Kerala state. On all sides of the river there is high elevation of about 600 to 700 meter and beyond. In the primary catchment area of the river i.e. within 25 km there does not exist any major industrial cargo consumption/production center. River stretch and length, navigable route restricts movement of cargo. Less navigability route of the river adds on the logistics cost and time taken for loading/ unloading of cargo. Mysuru is the only Industrial cluster located more than 50 km away from the river. Therefore, the potential of this river would be

analysed on the basis of passenger and tourism point of view. Kabini river area is very wide and there is availability of open land along the banks of rivers. Major occupations of the people are Agriculture and fishing.

Heggadadevanakote, also called as H D Kote is the only taluka considered as a catchment area of the river. Mysuru and Bangalore that are considered as industrial hub are located 52 km and 193 km respectively from H D Kote taluka. The study stretch of Kabini River falls under the wildlife circuit. Bank of Kabini river is rich with vegetation. There is abundance of juicy grass, bamboo trees, various shrubs and bushes.

FIGURE 4.2: Open land near Biraraballi – Kandegala village on the banks of river

Source: Site Visit

4.2.1. Economy profile of Mysuru

H D Kote taluka comes in Mysuru district. District ranks 4th in number of factories and 3rd in the labour force availability. Mysuru district does not have rich mineral reserve. Mysuru is known for its silk, handloom, crafts, Agarbatti making etc. Growing silk worms is the main cottage industry of the district. This makes Mysuru district ranks 1st in sericulture. Mysuru is considered as one of the well-developed districts in the state of Karnataka. Mysuru is also rich in forest area and utilizing irrigational facilities at fullest. Mysuru is also secondary IT hub of Karnataka. Following table describes historic contribution of three sectors to the economy.

TABLE 4-1: Annual growth rate of GSDP & GDP of Karnataka

Year	GSDP (Cr.)	Growth rate of GSDP %	GDP (Cr.)	Growth rate of GDP (%)
Fy 12	6,02,655	-	87,36,039	-
Fy 13	6,37,893	6	92,26,879	6
Fy 14	6,81,889	7	98,39,434	7
Fy 15	7,34,988	8	1,05,52,151	7
Fy 16	7,80,805	6	1,13,50,962	8

Source: Directorate of Economics and Statistics, Government of Karnataka, Central Statistical Office, GOI

TABLE 4-2: Sectoral contribution to the economy (%)

Sectors	Fy- 00	Fy- 06	Fy -09	Fy- 11	Fy- 13
Primary	26	21	16	23	14
Secondary	27	29	30	36	27
Tertiary	48	50	54	51	59

Source: Mysore district at a glance

Tertiary sector contribution to the economy over the years is highest compared to other two sectors. The contribution of Secondary sector in economy is second highest. There are sandalwood and other cottage industries that are prominent in the district. Agriculture, fishing comes in the primary sector, contributing least to the economy.

4.2.2. Primary sector

TABLE 4-3: Primary sector growth rate of GSDP of Karnataka (%)

Sector	Fy 13	Fy 14	Fy 15	Fy 16
Agriculture	-6.4	10	0.6	-7.7
Livestock	-	-	4.8	3.6
Forestry and Logging	5.6	5.3	-1.6	-1.4
Fishing	-9.2	12.1	11.9	5.1
Agriculture and Allied Sector	-4.9	9.4	1.6	-4.7

Source: Directorate of economics & statistics, Bangalore

4.2.3. Agriculture

Beechanahalli is the mouth of the river. There are water canals developed in this area to support agriculture activity. Kandegala village is located on the banks of Kabini river. Local farmers of this village have their own animals. These animals graze in the fields and are used for other activities. Agriculture takes place after rainy season in the catchment area of the river.

There exist canals which are used for irrigation for agriculture in Mysuru district. Total net irrigated area in the district is 1,59,230 Ha. Kabini river, Kaveri river and Harangi river are used for agriculture purpose. Irrigation requirement of the district is fulfilled by Kaveri & Kabini river.

As per census 2001, 3,25,823 farmers are involved in irrigation activity in the district. Climatic condition of Mysuru is suitable for horticulture crops. Nanjangud Rasabale, Mysore betel leaves, Mysore Mallige (Jasmine) and Erengere brinjal are some of the famous horticulture crops in the district. 3,030 Ha. of land is used for growing different types of fruits and 1,985 Ha. of land is used for growing vegetables in the district.

4.2.4. Fishing

Kittur village located on the banks of the river is where major fishing activity takes place. Inland fishing in the river is seasonal. i.e. only in rainy season (June) fishing activity takes place. After rainy season water level reduces and river becomes dry, which restricts fishing activity in other seasons.

There is also open land available in this village. There exists no fishing harbor for fishermen at this location. Fishermen construct their own shed in the monsoon season for carrying out fishing activity.

4.2.5. Forestry

Mysuru is the 2nd rich district in forest wealth after Uttara Kannada in Karnataka. District has only 10% of geographical area of whole Karnataka and the area is decreasing day by day.

4.2.6. Secondary Sector

In secondary sector, there is no restriction on the amount of finished goods to be produced like in primary sector, there is restriction on how much quantity to be extracted. Mysuru district needs more trained and qualified labour force to drive this sector towards more growth.

TABLE 4-4: Secondary sector growth rate of GSDP of Karnataka (%)

Sector	Fy 13	Fy 14	Fy 15	Fy 16
Mining and Quarrying	2	41	4	2
Manufacturing	8	6	5	5
Construction	2	4	3	4
Electricity, Gas and Water supply	2	11	7	3
Industry Sector	4	4	5	5

Source: Directorate of economics & statistics, Bangalore

4.2.7. Tertiary Sector

Hotels, Restaurants, Transport, storage and other communication industries, Banking & insurance, Public administration etc. come under tertiary sector. Tertiary sector has grown steadily over the years. Growth in service sector indicates that state is slowly turning into developed economy. There are very few resorts in the catchment area of the river, which are located on the bank of river.

TABLE 4-5: Tertiary sector growth rate of GSDP of Karnataka (%)

Sector	Fy 13	Fy 14	Fy 15	Fy 16
Railways	6	3	4	6
Transport by other means	8	8	34	9
Storage	-2	2	7	5
Communication	10	7	18	14
Trade, Hotels and Restaurants	3	0	11	7
Banking and Insurance	9	13	9	9
Real estate, Ownership of Dwellings and Business services	9	11	13	12
Public Administration	10	2	6	5
Other services	15	14	19	8
Tertiary Sector	8	8	10	9

Source: Directorate of economics & statistics, Bangalore

Mysuru is a famous tourist spot, also called as Palace City of India. About 3.5 mn tourists visit Mysuru every year i.e. about 15% of total tourist traffic of whole Karnataka. However H D Kote taluka is backward in terms of number of tourists visiting the taluka. Around 50,000 tourists visit H D taluka every year.

4.2.8. Demography & connectivity analysis

4.2.8.1. POPULATION OF HINTERLAND

Kabini river is in Heggadadevankote taluka only. Only 2 lac people reside in HD Kote taluka. The below table shows population of the taluka.

TABLE 4-6: Population of Heggadadevankote taluka

Taluka	Rural	Urban	Total
Heggadadevankote	2,37,968	25,738	2,63,706

Source: Census, 2011

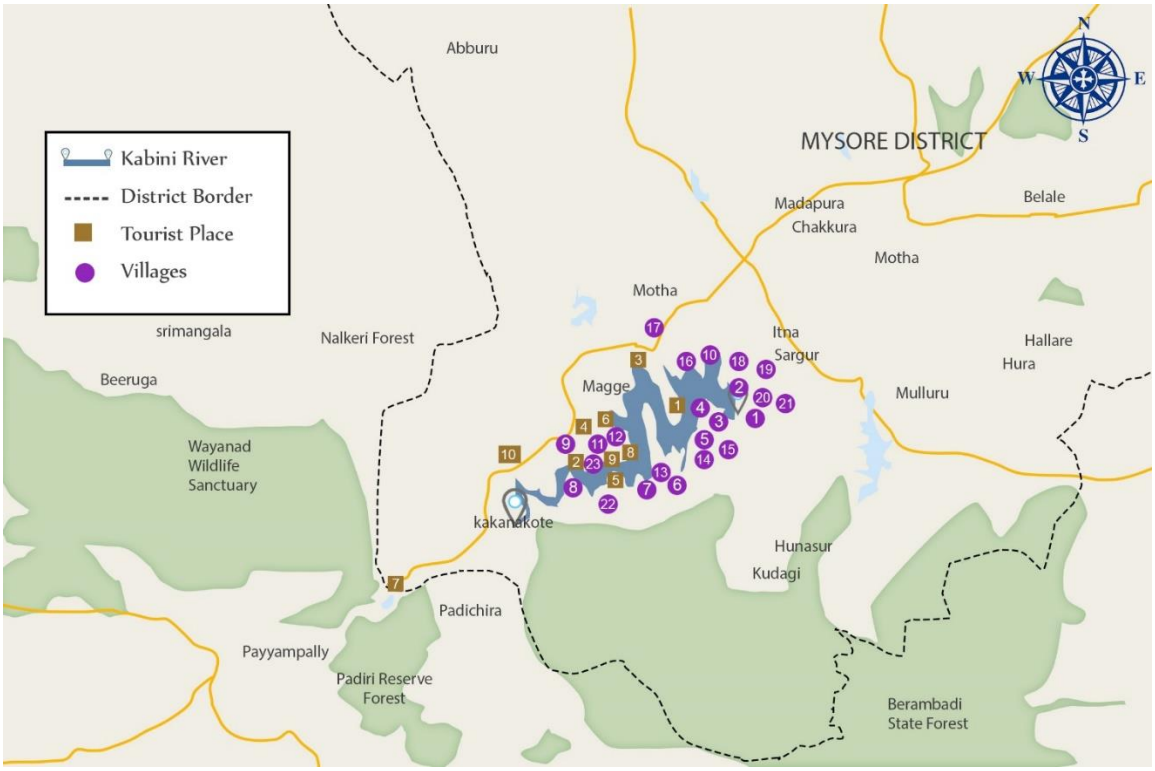
TABLE 4-7: Villages on the bank of Kabini river

Sr. No.	Villages	Number of households	Total Population
1	Agathur	503	2,100
2	Beechanahalli	311	1,174
3	Uyyamballi	145	631
4	Bidarahalli	403	1,702
5	Kandegala	86	386
6	Katawalu	266	1,195
7	Kenchanahalli	326	1,404
8	Hosahalli	441	1,723
9	Udbur	67	375
10	Nerale	644	2,692
11	N.Belathur	661	2,712

Sr. No.	Villages	Number of households	Total Population
12	Kanakanahalli	331	1,337
13	Kalasuru	148	688
14	Nanjanathapura	125	602
15	Hegganur	396	1,735
16	Jeeyara	121	544
17	Nuralakuppe	410	1,801
18	Magudilu	344	1,431
19	Sagare	872	3,586
20	Nallur	18	58
21	Narasipura	128	536
22	N.Begur	480	1,928
23	Beeramballi	370	1,556
	Total	7596	31,896

Source: Census, 2011

The below map shows villages and tourist places located in the catchment area of Kabini river.



Source: Mantrana Maritime Advisory Pvt Ltd

FIGURE 4.3: Villages and tourist place around Kabini river

4.2.8.2. INFRASTRUCTURE ANALYSIS

Infrastructure plays major role in the development. It is essential to understand various types of infra around river and new development that would become support-connecting waterway with other modes of transportation.

4.2.8.3. CONNECTIVITY ANALYSIS

Railway, roadway and airports around the waterway help to understand various ways through which evacuation of cargo and passengers could take place. It helps to determine best multimodal route for evacuation. The catchment area of Kabini river does not have very good connectivity; it is also a major hurdle for the proposed waterway.

4.2.8.4. ROADWAY

SH 33 and SH 86 are 6 km and 7 km away from Kabini river respectively. Road connectivity in the nearby villages is very poor. Kachha road has been made to access Kabini river. Following image shows approaching road to river. At present people residing on the banks of river use Dam road to go to the other side of the river.

Source: Site Visit

FIGURE 4.4: Approach road to Kabini

4.2.8.5. RAILWAY

There is no railway station in the primary catchment area of the river. Nanjangud Town and Mysuru railway stations are located 49 km and 62 km away from Kabini river respectively. South western railway connects the region with other major cities of the country. Southwestern railway is accessible from Nanjanagudu, Mysore & Ooty.

4.2.8.6. AIRPORT

There is no airport in the primary or secondary catchment area of the river.

4.2.8.7. EXISTING INFRASTRUCTURE

There are no bridges or railway line, which crosses the river. There does not exist any terminal on the river. There is Dam on the river in Beechanahalli.

Source: Site Visit

FIGURE 4.5: Dam on the river

This huge dam is around 2,284 feet in height with a gross capacity of storing 19.52 tmcft. Recently due to the high silt accumulation, its storage capacity is diminishing. About 22 villages are dependent on this dam. Dam is built on 55 Ha. of land covering river, forest etc. There are four gates on this dam. June to November is the filling period of the dam.

Source: Site visit

FIGURE 4.6: Kabini River

4.2.8.8. UPCOMING INFRASTRUCTURE

No upcoming infrastructure related Government plans were found during site visit and telephonic interview.

4.2.9. Existing & Proposed Industries

4.2.9.1. EXISTING INDUSTRIES

There do not exist any industries in the catchment area of the river. All the industries are located more than 50 km away from river stretch. No new industry could come up in the catchment area of the river in future due to wildlife sanctuary and reservoir around river. No cargo potential exist for the river.

TABLE 4-8: Type of industries in Mysuru

Industry	No. of Units
Agro based	38
Cotton textile	8
Woolen, silk & artificial Thread based clothes.	42
Ready-made garments & embroidery	36
Wood/wooden based furniture	174
Paper & Paper products	7
Leather based	33
Chemical/Chemical based	62
Rubber, Plastic & petro based	14
Mineral based	9
Metal based (Steel Fab.)	66
Engineering units	17
Electrical machinery and transport equipment	12
Repairing & servicing	4
Others	394
Total	**916**

Source: Mysore district Profile

4.2.9.2. TRAFFIC FROM MAJOR & NON-MAJOR PORTS

There exist no major or non major port in the catchment area of the river.

4.2.10. Commodity Composition

There exist no potential from commodities in the catchment area of the river, as no commodity was found in the region.

4.2.11. Originating & Terminating commodities

No commodity trade was found in the catchment area of the river.

4.2.12. Passenger Traffic

Passenger traffic consists of Ro-Ro traffic and people visiting tourist spots. At present, no passenger ferry operates on the river.

4.2.13. Tourism Traffic

Majority of visitors to Mysuru are students. There does not exist any facility to attract tourists apart from resorts on the banks of river. Not many people are aware about Kabini river tourism. There exists Kabini Wildlife Sanctuary located between Nagarhole and Bandipur Wildlife Sanctuaries. Various species of birds could be found in the catchment area of river. Herds of elephants roam around on open lands nearby river. Backwoods of the Kabini reservoir is rich in variety of wildlife. During summer season water level comes down and surrounding has green meadows.

TABLE 4-9: Village wise potential of local tourists

Villages	Area of Village (Ha.)	Potential Local tourist (No.)
Agathur	308	1,063
Beechanahalli	631	809
Uyyamballi	349	368
Bidarahalli	421	1,071
Kandegala	213	280
Katawalu	1,154	400
Kenchanahalli	431	764
Hosahalli	434	764
Udbur	210	178
Nerale	703	1,306
N.Belathur	2,028	1,566
Kanakanahalli	215	322
Kalasuru	36	244
Nanjanathapura	130	254
Hegganur	618	893
Jeeyara	394	389
Nuralakuppe	502	1,010
Magudilu	409	793
Sagare	1,344	1,935
Nallur	132	57
Narasipura	179	200
N.Begur	1,408	977
Beeramballi	682	743
Total	12,932	16,386

Source: District Census Handbook Mysore, Census, 2011

Above table describes potential of local people who might visit Kabini river. Other marginal and main workers and non workers of each village would most likely visit river.

TABLE 4-10: Resorts in the catchment area of the river

Sr. No.	Resort	Village
1	Red Earth Kabini	Kittur
2	The Bison	Beeramballi
3	Kabini Lake View Resort	Honnurkuppe
4	KAAV Safari Lodge Kabini	N Belathur
5	Orange County, Kabini	N Begur
6	Discovery Village Kabini	N Belthur
7	Kabini Springs Resorts	Bavali
8	The Serai Resorts Kabini	Kankanahalli
9	Waterwoods Kabini	N Begur
10	Kabini River Lodge	N Belthur

Source: Trip Advisor

Figure no. 4-3 shows map of the resorts located in the catchment area of Kabini river.

4.2.14. Orange County

The interior and exterior of the resort are done, keeping in mind the culture and habitat of the tribal villages or Hadis. Each room in the resort is a picturesque amalgamation of contemporary comforts and raw unadulterated beauty of the tribal villages. Kabini offers beautiful reading room, Ayurveda village, traditional style and an Infinity swimming pool. It also offers a boardroom with needed equipment and a bar stocked sufficiently. Honey-Comb and Kuruba Grill are two fine dining restaurants at the Orange County Resort offering Indian and International cuisines. Honey-Comb restaurant serves International as well as regional cuisines and it is named after the honey gathering tribe of the Kurubas. The resort offers swimming pool, Jacuzzi hut and pool, reading lounge, riverside dinning, wildlife safari, coracle rides and night safari as part of its activities and amenities.

4.2.15. The Kabini River Lodge

Jungle lodges and Resorts Limited and Karnataka Government's forest and tourism department came up with Kabini river lodge as their first eco-tourism venture. British Tatter's Travel Guide listed Kabini River Lodge in their top five wildlife resorts in the world. The resort has colonial style designs in its 14 spacious rooms along with five tented cottages and six twin bedded cottages. Lodge can accommodate 50 persons. The guests are kept entertained with numerous activities at the resort. The resort makes arrangements for its guests to take them for wildlife safari during their stay. The lodge also offers coracle rides on Kabini river, along with a naturalist and offers the provision of watching wildlife video films at the Viceroy's Bungalow. The resort offers conferencing facilities, well equipped bar, wildlife safari, riverside dining, coracle rides and twin bedded cottages as part of its activities and amenities.

4.2.16. Red earth Kabini

Red earth Kabini is bounded by water on three sides. The resort is located on the backwaters of Kabini dam. A dam is built across the Kabini River and The Kabini river divides the Bandipur and Nagarhole National parks. Bandipur-Nagarahole corridor has been identified as the National Tiger Conservation Authority (NTCA) as India's best bet for wildlife conservation in the long term. The best luxury vacation period is from September to May.

4.2.17. The Bison Resort

The Bison Resort is one of the best amongst the resorts on Kabini, undoubtedly being located at the confluence of Bandipur National park and Nagarhole National Park. The old hunting lodges of the British Raj and the East African camps blend in beautifully in presentation of the Bison resort. The resort offers picturesque view of the lush green forests and splendid sights of wild animals against the backdrop of their natural habitat. The Bison resort has been able to strike a perfect balance between comfort living and experiencing the wildlife. Every tent has been equipped with a double bed, mirrors and armchairs equipped dressing table and a writing table along with beautiful furnishing.

4.2.18. The Waterwoods Lodge and Resorts

Established in 1999, The Waterwoods Lodges and Resorts is the first private lodge at the Nagarhole National park. With its colonial style built and river facing location, the lodge makes for one of the best resorts in Kabini. The Brahmagiri range makes for a picturesque backdrop for the Waterwoods Lodges and Resorts. It is located between the two famous tiger reserves. The lodge has the harmonization of beauty of wild along with contemporary comforts. The colonial style of the standard rooms at the Waterwoods Lodge and Resorts imparts the feeling of Kabini from the bygone era of British Viceroys and Mysore Kings. The elevation of the superior rooms facilitates view of the beautiful Brahmagiri Range and Kabini River. The restaurant at Waterwoods Lodges and Resorts serves food in buffet style. The restaurant caters to special gustatory needs and diet requests of the customers in addition to serving recipes of different cuisines. The guests can go for an ATV ride in the resort's plantation or spend the day in the resort's beautiful swimming pool. Other facilities include tandoor oven, bonfire and outdoor cinema. The resort's expansive eco spiritual library caters to the reading lovers.

4.2.19. The Kabini Lake View Resort

Situated on the Nagarhole National Park's Southern border, the Kabini Lake View Resort is among the best resorts in Kabini. The aura of the environment of the beautiful Kabini River makes it a perfect getaway from city's madness. Wildfire Safaris, boat cruises, nature walk trails, bird watching and wildlife photography are the activities offered by the resort.

4.2.20. Kaav

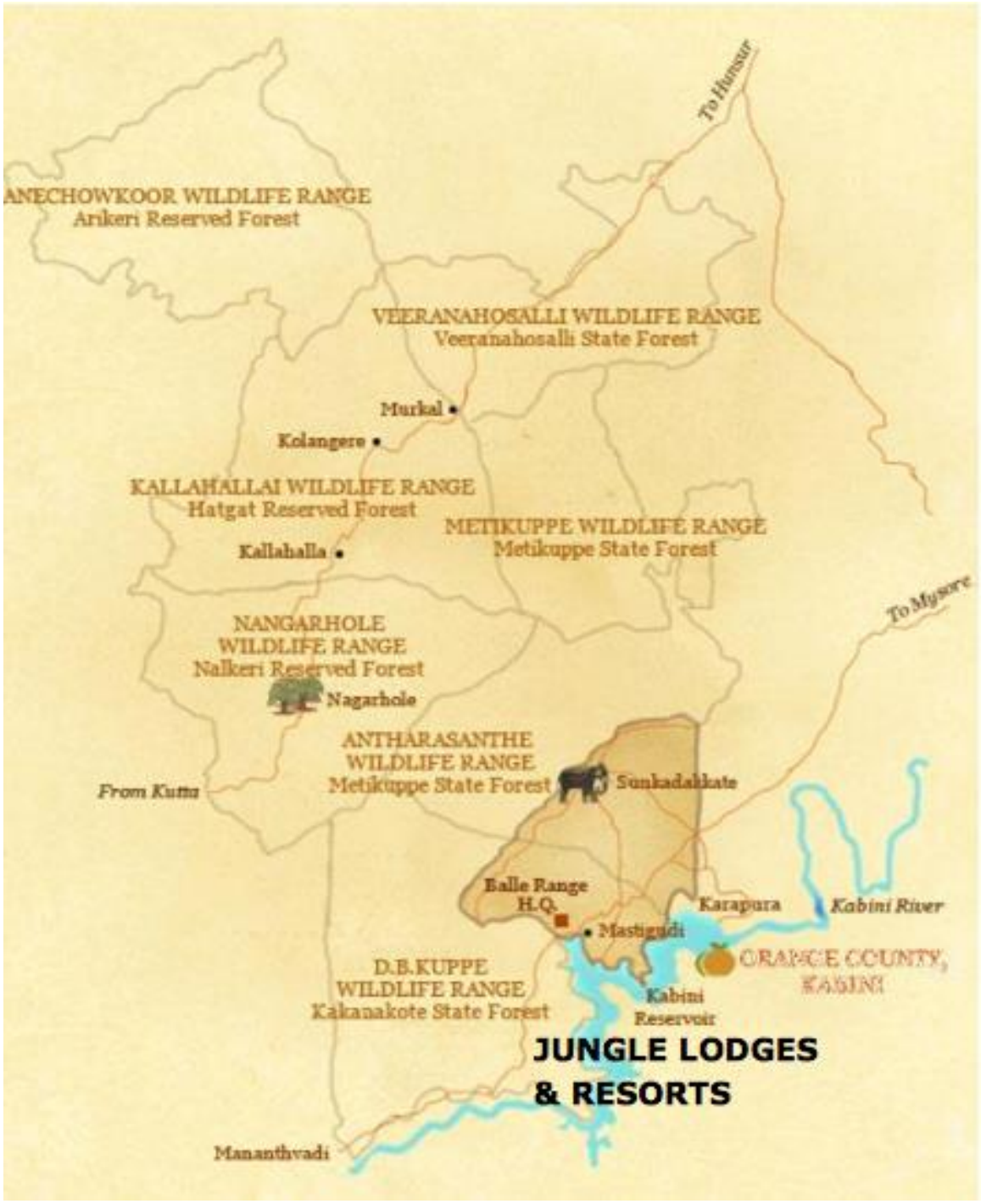
Situated on the Nagarhole National Park's Southern fringes, KAAV is a luxury jungle lodge. The Lodge is known for its wildlife abundance. The wildlife is part of the largest protected area in South India, the Nilgiri Biosphere Reserve, which is one of the World's 34 reserves. It has the world's largest congregation of Asiatic Elephants. The Kaav Safari Lodge has sophisticated and elegant accommodation. The resort is equipped with a swimming pool, viewing deck, alfresco dining, a common lounge and a barbeque on request. Indian Peafowl, Rain Quail, Painted Francolin, Jungle Bush Quail, Red Spurfowl and Painted Bush Quail are some of the 300 species of birds that are found in the Kabini region.

4.2.21. The Serai, Resort

The Serai resort is located amidst the wilderness of Nilgiri Reserve. The Serai Resort is counted among Kabini region's premium luxury resorts. Sprawling over 70 acres of land, The Serai offers a relaxed holiday with tranquility and peace. The resort uses only 10 acres while the remaining 60 acres is left for wildlife. Tourist can hear chirping of the birds with number of flower and fruit bearing trees surrounding the resort. The resort offers recreational facilities along with finest dining and accommodation. The Serai Kabini offers four different types of accommodation options. twin cottages of resort offers warm and cozy surrounding for tourist.

4.2.22. Sri Sri Ravi Rameshwara Kshetra

The Shree Kshetra is a peninsula. It is almost surrounded by the back water of Kabini Reservoir. The Eastern, Western and Northern sides of the temple of Shree Kshetra is covered by the Kabani back water. The only road to the temple is from the Southern side. The volume of back water stored around the temple looks like an ocean.



Source: Tourism projects for investment opportunities, Invest Karnataka 2016

FIGURE 4.7: Kabini river and forest area

4.2.23. Passenger Ferry Terminal

During site visit no passenger ferry terminal was found on the river. People use Road on the dam to go to the city. This road is very narrow at present. One time only one four wheeler can pass. People residing in villages on the banks of the river have two wheelers; they also use bullock cart for transportation.

4.2.24. Growth Trend

The below table shows the potential commodities for the proposed waterway and comparison with FSR study with reasoning for cargoes that are considered for future market and cargoes that does not have potential.

TABLE 4-11: Analysis of FSR Study

Commodity	Source	FSR Recommendation	DPR Findings	Reasoning
Cargo	-	✗	✗	No industries in the catchment area of the river
Passenger	Beemankolly	✓	✗	No existing ferry operation was found during site visit
Passenger & Ro-Ro	Beemankolly-Malali colony Udbur-Gundethur Karapura-Beeramballi	✓	✗	All these locations are on one side of the river. Existing population are using 2 wheeler & bullock cart for traveling purpose. State highway SH 33 passing above Kabini has Night Ban due to wildlife surroundings. No cargo movement was found in the catchment area of the river
Tourism	Resorts	✓	✓	Total 10 resorts exist on the bank of the river. Very few of them operate motorboat & speed boat on the river. These resorts provide many other facility like wildlife safari, traditional boat service called coracle ride etc. Visitors coming to resorts prefer to go to wildlife safari. To attract more tourism traffic awareness need to be developed.

Source: Mantrana Maritime Advisory Pvt Ltd

4.2.25. Cargo growth

There is no cargo growth for Kabini river. There do not exist any industries. Industries could not set up their plants in the catchment area of the river because there exist national park and secured forest area.

4.2.26. Passenger & Tourism growth

Apart from resorts located on the banks of Kabini river, there do not exist any tourist destination in H D Kote taluka. Therefore in future, tourist traffic would be generated from these resorts and their watersport activities. Watersport activities at present are very minimal. The major hurdle for growth in watersport activities is license issue to operate motorboat or other tourist boat on the river. SH 33, which connects Karnataka with Kerala passes above Kabini river. There is ban on using this road at night. Night ban has been imposed from 6 pm up till 6 am. Wild animals come on the road and to Kabini river to quench their thirst. Presence of wild animals near the river makes the place dangerous for tourists and local people. Tourists visiting resorts on the bank of Kabini river are more inclined towards doing jungle safari in nearby national parks/sanctuaries etc. Resort owners wants to

increase number of tours of jungle safari to attract more customers. In the past there was no tourism or ferry operation on the river.

4.2.27. Forecasting & Potential IWT Assumption

Critical Factors to be considered

- Karnataka Government has put night ban on many national & state highways that connect Kerala with Karnataka and which pass through forests or national park area. Night ban duration is from 6 PM to 6 AM .
- Wild animals visit Kabini river to drink water. Animals like Elephants, Deer, Cheetah etc roam on open land on the bank of Kabini river.
- Kakanakote Forest region which is beside Kabini river and easily accessible by SH 33 is a tiger reserve area.
- At present, boating activity takes place in Kabini river on a small scale. Boating is operational majorly for tourism purpose. There exists problem of license issue to operate tourist boats on the river.
- Nagarhole national park located less than a two kilometer from Kabini river is known for its tiger reserves. State Government has imposed a ban on all the tourism activities in the core areas of tiger reserves including Nagarhole Area.
- In the month of April, 2017, Karnataka is facing worst draught in this year. Lot of Animals from Nagarhole national park are visiting backwaters of Kabini to minimise their thirst. Many ponds and water sources in the national park are drying up. State Government has started digging Borewell nearby pond area and put solar panel to run the motor pump.
- During summer season more than 500 elephants roam around backwaters of Kabini along with other animals.

Source: The Hindu, April 16th,2017

FIGURE 4.8: Animals roaming around near Kabini backwaters

4.2.28. Growth Rates

Following assumptions are taken into consideration to arrive at probable tourist traffic on Kabini. Considering that all the clearances and certificates are obtained, there exists a possibility of developing a floating restaurant on the river.

- ✓ Growth in tourists' traffic of Karnataka from Fy-07 to Fy-15 is very inconsistent. Therefore it is assumed that average annual growth of Karnataka is considered as 5%
- ✓ Out of total tourists traffic of Karnataka, 4% share is assumed upto Fy-25 for Mysore district, which would increase to 6% after Fy-25
- ✓ 1% share of Mysuru district is assumed tourists arrival in H D Kote taluka every year.

TABLE 4-12: Estimated Traffic for the Hinterland of kabini (H D Kote)

Numbers ('000)	Fy-16	Fy-20	Fy-25	Fy-30	Fy-35	Fy-40
Karnataka	1,26,524	1,53,791	1,96,281	2,50,510	3,19,721	4,08,054
Mysore	5,061	6,152	7,851	15,031	19,183	24,483
HD Kote	57	79	144	261	474	861

- ✓ It is assumed that floating restaurant would have 300 seating capacity and it would get fully utilized from Fy-30.

TABLE 4-13: Floating Restaurant capacity assumption

Year	Capacity Share
2020	50%
By 2025	75%
2025- 2030	80%
2030 onwards	100%

- ✓ It is also assumed that out of total tourists arrival in H.D.Kote taluka, 65% of tourists could use a boat ride on Kabini river for leisure activity. Provided all the necessary clearance and license are obtained.
- ✓ It is also assumed that as per tourist department of Karnataka, 50,000 numbers of tourists visited H D Kote taluka in Fy-15.

4.2.29. Tourist Forecast

The tourist visitor at Kabini reservoir & lodges has been forecasted based on the tourist growth rates as observed from 2007 to 2015. The growth rates have been tapered at 5-year interval. Table below presents the traffic projections for Kabini River.

TABLE 4-14: Traffic Projections for Kabini River (in '000)

S. No.	Year	Floating Restaurants	Boat Rides
1	2020	25.0	82.8

S. No.	Year	Floating Restaurants	Boat Rides
2	2025	48.0	140.4
3	2030	51.2	219.8
4	2035	64.0	370.8
5	2040	64.0	622.0

4.2.30. Terminal wise IWT Traffic analysis

During site visits, it was found that neither do industries exist in vicinity of the River nor industrial cargo consumption is there in the catchment area of the River. Tourist resorts exist around the River and have considerable tourists visiting the wildlife sanctuaries around Kabini. Traditional coracle boat ride takes place in the River.

Source: Google Earth

FIGURE 4.9: Possible terminal locations

Kabini river stretch is zigzag and curvy in nature. Road connectivity is not much developed around the river. Cargo & passenger potential doesn't exist on the waterway. However, tourism potential exists of the River. The details of the same are explained in table below.

TABLE 4-15: Traffic Analysis for Kabini

Name of the waterway: NW-51 (Kabini River,23.171km)														
Sr. No	**Name of Cargo**	**Type of Cargo**	**Origin**	**Original Terminal on NW**	**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 (No Terminal Present on River)														
Proposed Terminal Opportunity for IWAI (There is no opportunity to develop a terminal on Kabini, There could be a possibility of developing a floating restaurant to attract nearby tourists who visit National Park and nearbby areas of Kabini)														
1	n/a	n/a	Indian & Foreign Tourists	n/a	H. D Kote Taluka	n/a	n/a	('000)	0	25.0	48.0	51.2	64.0	64.0
Boat ride on Kabini for leisure activity (A small jetty/terminal for boarding tourists on boat)														
1	n/a	n/a	Indian & Foreign Tourists		H. D Kote Taluka			('000)	0	82.8	140.4	219.8	370.8	622.0
* BULK/BREAK BULK/BULK LIQUID/ TRUCKS (in No.), etc..														

Source: Mantrana Maritime Advisory Pvt Ltd

During site visit it was found that there do not exist any industries or industrial cargo consumption in the catchment area of the river. There exist tourist resorts around river; however tourists are interested to visit wildlife sanctuaries and National Park. Only traditional country boat ride takes place in the river. Wild animals come to river for drinking water and roaming around. People residing in villages nearby are economically backward. However to attract tourists in visiting Kabini river, a floating restaurant could be developed. Floating restaurant do not require terminal for boarding the people. Boating activity could also be introduced to attract more tourists however for boating purpose small jetty/terminal would be required to make passenger berthing more easier.

4.2.31. Summary of Interviews

Resort Name	Person Name	Designation
Red Earth Kabini	Ravi	MD
Kabini Lake View Resort	Gautam	-
Orange County Kabini	Ravindra	-
Kabini Spring Resorts	-	-
The Serai Resorts Kabini	Radeesh	-
Waterwoods Kabini	-	-
Kabini River Lodge	-	-

Red Earth Kabini

Name: Ravi

Designation: Managing Director

The Resort is the only resort, which is situated near the reservoir. It doesn't face the problem of receding water levels in the river during summer season at its location. It manages 5-6 resorts at the same location and draws in 12,000 tourists monthly operating at 70% capacity of its accommodation. The local tourists that visit the resort are mainly from the metro cities of Mumbai, Pune, Bengaluru, Chennai and Hyderabad and from states like Gujarat. The International tourists come to visit in the month Of December during the winter season. The resort operates 1 speedboat and 1 motorboat each on the reservoir just to ferry the people across on to the other side. The resort also operates coracle rides.

Discussions regarding the development of water sport activities and deployment of houseboats on Kabini river has evoked positive response as the resort looks forward to have its own houseboats on the river and could conduct water sports and activities on the river provided the resort get speedy clearances. The reservoir of the Kabini river comes under the jurisdiction of Kaveri Neeravari Nigam Ltd., while the mouth of the river that enters the forest comes under the jurisdiction of Karnataka Forest Department. A 2012 court ruling barred the resorts (private players) to use their own private vehicles for wildlife safari. The court has permitted only Jungle Lodges and Resorts (JLR), which is a Government organization to operate their vehicles for safari on rent basis. JLR's vehicles would start from Kabini River Lodge and would take tourists for jungle safari.

Kabini Lake View Resort

Name: Gautam

The resort gets both local as well as international tourists. The locals visit the resort throughout the year. The International tourists visit specially during the months of October to March. Around 1500 local tourists visit the resort every year, whereas the international tourists' count is a meager 150 per year.

The resort, during the discussions, has pointed out that the red tapism involving the speedy clearance and acquisition of license applications put forward to the government. The resort is in favor of putting up its houseboats on the river and conducting water sport activities on Kabini River if granted license. The resort is also in favor of using the berthing facility by IWAI, if developed, for its own boats. It was also pointed out that the H D Kote Taluka doesn't promise any scope for tourism other than limited scope that exist around Kabini River.

Orange County Kabini

Name: Ravindra

The resort gets its traffic from the local tourists, who comprise around 80% of total visitors. The local tourists visit the resort throughout the year from places like Bengaluru, Mumbai. The international tourists visit the resort during the months of November to February. These tourists are mostly from U.S.A., U.K. and Germany and contribute to the rest 20% of the resort's visitors.

Discussions with the resort have yielded that the visitors of the resort show more interest in wildlife safaris as more than 50% of the H D KOTE taluka area covered by forests. It also wants the Karnataka Forest Department to put in an extra session for Safari visit, in addition to the existing two sessions, as only 18 people can be taken in one session through the waterway mode. They want the extra session to accommodate all the tourists to the wildlife safari, as presently the supply of sessions is less than the demand. There are security issues concerning the deployment of houseboats on the river, as the river is surrounded by two national parks on both sides.

Kabini Spring Resorts

The resort caters to domestic and international tourists. The resort also caters to corporate clients, particularly from Bengaluru. The tourists for the resort mainly hail from the southern part of India. The interstate traffic occurs from the states of Gujarat and Maharashtra, from cities of Mumbai, Pune and Nashik. The summer season in particular contributes to the spurt in tourism traffic for the resort.

The Serai Resorts, Kabini

Name: Radeesh

Owned by the Coffee Day chain, the resort sees majority of domestic tourists from all over India. Apart from local tourists, International tourists also form the clientele.

As per the discussion with the concerned person, the water from the river is supplied to Bengaluru. Hence there is less water for most water sport activities other than Kayaking. The visitors who visit the resort prefer to go for wildlife safaris.

Waterwoods Kabini

Majority of the visitor traffic generated at the resort comprises of domestic tourists. The domestic tourist traffic mostly comes from the states of Karnataka, Gujarat and Maharashtra and also from the metro cities of Kolkata, Chennai, Mumbai and Bengaluru. The river gets dried up during the months of April- May.

According to the resort spokesperson, buying and deploying houseboats incur high expenditure and it is financially unviable from the owner's standpoint. The resort affords to operate just one motorboat cruise to Bheemankoli. Also, the area shows more potential as a wildlife destination.

Kabini River Lodge

The visitor traffic at the lodge is mostly domestic and specially from Southern India. The domestic tourists come to the resort throughout the year. The international tourism traffic has a share of mere 5% to the total visitor count at the resort.

The resort has shared its tourism traffic for the months of April to October (6 months) i.e. 12,000. The current year witnessed severe rainfall shortage. The water from the River reservoir is used for irrigation and also the river gets dried up in the months of February and March.

Abbreviation	Full Form
GSDP	Gross State Domestic Product
GDP	Gross Domestic Product
H D Kote	Heggadadevana kote
Tmcft	One thousand million cubic feet

CHAPTER 5: TERMINALS

5.1. General Review

Terminals act as a connecting center 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. Identification and Site Location

Planning of the Inland Water Terminal location predominantly depends on the Traffic Origination and Traffic Destination criteria, which gives impetus to movement of traffic in inland waterways. Subsequent to the above, the site location in the vicinity can be considered duly taking into consideration of various influencing parameters, as below. In most of the cases the site location may not fulfil the idealistic scenario. However, the possibility of zeroing to a most suitable site may be possible based on certain basic parameters, as detailed.

Backup land availability / Stability of Bank / Water Depth availability in Lean season / Velocity & Discharge both in Lean season and Flood season / Approach Road / Possibility of Rail connectivity / Nearness to City or Town / Availability of essential services / Impact of Social, Ecological & Environmental aspects etc.

In the morphological rivers, due to seasonal precipitation there are fluctuations in river flow and the rapid changes in water flow causes shift in the location of the deep channel and results in erosion of banks and siltation. Accordingly, the basic requirement of an inland terminal is to ensure a permanent access to the navigational channel throughout the year. Keeping in view the above all, the terminal site location has been considered on Kabini River.

Kabini River is surrounded by state highway SH-33, SH-57 and SH-86 on both the banks. No Railway transport exists within 60 km of river catchment of proposed stretch of Kabini River waterway. The nearest railway station is Mysore Railway

Junction at about 63 km from Kabini dam. At present, it is being utilised by one ferry service operational from Beemankolly near Kabini Dam.

There are no Major Industries within 50 kms. However, major Industries located after 50 kms are Nestle Ltd, Jubilant Organics, Kirloskar Electric Company.

Taking into the consideration of the origin and destination and fairway, the most probable location has been considered at Beechanahalli and Beeramballi. The location has approx Lat 11º59'22.22"N and Long 076º20'55.94"E at Beechanahalli and has approx Lat 11º56'05.46"N and Long 076º15'13.36" E at Beeramballi. A general layout of the travel route between these two terminals are shown below in Figure 5.1.

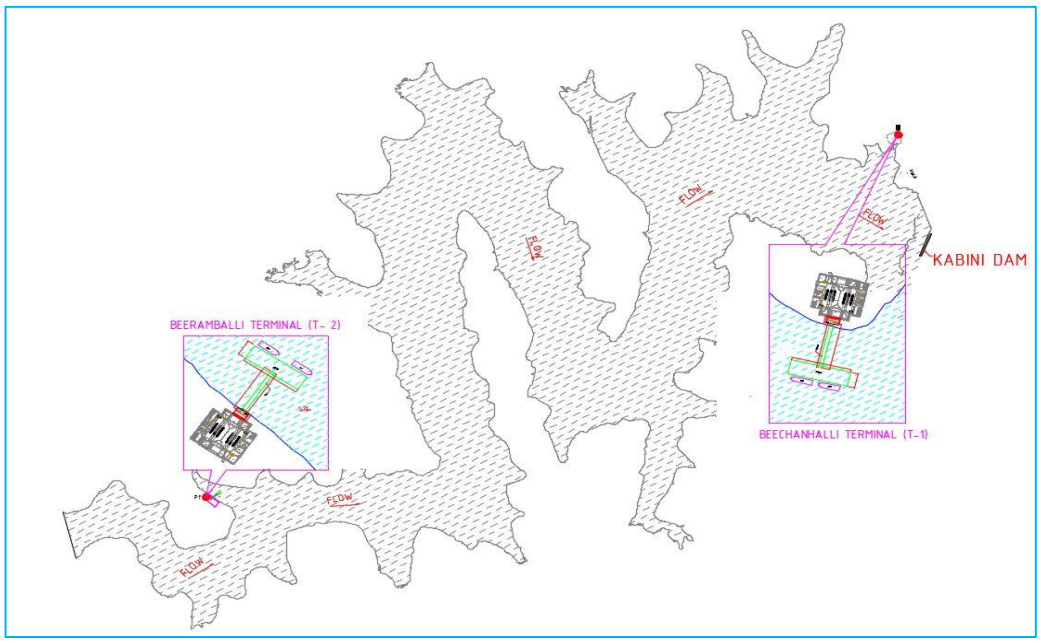


FIGURE 5.1: Route between two proposed terminals at Beechanahalli (T1) & Beeramballi ((T2)

The traffic volumes, as identified at Kabini are nil. However, keeping in view the Tourist Traffic, two passenger ferry terminal berthing facility has been planned. Thus, these expected tourist traffic arrivals are to be taken into consideration for IWAI Terminal development on Kabini River. A tentative Land requirement has been worked out for placing the terminal facility. The land belongs to the government as this is on the fringeline of the submergence at FRL however the cost of land has been considered in the costing probably required for payment to dam authorities.

5.3. Functional Requirements for Ferry Terminal

The ferry terminal at Beechanahali ferry ghat & Beeramhali ferry ghat 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 figures show an overall site plan of the proposed terminal location.

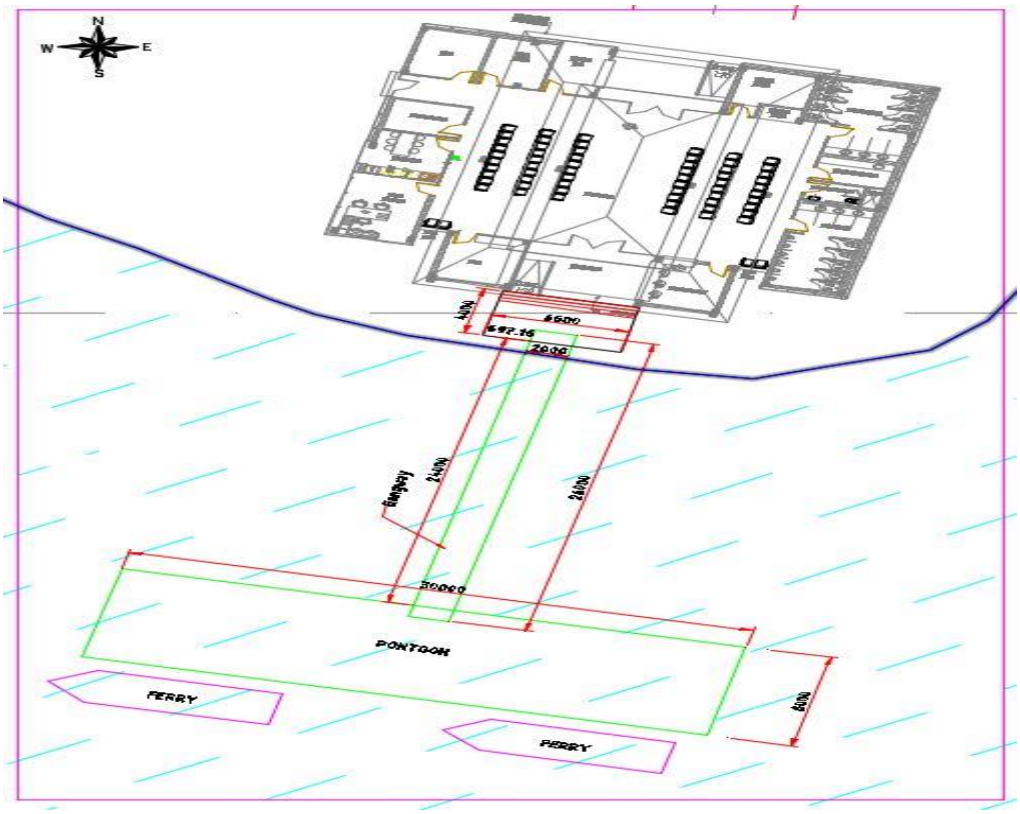


FIGURE 5.2: Overall site plan of proposed ferry terminal (T1) at Beechanahalli.

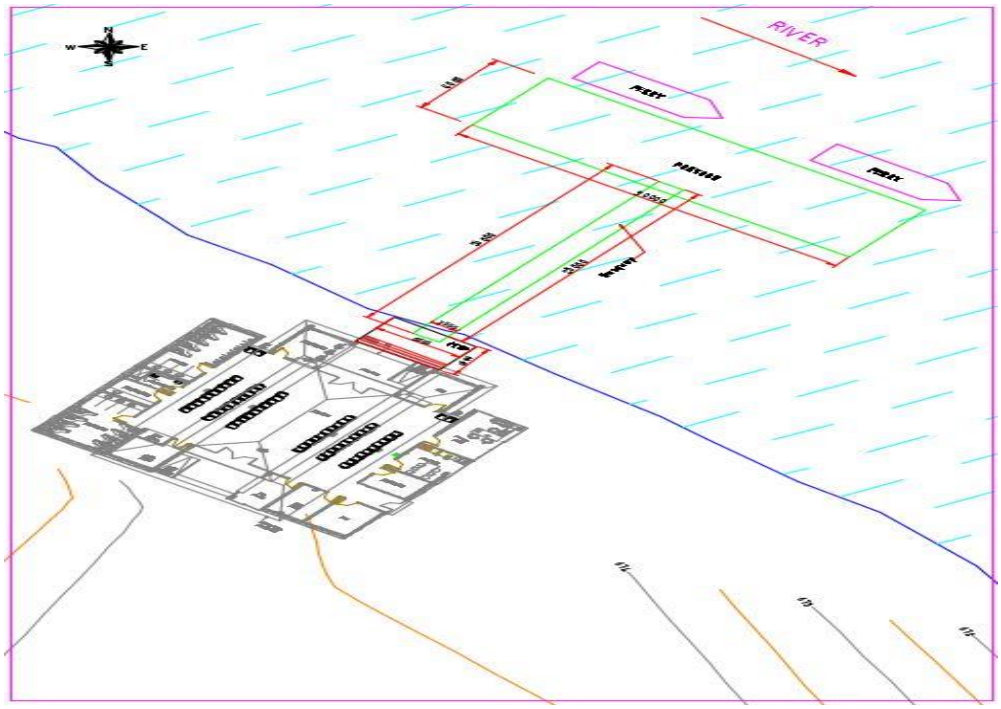


FIGURE 5.3: Overall site plan of proposed ferry terminal (T2) at Beeramballi.

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

5.4. Riverine Terminal Infrastructure

The riverine infrastructure comprises of the following components:

TABLE 5-1 : Components of Riverine Structure

Sl No.	Particulars
1.	Berthing pontoon (Beechanahalli) – 30x8m (01 no.)
2.	Berthing pontoons (Beeramballi) – 30x8m (01 no.)
3.	Aluminum Gangway – (approx.) 26m span x 2m wide (1no. at each terminal)
4.	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-A03**.

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 thickness for riverine infrastructures are shown in the Volume-II Drawing No. **P.010256-W-20309-A03**.

5.5. Planning of riverine infrastructure

The proposed ferry terminal is located on the rim of the reservoir in straight reach. 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. Since this is the submergence area of the existing reservoir aving FRL of EL696.16m & MDDL at EL590.68m. There is a difference of 5.48m between FRL & MDDL. 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 shall serve between FRL & MDDL connected through Aluminium Gangway of 26.0m.

5.6. 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 pontoon. The following figure shows general arrangement of berthing pontoons at high water level (FRL) and low water level.

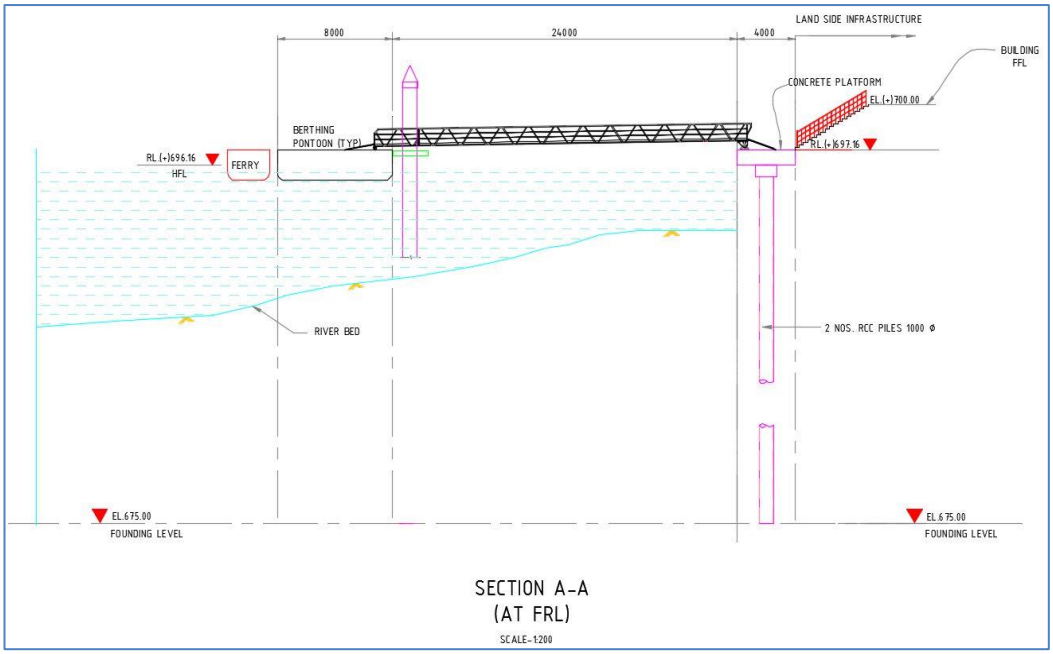


FIGURE 5.4: General arrangement of berthing pontoon at FRL (EL696.16m)

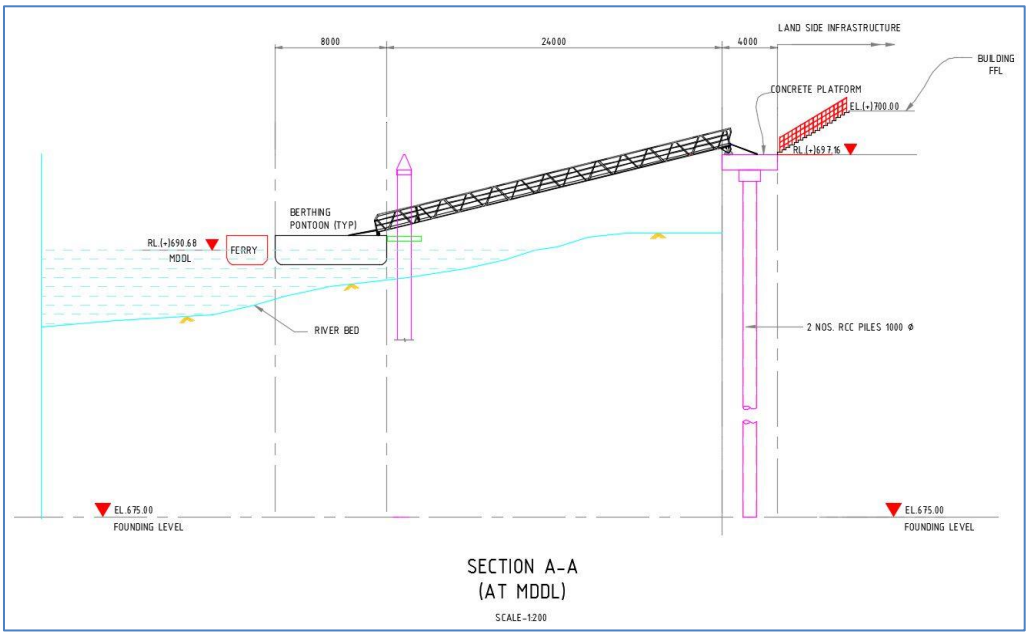


FIGURE 5.5: General arrangement of berthing pontoon at MDDL (EL690.68m)

BERTH OCCUPANCY AND BERTHING PONTOON REQUIREMENTS:

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:

5.7. 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 Kabini (NW-51), between Beechanahali and Beeramahali, is 23.17 Kms. The table below shows the calculation and assumptions considered to arrive at Turn Around time for single vessel at defined 23.17 km stretch of River Kabini (NW-51) carrying passengers.

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

Sl No.	Parameters	Unit	Beechanahalli to Beeramballi
1	NW-51 Stretch	Km.	23.17
2	Traffic Type Proposed	Type	Tourists
3	Terminal Proposed	Type	Passenger upgradable for Ro-Pax
4		No.	2
5	Embark / Disembark (both side)	Mins	30
6	Total Handling Time	Mins	30
7	Sailing Speed	Knots	10
8	Sailing Time	Mins	73 (Approx. 1 Hrs 13 mins.)
9	**Total Turn-around Time**	**Mins**	**206 (Approx. 3 Hrs 26 mins.)**

Based on the above assumptions, a vessel loaded with passengers would take about 4 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.

5.8. Traffic Requirements:

The number of vessels required to handle projected passenger and tourist traffic on the defined 23.17 km of River Kabini (NW-51). 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	Beechanahali and Beeramahali
1	Operational Days	Days	300
2	Daily Operational	Hours.	8
3	Carrying Capacity	No.	50 Pax.
4	Vessel Speed	Nm. / km.	10/19
5	Loading and Unloading Time	Mins	30
6	Chainage (Honnavar to Gersoppa)	Km.	23.17
7	Turn Around Time	Mins	**206 mins (Approx. 3Hrs 26 mins)**

Based on the above assumptions, number vessels required on the River Kabini (NW-51) is represented in the table below.

TABLE 5-4: Number of Vessel Requirement

Sl No.	Unit	FY23	FY25	FY30	FY35	FY40
Traffic (Boat Ride)	'000 No.	114	140	220	371	622
Annual Vessel Calls	No.	2280	2800	4400	7420	12440
Daily Vessel Calls	No.	7	9	14	24	41
Vessels Requirement	No.	2	2	3	4	7
Additional Vessel Requirement			-	1	1	3

The above calculation concludes that initially 2 passenger ferries will be required till FY27. Thereafter as per the projected traffic, need for additional one vessel will occur in FY28, FY32, FY36, FY38 and FY40. Total number of 7 vessels of 50 pax capacity with speed 10knots needs to be deployed in River Kabini (NW-51) to cater to the projected traffic. As shown in above calculations, it takes around 1.75 hours to reach to the other side terminal located at 23.17 km waterway distance. One vessel could make singe return journey in the considered speed and operational time above. The river is proposed to be developed for tourism, hence night navigation is not required.

5.9. 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 FRL (696.16m RL), the gangway are near horizontal (Bank Seat at 677.16m RL) and when the water level is at MDDL (690.68m RL), there is an upslope of almost 4H:1V. A pictorial view is shown in the figure below.

FIGURE 5.6: The Artistic View of Pontoon and Gangway Arrangement

5.10. 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.

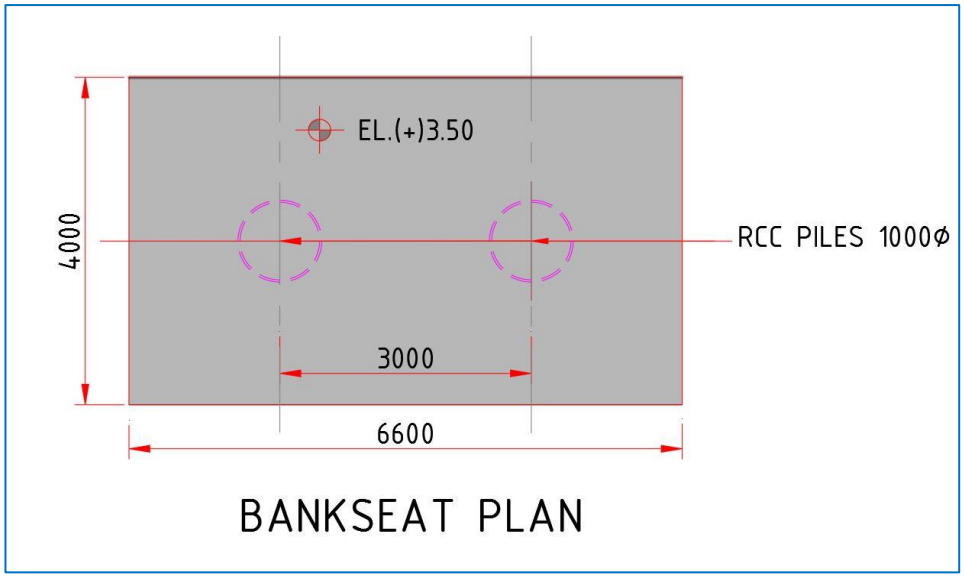


FIGURE 5.7: General arrangement of Bankseat

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.

5.11. 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 -

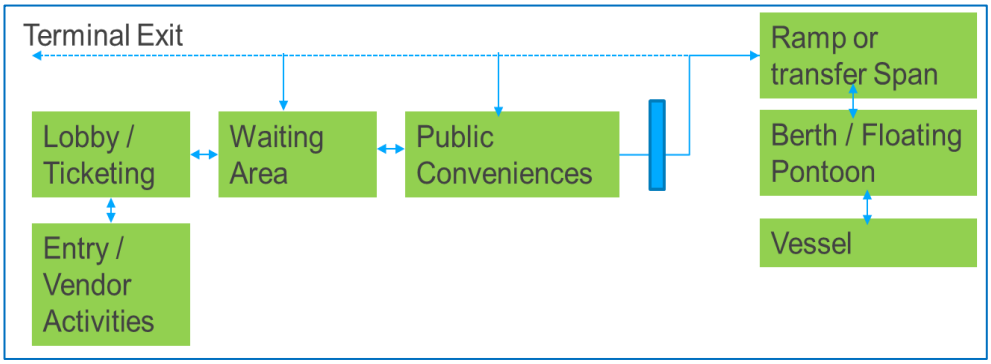


FIGURE 5.8: Typical element for terminal building

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

Land Area Requirement for Pontoon Side Given Below –

TABLE 5-5 : Land Area requirement Pontoon Side at Beechanahalli & Beeramballi

Sl no.	Facility	Nos.	Size	Area (in m^2)
1	Open Mobility Area	1	-	50
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	10.5
5	Electrical facility, Transformer etc.	1	4m x 3.5m	14
6	Fuel Bunkers	1	6m x 4m	20
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 x4m	20
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
15	Land required for Road Extension external approach road	1	-	200
	Total Area			**1691.68**

5.12. 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.

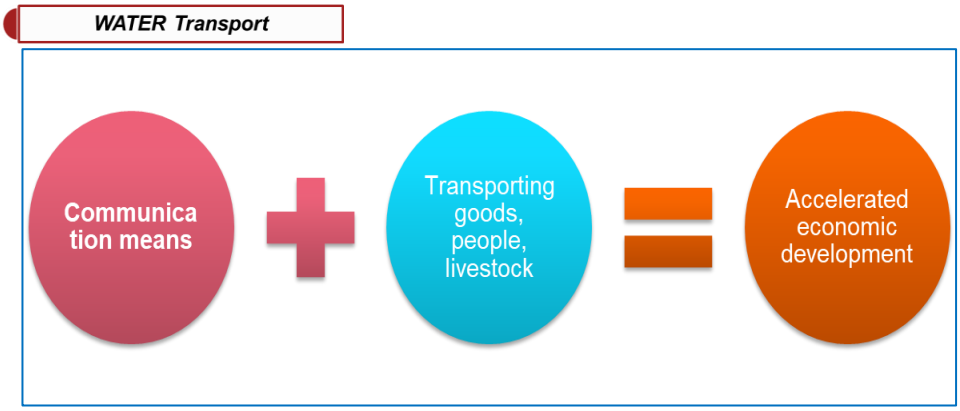


FIGURE 5.9: Water transport importance

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 5.10: 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.

5.13. Architecture Design of Terminal Building

Terminal design is driven by the following factors.

5.13.1. 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: -

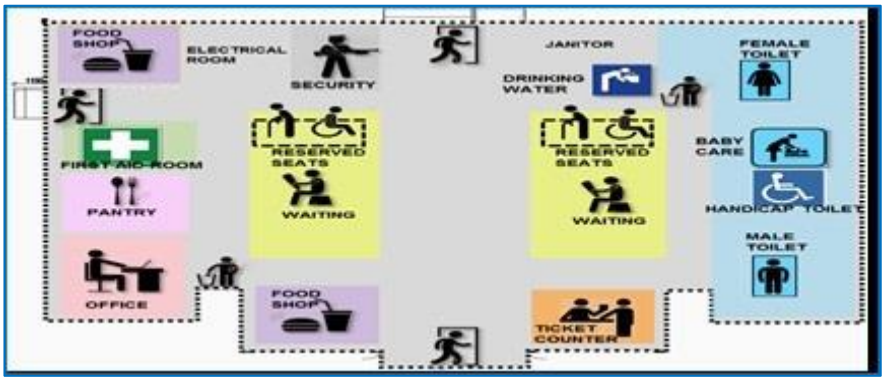


FIGURE 5.11: Terminal building: - zoning plan

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-A03**.

5.13.2. 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.

5.13.3. 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 Beechanahalli & Beeramaballi Ferry Terminal Ghat.

5.13.4. Terminal & Infrastructure

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

- 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: -

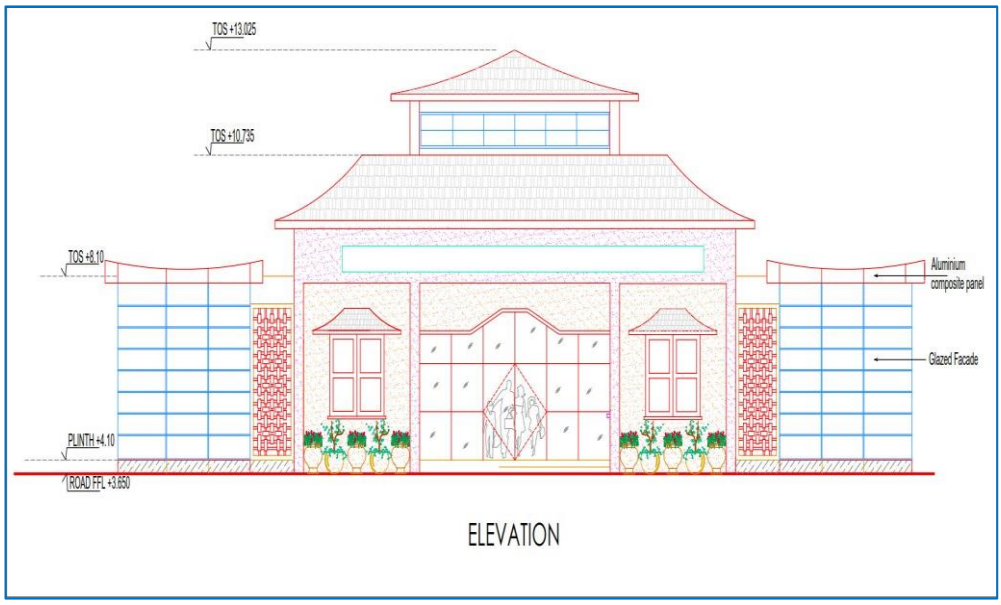


FIGURE 5.12: Terminal building: - Elevation

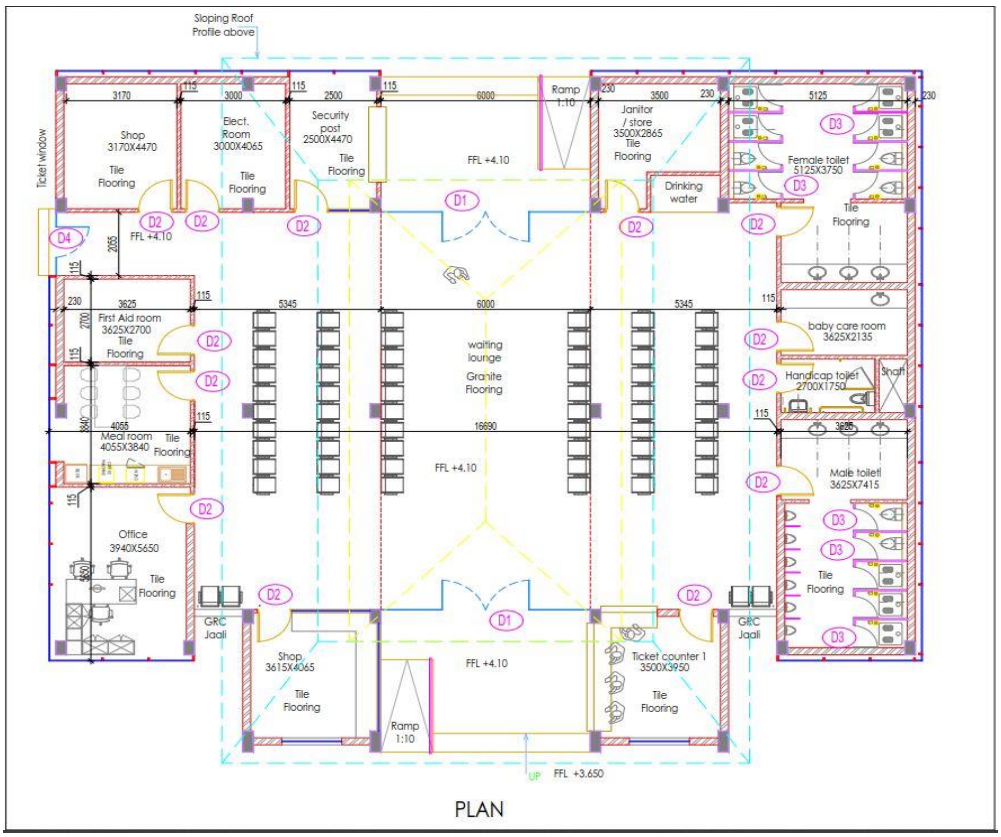


FIGURE 5.13: Terminal building: - Zoning Plan

5.14. Land Details

The Land area identified are at Two Locations i.e., at “Beechanahalli” (T1 – Surveyed) and “Beeramballi” (T2 – Not Surveyed).

TABLE 5-6: Terminal Land Details

Coordinates (UTM) N/E	**1325752**	**646855.16**
Coordinates (DMS) N/E	11°59'22.22" N	76°20'55.94" **E**
Village	Beechanahalli	
Taluka	Heggadadevanakote	
District	Mysore	
State	Karnataka	
Nearest Town	Sargur	
Distance of town (km)	10	
Land use	Reservoir area of Kabini dam	
Ownership	Govt. Land	
Water Distance	500m at present	
Nearest Road	Internal PWD/State road connecting dam	
Road Distance (m)	500	
Nearest Railhead	Sujata puram halt	
Railhead Distance	65km	
Nearby major Structure	Kabini Dam	
Terrain	Reservoir area land	
Soil/Subsurface strata	Reddish brown Gravely soil	
Surveyed Area (Approx)	34612 (m2)	

5.15. Geotechnical Investigations

The proposed project area falls under Toposheet No 58A05. The study area falls in Mysore district of Karnataka. The total extent of the district is 6,854 km2 of which 1,145 km2 is covered by forest. The district can be divided into 3 physiographic regions. The North to eastern portion is riverine plains of Cauvery including South easterly flowing Kabini river which is conflict at TirumalaKudu Narasipura. Secondly middle of the district with gentle slopes towards eastern side parts of Hunsur, Heggadadevana Kote, Krishnaraja Nagara, Nanjungud and Mysore showing gentle slope and plains with cultivated of seasonal crops like both irrigated and dry seasonal crops. The other portion of the district is belonging to Western Ghats that is parts of Hunsur and Piriyapatna with thick natural forest.

5.15.1. Regional Geology

The study area is located in the Western Ghat Belt which can be further subdivided into Western Ghat proper and the Coastal tract. The proposed area belongs to Western Ghat proper representing pediment pedeplains complex of the Peninsular Gneissic Complex (PGC) dotted with residual or denudational hills, inselbergs of granitic rocks, and linear mounds of dolerite dykes. Rock outcrops are intermittently found in the pedeplains.

The Peninsular Gneissic Complex (PGC) is of Achaean age and is predominantly represented by pink and grey Tonalite-Granodiorite with migmatites and granites. Gabbro-dolerite dykes and quartz veins/ reefs are present conspicuously.

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 of the Archaean granitoid gneisses.

The study area is traversed by 3 sets of joints-trending in N-S, NE-SW and E-W direction. There are 4 sets of lineaments in the study area trending in NNE-SSW, NNW-SSE, NE-SW & E-W. It was suggested that the study area was subjected to F1, F2, and F3 Sargur type of structure and deformational folds and joints formation in the past. Major geomorphic units delineated are Hills, Plateau, Piedmont zone, Plain, Reservoirs, River/stream and settlements.

The project area belongs to Peninsular Gneissic Complex of Archaen age mostly represented by granite gneiss. The geological map of the area is given in Figure 5.14 and the stratigraphic sequence as TABLE 5-7.

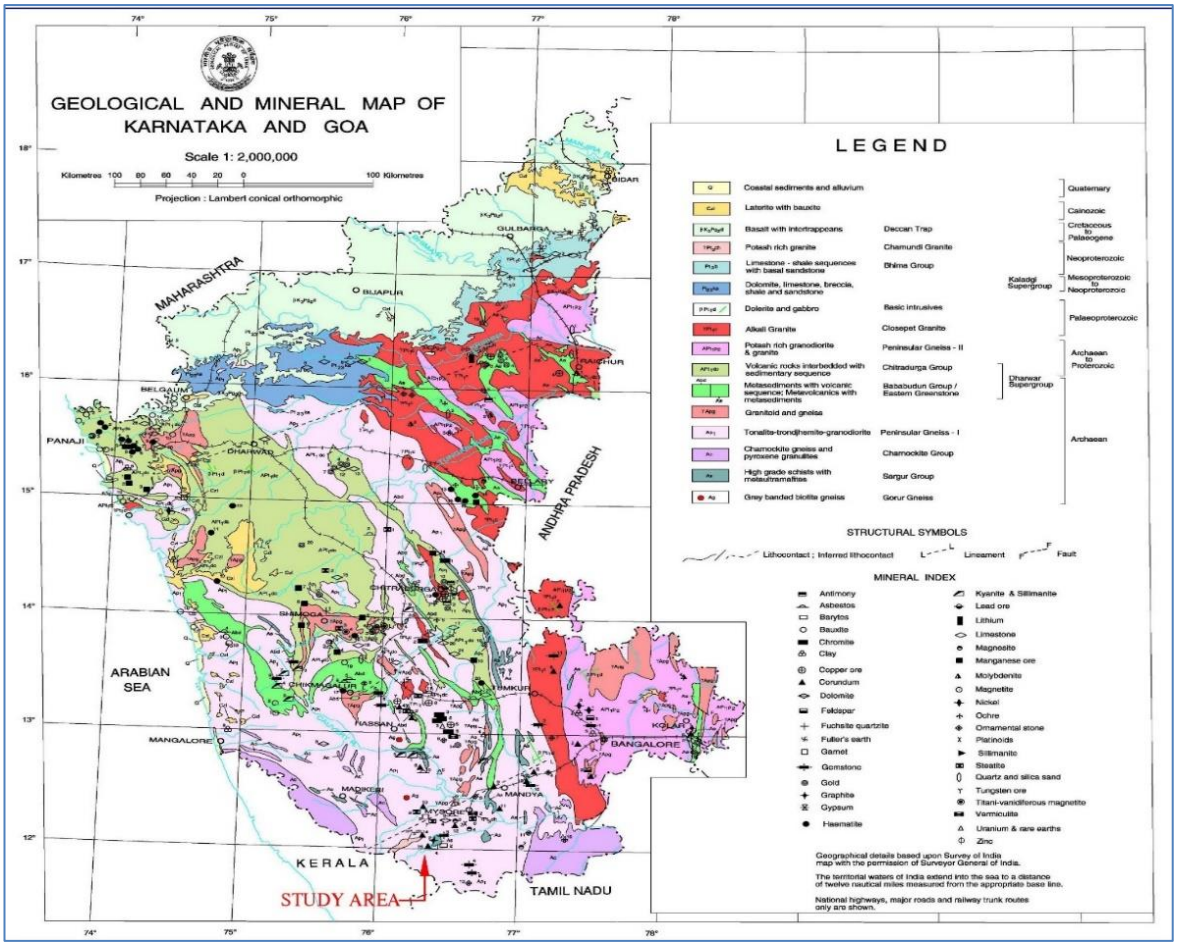


FIGURE 5.14: Geological and mineral map of Karnataka and Goa.

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

5.15.2. 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 subdivided 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.

Among the districts in Karnataka, Mysore district represents almost all types of variation in the topography. The Western parts of the district along the hill ranges evergreen forests are noticed. The rock exposures/ stony waste is formed by their own their texture. Trees like Teak, Honne, Rosewood, and Eucalyptus are existing. The other parts of the district neam, tamarind, mango jack is grown. The main crops like Sugarcane, Maize, Ragi, Pddy, Jowar, vegetables, Tea estates in Hunsur and Piriyapatna Taluks with natural thick forest is estimated.

As per the geomorphological studies of the project area, the district is classified as the upland areas. However, the south-western parts of the district falls under semi-malnad category. The next geomorphological unit is older flow plains mainly in the H. D. Kote taluk and parts of Mysore district. Ridges and valleys form the third important unit and are mainly restricted to the Nanjungud and H. D. Kote taluk and northwestern part of Mysore district. Flat valleys are not very common except for isolated appearances. The general elevation in the district ranges from 700-800 m above MSL except for the denudational hills and ridges. However, the H.D. Kote taluk in the southern parts of the district has higher elevation ranging from 2200-3150 m above MSL. The Mullur betta Naganpur reserved Forest, the Shigebetta (3231 m above MSL) of the Bedrampadi reserved forest mark the water divide making the southern boundary of H. D. Kote taluk and also of the district. The district shows various landforms like hills and plateaus, piedmont zone, plains, reservoir, reservoir islands, river/stream etc (Pushpavathi-2011, Basavarajappa et.al-2008).

The Mysore district is endowed with a number of perennial and non-perennial rivers the major with an elevation of 3150 m above MSL falls in the area. The drainage pattern of the Mysore district is order dendritic type of first order to fourth river system. The Hekkan betta (3724m above MSL) of the drainage in the district is cauvery (Pushpavathi-2009, Basavarajappa et.al-2009, Azadhe and Basavarajappa et .al-2009) river which traverse the Mysore plateau from Northwest to East along drainage in the district is Cauvery River which traverse the Mysore plateau from Northwest to east along with the tributaries Kabini, Suvarnavathi, Nugu, Gundal and Laxmanthirtha (FIGURE 5.15: Cauvery River basin map.

The Cauvery rises at Thalacauvery in Kodagu district and flows along the boundary of Piriyapatna taluk, K. R. Nagar taluk further flows into T. Narasipur and Kollegal.

Among the tributaries Kabini is the major tributary of Cauvery River that rises at waynad in Kerala state, enters into the state at Siddapur in Kodagu district then enters into the district at H.D. Kote taluk along with its tributaries Gundalu hole, the Nugge hole and small streams such as Taraka, vodehatti hole and the Sarathi hole (FIGURE 5.16: Kabini River basin map.
). The Kabini flows diagonally from southwestern part of the district to northeast before joining the Cauvery River at T. Narasipur in northeastern part of the district. The catchment area map of the Kabini irrigation project is shown in FIGURE 5.17: Catchment map of Kabini irrigation project.
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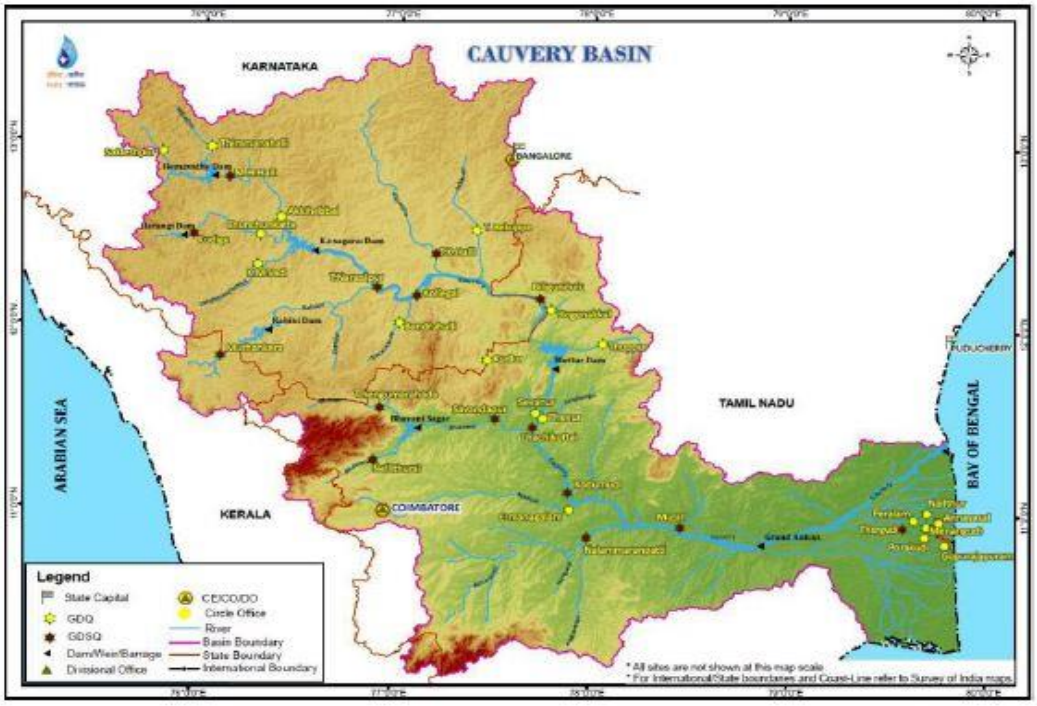

FIGURE 5.15: Cauvery River basin map.

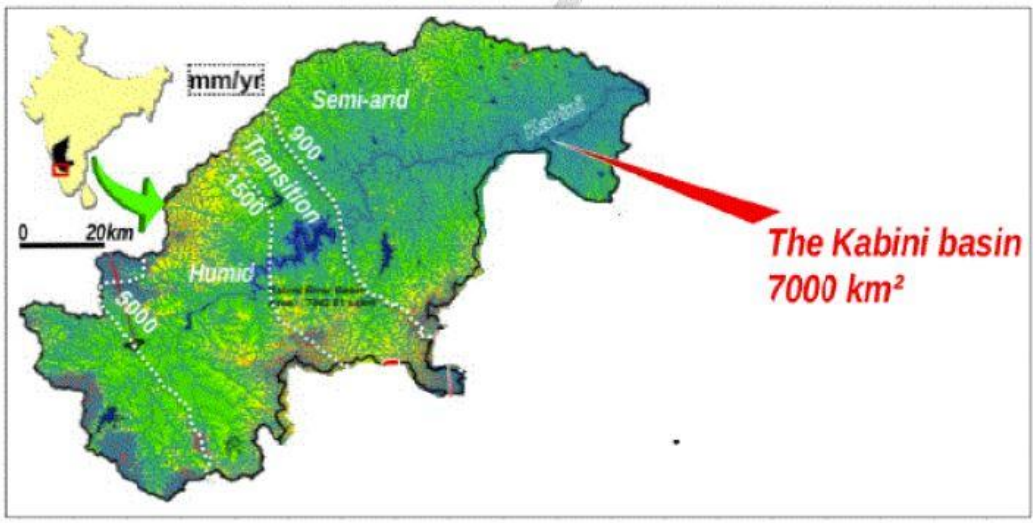

FIGURE 5.16: Kabini River basin map.

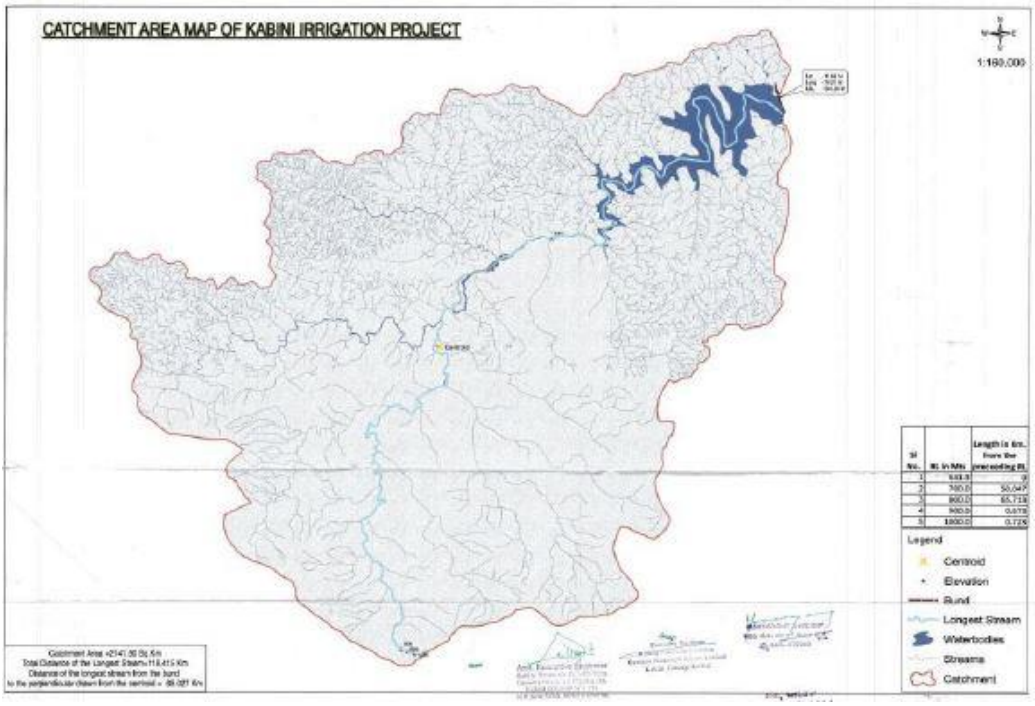

FIGURE 5.17: Catchment map of Kabini irrigation project.

5.15.3. General Geology and Stratigraphy

The study area belongs to Mysore district of Karnataka. Geologically, the district is mainly composed of igneous and metamorphic rocks of Pre-Cambrian age either exposed at the surface or covered with a thin mantle of residual and transported soils. The rock formation in the district falls into two groups, charnockite series and granite genesis and gneissic granite. A fairly wide area of the district consists of charnokites series of rocks, particularly along the southeastern borders of Yelandur and Biligirirangana hills and also at the western border near Hangod in Hunsur Taluk. The intervening ground consists of granitic genesis with thin beds, lenses and elongated runs of various hornblendic rocks, pyroxenites and durities containing chromate and magnesite. Dolerites are in large numbers to the west of Hunsur and Gundlupet taluks. The Sargur schist belt in H. D. Kote taluk extends from Sargur to Mysuru city for about 40 km. This belt was named as Sargur series. The series comprise of a complex series of metasediments and basic igneous rocks.

The garnets illuminate gneiss and the associated norites occurring as patches within the genesis of southern Mysuru represent the remnants of the older khondalite - charnockite system.

The between Bettadabidu and Doddakanya is essentially a flat lying genesis terrain with numerous enclaves of meta-sedimentary units consisting of quartzites, pelitic schists, crystalliner limestone, cal-silicates and ferruginous quartzites into which the ultramafic and the basic rocks have been emplaced. The enclaves of the schistose units vary in size from just maple units to whole hill ranges, for example, the Konnainabetta ranges. In the H. D. Kote and Gundlupet regions, the bands of highly altered rocks of kyanite, staurolite, siliceous schists and also bands of limestone and quartizites are found. These rocks are of great economic importance because of the presence of graphite, corundum and granets in them.

They extend from Bilikere region up to the southern border of the district in the southsouthwest direction for nearly 50 km. Fine textured granite beds are found in Mysuru taluk and around Mysuru city.

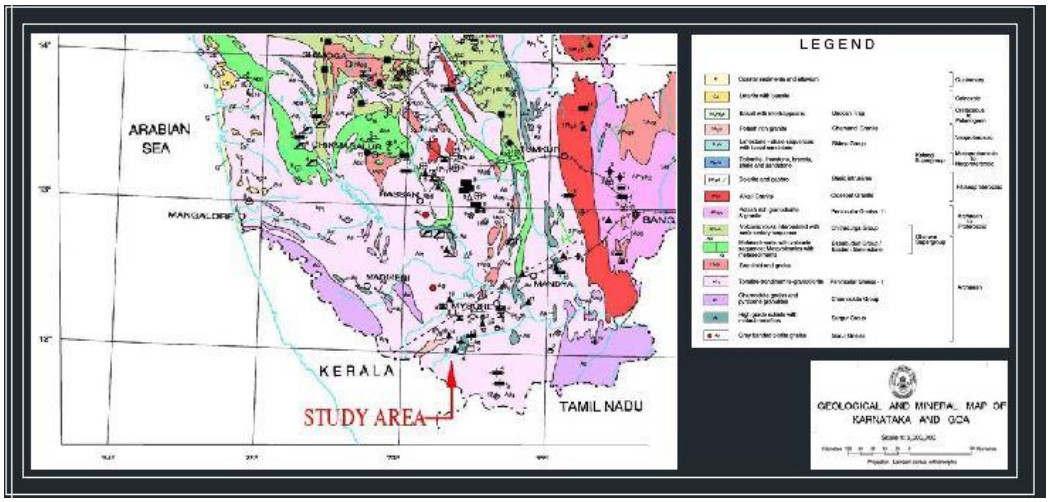

FIGURE 5.18: Geological map of Kabini area

The soils of the Mysore district are grouped into three types viz., the red sandy soils, red loamy soils and deep black soils. Almost entire district is covered by red sandy soil except a small parts of T. Narasipur taluk. The soils are having high permeability and neutral with a pH of 7. The thickness of the soil varies from less than a meter to 6m. Northeastern part of T. Narasipur taluk comprises of red loamy soil. It is characterized by clayey content mixed with sand. It is less permeable compare to sandy soil. It is having good moisture holding capacity and is fertile.

The thickness varies from less than a meter to 16m. Deep black soils occur in southwestern part of T. Narasipur taluk in a small area. These soils are dark brown, dark grayish brown to very dark grey or black in color.

The texture is usually clayey throughout the profile. These soils are fertile and generally produce good yields. Adequate soil and water management practices and drainage facilities are essential to obtain sustainable yields; otherwise, salinity and water logging conditions may develop. These soils need to be drained once in 3-5 years with good quality water. Hence, the important soil types that are encountered in study area i.e. Mysore district are namely clay, clay mixed soil, clay skeletal soil, loamy soil, loamy skeletal soil, rocky land soil. The soil map of Mysore district has been shown in FIGURE 5.19: Soil distribution map of Mysore district
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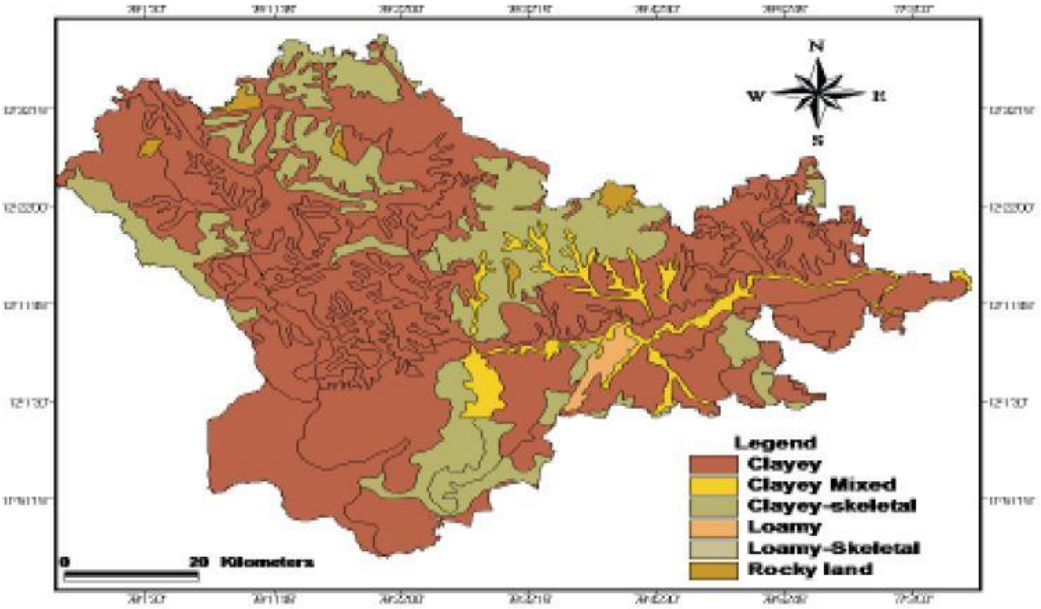

FIGURE 5.19: Soil distribution map of Mysore district

5.15.4. Sub-surface Investigations

The project area has been investigated through one drill hole and associated laboratory tests at the terminal building location. The objective of the investigation was to obtain the sub-surface geological and geotechnical condition with respect to the proposed foundation. The objective has been achieved through drilling (soil and rock) at the location with synchronised collection of soil and rock samples and finally the laboratory testing of the collected samples.

The soil strata have been tested for SPT at every 1.5m interval with collection of disturbed and undisturbed samples for shear strength parameters and engineering properties. The water samples were also collected for the chemical properties.

The drill hole BKA-1 has been drilled for 16.75m length and the results of drilling are summarised in TABLE 5-8.

TABLE 5-8: Summary of drill hole BKA-1.

S.No.	Hole no.	Location	Total Depth (m)	Depth (m)		Thickness (m)	Lithology
				From	To		
1	BKA-1	Kabini River	16.75	0.00	2.3	2.3	Reddish Clayey Silty Sand
				2.3	13.0	10.7	Reddish Completely Decomposed Rock
				13.0	16.75	3.75	Grey Highly to Moderately Weathered Granite

5.15.5. Geotechnical Results and Analysis

Although the detailed report on geotechnical investigations is appended as Volume-IV, the summarised results are discussed below. The field tests comprise of SPT tests in overburden/ soil. The summary of test results is given in TABLE 5-9.

TABLE 5-9: Summary of SPT tests in soil

S.No.	Strata	Depth From (m)	Depth To (m)	Observed SPT "N" value	Corrected SPT "N" value
1	Reddish Clayey Silty Sand	1.5	2.1	14	17
2	Reddish Completely Decomposed Rock	3.0	3.1	*R	NA
3		4.5	4.58	*R	NA
4		6.0	6.05	*R	NA
5		7.3	7.55	*R	NA
6		9.0	9.08	*R	NA
7		10.5	10.55	*R	NA
8		12.0	12.06	*R	NA

*R: Refusal

The core recovery and RQD percentage of the grey highly to moderately weathered granite bedrock in stratum-3 is given in TABLE 5-10.

TABLE 5-10: Core recovery and RQD percentage of bedrock.

S.No.	Lithology	Depth From (m)	Depth To (m)	Core recovery (%)	RQD (%)
1		13.0	14.0	15	NIL
2		14.0	15.0	30	NIL
3		15.0	16.0	65	50
4		16.0	16.75	75	75

The summary of laboratory test results of soil samples is given in TABLE 5-11 and the summary of laboratory test results of rock samples are given in TABLE 5-12.

TABLE 5-11: Summary of laboratory test results in soil samples.

SOIL TEST DATA SHEET

Project : DPR of Cluster 6 of National Waterways (NW-51) At Kabini River

Clients : M/S. Tractebel Engineering Pvt. Ltd. Date : 31/07/2017

Bore Hole	Depth in mtrs.		Sample Type	Density		Natural Moisture Content, w	Mechanical Analysis				Consistancy Limits				Soil Classification	Shear Strength Test			Consolid-ation		Specific Gravity	Remarks
				Bulk	Dry		Gravel	Sand	Silt	Clay	Liquid	Plastic	Plasticity Index, I_p	Shrinkage S_L		Type	Cohesion C_u	Degree	Comp. Index C_{cv} (Lab)	Initial Void Ratio		
No.	From	To	UD/ SPT	gm/cm³		%	%	%	%	%	%	%	%	%	IS		kg/cm²	ϕ	C_c	e_o	G	
BKA1	1.50	2.10	SPT	1.801	1.469	22.56	9	64	27	--->	Non Plastic			---	SM-SC	UU	0.10	28	----	----	2.62	
BKA1	4.50	4.58	SPT	1.830	1.442	26.87	9	32	51	8	35	20	15	----	CI	UU	0.18	21	----	----	2.64	
BKA1	7.50	7.55	SPT	1.800	1.475	22.03	15	35	46	5	31	20	11	---	CL	UU	0.17	25	----	----	2.63	
BKA1	10.50	10.55	SPT	1.859	1.516	22.61	18	31	41	10	43	23	20	----	CI	UU	0.15	31	----	----	2.66	

TABLE 5-12: Summary of laboratory test results in rock samples.

Sr. No.	Bore Hole no.	Core No.	Depth	Diameter	Height	H/D	Correction Factor	Crushing Load	Point Load Index	UCS	Modulus of Elasticit	Water absorption	Porosity	Dry density	Rock Type	Remark/s
			m	cm	cm			kg	kg/cm²	kg/cm²	kg/cm²	%	%	gm/cm³		
1	BKA-1	---	15.0 - 16.0	5.45	10.78	1.98	1.01	13500	---	582.29	1.9E+05	0.58	0.92	2.73	Granite	μ = 0.25
2	BKA-1	---	15.0 - 16.0	5.44	2.34			560	18.92						Granite	
3	BKA-1	---	16.0 - 16.75	5.43				850	28.83						Granite	
4	BKA-1	---	16.0 - 16.75	5.43	10.56	1.94	1.01	16500		719.11	3.5E+05	0.29	0.57	2.87	Granite	μ = 0.23

In order to determine aggressiveness of chemical content present in water on concrete and steel, chemical analysis of ground water recovered from the borehole was carried out. The results are summarised in TABLE 5-13.

TABLE 5-13: Summary of chemical analysis in collected water samples from drill hole.

S.No.	Test	Values	Remarks
1	pH	7.43	> 6 Hence OK
2	Sulphate, ppm	268	< 400ppm, , Hence OK
3	Chloride, ppm	412	< 2000ppm, Hence OK

In order to determine aggressiveness of chemical content present in soil on concrete and steel, chemical analysis of selected soil sample recovered from the bore hole was carried out. The results are summarised in TABLE 5-14.

TABLE 5-14: Summary of chemical analysis in collected soil samples from drill hole.

S.No.	Test	Values	Remarks
1	pH	7.29	> 6 Hence OK
2	Sulphate, %	0.057	< 0.2, Minimum Cement Content 280 Kg.m^3
3	Chloride, %	0.117	
4	Carbonate, %	0.0127	

5.16. Terminal Infrastructure including equipment

The land area identified is measuring to about 21529 Sq. m for Beechanahali (named as Teminal T1) and about 22287 Sq. m for Beerambhalli (named as Teminal T2) has been identified for placing the terminal. The actual land requirement for facilities of each terminal has been worked out to 1691.68 Sq. m, which can be accommodated within the surveyed land and this much land only is proposed to be considered for acquisition at this point of time.

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

5.17. 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 (in case of Kabini, 1.0m above FRL) matching 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

- Size (L x B x D) – 20 m x 2.2 m x 1 m
- Capacity – 50 Passengers
- Engine - 2 Marine Outboard Engines of 75 hp each

TABLE 5-15: Salient Features of Berthing Pontoon.

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

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

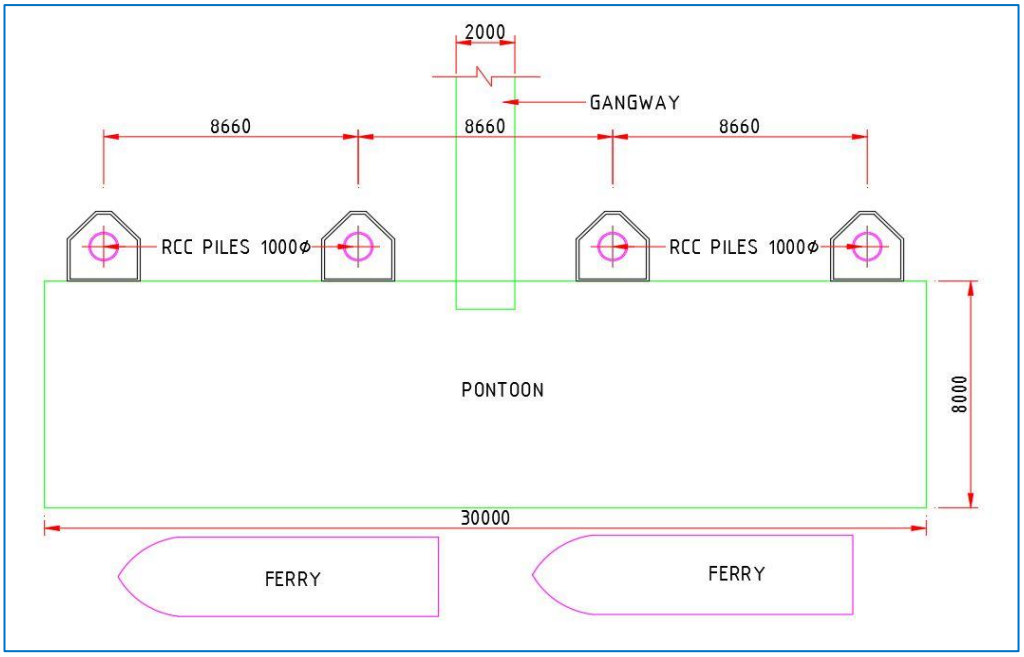

FIGURE 5.20: Structural Arrangement of Pontoon

The preliminary design has explained in the chapter 6. (Refer Volume-II **Drawing No. P.010256-W-20309-A03**)

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.

5.18. Terminal Costing

5.18.1. 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 fairway development is 5.06 Crores and the cost of ferry terminal at two locations work out to be about 13.31 Crores.

5.18.2. 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.

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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 training works 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 river banks 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.

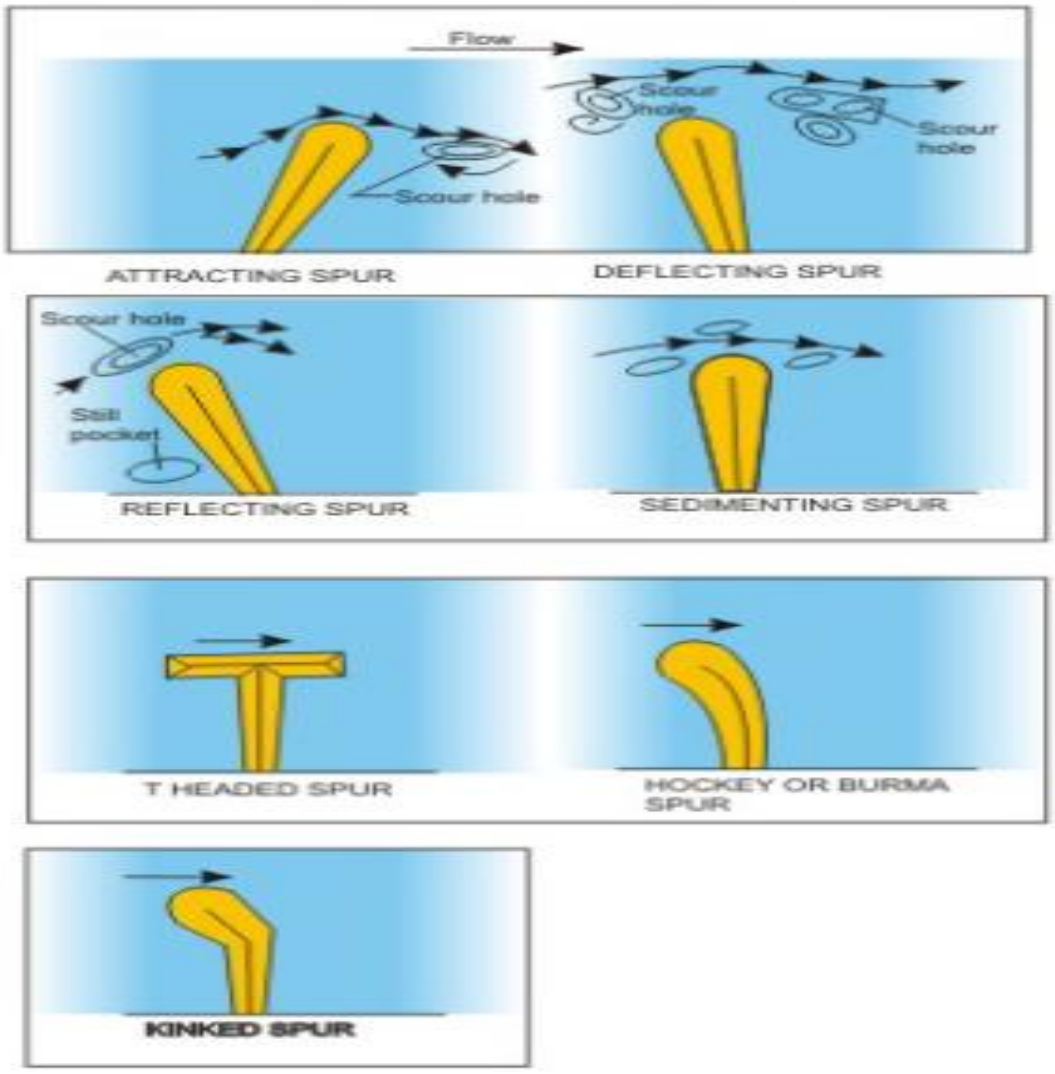

FIGURE 6.1: Different types of Spur

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 project upstream and a smaller portion downstream of the main spurs. Typical plan view of system of spur-dikes is shown in below Figure.

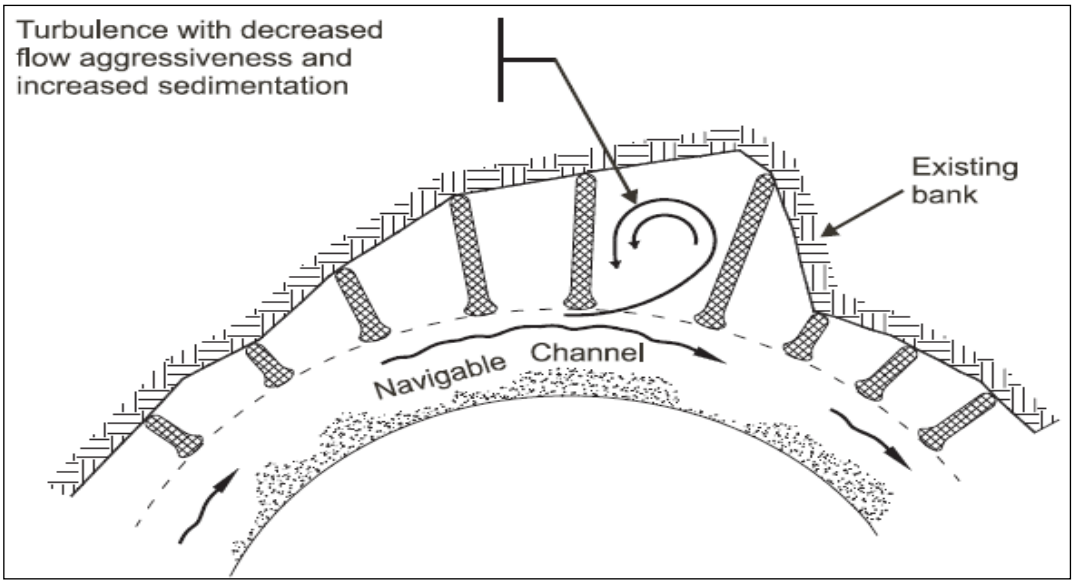

FIGURE 6.2: Plan view of system of spur-dikes constructed to control and stabilize the erosion of the outer band

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.

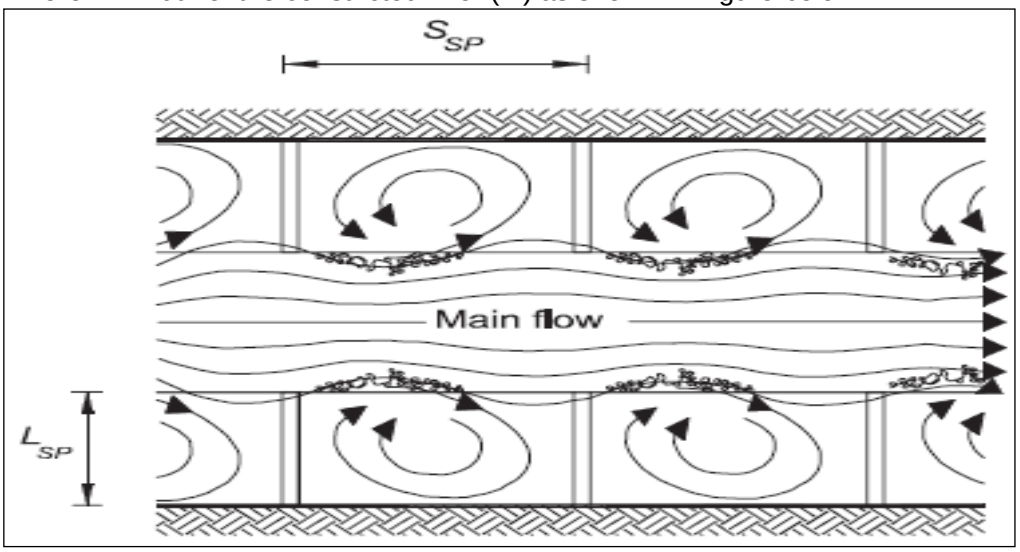

FIGURE 6.3: Diagram showing the length and spacing of the individual dikes with respect to the river width

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.

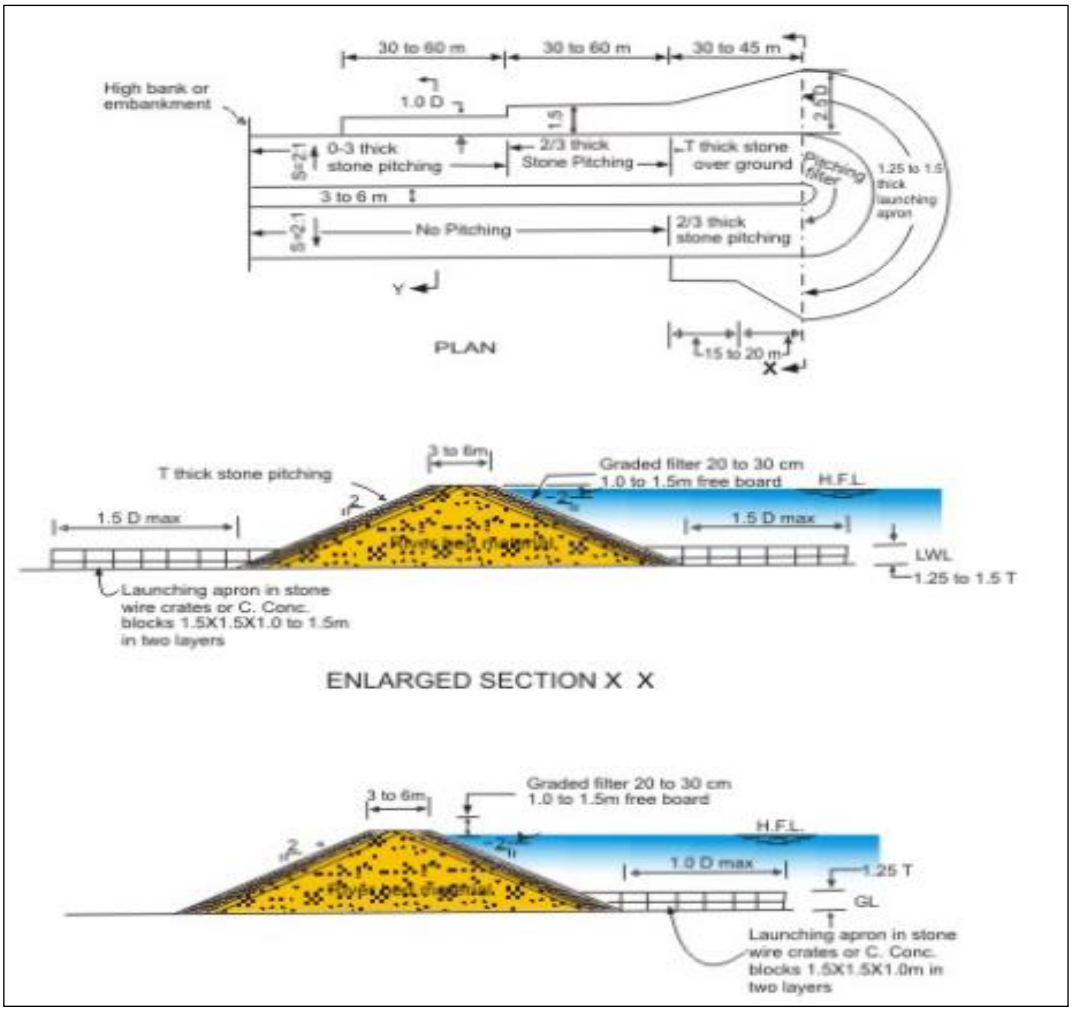

FIGURE 6.4: Typical layout and section of spur

FIGURE 6.5: Impermeable spurs

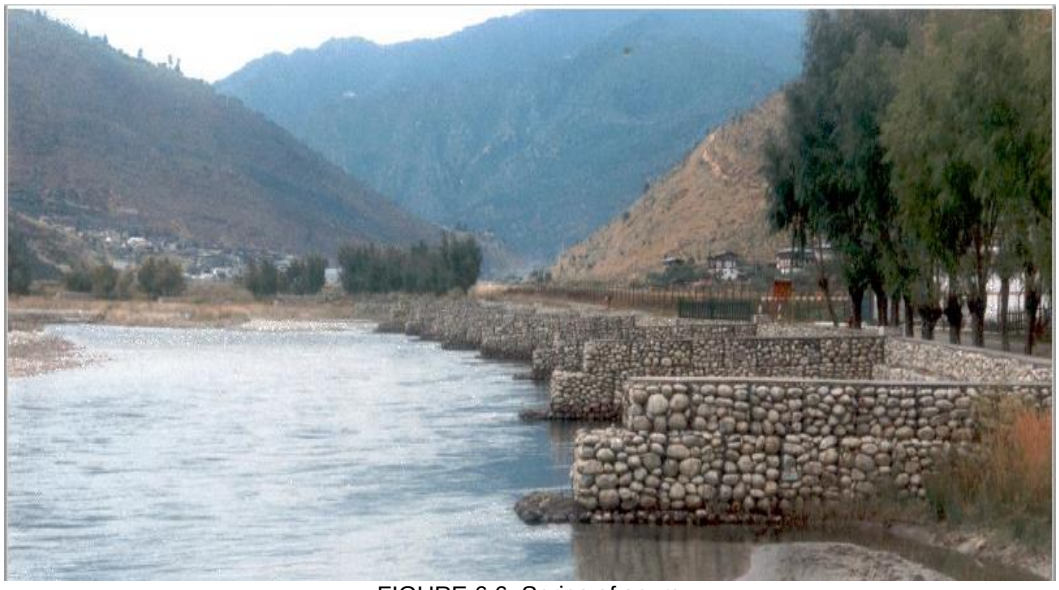

FIGURE 6.6: Series of spurs

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 strech, wherein the Design and Photos are placed herewith.

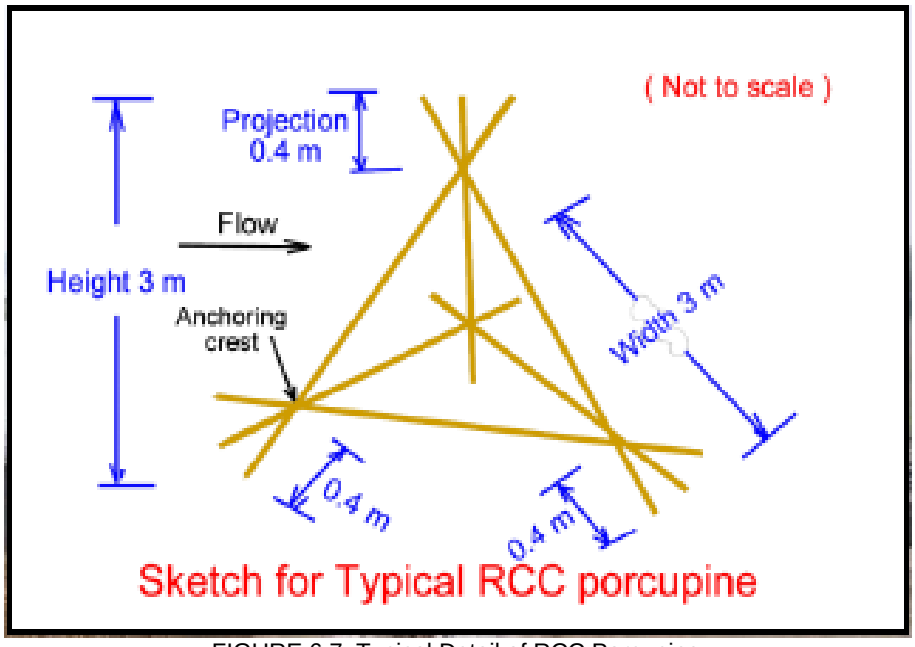

FIGURE 6.7: Typical Detail of RCC Porcupine

FIGURE 6.8: Placement Detail of RCC Porcupine

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.
- Escarameia M. (1998). River and Channel revetments: a design manual. Thomas Telford Publications,

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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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- Blaauw H.G. & van de Kaa E.J. (1978). Erosion of bottom and sloping banks caused by the screw race of manoeuvring ships. Publication no. 202, July 1978. Delft Hydraulics Laboratory.
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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-X03** 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.

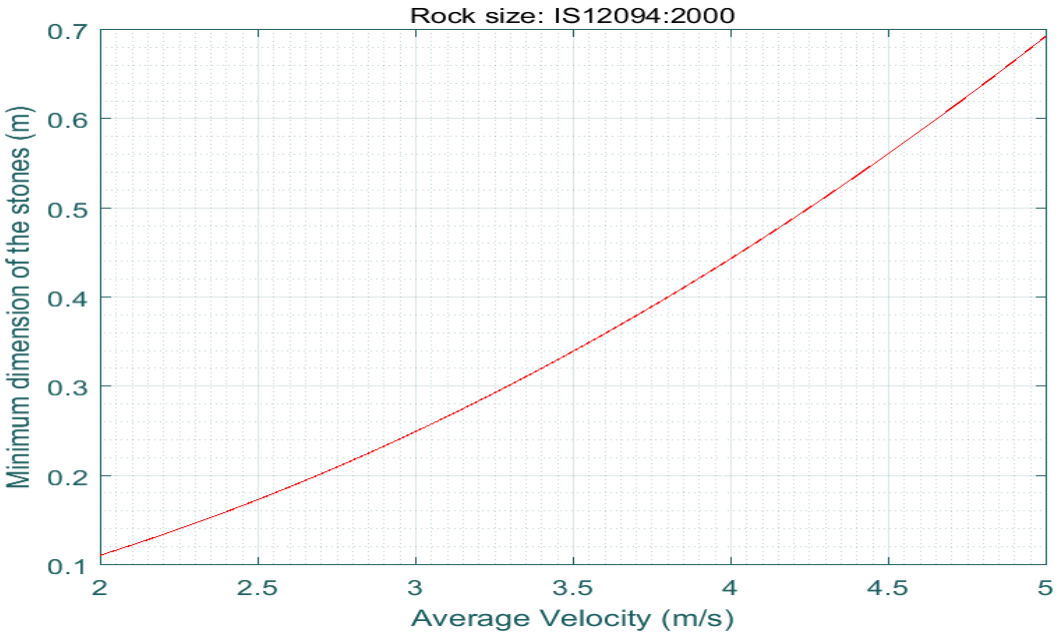


FIGURE 6.9: Minimum rock size according to the IS12094

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

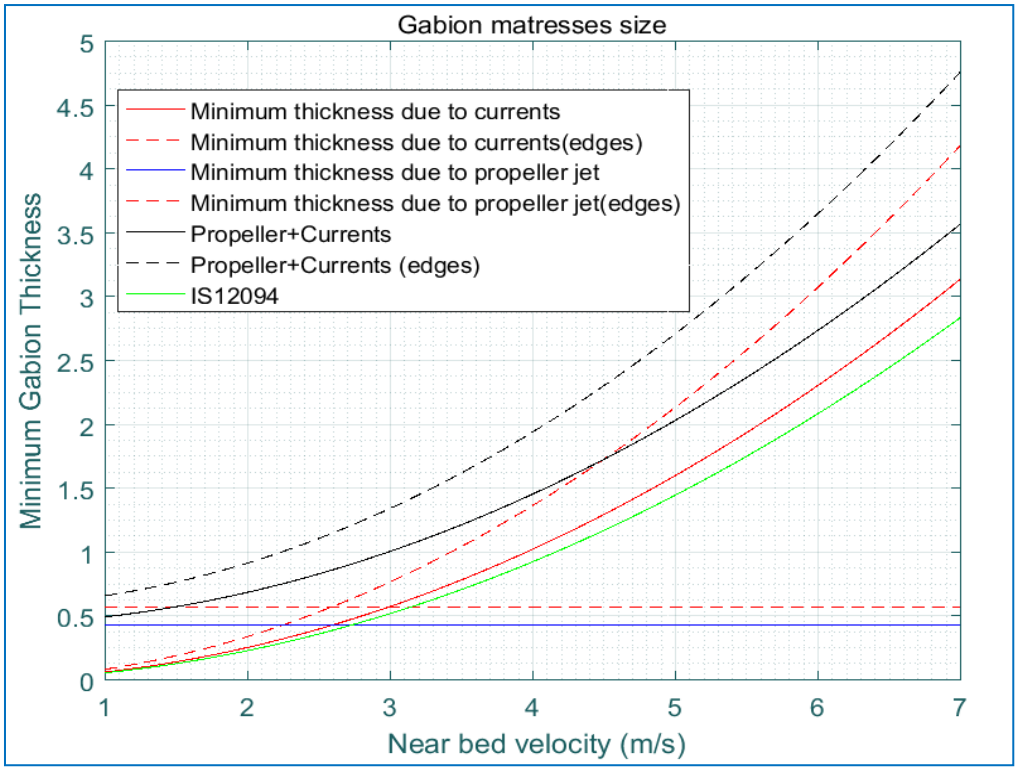


FIGURE 6.10: Minimum required thickness for revetment

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.

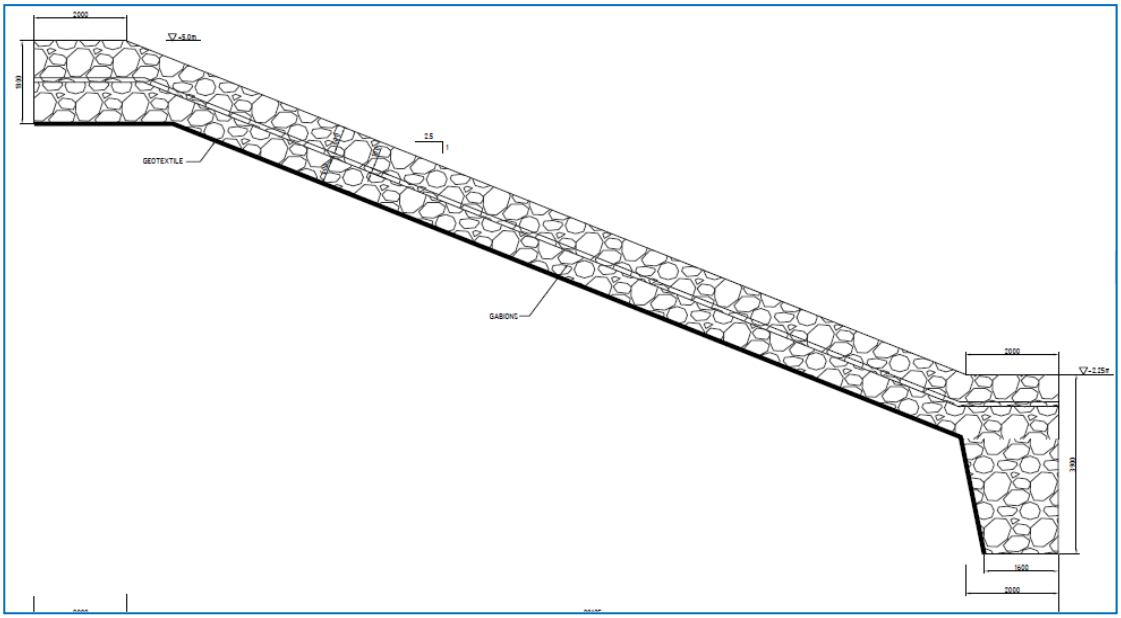


FIGURE 6.11: Detail of Bank Protection

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 (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.

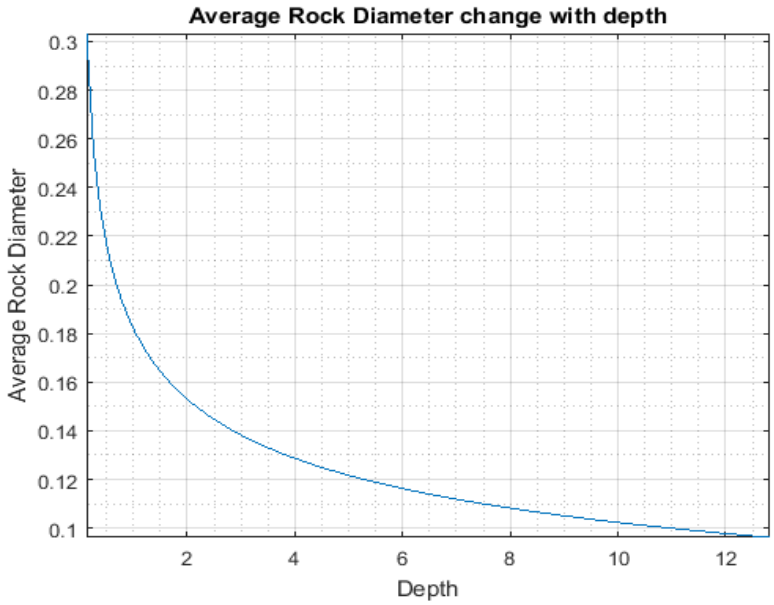


FIGURE 6.12: Minimum average rock diameter

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.

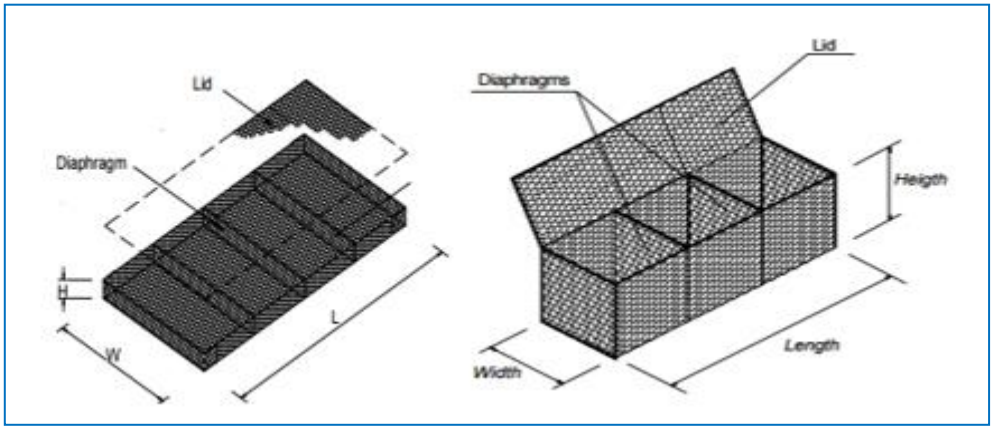


FIGURE 6.13: Example of a gabion mattress and gabion basket

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 composition	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

6.3.1. 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 : 10.9 m
- Breadth : 2.8 m
- Laden Draft : 0.50 m

6.3.2. Water levels

Estimation of FRL at Beechanahalli & Beeramballi Ferry Ghat

The waterway is in the upstream submergence area of Kabini reservoir and the for consideration of navigation, the highest water level is the FRL (696.16m RL) and the lowest water level is MDDL (690.68m RL). Dimensions of the largest ferry considered in the planning and design of the infrastructure are given below:

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

Building Floor Level +700.00 m RL

Top of Bank Sheet	+697.16 m RL
Gangway caters for differential flood levels in a slope of	1 in 4 to 1 in 12
Building levels	Refer drawing Volume-II Drawing No. **P.010256-W-20364-A03**

6.3.4. 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.

6.3.5. Topography

Topographic survey has been carried out in the location of the proposed terminal. Average existing ground level in the terminal area varies from +698.00 RL (approx.) to +699.5mRL (approx.).

6.3.6. Bathymetry

The bathymetric survey in the terminal location depicts that the riverbed level varies from +690 m RL (approx.) at landfall point to +696 m RL (approx.) at berthing pontoon location.

6.3.7. 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 6-5 : 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.

6.3.8. Scour

The scour depth has been estimated as below:

Design discharge adopted Q = 31007 m^3/s

Particle size, D50= 4.75 mm

Silt factor, f= 1.76 * Sqrt (D50) = 3.84

Lacey's regime scour depth = 0.473 * (Q/f) (1/3) = 10.07 m

Scour depth from HFL= 2*10.07= 20.15 m

HFL= 696.16 m (amsl)

Scour Level from Lacey Regime depth formula= 696.16 -20.15 = 676.00 m

The pile is taken upto RL 675.00m

Existing bed level close the location = 697.16 m

The pile termination level is kept at 675.00m which will provide a 5.0m developmental length having socketing arrangement with surrounding rock.

6.4. Materials of Construction

6.4.1. 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/mm^2
- 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.

6.5. 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.

6.5.1. 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.

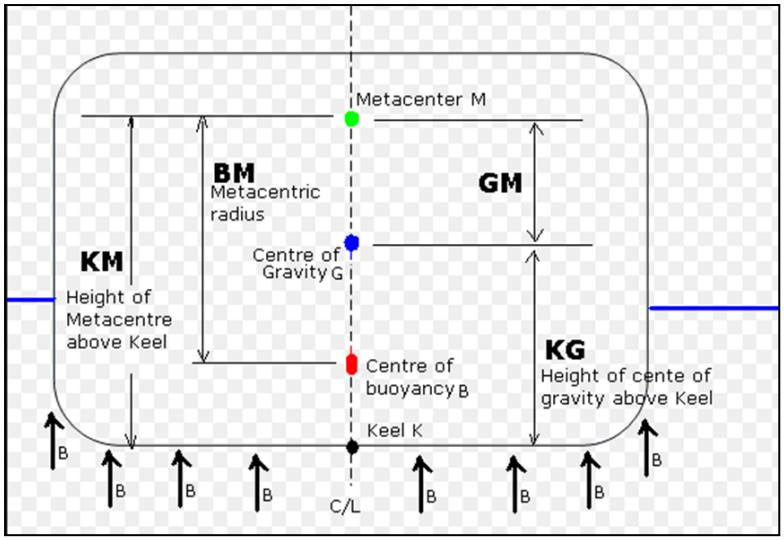


FIGURE 6.14: Floatation Stability Calculations

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.

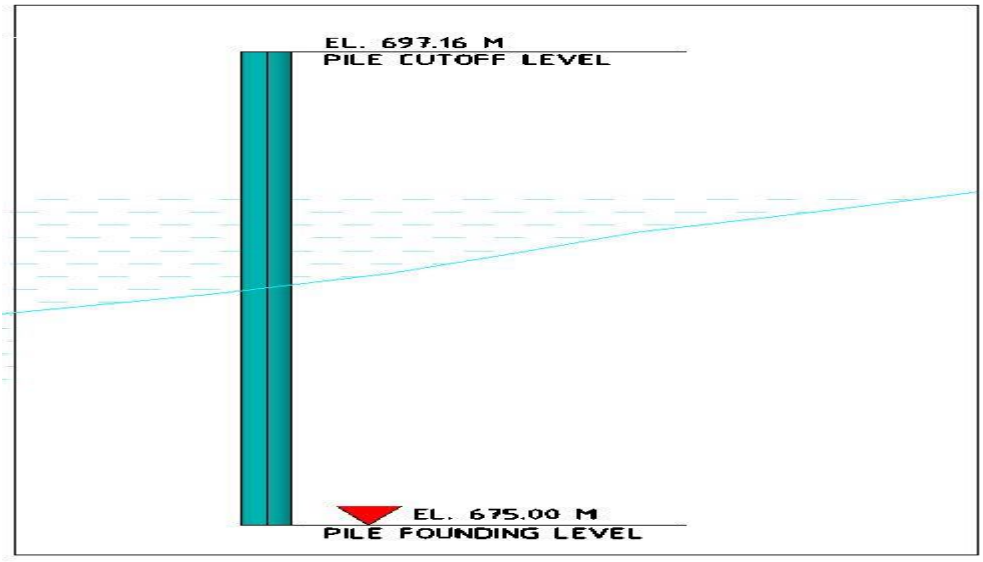


FIGURE 6.15: STAAD-Pro analysis model of pile for berthing pontoons

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

6.5.2. 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 I in 4.5 to 1 in 12. Only one gangway spanning 26.0m is proposed for this riverine infrastructure development for both the terminal location of Beechanahalli & Beeranballi with detail as below.

TABLE 6-6 Salient Features of Gangway

Sl No.	Location	Span	Width
1.	Gangway (Beechanahalli)	26 m	2.0m
2.	Gangway (Beeramballi)	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.

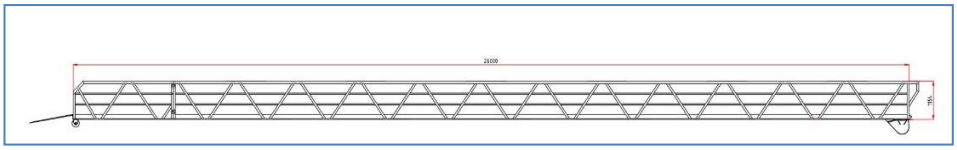


FIGURE 6.16: Elevation of Aluminium Gangway Span of 26.0m

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

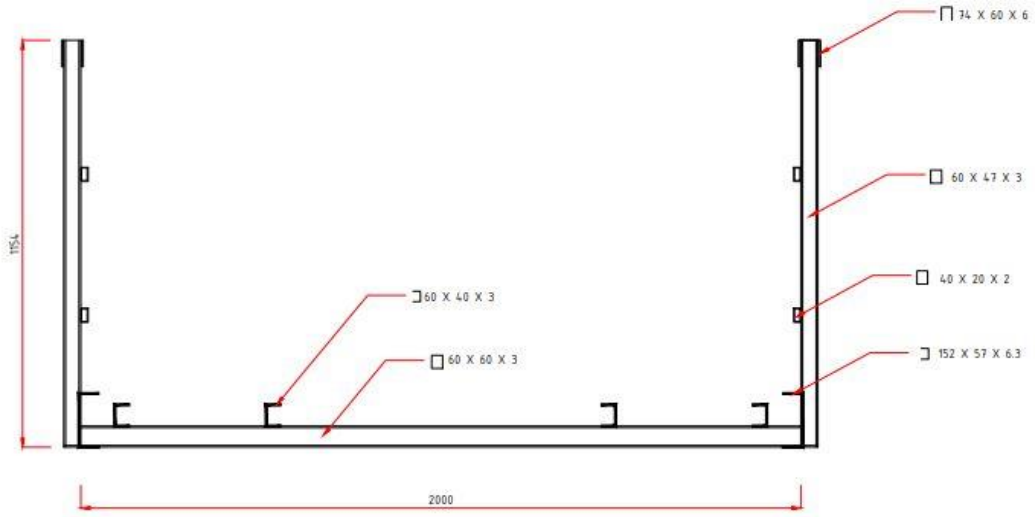


FIGURE 6.17: Section properties of member components of Aluminium Gangway

TABLE 6-7 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

6.6. 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

River Kabini (NW-51) is proposed to develop for tourists' movement. No cargo opportunity exists for IWT movement. Presence of national park on the river obstructs any scope of industrialisation in the hinterland. River Kabini (NW-51) has certain limitations imposed by government to protect local wild life. Traffic for River Kabini is projected based on the assumptions that government would release liberal and tourist friendly policies for upliftment of local economy. Two terminals have been proposed for alongside movement of ferry boats at Beechanahali and Beeramahali. Tourists could enjoy boat ride between these two terminals. A floating restaurant has also been proposed in the vicinity of Beechanahali terminal.

The predominant factors in vessel designing are Fairway and Traffic i.e., the Fairway availability and Traffic Type and Volumes to be 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 Kabini (NW-51) 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.

7.2.1. 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				
	Minimum 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 + 01 centimetres 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 Kabini (NW-51) has been considered as Class III. Class III waterways can operate passenger carrying vessel. It has been suggested and recommended to have 2 Terminals in River Kabini (NW-51) each at Beechanahali and Beeramahali.

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. River Kabini (NW-51) 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 Kabini (NW-51) is considered as 1.7 m. Vessels with draught less 1.7 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 Kabini (NW-51).

TABLE 7-2: Specification of Vessels – Sample

Vessel Name	Length (m)	Beam (m)	Draught (m)	Capacity (Pax.)
Wantaim 14m Fast Ferry	14	3.2	1.2	45
Wavelength 6	19.9	6.5	1.05	57
Fibreglass 67 Passenger Vessel	15.86	4.6	1.3	67
Aquacat	17.3	6	0.95	62
15m 50ft 75 seats Catamaran	15.0	4.5	0.8	75
ODC Marine - Vedette	18	4.7	1.25	84
Aresa 1650 FCAT	16.5	6.4	1.4	90
Ferry 75	22.9	6.5	0.8	100

Source: Consultant's Analysis

FIGURE 7.1: ODC Marine – Vedette 18m 84 Pax

FIGURE 7.2: Wavelength 6 – 57 Pax Ferry

FIGURE 7.3: Wavelength 6 – 57 Pax Ferry

FIGURE 7.4: 15m 150ft 75 Seats Catamaran Passenger Ferry

Any passenger ferry with less than 1.5 m draught is suitable for navigating in the defined stretch, as targeted depth of River Kabini (NW-51) is 1.7 m. The sample vessel specification proposed for tourist mobility considered at the initial stage is as follows.

(For Mono Hull Steel Boat)

- Size (L x B x D) – 20 m x 2.2 m x 1 m
- Capacity – 50 Passengers (seating capacity)
- Engine – 2 Marine Outboard Engines of 75hp (approx.)
- Speed - 12 Knots (max.)

(For FRP Boat)

- Size (L x B x D) – 20 m x 2.2 m x 0.8 m
- Capacity – 50 Passengers (seating capacity)
- Engine – 2 Marine Outboard Engines of 60hp (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 Kabini (NW-51), between Beechanahali and Beeramahali, is 23.17 Kms. The table below shows the calculation and assumptions considered to arrive at Turn Around time for single vessel at defined 23.17 km stretch of River Kabini (NW-51) carrying passengers.

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

Sl No.	Parameters	Unit	Honnavar to Gersoppa
1	NW-51 Stretch	Km.	23.17
2	Traffic Type Proposed	Type	Tourists
3	Terminal Proposed	Type	Passenger upgradable for Ro-Pax
4		No.	2
5	Embark / Disembark (both side)	Mins	30
6	Total Handling Time	Mins	30
7	Average Sailing Speed	Knots	10
8	Sailing Time	Mins	73 mins (Approx. 1 Hrs and 13 mins)
9	**Total Turn-around Time/trip/voyage**	**Mins**	**206 mins (Approx. 3Hrs 26 mins)**

Based on the above assumptions, a vessel loaded with passengers would take at least 3 hours 26 mins to complete one trip. 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 23.17 km of River Kabini (NW-51). 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 7-4: Assumptions for Calculating Vessel Requirement

Sl No.	Parameters	Unit	Beechanahali and Beeramahali
1	Operational Days	Days	300
2	Daily Operational	Hours.	8
3	Carrying Capacity	No.	50 Pax.
4	Vessel Speed	Nm. / km.	10/19
5	Loading and Unloading Time	Mins	30
6	Chainage (Honnavar to Gersoppa)	Km.	23.17
7	Turn Around Time/trip/voyage	Mins	**206 mins (Approx. 3Hrs 26 mins)**

Based on the above assumptions, number vessels required on the River Kabini (NW-51) is represented in the table below.

TABLE 7-5: Number of Vessel Requirement

Sl No.	Unit	FY23	FY25	FY30	FY35	FY40
Traffic (Boat Ride)	'000 No.	114	140	220	371	622
Annual Vessel Calls	No.	2280	2800	4400	7420	12440

Sl No.	Unit	FY23	FY25	FY30	FY35	FY40
Daily Vessel Calls	No.	7	9	14	24	41
Vessels Requirement	No.	2	2	3	4	7
Additional Vessel Requirement			-	1	1	3

The above calculation concludes that initially 2 passenger ferries will be required till FY27. Thereafter as per the projected traffic, need for additional one vessel will occur in FY28, FY32, FY36, FY38 and FY40. Total number of 7 vessels of 50 pax capacity with speed 12 knots need to be deployed in River Kabini (NW-51) to cater to the projected traffic. As shown in above calculations, it takes around 1.75 hours to reach to the other side terminal located at 23.17 km waterway distance. One vessel could make singe return journey in the considered speed and operational time above. 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 deployement of ferry for tourism would be by 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 River Kabini (NW-51) for tourism and passenger movement is as follows.

- ✓ Market Price for steel boat – Approx. INR 135 Lakhs
- ✓ Size (L x B x D) – 20 m x 2.2 m x 1 m, 50 pax
- ✓ Engine - 2 Marine Outboard Engines of 75 hp each.
- ✓ Market Price for FRP boat – Approx. INR 90 Lakhs
- ✓ Size (L x B x D) – 20m x 2.2 m x 0.8 m, 50 pax
- ✓ Engine - 2 Marine Outboard Engines of 60 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 3.5 Hrs mobility in a cycle and having 2 cyclic maximum operations in a day, cost per annum will be as detailed.
- 300 cycles x 3.5 Hrs x {0.16 Liter per hour x 2 Engines x 75 Bhp} x INR 94 per Liter = INR 23.68 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 {2*75} = **INR 3 Lakhs Per Annum**
- Repair Cost for **FRP boat** is @ 1% P. A of CAPEX i.e., 0.01 {2 x 60} = **INR 1.20 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 foolproof 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.

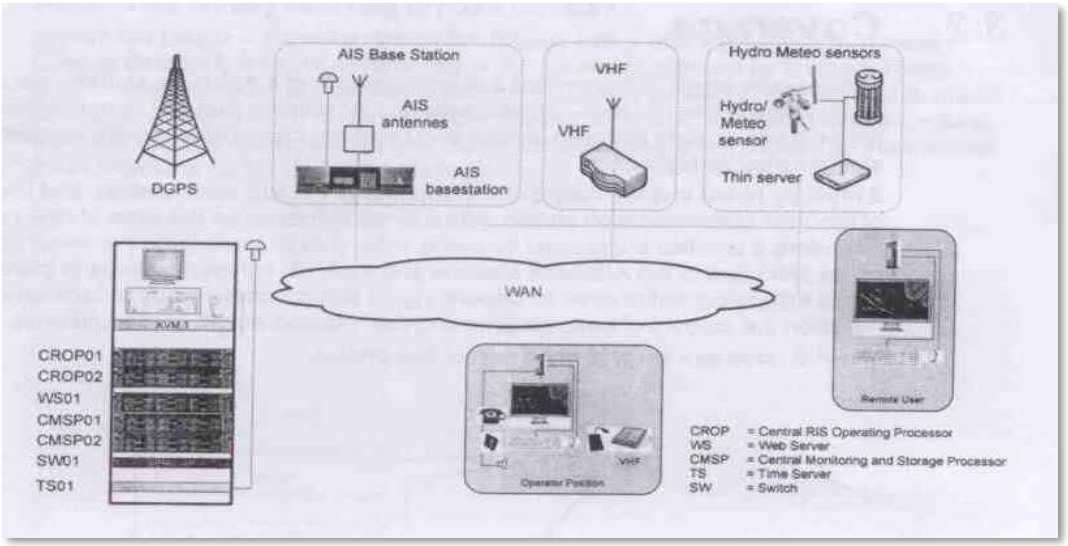


FIGURE 8.1: Main components of the RIS system are given below in flowchart

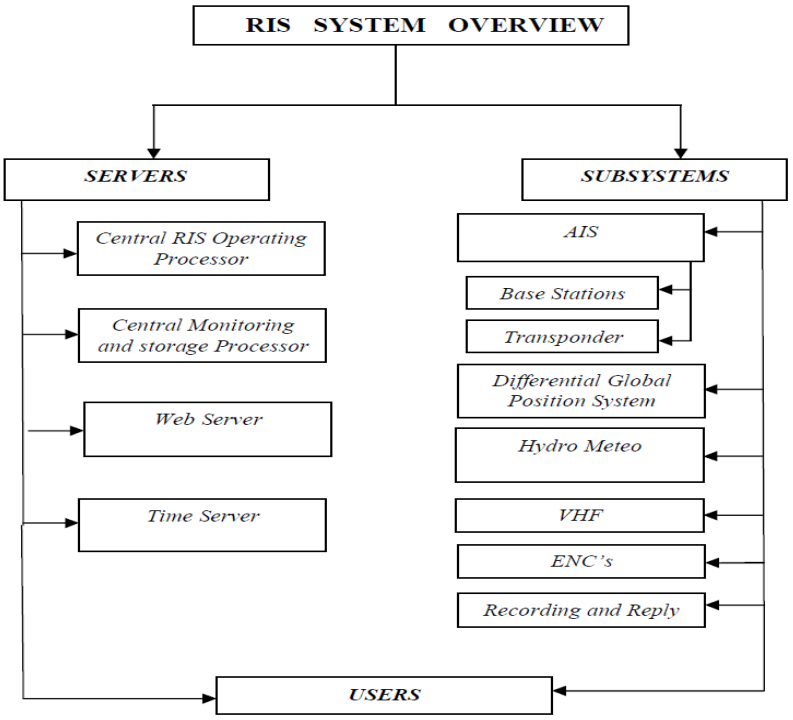


FIGURE 8.2: RIS System Overview

8.1.3.1. 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.

8.1.3.2. 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.

8.1.3.3. 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 other Terminal;
- Logistic supply chain manager at other 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.

8.1.3.4. 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 display 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 have been developed 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 at this stage. Anything discussed in this chapter is only academic and not recommended at this stage.

8.4. Costing

Since the Kabini Dam study stretch is not suggested with any communication system, there will not be any Capital Cost and O & M Cost. However, a nominal Lump Sum amount of INR 20 Lakhs has been provisioned under this head to meet the requirement at later date, when found.

8.4.1. Capital Cost

Lump-sum provision of INR 20 Lakhs has been considered.

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. 51 under the National Waterways Act 2016 and is located on Kabini river in the Mysuru district of Karnataka State. It is a 23.17 km stretch of the Kabini river beginning from Kabini dam site near village Beechanahalli at Lat 11°58'24.52"N, Lon 76°21'9.69"E to the identified terminal site near village Beeramballi at Lat 11°56'9.55"N, Lon 76°14'17.58"E.

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 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.

(Source: https://www.karnataka.com/profile/physiography/)

Mysore District, where the proposed waterway is located, is an undulating tableland with granitic rocks protruding at odd intervals. The general elevation of the district ranges between 700 and 900 metres above the mean sea level. The mountain ranges in the district originate from the Nilgiris along its southern borders and runs in a northwest and northeast direction. There are the Ghats and, in between them lies the Mysuru plateau, with an average elevation of 700 metres. Except in the north, the district is almost entirely surrounded by the Western Ghats which at places are at an elevation of more than 1200 meters above the mean sea level. Only along the southeast, the mountain ring is broken, where the river Cauvery takes its course towards the Ghats and plunges into the famous Gaganachukki and Barachukki falls at Shivansamudram. (Source: http://www.mysore.nic.in/geography.htm)

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

(Source: https://www.karnataka.com/profile/physiography/)

Together with their tributaries the seven river systems form a catchment of 191,773 sq km. The state accounts for about 6% of the country's surface water resources. The Western Ghats are a major divide for river basins. Rivers flowing westward into the Arabian Sea carry 40% of the state’s surface water and those flowing eastward 60%. (Source: State of Enviornment Report, Karnataka, 2011; Website: www.karnataka.gov.in/empri)

Mysuru district is endowed with a number of perennial and non-perennial rivers. The Cauvery which is the major system of the district traverses the Mysuru plateau from northwest to east along with its tributaries Kabini, Suvarnavathi, Laxmanathirtha and others. The Cauvery rises at Talacauvery in Kodagu district and flows along the boundary of Periyapatna taluk, enters into the district through K R Nagar taluk. It further moves into T. Narasipur and Kollegal before reaching Tamil Nadu.

The total catchments area of the river is the second largest in the State and it covers nearly 18 per cent of the land area of the State. It is the only river which has been harnessed for irrigation from ancient times and it is estimated that as much as 95 per cent of its surface flow is put to use before it enters into the Bay of Bengal. (Source: http://www.mysore.nic.in/geography.htm)

Kabini River, where the waterway under consideration is located, is a right bank tributary of Cauvery River. The Kabini River passes through the Wayanad District of Kerala State and Mysore District of Karnataka State. Kabini River originates from the Pakramthalam hills (Western Ghat) in Wayanad district of Kerala state at an altitude of about 2140m. It flows eastward to join the Kaveri River at Tirumakudalu Narasipura in Karnataka and the Kaveri River then empties into the Bay of Bengal. The total length of the river is about 195.50 km from origin up to the dam site.

The total catchment area of Kabini River is 2142 sq km.

9.2.2. Geology and Seismicity

Geologically, the Mysuru district is mainly composed of igneous and metamorphic rocks of Pre-Cambrian age either exposed at the surface or covered with a thin mantle of residual and transported soils. The rock formation in the district falls into two groups, charnockite series and granite genesis and gneissic granite. A fairly wide area of the district consists of charnokites series of rocks, particularly along the southeastern borders of Yelandur and Biligirirangana hills and also at the western border near Hangod in Hunsur Taluk. The intervening ground consists of granitic genesis with thin beds, lenses and elongated runs of various hornblendic rocks, pyroxenites and durities containing chromate and magnesite. Dolerites are in large numbers to the west of Hunsur and Gundlupet taluks.

The Sargur schist belt in H. D. Kote taluk extends from Sargur to Mysuru city for about 40 km. This belt was named as Sargur series. The series comprise of a complex series of metasediments and basic igneous rocks. The garnets illuminate gneiss and the associated norites occurring as patches within the genesis of southern Mysuru represent the remnants of the older khondalite - charnockite system.

In the H. D. Kote and Gundlupet regions, the bands of highly altered rocks of kyanite, staurolite, siliceous schists and also bands of limestone and quartizites are found. These rocks are of great economic importance because of the presence of graphite, corundum and granets in them. They extend from Bilikere region up to the southern border of the district in the south-southwest direction for nearly 50 km.

(Source: http://www.mysore.nic.in/geography.htm)

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 II. (Source: National Disaster Reisk Reduction Portal (Karnataka), National Institute of Disaster Management; Website: http://nidm.gov.in/pdf/dp/Karnataka.pdf)

Seismic observatories in Mysore, Somwarpet Taluk, Chincholi Taluk including a permanent station at Gulbarga are set up to monitor the magnitude of seismic waves in Karnataka. 11 districts in the state namely Bidar, Gulbarga, Bijapur, Bagalkot, Belgaum, Dharwad, Uttar Kannada, Shimaoga, Udupi, Dakshina Kannada and Kodagu are falling under seismic zone III. A total 42.173 Lakh hectares (22.13%) of the total geographical area of Karnataka is under moderate earthquake damage risk zone III (MSK VII) & remaining area of the state is under low damage risk zone. (Source: http://www.ndma.gov.in/en/karnataka-sdma-office)

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. (Source: https://www.karnataka.com/profile/physiography/)

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. This season is quiet pleasant as humidity reduces significantly. Winter stays in Karnataka during the months of January and February. The state experiences low temperature and reduced humidity. (Source: https://www.karnataka.com/profile/physiography/)

Karnataka is divided into three meteorological zones, as under:

Coastal Karnataka — This zone comprises the districts of Uttara Kannada, Udupi and Dakshina Kannada. It is a region of heavy rainfall and receives an average rainfall of 3638 mm per annum.

North interior Karnataka — This zone occupies the districts of Bidar, Belgaum, Bijapur, Bagalkot, Haveri, Gadag, Dharwad, Gulbarga, Koppal, Bellary and Raichur districts. This is an arid zone receiving only about 711 mm of average rainfall per annum.

South interior Karnataka — The rest of the districts of Karnataka falls into this zone. This zone receives about 1,064 mm of average rainfall per annum.

(Source: State of Enviornment Report, Karnataka, 2011; Website: www.karnataka.gov.in/empri)

Mysuru district enjoys cool and equable temperatures. Mysuru district shares the wider climatic pattern of the state as a whole, although there are some distinctive features. The climate of the district may be described as essentially tropical monsoon type. (Source: http://www.mysore.nic.in/geography.htm)

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

(Source: https://www.karnataka.com/profile/physiography/)

Six major types of soil are found in Karnataka in addition to 75 associations of subgroups. The major soil types include red soils covering 37.2% of the geographical area followed by black cotton soil with 27.8%. Other major types are alluvial soils with 15.7% followed by lateritic soil with 11.6%. (Source: State of Enviornment Report, Karnataka, 2011; Website: www.karnataka.gov.in/empri)

The soils of Mysore district can be broadly classified as the laterite, red loam, sandy loam, red clay and black cotton soils. The laterite soil occurs mostly in the western part of the district while the red loam is found in the northwest. These two accounts for nearly half the area of the district. The black cotton soil is found mostly in the north-eastern

parts of the district. The red sandy loam soils are derived from the granites and gneisses. The western taluks of Periyapatna, H D Kote and Hunsur are covered with hilly terrain and contain red, shallow gravelly soils. In the taluks of T. Narasipura and Nanjanagud, there is deep red loam occasionally interspersed with black soils. The red soils are shallow to deep well drained and do not contain lime nodules. The black soils are 1 to 1.5 metre in bases with good water holding capacity for a longer time. (Source: http://www.mysore.nic.in/geography.htm)

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. Whereas, uncultivable waste land, barren and fallow land are unused lands.

TABLE 9-1: Land Use Pattern in Karnataka

KARNATAKA
STATE
CLASSIFICATION OF TOTAL GEOGRAPHICAL AREA IN KARNATAKA

Unit: Area in lakh hectares.

Sl. No.	Classiication	Yea						
		1960-61	1970-71	1980-81	1990-91	2000-01	2010-11	2011-12
	Total Geographical Area	187.80	189.43	190.50	190.50	190.50	190.50	190.50
1	Forest	27.09	28.90	30.33	30.74	30.68	30.72	30.72
	Not available for cultivation:							
2	a) Land put to non-agri.uses	8.12	9.37	10.66	11.89	13.12	14.30	14.33
3	b) Barren & uncultivable land	9.22	8.39	8.44	7.99	7.94	7.87	7.87
4	Cultivable waste	6.56	6.15	5.02	4.46	4.27	4.14	4.13
	Uncultivated land excluding fallow land:							
5	a) Permanent pastures & other grazing land	17.39	16.19	13.46	10.98	9.59	9.12	9.08
6	b) Misc. Tree crops, Groves	3.66	3.11	3.42	3.16	3.03	2.86	2.85
	Fallow Land							
7	a) Current fallow	8.35	8.11	14.59	12.90	13.67	11.99	16.72
8	b) Other fallow land	5.13	6.72	5.58	4.57	4.08	4.26	5.39
9	Net Area Sown	102.28	102.48	98.99	103.81	104.10	105.23	99.41
	Total Cropped Area	**105.88**	**108.87**	**106.60**	**117.59**	**122.84**	**130.62**	**120.59**
	Area sown more than once	3.60	6.39	7.61	13.78	18.74	25.40	21.18
	Cropping Intensity - %	**103.52**	**106.24**	**107.69**	**113.27**	**118.00**	**124.13**	**121.30**

Source: Annual Season & Crop Reports of DE&S, Bangalore.

Source: http://raitamitra.kar.nic.in/ENG/statistics.asp

TABLE 9-2: District-Wise Land Use Pattern in Karnataka

CLASSIFICATION OF TOTAL GEOGRAPHICAL AREA IN KARNATAKA - 2011-12

(Area in Hectares)

S. No.	District	Total Geo-graphical area	Classification of area										
			Forest	Not available for cultivation		Cultivable waste	Uncultivated land excluding fallow land		Fallow land		Net Area Sown	Total Cropped Area	Area Sown more than once
				Land put to non-agri. uses	Barren & uncultivable land		Pmt.pastures & other grazing land	Mics.tree crops, groves	Current fallows	Other Fallow land			
1	Bagalkote	658877	81126	28832	24810	2035	3429	274	30819	9971	477581	616301	138720
2	Bangalore (Urban)	217410	5055	115806	4911	3844	5674	7517	17779	5391	51433	53591	2158
3	Bangalore (Rural)	229519	11322	39978	11124	3898	3879	12498	9653	11397	125770	130615	4845
4	Belgaum	1344382	190424	69795	44342	11465	24807	3046	226952	6971	766580	1011264	244684
5	Bellary	813196	97017	110291	53477	24839	5472	3606	91048	13374	414072	532016	117944
6	Bidar	541765	27707	22006	19127	19382	13964	10915	37597	40275	350792	415695	64903
7	Bijapur	1053471	1977	36068	29059	5502	9575	1316	215485	5685	748804	844202	95398
8	Chamarajanagar	569901	275610	24611	21434	7637	22750	4741	15745	12977	184396	222404	38008
9	Chikkaballapur	404501	49704	31933	34302	4743	55550	6482	9939	6381	205467	215484	10017
10	Chikkamagalur	722075	200485	43190	28322	19412	88585	21257	23044	4792	292988	323635	30647
11	Chitradurga	770702	73719	51243	25403	21612	88740	11317	89767	21801	387100	453484	66384
12	Dakshina Kannada	477149	128476	65509	58780	30554	19027	31652	6288	5417	131446	157683	26237
13	Davanagere	597597	89918	39079	20533	8525	19538	4955	20620	5419	389010	486680	97670
14	Dharwad	427329	35235	22982	3985	2669	3571	202	63426	6617	288642	477025	188383
15	Gadag	465715	32614	10481	11628	1010	2592	273	49348	5145	352624	494617	141993
16	Gulbarga	1094120	35316	38420	35113	9417	25855	1131	38648	14394	895826	972506	76680
17	Hassan	662602	58775	79405	30365	14142	32943	6963	50127	30690	359192	449236	90044
18	Haveri	485156	47454	33096	5793	2989	12209	2290	12114	6004	363207	411129	47922
19	Kodagu	410775	134597	24215	31010	9076	13884	20219	4231	3621	169922	185882	15960
20	Kolar	374966	20620	45677	28870	6397	39418	7009	33449	10312	183214	194233	11019
21	Koppal	552495	29451	39003	16627	2568	14675	210	19659	80104	350198	433195	82997
22	Mandya	498244	24765	60906	21519	41955	32049	3428	34867	46351	232404	272524	40120
23	Mysore	676382	62851	75946	45018	21407	46808	5871	39116	34457	344908	536323	191415
24	Raichur	835843	18167	20563	20084	10712	19816	13684	227704	47051	458062	541135	83073
25	Ramanagar	355912	69946	26225	24339	1178	24662	3950	20435	20875	164302	168997	4695
26	Shimoga	847784	276855	88708	13312	16311	163463	26868	8811	25491	227965	267814	39849
27	Tumkur	1064755	45177	84956	67539	62642	76453	21033	167729	29684	509542	575961	66419
28	Udupi	356446	100102	39876	11595	38528	10625	46763	269	8560	100128	117884	17756
29	Uttara Kannada	1024679	813595	34547	16234	6450	16625	4806	5906	14214	112302	123533	11231
30	Yadgir	516088	33773	29609	27966	2385	11755	737	101212	5129	303522	374319	70797
	Karnataka State:	**19049836**	**3071833**	**1432956**	**786621**	**413284**	**908393**	**285013**	**1671787**	**538550**	**9941399**	**12059367**	**2117968**
	Area in Lakh Hects.	**190.50**	**30.72**	**14.33**	**7.87**	**4.13**	**9.08**	**2.85**	**16.72**	**5.39**	**99.41**	**120.59**	**21.18**

Source: Annual Season & Crop Report 2011-12, DE&S, Bangalore.

Source: http://raitamitra.kar.nic.in/ENG/statistics.asp

e project area is characterized by mixed land use comprising largely mangrove forests and agricultural land interspersed with minor settlements, fishing jetties and roads.

9.2.6. Ambient Air and Noise Quality

The Air (Prevention & Control of Pollution) Act, 1981 of India describes air pollutants as *'Any solid, liquid or gaseous substance (including noise) present in the atmosphere in such concentration as may or tend to be injurious to human beings or other living creatures or plants or property or environment'*. The condition of air quality in the surroundings is the ambient air quality.

In India the Central Pollution Control Board (CPCB) coordinates the air quality monitoring regime through its nationwide programme known as National Air Quality Monitoring Programme (NAMP). CPCB has been monitoring ambient air quality through 363 stations in 139 cities across the country as of November, 2009.

The Karnataka State Pollution Control Board (KSPCB) is monitoring ambient air quality under NAMP in 14 monitoring stations at Bangalore and other six major towns in the state. Six of them are in industrial areas, six in residential, rural and other areas and two in sensitive areas.

National Ambient Air Quality Standards (NAAQS) set limits for air pollutants with an adequate margin of safety to protect public health, vegetation and property. There were seven parameters, namely, sulphur dioxide (SO2), oxides of nitrogen (NOX), ozone (O3), particulate matter (PM), lead (Pb), carbon monoxide (CO) and ammonia (NH3) notified under the Air Act, 1981 and the Environment (Protection) Act, 1986. These are known as air quality criterion pollutants. Under NAMP, CPCB and KSPCB regularly monitor only four viz., Sulphur dioxide (SO2), oxides of nitrogen (NOX), suspended particulate matter (SPM) and respirable suspended particulate matter (RSPM) which are less than 10 µg in weight, commonly called PM10.

(Source: State of Enviornment Report, Karnataka, 2011; Website: www.karnataka.gov.in/empri)

The project area is devoid of any industrial establishment and has limited vehicular movement. There are no major industries within 50 km of the project area. There is one ferry service operational from Beemankolly near Kabini Dam. There are thick forests on both banks of the river. As per the hydrographic survey carried out for NW 51, there are five villages located on the right bank of the river along the proposed waterway stretch and six villages located on the left bank. There is agricultural land on both banks of the river all along the proposed waterway stretch. With little habitation, no industries and limited vehicular movement, there are no major sources of air and noise pollution

in the project area and the overall ambient air quality in the project area is found to be of acceptable standards.

Primary data on ambient air quality monitoring in the project area is to be collected as part of the EIA study for the project to be carried out separately by IWAI.

9.2.7. Ambient Water Quality

As per surface water sample tests carried out as part of the present study, the river water in the NW-51 stretch is slightly basic in nature with average pH being 7.51. Surface water quality analysis has been done at three sample locations in the project stretch as part of the hydrographic survey carried out for the present DPR study. The sample locations for water quality analysis include Beechanahalli, Sogahalli and Beeramballi at Ch. 0 km, Ch. 10 km and Ch. 20 km respectively. The pH values for the three locations are 7.61, 7.51 and 7.42 respectively, which indicates the alkaline nature of water in the identified stretch of NW-51 in the Kabini river.

As per the State of Environment Report, Karnataka, 2011, surface and groundwater of the state is under increasing pressure with rising contamination levels of biological, toxic, organic and inorganic pollutants. The main sources are industrial and domestic effluent (so-called point sources) and non-point sources such as agricultural run-off carrying agro-chemicals, municipal waste and human faeces from open defecation.

Surface water bodies particularly rivers and lakes are highly polluted with increasing pollution loads from agricultural discharge, industrial effluents and sewage. Karnataka State Pollution Control Board (KSPCB) assessed water quality, sediment and biological samples in the Tunga, Bhadra and Tungabhadra rivers in 2006-07. The analysis reveals that in the Tunga river, one of three sample locations is ‘moderately polluted’ and two ‘slightly’. In the Bhadra river, two of the four sampling stations are ‘moderately polluted’ and another two ‘slightly’. In the Tunganhadra river, seven of the ninemonitoring stations were classified as ‘moderately polluted’ and one as ‘slightly’. It is inferred that these rivers have become outlets for untreated or insufficiently treated wastewater from industries and households.

Between 2009 and 2010 highly polluting (or Red category) establishments in Karnataka regulated by KSPCB were investigated by Environmental Management & Policy Research Institute (EMPRI). The study identified 13,125 operating Red establishments, including 2,881 industries, 6,391 heath care establishments, 293 mines, 1,616 stone crushers and 1,944 local bodies.

(Source: State of Enviornment Report, Karnataka, 2011; Website: www.karnataka.gov.in/empri)

The Central Pollution Control Board (CPCB) has established a network of monitoring locations on aquaitic resources across the country. The present network operated under Global Environmental Monitoring System (GEMS) and Monitoring of Indian National Aquatic Resources System (MINARS) covers 445 rivers in 29 States and 6 Union territories having 1275 locations.

Based on an anlysis of the water quality data for the years 2009-2012, CPCB published a report in February 2015 titled 'River Stretches for Restoration of Water Quality' (Monitoring of Indian National Aquatic Resources Series: MINARS/37 /2014-15).

In the said report, the rivers have been prioritized based on the concentration of BOD in five classes from Priority I to V. The criteria of each priority are elaborated indicating the concentration range of BOD in mg/l. The degree of violation is with respect to water quality criteria for drinking water source with conventional treatment with respect to BOD. The polluted locations in a continuous sequence are defined as polluted river stretches.

Criteria for Priority I

Monitoring locations exceeding BOD concentration 30 mg/l.

Criteria for Priority II

Monitoring locations having BOD between 20-30 mg/l.

Criteria for Priority III

Monitoring locations having BOD between 10-20 mg/l.

Criteria for Priority IV

Monitoring locations having BOD between 6-10 mg/l.

Criteria for Priority V

Monitoring locations having BOD between 3-6 mg/l.

According to this report, water quality of rivers in Karnataka is measured at 61 locations on 25 rivers and among them 38 locations is non-complying to the Water Quality Criteria with respect to BOD. These 38 locations are on 15 rivers. The names of 15 polluted rivers are; Arkavathi, Bhadra, Bhima, Cauvery, Ghatprabha, **Kabini**, Kagina, Kali, Krishna, Lakshmantirtha, Malprabha, Manjira, Shimsha, Tungabhadra and Tunga. These rivers are classified in priority class IV and V based on the level of BOD.

The details of the polluted river stretches in Karnataka are provided in Table 9-3.

TABLE 9-3: Details of Polluted River Stretches in Karnataka

S. No	River Name	Stretch Identified	Towns Identified	Approx. Length of the Stretch (in Km)	BOD Range / Max. Value	Priority Class
1.	Arkavathi	Halli Reservoir to Kanakapura Town	Bengaluru, Bhadravathi	35	5.0-8.0	IV
2.	Bhadra	Holehunnur to Bhadravathi	Chikkodi, Kopa	10	6.0	V
3.	Bhima	Ghanapur to Yadgir	Jevargi	80	3.8-5.0	V
4.	Cauvery	Ranganathittu to Sathyamangalam Bridge	Sriranga Patna	50	4.0	V
5.	Ghatprabha	Gokak To Chigadolli	Gokak	5	4.0	V
6.	**Kabini**	**Nanjanagud to Hejjige**	**Basavanapura, Chikkaiahnachatra**	**5**	**5.0**	**V**
7.	Kagina	Shahabad to Hongunta	Bhankoor	10	3.1-3.2	V
8.	Kali	Hasan Maad (West Coast Paper Mill) to Bommanahalli Reservoir	Dandeli	10	4.3	V
9.	Krishna	Yadurwadi to Tintini Bridge	Ugarkhurd, Chikkodi, Narayanpura	200	3.2-4.8	V
10.	Lakshman Tirtha	Kattemalavadi to Hunsur	Undavadi	10	4.0-5.0	V
11.	Malprbha	Khanapur to Dharwad	M.K Hubli, Kadrolli	80	3.4-4.6	V
12.	Manjira	Bidar to Hussain Nagar	Nittur, Chambol, Bidar	10	3.5	V

S. No	River Name	Stretch Identified	Towns Identified	Approx. Length of the Stretch (in Km)	BOD Range / Max. Value	Priority Class
13.	Shimsha	Yediyar to Halagur	Thattekere, Mallur	80	4.5	V
14.	Tungabhadra	Harihar to Korlahalli	Ullanur, Harihar	60	3.5-9.3	IV
15.	Tungha	Shivamoga to Kudli	Shivamoga	10	6.7	IV

Source: River Stretches for Restoration of Water Quality, CPCB, 2015 (Monitoring of Indian National Aquatic Resources Series: MINARS/37 /2014-15).

The identified polluted stretch of 5 km of Kabini river, which runs from Nanjanagud to Hejjige, lies beyond the proposed NW-51 stretch. As can be noted from the data provided in Table 1-3 above, with a maximum BOD value of 5.0 the the river stretch under consideration is amongst the least polluted river stretches and falls under Priority Class V.

Additional primary data on water quality in the project area may be collected at a later stage as part of the EIA study to be carried out eparately by IWAI.

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 kms 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 Arabian Sea. The floods are quite common in the districts namely Belgaum, Bijapur, Bagalkote, Raichur, Gulbarga, Shimaoga, Chikkamagalur, Udupi, Coorg, Bellary, Dakshina Kannada, Dharwad, Davanagere, Gadag, Hassan, Uttara Kannada, Koppal, Bidar, Bangalore (R), Bangalore(U), Kolar, Mandya, Mysore, Chamarajanagar. In the North Karnataka region covering the Krishna and Godavari Basins, even when the state was suffers under drought like conditions, heavy discharges from Maharashtra cause floods.

Hilly regions of Western Ghats spread in the districts of Kodagu, Chikmagalur, Hassan, Shimoga, D. Kannada and U. Kannada record a very high rainfall of 2000mm to 4000mm. Landslides are common in these districts. During the rainy periods these hilly regions regularly experience displacement of rocks and soils causing widespread damage to property, infrastructure such as rails, roads and loss of human life.

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

(Source: National Disaster Risk Reduction Portal (Karnataka), National Institute of Disaster Management; Website: http://nidm.gov.in/pdf/dp/Karnataka.pdf)

9.2.9. Estuary and Coastal Zone

Karnataka has a coastline of over 300 km and there is gradual transition between the Konkan coast in the north and Kerala coast in the south. The coastal region is further divided into two parts, the plains and the Western Ghats. The coastal plains are partly formed by marine denudation, but the level character of the land is severely restricted directly by the Western Ghats and transverse intrution. Esturine plains of Kali, Gangavali and the Tadri (Bedti) and the Sharavati rivers, separated by two east-west Sahydri off shoots, boarders the coastline. To the east of the coastal plains, the general elevation is higher, and increase occurs abruptly resulting in Western Ghats sections. The Western Ghats run NNW to SSE for about 320 km.

(Source: National Wetland Atlas: Karnataka, sponsored by Ministry of Environment and Forests, Government of India as a part of the project on National Wetland Inventory and Assessment (NWIA), Space Applications Centre (ISRO), Ahmedabad and Karnataka State Remote Sensing Applications Centre, (KSRSAC), Bangalore, August 2010)

The entire National Waterway 51 project area falls in the non-tidal zone.

9.2.10. Archaeological and Heritage Locations

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

As per the information available on the website of Arachaeological Survey of India, Karnataka has a total of 747 Protected Monuments. 30 of these protected monuments are located in Mysore District. None of these protected monuments are located close to Kabini River stretch falling under NW-51. Accordingly, no activities relating to the project will be carried out inside the prohibited or regulated areas of these protected monuments. Therefore, no clearance requirement is envisaged with respect to these structures.

Prohibited and Regulated Areas are defined in the Ancinet Monuments and Archeological Sites and Remains (Amendment and Validation) Act, 2010, and the definition of the two terms is as follows:

Prohibited Area: Every area, beginning at the limit of the protected area or the protected monument, as the case may be, and extending to a distance of one hundred metres in all directions shall be the prohibited area in respect of such protected area or protected monument.

Regulated Area: Every area, beginning at the limit of prohibited area in respect of every ancient monument and archaeological sites and remains, declared as of national importance and extending to a distance of two hundred metres in all directions shall be regulated area in respect of every ancient monument and archeological site and remains.

A list of the protected monuments located in Mysore District, alongwith their distance from the proposed waterway as measured on Google Map, is provided in Table 9-4 below.

TABLE 9-4: Protected Monuments Located in Mysore District, Karnataka

Sl No.	**MONUMENTS**	**SHORTEST DISTANCE FROM NW-51 (km)** **As Measured on Google Map**	**LOCATION**
1.	Varahaswamy Temple	61.4	Mysore
2.	Lakshmiramana Temple	41.8	Mysore
3.	Trinayanesware Temple	-	Mysore
4.	Prasanna Krishnaswamy Temple	47.37	Mysore
5.	Kodi Someshvara and Kodi Bhairaveswara Temples	84.88	Mysore
6.	Chamundesvari Temple and Mahabalesvara Temple on hill	48.19	Mysore
7.	Colossal Bull	-	Mysore

Sl No.	MONUMENTS	SHORTEST DISTANCE FROM NW-51 (km) As Measured on Google Map	LOCATION
8.	Mahalingesvara Temple	43.22	Mysore
9.	Temples	-	Mysore
10.	Ramesvara Temple	58.50	Mysore
11.	Varadaraja Temple	25.33	Mysore
12.	Lakshmikanta Temple and adjoining Temples, Mantapas and Sandle wood door of Sati Shrine	171.22	Mysore
13.	Somesvara Temple	--	Mysore
14.	Narayana Temple	--	Mysore
15.	Lakshmikanta Temple	--	Mysore
16.	Nagesvara Temple	52.51	Mysore
17.	Ramanujacharya Temple	--	Mysore
18.	Adinath Basti	--	Mysore
19.	Arkesvaraswami Temple	174.64	Mysore
20.	The Temples and the Gomatesvara figure at Gometesvara Hill	--	Mysore
21.	Keshava Temple	168.76	Mysore
22.	Agasthesvara Temple	66.48	Mysore
23.	Hanumanthesvara Temple	--	Mysore
24.	Amruthesvara Temple	--	Mysore
25.	Wellington Lodge	50.33	Mysore
26.	Gunjanarasimhaswamy Temple	66.03	Mysore
27.	Yoganarasimhaswamy Temple	48.2	Mysore
28.	Mulastanesvaa Temple	--	Mysore
29.	Talakadu Maralu Dibbagalu	--	Mysore
30.	Chennakeshara Temple	137.50	Mysore

(Source: http://asi.nic.in/asi_monu_alphalist_karnataka_bangalore.asp)

9.2.11. Flora and Fauna

Karnataka has a rich diversity of flora and fauna. The state has a recorded forest cover of 39,369 km^2 which constitutes 20.5% of the total geographical area of the state. These forests support 25% of the elephant and 18% of the tiger population of India. The Western Ghats, a biodiversity hotspot, includes the western region of Karnataka. The abundant diversity of the Western Ghats includes hundreds of medicinal plants of high value.

The Western Ghats region, which extends well beyond Karnataka, is recognised as one of the 25 biodiversity hotspots of the world and accounts for 4,000 known species of flowering plants.

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.

A study of Bawa K.S. et al. (2007) funded by the Critical Ecosystem Partnership Fund made an exhaustive analysis of biodiversity of the Western Ghats. It concludes that 50% of its biodiversity is present in Karnataka. It further found that 332 globally threatened species occur in the Western Ghats, comprising of 229 plant species, 31 mammals, 15 bird species, 52 amphibians, four reptiles and one fish species. 55 of these are critically endangered, 148 endangered and 129 are vulnerable.

(Source: State of Environment Report: Karnataka, 2011)

9.2.11.1. FLORA

Outside forests, Karnataka's tree cover is estimated to be 5,733 sq km. This accounts for 3.0% of the state's geographical area and consists of tree plantations of rubber (*Haevia braziliensis*), silver oak (*Grevillea robusta*), dadap (*Erythrina indica*), mango (*Mangifera indica*), coconut (*Cocos nucifera*), cashewnut (*Anacardium occidentale*), eucalyptus, casurina (*Casuarina equisetifolia*) and other cash crops. The growing stock of woody biomass for major forest types has been estimated to be 417 million cu m. This estimate considers both the forest inventory and trees outside forests.

Nair and Daniel (1986) estimated that there are 4,000 species of flowering plants in the Western Ghats of which about 1,500 are endemic. Approximately 63% of India's woody evergreen taxa are endemic to the Western Ghats according to Johnsingh (2001). Daniels (2001) states that 352 of the 650 tree species found in the Western Ghats are endemic. Tree genera endemic to the Western Ghats include *Blepharistemma, Erinocarpus, Meteromyrtus, Otenophelium, Poeciloneuron, and Pseudoglochidion.*

Other plant genera endemic to the Western Ghats include Adenoon, Griffithella, Willisia, Meineckia, Baeolepis, Nanothamnus, Wagatea, Campbellia, and Calacanthus (Nair, 1991). The grass family *Gramineae (Poaceae)* has the highest number of endemic genera and the genus Nilgirianthus has 20 endemic species across all genera in this family (Nair, 1991).

(Source: State of Environment Report: Karnataka, 2011)

9.2.11.2. FAUNA

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).

Insects

Butterflies in the Western Ghats belong to five families, 166 genera, and 330 species, of which 37 species are endemic (Gaonkar, 1996). The southern Western Ghats extending from Agasthyamalai to the Palghat Gap holds the highest diversity of butterfly species with the most number of endemics (Gaonkar, 1996). Goa and Uttara Kannada are other regions within the Western Ghats with high butterfly diversity.

According to a recent study, there are at least 200 species of spiders in the Western Ghats. The dominant families are *Argyopidae, Salticidae, Thomisidae, Oxyopidae, Lyniphidae, and Hersilidae* (Rajashekhar and Raghavendra, 2001 cited by Daniels, 2001). Studies have indicated that there has been a decline in the diversity of aquatic insects in some areas of the Western Ghats due to anthropogenic interference leading to habitat loss and pollution (Daniels, 2001).

Fishes

Daniels (2001) reports 218 species of fishes from primary and secondary freshwaters in the Western Ghats, of which 116 (53% representing 51 genera) are endemic to the region. Streams and rivers in the southern parts tend to support greater diversity than those in the north and east-flowing streams and rivers have richer fish faunas than west-flowing ones. High levels of endemism are also associated with the ichthyofauna of the southern Western Ghats, which includes several endemic genera (*Brachydanio, Lepidopygopsis, Bhavania, Travancoria, Horabagrus, Horaglanis, Horaichthys*). The highest diversity of freshwater fishes is in deep, slow-moving waters. The species composition of many freshwater fish assemblages has been extensively modified by the introduction of invasive alien species, which are now naturalised. The distribution

of many species is also adversely affected by the construction of dams to create artificial lakes and reservoirs.

Amphibians

Approximately 126 species of amphibians from 24 genera are known from the region, with new species being frequently added to the list (Daniels, 2001). The Western Ghats has the highest levels of amphibian endemicity in India. The largest family is *Ranidae* (49 species) followed by *Rhacophoridae* (30 species). The Western Ghats also harbour a remarkable number of caecilians (families *Ichthyophidae* and *Caeciliidae*) – 16 species, all of them endemic to the region. Distribution within the region varies from extremely widespread e.g. black-spined toad (*Bufo melanostictus*), skittering frog (*Euphlyctis cyanophlyctis*), Indian bullfrog (*Hoplobatrachus tigerinus*) to highly restricted e.g. Malabar torrent toad (*Ansonia ornata*), *Indirana gundia* and *Micrixalus kottigeharensis* (Nair, 1991 and Daniels, 1992).

Reptiles

Approximately 157 species of reptiles are reported from the Western Ghats, representing 36 genera: Two genera of turtles/tortoises, 14 genera of lizards, and 20 genera of snakes (Ishwar, unpublished information). Of these, nearly 50% are endemic.

Among the different habitats of the Western Ghats, the evergreen forests alone are known to support approximately 130 species of reptiles. Certain groups of reptiles have a very high proportion of endemics; for example, about 70% of the uropeltid snakes are endemic to the Western Ghats. Endemism is also high among lizards (65%). Many of the rare and endemic reptiles are known only from single locality records. A major challenge to conservation efforts in this region is the lack of a complete understanding of the distributional patterns, habitat requirements, and conservation status of reptiles in the Western Ghats.

Birds

The status and distributions of bird species in the Western Ghats is relatively well known. A total of 508 species have been recorded in the region, including 324 resident species (64%). This figure also includes 144 (28%) species of aquatic birds, many of them from the western coastline. The central parts of the region (especially Uttara Kannada district) harbour the highest diversity of bird species. Due to the interspersion and juxtaposition of different habitat types in secondary and disturbed evergreen and moist deciduous forests, these forests have the highest number of bird species including many habitat generalists and migrants in addition to resident and endemic species. 16 species are endemic to the Western Ghats region (Daniels, 2001), most of

them occurring in the areas southwards of Goa. Many of the endemics are obligates of evergreen forests and shola-grassland systems.

Mammals

Of the 137 species of mammals recorded in the Western Ghats, the largest representation is from the orders Chiroptera (41 species), Rodentia (27 species) and Insectivora (11 species). Of the 127 species, 14 are endemic (Daniels, 2001) and three are listed as critically endangered. One of the critically endangered species, Wroughton's free-tailed bat (*Otomops wroughtonii*), is restricted to a single cave within the Western Ghats and has been recently discovered in Cambodia and north-eastern India (Walston and Bates, 2001 and Thabah and Bates, 2002).

A total of seven species of mammals are endemic to the southern Western Ghats and Sri Lanka as a unit: The mountain shrew (*Suncus montanus*), slender loris (*Loris tardigradus*), stripe-necked mongoose (*Herpestes vitticollis*), Sri Lankan giant squirrel or grizzled giant squirrel (*Ratufa macroura*), Layard's striped squirrel squirrel (*Funambulus layardi)*, dusky striped squirrel (*Funambulus sublineatus*), and the Travancore flying squirrel (*Petinomys fuscocapillus*).

(Source: State of Environment Report: Karnataka, 2011)

Threatened and Endangered Species

Critically endangered flora in Karnataka includes evergreen trees such as *Dipterocarpus bourdilloni, Hopea erosa and Hopea jacobi, Croton lawianus* (a small tree) and *Pinnatella limbata* (a moss). Other endangered trees include *Isonandra stocksii, Kingiodendron pinnatum, Maesa velutina, Myristica magnifica, Rapanea striata* and *Xylosma latifolium*.

Endangered fauna in Karnataka includes the tiger, the Indian elephant, the lion tailed macaque, the turtle and the Indian wild dog dhole (*Cuon alpinus*). It also includes amphibians (*Indirana brachytarsus, Microhyla sholigari, Minervarya sahyadris, Nyctibatrachus aliciae, Nyctibatrachus hussaini, Nyctibatrachus sanctipalustris, Philautus charius, Philautus wynaadensis, Ramanella mormorata* and *Rhacophorus lateralis*), a toad (*Bufo beddomii*) the Kolar leafnosed bat (*Hipposideros hypophyllus*) and a mollusc (*Pseudomulleria dalyi*).

(Source: State of Environment Report: Karnataka, 2011)

9.2.12. National Parks, Forests, Wildlife Sanctuaries and Reserves

The geographical area of the state is 191,791 sq km of which 43,356 sq km (22.6%) is forest area. Notified forests measure 33,238 sq km (17.3%) and include reserved, protected, village and private forests. (Source: State of Environment Report: Karnataka, 2011)

Based on Champion and Seth's system of classification (1968), the following major forest types 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.

As per State of Forest Report 2015, Forest Survey of India, Karnataka has 36,421 sq km of recorded forest area which is 18.99 per cent of its geographical area (1,91,791 sq km). The Western Ghats which includes Nilgiri Biosphere Reserve adds up to 84 per cent of forest cover of the State.

In 2012, the UNESCO inscribed Western Ghats on the World Heritage list. The property recognised as a 'World Heritage Property' has 39 sites spread across four States, of which 10 are in Karnataka. The sites in Karnataka include five Protected Areas i.e., Pushpagiri Wildlife Sanctuary (WLS), Brahmagiri WLS, Talacauvery WLS, Someshwara WLS and Kudremukh National Park (NP). Interspersed along with this is the "Nilgiri Biosphere Reserve" (NBR), which covers an area of about 5,520 sq km in the states of Karnataka, Tamil Nadu and Kerala. Nilgiri Biosphere Reserve is the first and the largest biosphere reserve in the country and was recognised as one of the Heritage sites by UNSECO in 1986. In Karnataka, the Western Ghats pass through 11 districts which contribute a forest cover of 30,573 sq km out of the geographical area of 62,795 sq km covered by these districts. Against the total area of 9,576.88 sq km covered by the 35 National Parks and Wildlife Sanctuaries in the State, 16 are located in the Western Ghats-Nilgiri Biosphere Reserve region covering an area of 8,485 sq km and constituting 88 per cent of area under Protected Areas in the State.

There are five National Parks, 30 Wildlife Sanctuaries, 13 Conservation Reserves and one Community Reserve in the State spread across an area of 10,222.19 sq km, out of which, five NPs / WLSs have been declared as Tiger Reserves namely Bandipur NP, Bhadra WLS, Biligiri Ranganathaswamy Temple WLS, Dandeli-Anshi and Rajiv Gandhi (Nagarahole) NP.

(Source: http://admin.indiaenvironmentportal.org.in/files/file/Administration_of_National_Parks_and_Wildlife_Sanctuaries_Government_of_Karnataka.pdf)

The list of National parks and Wildlife sanctuaries in the State has been provided in Table 9-5 and Table 9-6 below.

TABLE 9-5: National Parks in Karnataka

Name of the National Parks	Year of Establishment	Area (sq km)	Nearest Dist. HQ
Anshi National Park	1987	417.34	Karwar 60 Bengaluru 580
Bandipur National Park	1974	872.24	Chamarajnagar 52 Bengaluru 218
Bannerghatta National Park	1974	260.51	Bengaluru 22
Kudremukh National Park	1987	600.57	Udupi 90 Bengaluru 263
Nagarahole (Rajiv Gandhi) National Park	1988	643.39	Mysuru 120 Bengaluru 240

Source: Website of Karnataka Forest Department - http://www.aranya.gov.in/Static%20Pages/NationalParks.aspx

TABLE 9-6: Wildlife Sanctuaries in Karnantka

Sl.No	Name of the Wildlife Sanctuaries	Area (sq km) Notified under Section of WLP Act, 1972	Date/Year	Area (sq km)
1	Adichunchanagiri Peacock Sanctuary, Mandya Dist	Section 26 (A) (1)	No.FEE-56-FWL-96, dated: 01-09-1998	0.840
2	Arbithittu Wildlife Sanctuary, Mysore Dist.	Section 18	No. AHFFD 3 FWL 85 30-04-1985	13.500
3	Attiveri Bird Sanctuary, Uttara Kannada & Dharwad Dist.	Section 26 A (1) (a)	No.FEE-17-FWL-99, dated: 17-08-2000	2.230
4	Bhadra Wildlife Sanctuary, Chikmagalur Dist.	Section 26 (A) (b) Section 26 (A) (b)	No.FEE-58-FWL-96, dated: 09-03-1998 No.FEE-177-FWL-2008(1) to 2008(6), dated: 28-04-2010	500.160
5	Bramhagiri Wildlife Sanctuary, Kodagu Dist.	Section 26 A (1) (b)	No.FEE-29-FWL-2013, dated: 29-07-2013	181.290
6	BRT Wildlife Sanctuary, Chamarajanagar Dist.	Section 26 (A) (b)	No.FEE-57-FWL-94, dated: 13-06-1994	539.520
7	Cauvery Wildlife Sanctuary, Ramanagar & Chamrajanagar Dist.	Section 26 (A)	No.FEE-166-FWL-94, dated: '03-08-1994 No.FEE-302-FWL-2011-(IV), dated: 27-12-2011	
8	Dandeli Wildlife Sanctuary, Uttara Kannada Dist.	Section 26 (A) (3) Section 26 (A)	No.FEE-58-FWL-96, dated: '09-03-1998 No.FEE-302-FWL-2011-(I), dated: 27-12-2011	886.410
9	Daroji Bear Sanctuary, Bellary Dist.	Section 26 A (b)/Section 26 A (b)	No.Apaji-139-FWL-91, dated: 17-10-1994 No.FEE-119-FWL-2008, dated: 03-10-2008	82.720

10	Ghataprabha Bird Sanctuary, Belgaum Dist.	Section 26 A (1) (a)	No.FEE-58-FWL-96, dated: 08-07-1999	29.780
11	Gudavi Bird Sanctuary, Shimoga Dist	Section 26 A (1) (a)	No.FEE-220-FWL-99, dated: 04-09-2000	0.730
12	Melkote Wildlife Sanctuary, Mandya Dist	Section 26 (A) (b)	No.FEE-58-FWL-96, dated: 09-03-1998	49.820
13	Mookambika Wildlife Sanctuary, Shimoga & Udupi Dist.	Section 18 /Section 26 (A)	No.KFD-48-FWL-74, dated: 22-05-1978/No.FEE-302-FWL-2011-(III), dated: 27-12-2011	370.370
14	Nugu Wildlife Sanctuary, Mysore Dist.	Section 26 (A) (b)	No.FEE-58-FWL-96, dated: 09-03-1998	30.320
15	Pushpagiri Wildlife Sanctuary, Kodagu Dist.	Section 26 A (b)	No.FEE-57-FWL-94, dated: 13-06-1994	102.920
16	Ranebennur Black Buck Sanctuary, Haveri Dist.	Section 18	No.AFD-58-FWL-74, dated: 12-06-1975	119.000
17	Ranganathittu Bird Sanctuary, Mandya Dist.	Section 26 A (1) (a)	No.FEE-58-FWL-96, dated: 01-09-1998	0.670
18	Sharavathi Wildlife Sanctuary,Shimoga Dist	Section 18	No.AFD-22-FWL-74, dated: 28-06-1978	431.230
19	Shettihalli Wildlife Sanctuary, Shimoga Dist	Section 18	No.AFD-47-FWL-74, dated: 25-01-1977	395.600
20	Someswara Wildlife Sanctuary, Udupi & Shimoga Dist.	Section 18/Section 26 A (b)	No.AFD-51-FWL-76, dated: 12-10-1979/No.FEE-302-FWL-2011-(V), dated: 27-12-2011	314.250
21	Talacauvery Wildlife Sanctuary, Kodagu Dist.	Section 26 A (b)	No.FEE-57-FWL-94, dated: 13-06-1994	105.590

22	Bhimgad Wildlife Sanctuary, Belgaum Dist.	Section 26 A (b)	No.FEE-10-FWL-2009, dated: 28-11-2011	190.420
23	Rangayyanadurga Four horned Antelope Sanctuary, Davangere Dist	Section 26 A (b)	No.FEE-240-FWL-2010, dated: 10-01-2011	77.230
24	Chincholi Wildlife Sanctuary, Kalburgi Dist.	Section 26 A (b)	No.FEE-224-FWL-2011, dated: 28-11-2011	134.880
25	Ramadevara Betta Vulture Sanctuary, Ramanagara Dist.	Section 26 A (b)	No.FEE-234-FWL-2008, dated: 30-01-2012	3.460
26	Malai Mahadeshwara Wildlife Sanctuary, Chamrajanagar Dist.	Section 26 A (1) (b)	FEE 90 FWL 2013 Dt.07-05-2013	906.187
27	Gudekote Sloth Bear Sanctuary, Bellary Dist.	Section 26 A (b)	FEE 72 FWL 2013 Dt.11-11-2013	47.610
28	Jogimatti Wildlife Sanctuary, Chitradurga Dist.	Section 26 A (b)	FEE 77 FWL 2015 Dt.23-12-2015	100.480
29	Yadahalli Chinkara Wildlife Sanctuary, Bagalkote Dist.	Section 26 A (b)	FEE 204 FWL 2015 Dt.23-12-2015	96.360
30	Thimlapura Wildlife Sanctuary, Tumkur Dist.	Section 26 A (b)	FEE 301 FWL 2015-1 Dt.16-01-2016	50.860

Source: Source: Website of Karnataka Forest Department - http://www.aranya.gov.in/Static%20Pages/Sanctuary.aspx

Mysore District has a forest cover of 1449.87 sq km, out of which 1208.75 sq km is reserved forest, 23.31 sq km is protected forest and 217.81 sq km is unclassified forest.

Bandipur National Park

Bandipur National Park and Tiger Reserve situated in Mysore (Nanjungud and H.D.Kote taluks) and Chamarajanagar (Gundlupet taluk) districts of Karnataka State lies between the North Latitudes 11^0 35' 34" and 11^0 55' 02" and between the East Longitudes 76^0 12' I7" and 76° 51' 32".

Bandipur National Park was formed by including most of the torest areas of the then Venugopala Wildlife Park and its Sanctum Sanctorum at Bandipur in the year 1974. In the year 2001, after going through the due process of law, the State Government vide its Notification No. FEE 211 FWL 98 Dated 27-06-2001 notified an area of 870.36 sq km as the National Park under the provisions of the sub-section (4) of section 35 of the Wildlife (Protection) Act, 1972. This is one of the nine Protected Areas brought under Project Tiger during 1973. Presently, a total area of 912.04 sq km including adjoining forest areas which are part of the buffer zone notified vide No.FEE 136 FWL, 2008, dated 31-08-2010 is under Bandipur Tiger Reserve and declared as Core/Critical Tiger habitat as per section 38 V of the Wildlife (Protection) Act, 1972.

The Bandipur Tiger Reserve is not only central and critical part of the 5500 sq km Nilgiri Biosphere Reserve but also forms an integral part of the Mysore Elephant Reserve under the Project Elephant. It supports a very high density of wild elephant population with significantly higher number of adult tuskers. This area forms part of the designated elephant corridor namely Kaniyanpura Elephant Corridor which connects Sathyamangalam and Moyar Reserves. It is one of the high density tiger landscapes recognized by the Global Tiger Initiative for conservation of tiger and also is one of the richest wildlife areas noted for the intact assemblage of seven large ungulate species such as Chital, Sambar, Chowsingha, Gaur, Muntjac, Wild Pig and Elephant and has more than 250 species of birds.

This Protected Area is catchment of important perennial rivers such as Kabini, Moyar, and Nugu. The area is completely free from human habitation requiring no resettlement of any human population; The Kabini Reservoir is providing a good aquatic habitat for fish and many species of birds and Otters.

The Central Government vide its notification dated 04 October, 2012 has notified the area upto 7.78 km from the boundary of the protected area of Bandipur National Park and Tiger Reserve, enclosed within the boundary described below in the State of Kamataka, as the Eco-sensitive Zone.

The Eco-sensitive zone covers a geographical area of 479.18 sq km which includes one hundred and twenty three villages. The range of extent of the Eco-sensitive zone varies from 0-7.78 kilometers with a mean distance of 3.62 kilometers.

Nagarhole National Park

Nagarhole National Park is located in Kodagu and Mysuru Districts of the State. This Park lies between the latitude of 12°15'37.69″N and longitude of 76°17'34.4″E, spreading towards Kerala state. This park has an area of 643 Square kilometres, located to the north-west of Bandipur National Park. Nagarhole National Park is also called as Rajiv Gandhi National Park.

This National Park, which is the part of 'Nilgiri Biosphere Reserve', has been selected as one of the World Heritage Sites by UNESCO World Heritage Community.

Lakshmana, Teentha and Kabini are the three rivers which flow in the vicinity of Nagarhole National Park. Kabini River separates this park from Bandipur National Park. (Source: https://nagarholenationalpark.org/)

Tiger Reserves in Karnataka

Karnataka has been declared as No.1 State in tiger population in the country. At present, the tiger population is estimated around 300 as per India Tiger estimate 2010 conducted by the Ministry of Environment and Forests, Govt. of India. The State has 5 Tiger Reserves namely, Bandipur, Bhadra, Nagarahole, Dandeli-Anshi and BRT Tiger Reserves.

A list of Tiger Reserve in Karnataka has been provided in Table 9-7 below.

TABLE 9-7: Tiger Reserves in Karnataka

Name of the Tiger Reserve	Area (sq. kms)	Year of Establishment
Bandipur	872.24	1973
Bhadra	500.16	1998
Nagarahole	643.39	2000
Dandeli-Anshi	475.00	2006
BRT	539.52	2011

Source: http://www.aranya.gov.in/Static%20Pages/TigerReserves.aspx

Proximity of the Project to Protected Areas

Kabini River, where the project is located, is flanked by Nagarhole National Park on one side and Bandipore National Park on the other. Nilgiri Biosphere Reserve of the State covers part of Nagarhole National park and Bandipore National Park. Both the National parks have been declared as Tiger Reserves.

More than half of the NW – 51 waterway stretch falls within the notified Eco-Sensitive Zone of the Bandipore National Park. The entire project area falls within a distance of 10 km from the boundary of Nagarhole National Park. The Eco-Sensitive Zone pertaining to Nagarhole National Park is yet to be notified.

Location of NW-51 vis-a-vis the Bandipore National Park and Nagarhole National Park has been depicted in Figure 9-1 below. As can be seen from Figure 9-1, the shortest between NW-51 and Nagarhole National Park is 800 m at Ch 23.00 km and the shortest between NW-51 and Bandipore National Park is 3.1 km at Ch 23.00 km. The proposed location for Terminal 1 (Beechanahalli) is at a distance of 9.5 km and 7.1 km respectively from Nagarhole National Park and Bandipore National Park. The distance of the proposed Terminal 2 (Beeramballi) is 1.5 km and 3.6 km respectively from Nagarhole National Park and Bandipore National Park.

Since the project lies within the Eco-Sensitive Zone of Bandipore National Park and within a distance of 10 km from the boundary of Nagarhole National Park, for which the Eco-Sensitive Zone has not been notified, it shall require Wildlife Clearnce.

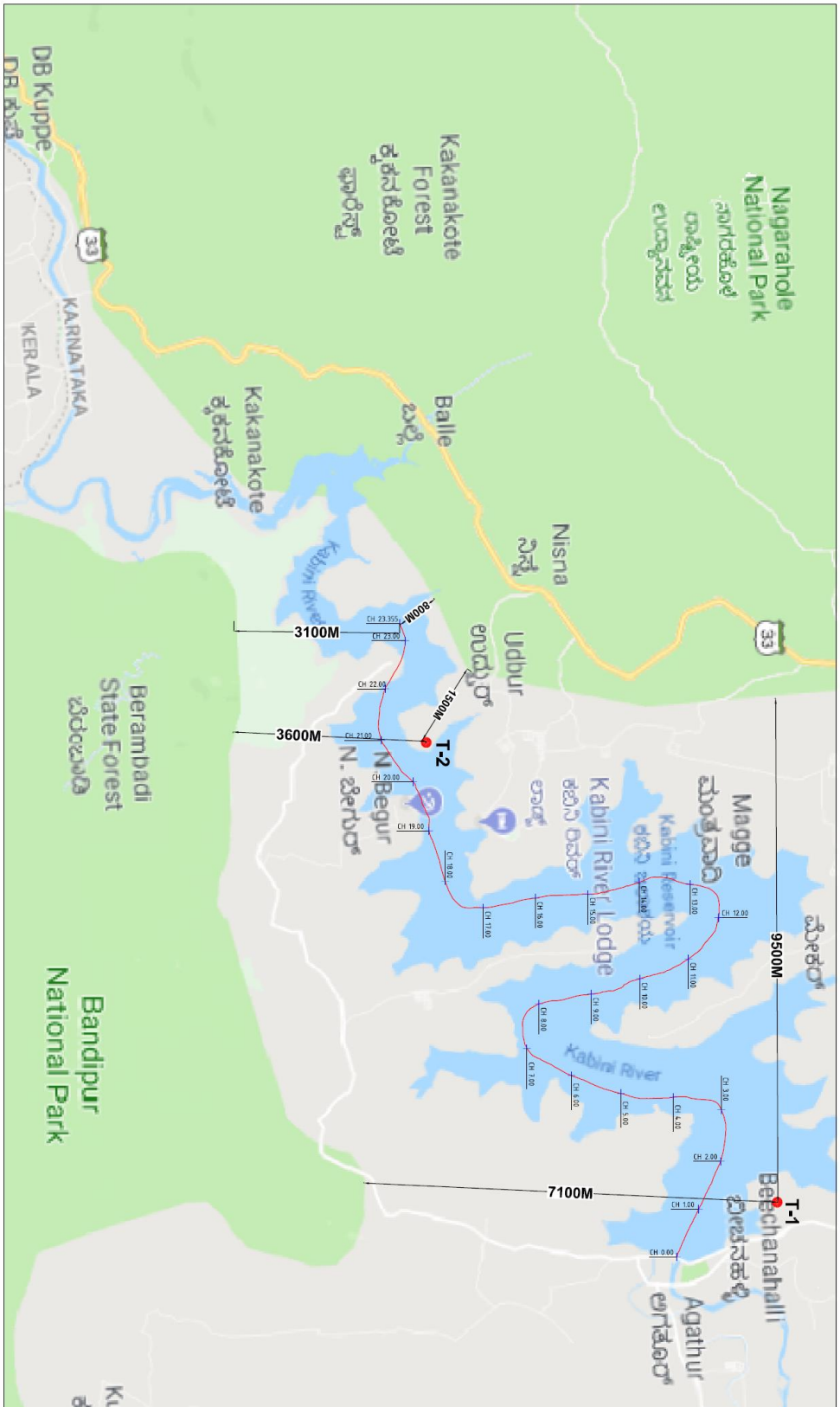


FIGURE 9.1: Protected Areas and the Project Location

9.2.13. Socio-economic Profile

The total area of Mysore district, where NW-51 is located, is 6307 sq km. Mysore district with a total population of 30, 01,127 stands at 3rd place in the State. It accounts for 4.9 percent of the total population of the State, third highest after Bangalore and Belgaum. The district ranks 3rd in terms of rural population and 2nd in terms of urban population. The district has the second highest population density of 476 in the State.

With the decadal growth rate of 13.6 percent, it ranks 11th in the State in terms of decadal growth rate. The district with a Sex ratio of 985 holds 13th rank in the State. The district with a Sex ratio of 961 among the child population in the age group 0-6 holds the 6th rank in the State. The proportion of child population (0-6 age-group) is 10.2 percent in the district and holds the 21st rank in the State.

The district has a literacy rate of 72.8 percent and is placed at 18th position in the State. The male literacy rate in the district is 78.5 percent and the female literacy rate is 67.1 percent. The Scheduled Caste population contributes 17.9 percent and the Scheduled Tribe population contributes 11.1 percent to the total population of the district.

The district has registered a work participation of 43.8 percent and stands at 23rd place in the State. The work participation rates for Male and Female population in the district are 61.0 and 26.3 respectively. Among the total workers in the district 82.3 percent are Main workers and 17.7 percent are Marginal workers. Major work force of 50.3 percent is engaged in Agricultural sector i.e., Cultivators (26.6 percent) and Agricultural Labourers (23.7 percent). In the district 47.6 percent are other workers and 2.1 percent of the total workers are engaged in Household Industry. About 56.2 percent of the total population in the district is non-workers. The percentage of cultivators and agricultural labourers are higher than household industry workers and other workers in all C.D blocks.

Mysore district has 1,336 villages and 9 Statutory Towns and 10 Census Towns.

(Source: District Census Handbook: Mysore, Series 30, Part XII-B, Census of India, 2011)

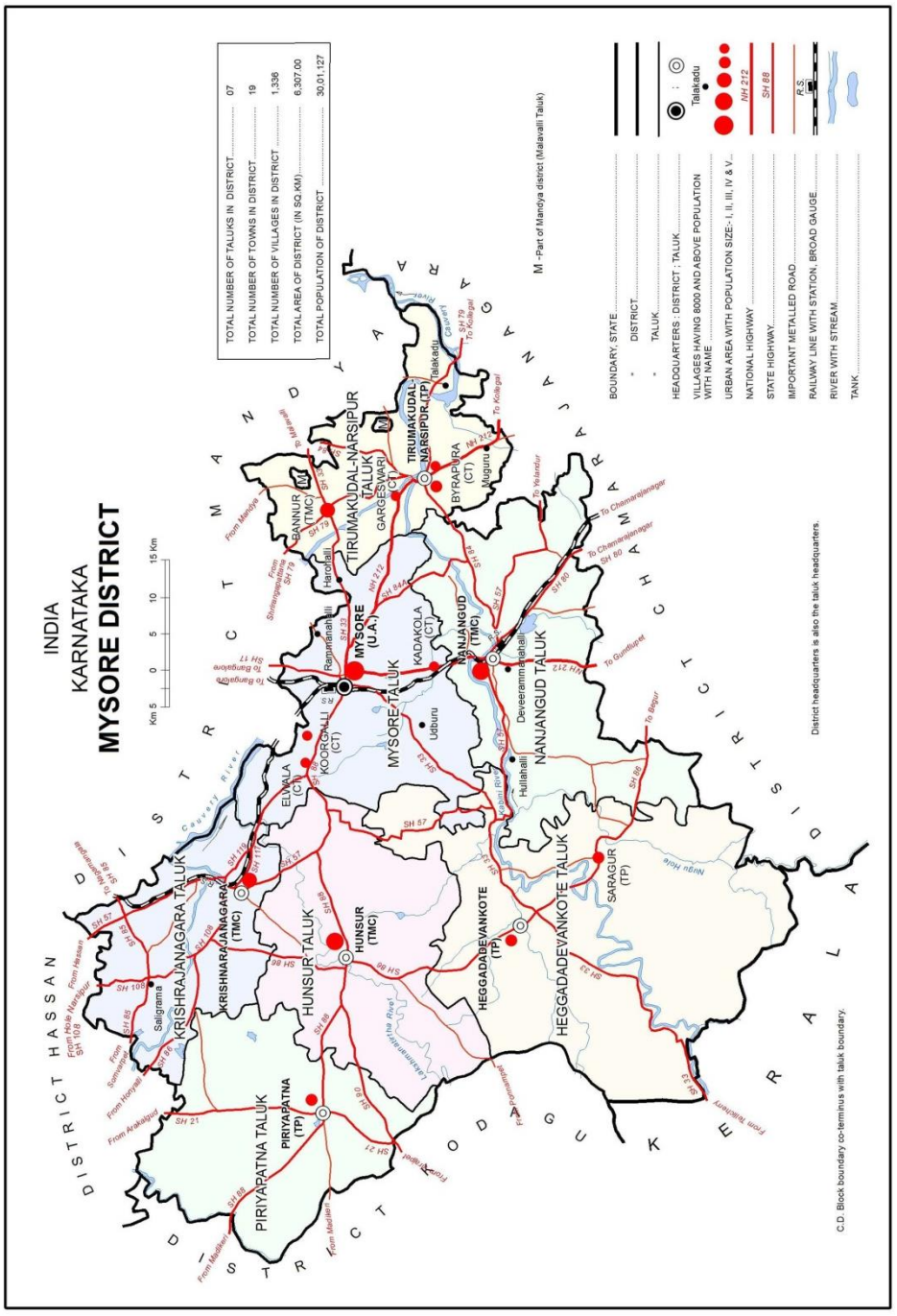


FIGURE 9.2: Map of Mysore District

(Source: District Cenus Handbook: Mysore, Series 30, Part XII-B, Census of India, 2011)

The total Scheduled Castes and Scheduled Tribes population in the district are 5,36,643 and 3,34,547 respectively, which constitutes respectively, 17.88 percent and 11.15 percent of the total population.

The percentage of Scheduled Castes population to total population in rural areas is about 21.67 percent and in the urban areas, it is about 12.55 percent. Similarly, the percentage of Scheduled Tribes to total population is 14.64 percent in the rural areas and 6.22 percent in urban areas.

Mysore district is divided into two Agro- climatic zones namely Southern Dry Zone and Southern Transition Zone.

The Southern Dry Zone consists of Nanjangud, Yelandur, T. Narasipur, Mysore and Krishnarajanagar taluks. Since more than 50 per cent of rain is received during Kharif season, this zone is also known as Kharif Zone. The soils in this part of Mysore are red sandy loams and black soils, which are suitable for growing principal crops like paddy, ragi, pulses, minor millets and sugarcane.

The remaining taluks namely, Heggadadevankote, Hunsur and Piriyapatna comes under Southern Transition Zone. Potato, onion, tomato, beans, brinjal, banana, grapes, mango, papaya, cashewnut, guava, sapota and lemon are plantation and horticultural crops grown in the district. Among the condiments and spices, dry chillies, turmeric, dry ginger, black pepper, arecanut, coriander and coconut are being raised in the district.

Irrigation through well, tank and canals have helped agriculture and horticulture flourish in the district. Paddy, Ragi, Jowar and Maize are the major cereal crops grown in all the seven taluks of the district. Paddy and Ragi occupy large area under cultivation. Under cereals, Tur, Gram and oil seeds are the other important pulses. Sugarcane, tobacco and cotton are cash crops. Permanent fallows are areas under roads, tanks, gramatanas and other non- agricultural purpose.

The number of marginal holdings below one hectare and small holdings of size one to two hectares constitute 88.83% of the total holdings. Only 0.15% holder own land more than ten hectares.

Though the district is not rich in its mineral wealth, occurrence of few of them is reported from certain parts of the district. These deposits include chromite, corundum, graphite, kyanite, magnesite, limestone and dolomite, vermiculite, and ornamental building stones.

As per the statistics of the livestock Census 2007, the district has the livestock population of 11,90,176.The district ranks at 2nd place in its total cattle population.Sheepbreeding, rearing of goats, dogs and rabbits are also of considerable importance. The district is the 5th largest in the State in poultry.

Fishing activity is confined to inland fishing sources through its rivers, reservoirs, tanks, ponds and wells. There are 92 major tanks and 189 minor tanks in the district. There are 11 fish farms engaged in fish seed production, fish rearing and nurseries. Further seven ice plants, two cold storage and one frozen plant support this activity. The fishermen population in the district numbers to 1,16,051 of which active fishermen population is 19,289, which ranks at 4th place having highest population in the State.

There are a total of 591 factories in the district providing employment to 53058 persons. Some of the important industries in the district are The Govt. Sandalwood Oil Factory, Govt. Silk Weaving Factory, Govt. Silk Filatures, Mysore Lac and Paints, South India Paper Mills in Nanjangud, Sunanda Aromatic Industries, and Hunsur Plywood Works at Hunsur.

Mysore city is the main centre of all trading and commercial activities. All the taluk headquarters and the municipal towns of Bannur, Sargur, Nanjangud and Krishnarajanagara are some of the important centres for trade and commerce. All the taluks have branches of commercial banks. State Agricultural and Rural Development Banks are functioning in all the taluks. These banks provide financial help to merchants and small entrepreneurs. The district has 242 commercial banks, 82 Grameen Banks, 10 Urban Cooperative banks and 108 Co-operative banks.

Mysore became a part of the Union of India in September 1947 and erstwhile Maharaja was appointed as the Rajapramukh of the State. As a result of the reorganization of the States in 1956, the taluk of Kollegal belonging to the erstwhile Coimbatore district of Tamil Nadu was included in the Mysore district. In 1997 a new district namely Chamarajnagar was carved out of the Mysore district.

Presently Mysore district consists of seven taluks namely Heggadadevanakote, Hunsur, Krishnarajanagar, Mysore, Nanjangud, Tirumakkudal Narsipur and Piriyapatna and the remaining four taluks namely, Kollegal, Yelandur, Chamarajnagar and Gundlupet formed Chamarajnagar district.

(Source: District Cenus Handbook: Mysore, Series 30, Part XII-A, Census of India, 2011)

The proposed project NW-51 is located entirely in Heggadadevanakote Taluk, which is also known as H. D. Kote Taluk, of Mysore District.

There are 281 villages and 2 towns in Heggadadevankote Taluk. Agricultural activity is predominant in Heggadadevanakote C.D block, where 84.35 per cent of them are involved in this activity.

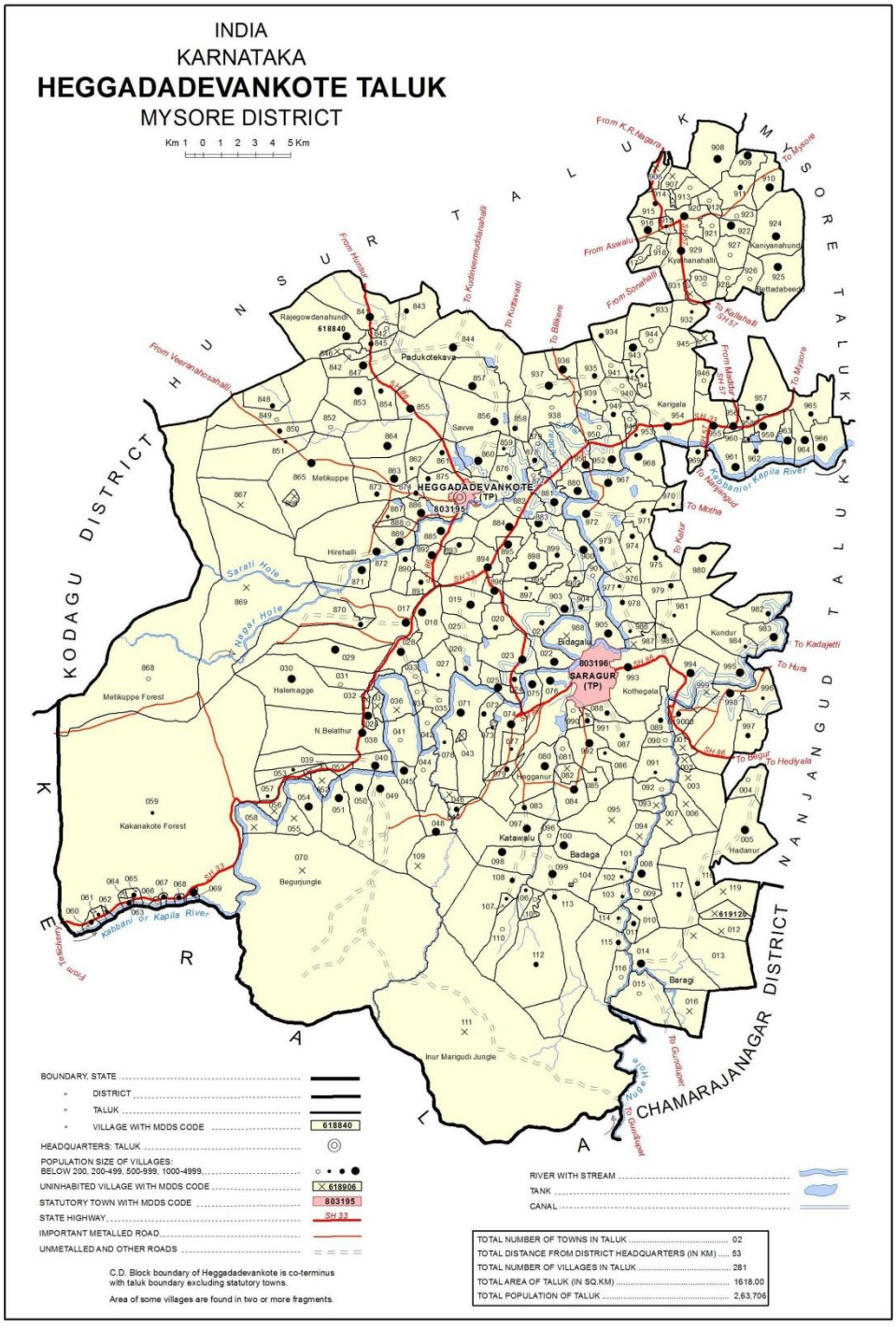


FIGURE 9.3: Map of Heggadadevanakote Taluk

(Source: District Cenus Handbook: Mysore, Series 30, Part XII-B, Census of India, 2011)

As per Census 2011, Heggadadevankote Taluk has 61,469 households, population of 2,63,706 of which 1,32,748 are males and 1,30,958 are females. The population of children between age 0-6 is 29,554 which is 11.21% of total population.

The sex-ratio of Heggadadevankote Taluk is around 987 compared to 973 which is average of Karnataka state. The literacy rate of Heggadadevankote Taluk is 56.92% out of which 63.29% males are literate and 50.46% females are literate. The total area of Heggadadevankote is 1,618 sq km with population density of 163 per sq.km.

There are 27.78% Scheduled Caste (SC) and 23.61% Scheduled Tribe (ST) of total population in Heggadadevankote Taluk.

(Source: https://www.censusindia2011.com/karnataka/mysore/heggadadevankote-population.html)

9.3. Potential Environmental and Social Impacts of the Project

As per the traffic study undertaken as part of the present DPR study, there is no market demand that necessitates the development of the proposed waterway. Accordingly, the DPR recommends development of the proposed NW-51 only if demand for the same arises in future, which is likely to be induced primarily on acoount of increased tourist activities.

Development of NW-51, which shall be for a stretch of 23.171 km, shall involve dredging of 70,214.61 cu m of river material between Ch 10.00 km and Ch 23.171 km, construction of two terminal buildings – one near village Beechanhalli (Terminal 1) and another near village Beeramballi (Terminal 2), construction of a 7.5m wide approach road for a length of 300 m near Terminal 1 and construction of 7.5m wide road for a length of 1 km near Terminal 2. No bank protection works are envisaged under the project.

Thus, the development of NW-51 in future envisages the following major construction activities:

- Construction of two terminal buildings - one each at Beechanhalli and Beeramballi.
- Construction of access roads leading to terminals – 7.5m wide and 300m long at Beechanhalli (Terminal 1), and 7.5m wide and 1000m long at Beeramballi (Terminal 2).
- Bank protection works – Nil.
- Dredging of the river for development of fairway - to be done between Ch 10.0 km to Ch 23.171 km with the estimated volume of dredged material being 70,214.61 cu m.

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.

As has been mentioned above, two terminals are proposed to be constructed for operation of NW-51. Terminal 1 is located near village Beechanhalli at Ch 0.00 km (11°59'22.22" N, 76°20'55.94"E). Terminal 2 is located near village Beeramballi at Ch 23.171 km (11°56'5.46"N, 76°15'13.36"E).

A total of 2.0 ha of land will be required for each of the terminal buildings. The land identified for the construction of Terminal 1 is Government land and falls under the submergence area at FRL of Kabini Dam. As such no dislocation of population is envisaged due to the project. The ownership of land identified for construction of Terminal 2 is yet to be confirmed.

Since limited land is required for construction of terminals and access roads, no significant adverse impact on account of land use change is anticipated due to the project.

Development of NW-51 also envisages dredging for creation of a navigable channel. The estimated quantity of dredged material for NW-51 is 70,214.61 cu m. Dredging is envisaged only for the stretch between Ch 10.00 km to Ch 23.171 km. No dredging is proposed for the first 10 km of the waterway. 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. Impacts on aquatic ecology due to dredging and disposal of the dredged material within the riverbanks need to be established as part of the EIA study to be carried out separately for the project by IWAI.

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.

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 positive impacts on the project will include improved waterway facilities and other allied infrastructure facilities 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

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 entire project area falls under non-tidal zone. As such the project shall not require clearance under the CRZ Notification 2011.

The Ministry of Environment, Forest and Climate Change (MoEFCC), 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. 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).

ii. Explanation - For the purposes of this sub-paragraph the expression tidal influenced water bodies means 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, Forest and Climate Change (MoEFCC) 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 upto 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 is required only if the project involves diversion of any forest land. The land identified for construction of terminal is Government Land. Therefore, no forest clearnce is required for construction of Terminal at Beechanhalli.

The ownership of land required for construction of Terminal 2 and for approach roads to the two terminals is yet to be ascertained. Need for Forest Clearance relating to construction of these components can be confirmed only after the ownership of land required for these activities is known.

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. The Notification, as amended in 2009, includes ‘Dredging’ as an activity for which prior environmental clearance is required.

However, **as per the MoEFCC letter dated 21 December 2017, National Waterway projects are exempt from the requirement of prior Environmental Clearance on account of maintenance dredging for creation of navigational channel.** The project, therefore, does not need to obtain Environmental Clearance from the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India. The MoEFCC letter to this effect is enclosed as Annexure 9.1 of the DPR.

The project shall, however, have to comply with the conditions stipulated in the said letter.

9.5.2. Other Major Clearances / Approvals / Permits Applicable to the Project

Wildlife Clearance

The project area is located close to Nagarhole and Bandipore National Parks. The entire project area falls within 10 km from the boundary of Nagarhole National Park and a large part of the project falls within the eco-sensitive zone declared around Bandipore National Park. Therefore, the project shall require Wildlife Clearance from the MoEF, Government of India.

Since no structures of cultural, historical or archaeological are anticipated to be impacted due to the project, no clearance from the Archaeological Survey of India (ASI) or the State Department of Culture is envisaged for the project.

Other clerances required for the project shall include those that need to be obtained by the Contractors such as the Certificate of Registration from the Labour Department under various applicable labour laws, permission from SPCB for setting up of batching plants, license for storing petroleum / diesel etc.

A summary of major clearances / approvals / permits and their applicability to the project is provided in Table 9-8 below.

TABLE 9-8: Major Clearances / Approvals / Permits and their Applicability to the Project

Sl No.	Clearance / Approval	Applicability to the Project	Applicable Legislation	Remarks
1.	Enviornmental Clearance	No	EIA Notification 2006	Exempted by MoEFCC vide its letter dated 21 December 2017.

2.	Forest Clearance	Not required for construction of Terminal 1. May be required for terminal 2 and approach road construction.	Forest Conservation Act, 1980	
3.	Wildlife Clearance	Yes	Wildlife Protection Act, 1972	The project falls within the eco-sensitive zone of Bandipore National Park and within 10 km from the boundary of Nagarhole National Park.
4.	CRZ Clearance	No	CRZ Notification 2011	The entire project falls in non-tidal zone.

9.6. Cost Implications

As per the scope of services for further environmental and social impact assessment (EIA & SIA) studies and requirement of obtaining all mandatory statutory clearances for the project approximately 1 year is adequate period for consultancy services related to EIA & SIA studies. In this regard, the project authority may engage to QCI/NABET accredited EIA consultant for Category – A projects, who shall conduct rapid EIA & SIA studies and shall prepare a stand-alone EMMP (EMP & EMoP) for inclusion in the contractor bid documents. The generation of environmental baseline data at pre-construction stage along with environmental monitoring during construction and operation stages shall be carried out by the NABL/MoEF&CC approved laboratory to assess the project performance during entire project cycle.

A lump sum provision of 5 % of the project cost has been catered 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;

(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 projected as a support requirement in the Chief Engineer's office.

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.

Kabibi river due to its small stretch and no commercial opportunity at this stage doesnot need an exclusive vessel for maintenance of waterway.

Currently, Kabini waterway is proposed to be developed for tourism purpose at Beechanahali Terminal (T1) & Beeramahali Terminal (T2). The fairway between these two terminals shall be dredged in conformity with class-III waterway and the dredging quantity is 1.78 Lakh cum.

In the beginning stage, ferry service 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 be directly utilized for cargo or commercial use.

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 sections. 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)
1	Director	0	78800	0
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	1	35400	69,030
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	4		2,96,985

TABLE 10-2: Financial implication – Capital and Maintenance

Institutional Cost (Kabini River - NW-51)			
Sl. No.	**Name of the Item**	**Capital Cost (INR)**	**Financial Implication per month (INR)**
1	Office premises	*	0
2	Furniture etc.,	20,00,000	0
3	Pay and Allowances for 4 Nos.	--	2,96,985
4	Vehicle 1 No.	0	--
5	Computer Systems including UPS etc.,1Nos. @ 1 lakh each	1,00,000	5,000
6	Printers 1 Nos. @ 0.25 lakhs each	25,000	20,000
7	Alternate Uninterrupted Power Supply with D. G set 1 No @ 2.0 Lakhs per no.	2,50,000	30000
8	Other General Office maintenance including stationery, consumables etc.,	--	1,50,000
Total		**2375000**	**5,01,985**

+ 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, whereas othe items above are being provisioned for undertaking the requisite functions under the Institution requirements.

+ Since there is no cargo and no cargo operation is being mooted in the project except the development of ferry terminals to facilitate tourism operation with its fullest safety & security, therefore INR 23.75 Lakhs is provisioned for one time expense and maintenance cost per month will be around (approx) INR 5.01 Lakhs. So, the institutional cost shall be 23.75 lakhs & the O&M cost is 5.01 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 items which are non available in the SoR have been proposed based on the Market Rates or based on the realistic budgetary quotations, to the extent possible.

11.3. Development Cost

The Kabini Dam is not having any IWT mobility 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.

In view of the above, the costing has been considered as a nominal fairway development for ferry services and development of ferry terminal facility to facilitate tourism operation with its fullest safety & security through proposed twin terminal locations.

11.4. Capital Expenditure

As explained above, the Fairway related development cost has been worked out and placed herewith. The fairway between the proposed terminals shall be dredged in conformity with class-III waterway and the dredging quantity is 1.78 cum.

TABLE 11-1: Abstract of Cost for Kabini Fairway Development for Captive Terminal Operations

Sl No.	Item Description	Amount (in Lakh Rs.)	Reference in Annexure
A	**Fairway**		
1	Dredging		
(i)	General Soil	436.10	11.4
(ii)	Hard Soil	0.00	11.4
2	Low Cost River Structures		
(i)	Bandaling	0.00	
(ii)	Bottom Paneling	0.00	
3	River Training Works		
(i)	Spurs	0.00	
(ii)	Bank Protection Works for river	0.00	
(iii)	Porcupine	0.00	
4	Night Navigation		
(i)	Channel Marking Buoy, Mooring Gear & Lighting Equipments	0.00	
5	Land Acquisition	0.00	
	Sub-total (A)	**436.10**	
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**		
(i)	RIS Centre		
(ii)	AIS Base Station	20.00	
(iii)	Vessels - Survey vessel & Other Vessel		

Sl No.	Item Description	Amount (in Lakh Rs.)	Reference in Annexure
(iv)	Buoys		
	Sub-total (C)	**20.00**	Chapter 8
	Sub-total (A)+(B)+(C)+(D)	**456.10**	
E	Enviornmental Management Plan Cost @ 5% of Prime cost as per Chapter 9 of DPR	22.81	
F	Project Management & consultancy Charges @3% of Prime cost	13.68	
G	Contingencies and Unforseen Items of Works @ 3% of Prime cost	13.68	
	Project total Hard Cost	**506.27**	
		5.06 Crores	

The requirements of ferry terminal facility have been worked out and placed herewith.

Sl No.	Item Description	Amount (in Lakh Rs.)	Reference in Annexure
A	**Terminals**		
	Beechanahalli Terminal (T1)		
(i)	Land	31.78	11.6
(ii)	Riverine Components/ Pontoons	305.89	11.7
(iii)	Infrastructure Components including internal roads	186.50	11.9
(iv)	Bank Protection Works for terminal	54.73	11.11
	Sub-total (A1)	**578.89**	
	Beeramaballi Terminal (T2)		
(i)	Land	31.78	11.6
(ii)	Riverine Components/ Pontoons	305.89	11.8
(iii)	Infrastructure Components including internal roads	186.50	11.10
(iv)	Bank Protection Works for terminal	54.73	11.11
	Sub-total (A2)	**578.89**	
	Sub-total (A)	**1157.79**	
B	**Vessels**		
(i)	Vessel Size	0.00	
(ii)	Vessel Capacity	0.00	
	Sub-total (B)	**0.00**	

Sl No.	Item Description	Amount (in Lakh Rs.)	Reference in Annexure
C	**Institutional Requirement**		
	Office Development Cost	23.75	
	Sub-total (C)	**23.75**	
	Sub-total (A)+(B)+(C)	**1181.54**	
D	**Equipments for Both Terminals**		
(i)	Ambulance - 1 no.	18	
(ii)	Dumper Trucks 16 T Capacity - 1 no.	0	
(iii)	Cranes with 50 T Capacity - 1 no.	0	
(iv)	Fork lift trucks 20 T Capacity - 1 no.	0	
	Sub-total (C)	**18.00**	
	Sub-total (A)+(B)+(C)	**1199.54**	
E	Enviornmental Management Plan Cost @ 5% of Prime cost as per Chapter 9 of DPR	59.98	
F	Project Management & consultancy Charges @3% of Prime cost	35.99	
G	Contingencies and Unforseen Items of Works @ 3% of Prime cost	35.99	
	Project total Hard Cost	**1331.48**	
		13.31 Crores	

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 for development after obtaining requisite approvals from the concerned departments' viz., Tourism Department & Environment & Forest Department. The fairway development and Ferry Terminal development in both the locations are proposed to be completed in 24 months commencing from from FY: 2023. The financial modules have been developed accordingly.

CHAPTER 12: IMPLEMENTATION SCHEDULE

12.1. Time Frame

The development of river Kabini is proposed for tpurism purpose. Accordingly, it is proposed to develop the waterway for ferry vessel from Beechanahalli to Beeramballi to be implemented in FY: 23-24.

It is suggested for a nominal investment of INR 13.31 Crores for ferry terminal development at two locations and fairway development at a cost of 5.06 Crores.

In order to facilitate the passenger traffic for tourism activity and local / confirmed traffic, the investment on Fairway development consisting of the activities of Dredging; Bank protection; Day / Night Navigation facilities & aids (Buoy & Light) along with Environmental Management Plan (EMP) have been proposed. With the development of fairway, the revenue collection can be considered for the traffic with possible increase in tourist traffic. The Implementation Schedule in Pictorial form is placed at Annexure 12.1 & 12.2.

12.2. Phasing

The fairway development and Ferry Terminal development in both the locations are proposed to be completed in single phase in 24 months, after obtaining necessary clearances and approvals.

The ferry vessel requirement will be taken care by entrepreneurs. In the beginning stage, where ferry service 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.

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

Kabini River (NW 51) development has been distinguished across two subsectors including Fairway and Terminals. This is depicted in the following Table 13 1:

TABLE 13-1 NW 51 Development

Sub-sector	FY23	FY24	FY25	FY30	FY35	FY40
Fairway	Development					
		Operational				
Terminal	Development					
		Operational				

Source: Tractebel; Consultant

At present, there exists no opportunity for handling cargo on Kabini River. There are no industries in the primary catchment area. Presence of a national park on the river stretch prevents any scope of industrialization in the vicinity of river. The primary catchment area witnesses low tourist influx due to several limitations. Some of the limitations imposed by government are as follows.

- Licensing issues for operating motorboats on the stretch
- Night ban on using access roads to the national parks
- Connectivity Issues surrounding catchment area
- Several restrictions on tourists by Government to protect wild life

The traffic projection chapter 4 has projected future growth of traffic assuming liberal and tourist friendly policies by Government. Government would allow development of tourism related amenities in the surrounding areas. This would help increase influx of tourists in the region.

Currently, Kabini waterway is proposed to be developed for tourism purpose. Two ferry terminals would be developed to handle the projected tourist traffic. These terminals are at Beechanahalli Terminal (T1) & Beeramaballi Terminal (T2). These terminals will support ferry berthing. Proposition for a floating restaurant along with boat ride for sightseeing has been made, which will provide an initial impetus to invest towards development of the waterway. The floating restaurant has been situated in close vicinity to the Beechanahalli Terminal and such facility shall promote boat ride between both the Terminals.

In the beginning stage, ferry service and other 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. IWAI would develop fairway for class III 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. from FY:23-24 and operation will get started by FY24 till FY40. IWAI prescribed tariffs (notified in 2011) has been assumed for vessel berthing. IWAI tariff sheet has not prescribed any tariffs specific to passenger. Consultants have assumed proportional tariff for IWAI. The table below shows the revenue generating sources considered in this financial study.

TABLE 13-2 Revenue Sources for IWAI

Sr. No	Source	Tariff	Description
	Royalty from Tour Operators		
	Floating Restaurant	INR 120 / Pax	20% of ticket fee charged by Operator (Floating Restaurant INR 600/Pax Boat Ride INR 100/Pax)
	Boat Ride	INR 20 / Pax	
	Vessel Berthing	INR 1,000 / Day	By IWAI
	Fairway Usage	NIL	By IWAI
	Real Estate Leasing	INR 500 / Day	04 Shops

Source: IWAI and Consultant

Royalty from tour operators would be the primary revenue source for IWAI. It has been assumed that a person would spend INR 600 on an average after visiting Floating restaurants for food. The operator of the Floating restaurants would pay a royalty of 20% from their revenue to IWAI. Similarly, the boat operators too 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 and leasing of real estate space on the terminals

13.1 Input Sheet

The following table lists all the assumptions and input values used in the financial modeling of Kabini River. This includes financial analysis for the navigation infrastructure (fairways), and terminals operation:

TABLE 13-3 Input Sheet for NW 51

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%
Dredging Costs Escalation	Annual	5%	
Other Costs Escalation	Annual		6%
Fairway Chainage	km	21	
Chainage (mouth of the river to Terminal)	Km		21
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**
Economic loss due to Road Accidents	of GDP	3%
GDP of India@ Current Prices	Rs Lakhs Crores	125.41
Value of economic loss due to road accidents	Rs Lakhs Crores	3.7623
Total Road network in India	Lakh KM	0.4865
Safety Index (IWT as base)	times safer than road	50
	times safer than rail	5
Accidental Loss		
Road	Rs Lakhs/KM	7.6
IWT	Rs Lakhs/KM	0.15
Fuel Cost (1 liter of fuel moves)		
Road	t-km	24
IWT	t-km	105
Total Distance	KM	21 x 2
Fuel price	Rs/Litre	94
Vehicular Operating Cost (VOC)		
Road	Rs/t-km	1
IWT	Rs/t-km	2.5
Emission Reduction		
Road	INR/Trip	650
IWT	INR/Trip	105.5

Source: Consultant, Market standards

All the necessary assumptions for financial modeling are either market driven or provided by IWAI. The chainage of 21 km is between both the proposed terminals. In EIRR, round-trip distance is considered in economic viability evaluation.

13.1.1. Revenue

Revenue for the cumulative stretch of Kabini River will be generated from the core operations, which include 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 Kabini River are presented in the table below:

TABLE 13-4 Revenue for NW 51 (INR Lakhs)

Description	FY23	FY24	FY25	FY30	FY35	FY40
Fairway	-	0.0	0.0	0.0	0.0	0.0
Terminal	6.4	108.4	128.7	216.6	420.8	778.9
Total	**6.4**	**108.4**	**128.7**	**216.6**	**420.8**	**778.9**

Source: Consultant

IWAI has waived of fairway tariffs in their circular May, 2021. They would not be charging any tariff for use of waterways by vessels. It is belived that IWAI will maintain desire navigable depth in waterway to meet their mandate of making National Waterways navigable.

Since, IWAI would be creating and maintaining navigable fairway without any charges from users, the finanicals of fairway development is not desired. The revenue on account of fairway with “0” (Zero) tariff would be “0” (Zero). There would be no profit and loss statement. There would be no return on investment as IWAI will be investing in creation of fairway and maintaince of fairway without any revenue.

13.2. Costs

This section presents the total project cost for fairway and terminal development on River Kabini. IWAI would be developing fairway and maintaining navigable depth without charging its users. Hence, financial for fairway cannot developed. The capital cost of development is estimated and presented in this section to ascertain quantum of investment required by IWAI to make river navigable.

TABLE 13-5 Project Cost (INR Lakh)

Description	Total	FY23	FY24
Fairway			
Fairway	436.1	218.1	218.1
Communication System	20.0	10.0	10.0
Environmental Management Plan Cost as per chapter-9 of the DPR	22.8	11.4	11.4
Project Management & consultancy Charges @ 3% of Prime cost	13.7	6.8	6.8
Contingencies and Unforeseen Items of Works@ 3% of Prime cost	13.7	6.8	6.8
Total Project Cost	**506.3**	**253.1**	**253.1**
Terminals			
2 Ferry Terminal	1157.8	578.9	578.9

Description	Total	FY23	FY24
Equipment at both the Terminals	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	60.0	30.0	30.0
Project Management & consultancy Charges @ 3% of Prime cost	36.0	18.0	18.0
Contingencies and Unforeseen Items of Works @ 3% of Prime cost	36.0	18.0	18.0
Total Project Cost	**1,331.5**	**665.7**	**665.7**

The onus of vessel acquisitions and floating restaurants installation 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 investment has been assumed in the IWAI model.

13.3. Financial Analysis / FIRR

The financial indicators dictating FIRR for 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 Hy. Surveyor	1	11.1	-	11.7	12.3	15.7	20.0	25.5
Junior Accounts Officer	1	11.1	-	11.7	12.3	15.7	20.0	25.5
Supervisor	1	8.3	-	8.7	9.1	11.7	14.9	19.0
Attendant	1	5.1	-	5.3	5.6	7.1	9.1	11.6
Total Salary (INR Lakh)	**4**	**-**	**-**	**37.4**	**39.3**	**50.1**	**64.0**	**81.7**

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 tourism 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 tourism companies operating ferry and floating restaurants.

TABLE 13-7 Depreciation (Using SLM Method) (INR Lakh)

Depreciation & Amortization	FY23	FY24	FY25	FY30	FY35	FY40
Terminals						
Gross Block	665.7	1,331.5	1,331.5	1,331.5	1,331.5	1,331.5
Depreciation & Amortization	-	102.8	102.8	76.4	74.1	0.9
Cumulative Depreciation & Amortization	-	102.8	205.6	666.7	1,045.4	1,328.0
Net Block	**665.7**	**1,228.7**	**1,125.9**	**664.7**	**286.1**	**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
Terminals						
Revenue	**6.4**	**108.4**	**128.7**	**216.6**	**420.8**	**778.9**
Cost	**6.5**	**77.7**	**82.2**	**108.4**	**144.5**	**193.6**
PBDIT	-22.5	-46.3	-48.5	-61.1	-76.2	-93.6
Depreciation	0.0	38.9	38.9	28.9	28.9	0.0
Interest	18.1	36.2	31.9	10.6	0.0	0.0
PBT	-40.6	-121.4	-119.3	-100.5	-105.0	-93.6
Tax	0.0	0.0	0.0	0.0	0.0	0.0
PAT	**-40.6**	**-121.4**	**-119.3**	**-100.5**	**-105.0**	**-93.6**

Source: Consultant

Terminal does not generate profit till FY40. The following table provides viability of project and calculates Financial Returns of the individual projects under the development of the Kabini River:

TABLE 13-9 FIRR for NW 51 (INR Lakh)

Parameter	FY23	FY24	FY25	FY30	FY35	FY40
Terminals						
Project Cashflow (Pre-tax)	-665.8	-635.0	46.5	108.2	276.3	585.3
Project IRR (Pre-tax)	**9.7%**					
Project Cashflow (Post-tax)	-665.8	-635.0	46.5	107.2	225.7	439.2

Project IRR (Post-tax)	**8.0%**

Source: Consultant

Revenue prospect for terminal development and operation gives healthy returns. 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 51 – Whole Project (INR Lakh)

Parameter	FY23	FY24	FY25	FY30	FY35	FY40
Whole Project						
Project Cashflow (Pre-tax)	-941.4	-935.3	-3.1	45.1	195.7	482.5
Project IRR (Pre-tax)	**2.4%**					
Project Cashflow (Post-tax)	-941.4	-935.3	-3.1	45.1	172.9	362.2
Project IRR (Post-tax)	**1.1%**					

Source: Consultant

Financial working of entire project gives positive returns making project commercially viable for long run.

13.4. 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
Terminals						
Economic Cash Outflow	-6.7	-8.4	-1.9	-2.6	-3.8	-5.7
Net Cash Flow to Project	-4.0	-3.1	1.1	1.9	4.0	7.6
Project EIRR	**23.9%**					

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	-9.5	-11.6	-2.6	-3.6	-5.3	-7.7
Net Cash Flow to Project	-5.6	-5.1	0.6	1.3	3.0	6.1
Project EIRR	**13.1%**					

Source: Consultant

The project as a whole generates 13.1% economical IRR that means project once developed would benefit in many ways.

13.5. 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
Terminals					
Revenue	6.4	118.6	140.8	237.3	461.6
PAT	-53.1	-178.5	-148.5	9.0	174.1
Project IRR (Pre tax)	**10.1%**				
Project IRR (Post tax)	**8.5%**				

Source: Consultant

TABLE 13-14 Sensitivity Analysis (+10% Revenue, -10% Project Cost)

Revenue Source	FY23	FY25	FY30	FY35	FY40
Terminals					
Revenue	6.4	118.6	140.8	237.3	461.6
PAT	-42.3	-136.2	-108.3	27.5	189.1
Project IRR (Pre tax)	**12.7%**				
Project IRR (Post tax)	**10.8%**				

Source: Consultant

TABLE 13-15 Sensitivity Analysis (-10% Revenue, +10% Project Cost)

Revenue Source	FY23	FY25	FY30	FY35	FY40
Terminals					
Revenue	6.4	98.2	116.5	195.9	380.0
PAT	-53.1	-198.4	-172.3	-28.5	114.2
Project IRR (Pre tax)	**6.8%**				
Project IRR (Post tax)	**5.3%**				

Source: Consultant

TABLE 13-16 Sensitivity Analysis (-10% Revenue, -10% Project Cost)

Revenue Source	FY23	FY25	FY30	FY35	FY40
Terminals					
Revenue	6.4	98.2	116.5	195.9	380.0
PAT	-42.3	-156.1	-132.1	-3.9	129.1
Project IRR (Pre tax)	**9.1%**				
Project IRR (Post tax)	**7.4%**				

Source: Consultant

13.6. 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 approvals from environment to allow large scale uninterrupted tourism activity, improvement of connectivity for seamless movement of tourists to the Kabini catchment from all over India and overseas.

The traffic projections and financial analysis assumes liberalization of policies by state government and local bodies to assist in promotion of tourism around River Kabini. Kabini River tourism potential have not been realized due to several restrictions imposed by state government for protecting wildlife. Traffic generation and future projections was made assuming liberal and tourist friendly policies by Government to boost tourism inflow.

13.7. 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.

Terminal development and operations shows commercial and economic viability. VGF is not required for terminal development.

13.8. Conclusion

The following table gives a snapshot of the project cost and viability indicators for all the sub-sector developments for NW 51:

TABLE 13-17 Critical indicators for the NW 51

Sl No	Factors	Section	Unit	Outcome
1	Project Cost	Fairway	Cr.	5.06
		Terminals	Cr.	13.31
2	Tariff	Vessel Berthing	INR Vessel/Day	1,000
		Royalty	20% of Tickets	Floating Restaurant - 120, Boat Ride - 20
		Fairway Usage	INR GRT-Km	0.00
2	Traffic	Passengers	In '000 (FY40)	686.01
3	Revenue	Fairway (FY40)	Cr.	0.00
		Terminals (FY40)	Cr.	7.79
4	FIRR	Fairway	-	-
		Terminals	-	8.0%
		Whole	-	1.1%
5	EIRR	Fairway	-	-
		Terminals	-	23.9%
		Whole	-	13.1%

Source: Consultant

Both the projects including terminals and fairway has to be developed together. They do not exist in isolation. The traffic of terminals would fall in the absence of well-developed fairway. It would render terminal project unviable. The cumulative returns from both the terminals and fairway is positive.

CHAPTER 14: CONCLUSIONS AND RECOMMENDATIONS

The study of Second Stage Detailed Project Report (DPR) for Development of Kabini River (NW 51) in the stretch of 23.17 Kms from the mouth of the river (Lat 11° 56' 0.9311" N, Long 76° 14' 17.5004" E.) has been carried out as per the Terms of Reference (ToR) and the details of the study are given in the preceding chapters.

A summary of the recommendations and conclusions as a result of the study is placed herewith:

- The study stretches of Kabini River National Waterway – 51 (NW 51) is of 23.171 Kms from Lat 11° 56' 0.9311" N, Long 76° 14' 17.5004" E.
- Detailed Hydrographic Survey has been carried out so as to assess the required developments in the Fairway along with interrelated activities.
- 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. Further, this analysis may not have any impact since the study stretch is in the submergence of the Kabini Dam. (Foreshore submersion).
- Based on the Hydrographic Survey data the stretch up to Ch. 20 km is having a water depth of 1.7 m (LAD).
- Based on the Hydrographic Survey inputs and other site data collected, it has been noticed that no bridges are located, and no HT Lines are crossing the study stretch.
- No pipeline is crossing the study stretch. No Dams / Barrages / Locks / Weirs / Anicuts / Aqueducts are located. 5 Nos. Bend locations have been identified in the study stretch.
- No cargo mobility is existing. Even in the forecast, no cargo is anticipated. There is an estimated Tourism potential, which can be considered with the permission / consent / approvals from the concerned state departments and other authorities.
- Currently, Kabini waterway is proposed to be developed for tourism purpose by proposing two birthing pontoons at Beechanahalli Terminal (T1) & Beeramballi Terminal (T2). The fairway between these two terminals shall be dredged in conformity with class-III waterway and the dredging quantity is 1.78 Lakh cum for provision of safe navigable fairway.

- In the beginning, ferry service 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 self-propelled vessel as described in the document is indicative only and no such deployment has been suggested in the DPR at this stage. No bridges and cross structures are present in the study reach and hence no modifications are needed. No Bend criteria is relevant as the waterway is in the submergence area of Kabini Dam, hence not needed and suggested on this aspect. Since the Dam area is bound by Forest, only day mobility has been suggested and hence no provision has been catered for marking. (Also keeping in view of the submergence). No night navigation has been recommended. Nominal provisions have been suggested towards communication system and Institutional Requirements. The sample vessel specification proposed for tourist mobility considered at the initial stage is as follows.

  (For Mono Hull Steel Boat)

  - Size (L x B x D) – 20 m x 2.2 m x 1 m
  - Capacity – 50 Passengers (seating capacity)
  - Engine – 2 Marine Outboard Engines of 75hp (approx.)

  (For FRP Boat)

  - Size (L x B x D) – 20 m x 2.2 m x 0.8 m
  - Capacity – 50 Passengers (seating capacity)
  - Engine – 2 Marine Outboard Engines of 60hp (approx.)

- A tentative Land has been worked out which is based on requirement for tourism development and arrived at 1691.68 Sq. M at Beechanahalli and 1691.68 Sq. M at Beeramballi. The Land Survey was considered at Beechanahalli and Land Details of the location has been firmed up. It is in the Vadkhal Village; Heggadadevenakote Taluka; Mysore District of Karnataka. Geotechnical Investigations have been completed along with the laboratory tests.

- Kabini Waterway of 23.17kms is proposed to be developed as Class III waterway classification. Also, Kabini waterway is proposed to be developed for tourism purpose and two birthing pontoons, shall be developed each at Beechanahalli (T1) & Beeramballi (T2) which is capable of handling passenger ferry services.

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.

- Detailed study suggested one number of 30.0m (long) and 8.0m (wide) berthing pontoons for the ferry terminal having 26.0m long and 2.0m wide aluminium gangway & bank seat at each of the terminal location. The sizing of the berthing structure/Pontoons/Bankseat & Gangway at two locations are shown below:

Sl No.	Particulars
1.	Berthing pontoon (Beechanahalli) – 30x8m (01 no.)
2.	Berthing pontoons (Beeramballi) – 30x8m (01 no.)
3.	Aluminum Gangway – (approx.) 26m span x 2m wide (1no. at each terminal)
4.	Bankseat (6.6m wide and 4.0m long)

- Preliminary Designs have been worked out for Spurs; Bank Protection with Gabions; Navigational Aids for which a lumpsum money has been provisioned.

- With regard to the Environmental aspects, the requirements as per the norms have been suggested and also a Lump Sum provision @ 5% of project cost has been considered to meet the expenditure on this account.

- Regarding the Institutional requirements, it is suggested / recommended to to look after the Waterways under Cluster 6 covering Karnataka and Kerala along with appropriate manpower and other office infra requirements having control with Kochi directorate. However, Kabini due to its far proximity, provision of nominal staffings has been considered.

- No night navigation has been proposed. Further, to have quick inspections and also to have periodical visits, Speed Boats may be available as an Infrastructure within the controlling office. This speed boat can be improvised fitted with survey instruments and requisite software to cater the requirements of the survey.
- Since there is no cargo and no cargo operation is being mooted in the project except the development of ferry terminals to facilitate tourism operation with its fullest safety & security, therefore INR 23.75 Lakhs is provisioned for one time expense and maintenance cost per month will be around (approx) INR 5.01 Lakhs. So, the institutional cost shall be 23.75 lakhs & the O&M cost is 5.01 lakhs per month.

- The cost estimates have been worked out and segregated into 2 Modules i.e., Fairway Module which is working out to 506.27 lakhs (approx) and development of two ferry terminals at a cost of 1331.48 Lakhs. All the capital assets will be provisioned in 24 months commencing from FY: 2023-24 after ascertaining the required confirmations and approvals from the concerned departments.

- 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.

Sl No	Factors	Section	Unit	Outcome
1	Project Cost	Fairway	Cr.	5.06
		Terminals	Cr.	13.31
2	Tariff	Vessel Berthing	INR Vessel/Day	1,000
		Royalty	20% of Tickets	Floating Restaurant - 120, Boat Ride - 20
		Fairway Usage	INR GRT-Km	0.00
2	Traffic	Passengers	In '000 (FY40)	686.01
3	Revenue	Fairway (FY40)	Cr.	0.00
		Terminals (FY40)	Cr.	7.79
4	FIRR	Fairway	-	-
		Terminals	-	8.0%
		Whole	-	1.1%
5	EIRR	Fairway	-	-
		Terminals	-	23.9%
		Whole	-	13.1%

- The project doesnot have cargo transportation hence this aspect has not been found commercially and economically viable. The development of the study stretch of Kabini river is recommended for tourism traffic in the submergence area of the Dam from Beechanahalli to Beerambhalli for about 23.17 Kms with Class III system of the NW standards. The development shall kickstart a structured facility which will attract and promote tourism activities. In the most optimistic scenario, development of river Kabini (NW-51) may be considered only for the tourist and passenger services.

- The state govt. has proactive role to play in such kind of development and likely to promote tourism in this reason which is already an identified location by the state Govt.

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	✓		The project area falls within the Eco-Sensitive Zones of Nagarhole and Bandipore National Parks.
b) Wildlife/ Bird Sanctuary		✓	
c) Tiger or Elephant Reserve	✓		Nagarhole and Bandipore National Parks have been declared as Tiger Rerserves.
d) Biosphere Reserve	✓		Nagarhole and Bandipore National Parks partly come under Nilgiri Biosphere Reserve.
e) Reserved / Protected Forest		✓	
f) Wetland		✓	
g) Important Bird Areas		✓	
h) Mangroves Areas		✓	
i) Estuary with Mangroves		✓	
j) Areas used by protected, important or sensitive species of fauna for breeding, nesting, foraging, resting, over wintering, migration	✓		The project area falls within the Eco-Sensitive Zone of Bandipore National Park and within 10 km of Nagarhole National Park.
k) World Heritage Sites		✓	
l) Archeological monuments/ sites (under ASI"s Central / State list)		✓	
2. Is the project located in whole or part in / near any Critically Polluted Areas identified by CPCB?		✓	
3. Is, there any defense installations near the project site?		✓	
4. Whether there is any Government Order/ Policy relevant / relating to the site?	✓		EIA Notification 2006 Wildlife Protection Act, 1972 Water Act, 1974 Air Act 1981
5. Is the project involved clearance of existing land, vegetation and buildings?	✓		For construction of terminal buildings and access roads.
6. Is the project involved dredging?	✓		The project will require dredging for a length of nearly14 km of the proposed waterway.

Screening Question	Yes	No	Details / Remarks
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?		✓	
9. Is the project involved any demolition of existing structure?		✓	
10. Is the project activity require acquisition of private land?		✓	Land identified for construction of Terminal 1 at Beechanhali is Govt Land. Ownership of land identified for Terminal 2 and for construction of access roads leading to the two terminals is not confirmed as of now.
11. Is the proposed project activity result in loss of direct livelihood / employment?		✓	No dislocation is anticipated on account of the project.
12. Is the proposed project activity affect schedule tribe/ caste communities?		✓	

15.2. 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	✓		The project area falls within the Eco-Sensitive Zones of Nagarhole and Bandipore National Parks.
b) Wildlife/ Bird Sanctuary		✓	
c) Tiger or Elephant Reserve	✓		Nagarhole and Bandipore National Parks have been declared as Tiger Rerserves.
d) Biosphere Reserve	✓		Nagarhole and Bandipore National Parks partly come under Nilgiri Biosphere Reserve.
e) Reserved / Protected Forest		✓	
f) Wetland		✓	
g) Important Bird Areas		✓	
h) Mangroves Areas		✓	

Screening Question	Yes	No	Details / Remarks
i) Estuary with Mangroves		✓	
j) Areas used by protected, important or sensitive species of fauna for breeding, nesting, foraging, resting, over wintering, migration	✓		The project area falls within the Eco-Sensitive Zone of Bandipore National Park and within 10 km of Nagarhole National Park.
k) World Heritage Sites		✓	
l) Archeological monuments/ sites (under ASI"s Central / State list)		✓	
2. Is the project located in whole or part in / near any Critically Polluted Areas identified by CPCB?		✓	
3. Is, there any defense installations near the project site?		✓	
4. Whether there is any Government Order/ Policy relevant / relating to the site?	✓		EIA Notification 2006 Wildlife Protection Act, 1972 Water Act, 1974 Air Act 1981
5. Is the project involved clearance of existing land, vegetation and buildings?	✓		For construction of terminal buildings and access roads.
6. Is the project involved dredging?	✓		The project will require dredging for a length of nearly14 km of the proposed waterway.
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?		✓	
9. Is the project involved any demolition of existing structure?		✓	

Screening Question	Yes	No	Details / Remarks
10. Is the project activity require acquisition of private land?		✓	Land identified for construction of Terminal 1 at Beechanhali is Govt Land. Ownership of land identified for Terminal 2 and for construction of access roads leading to the two terminals is not confirmed as of now.
11. Is the proposed project activity result in loss of direct livelihood / employment?		✓	No dislocation is anticipated on account of the project.
12. Is the proposed project activity affect schedule tribe/ caste communities?		✓	

S. N.	Result of Screening Exercise	(Yes / No)
1.	Environment Impact Assessment is Required	Yes
2.	CRZ Clearance is Required	No
3.	Environmental Clearance is Required	No
4.	Forest Clearance is required	Not Required for Terminal 1. Ownership of land for Terminal 2 and Access Road sis yet to be confirmed.
5.	Wildlife Clearance is required	Yes
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

S. N.	Result of Screening Exercise	(Yes / No)
1.	Environment Impact Assessment is Required	Yes
2.	CRZ Clearance is Required	No
3.	Environmental Clearance is Required	Yes (for dredging)
4.	Forest Clearance is required	To be confirmed
5.	Wildlife Clearance is required	Yes
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

15.3. Traffic Template

15.3.1. Catchment Baseline

- Local economic geography - Heggadadevankote Taluka in Mysuru district is the only taluka in which Kabini River flows.
- Catchment area – H D Kote Taluka
- Population – As per census 2011, H D Kote taluka has 2,63,706 people out of which villages located on the bank of Kabini river has 31,896 people residing.
- Economic activities – Agricultural, inland fishing and sericulture activities and other low scale activities. Most of the local people do not own two wheeler for traveling purpose. Local people have their own animals which are used for various purpose.
- Major industries - No industries found in the catchment area of river.
- Connectivity
  - ✓ Major roads – SH 33 is the only major road which runs parallel to river. Apart from that there are internal village roads (Kachha rodas).
  - ✓ Major railway – No rail connectivity found in the primary catchment area. Nearest railway station is located more than 45 km away from river.
- Catchment area Map

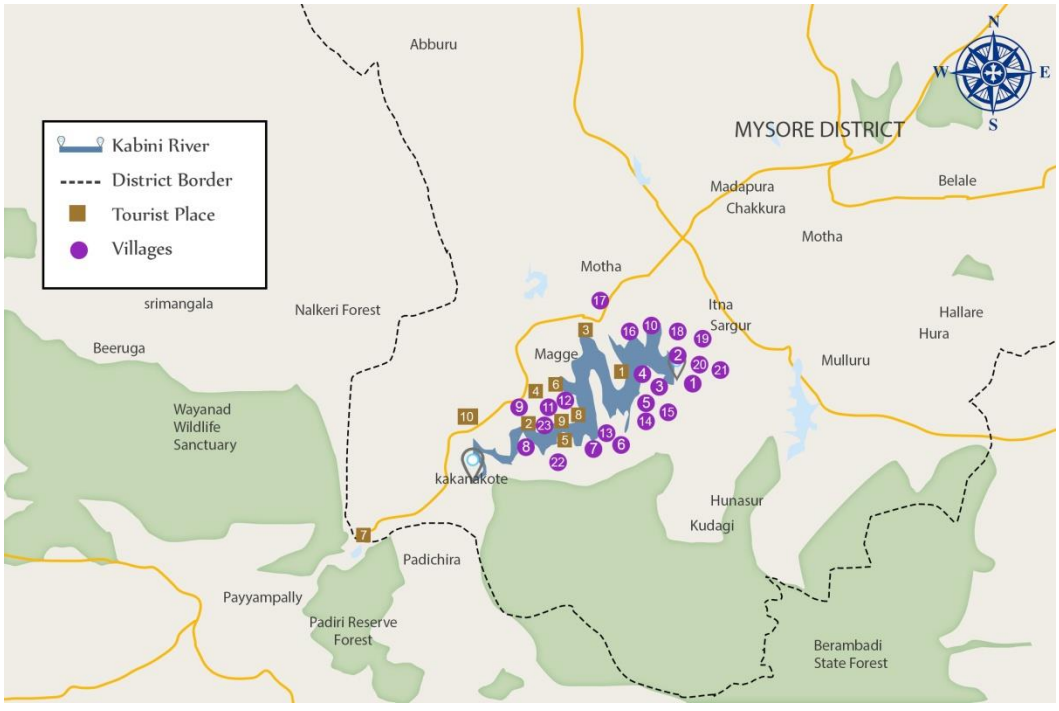


FIGURE 15.1: Catchment Area Map

15.3.2. Navigation Baseline

- ✓ No existing cargo movement on the river.
- ✓ Only small round shape wodden boats ply on river for tourism purpose. At present, boating activity takes place in Kabini River on a small scale. There exists problem of license issue to operate tourist boats on the river.
- ✓ During summer season water level reduces. River water is also supplied to Bangalore & other areas.
- ✓ There is dam built on Kabini River. It is built on 55 Ha. of land covering river & forest area. There are four gates on this dam. Height of dam is 2,284 feet
- ✓ Lot of Animals from Nagarhole National Park (2kms from Kabini) are visiting backwaters of Kabini to minimise their thirst. Many ponds and water sources in the national park are drying up. State Government has started digging Borewell nearby pond area and put solar panel to run the motor pump. This park is also tiger reserve area and State Government has put ban on all tourism activities in core areas of tiger reserves.
- ✓ Karnataka Government has put night ban on many national & state highways that connect Kerala with Karnataka and which pass through forests or national park area. Night ban duration is from 6 PM to 6 AM.

15.3.3. Market Baseline

- Potential Market

  No cargo or passenger potential for Kabini River. Majority of tourists visiting Kabini & resorts located on the bank of river are more interested in Jungle safari/ wildlife tour.

15.3.4. Forecasting Years

Name of the waterway: NW-51 (Kabini River,23.171km)														
Sr. No	**Name of Cargo**	**Type of Cargo**	**Origin**	**Original Terminal on NW**	**Final Destination**	**Destination Terminal on NW**	**Co-ordinates**	**Unit p.a**	**Fy-16**	**Fy-20**	**Fy-25**	**Fy-30**	**Fy-35**	**Fy-40**
Boat ride on Kabini for leisure activity (A small jetty/terminal for boarding tourists on boat)														
1	n/a	n/a	Indian & Foreign Tourists		H. D Kote Taluka			('000)	0	82.8	140.4	219.8	370.8	622.0
* BULK/BREAK BULK/BULK LIQUID/ TRUCKS (in No.), etc..														

15.3.5. Market Success Factors

As such there is no cargo mobility observed in the study stretch and there is no scope of further improvement in the existing scenario due to the proximity of forest coverage.

Apart from resorts located on the banks of Kabini river, there do not exist any tourist destination in H D Kote taluka. Therefore, in future, tourist traffic would be generated from these resorts and their watersport activities. Watersport activities at present are very minimal. The major hurdle for growth in watersport activities is license issue to operate motorboat or other tourist boat on the river. SH 33, which connects Karnataka with Kerala passes above Kabini river.

There is ban on using this road at night. Night ban has been imposed from 6 pm up till 6 am. Wild animals come on the road and to Kabini river to quench their thirst. Presence of wild animals near the river makes the place dangerous for tourists and local people. Tourists visiting resorts on the bank of Kabini river are more inclined towards doing jungle safari in nearby national parks/sanctuaries etc. Resort owners wants to increase number of tours of jungle safari to attract more customers. In the past there was no tourism or ferry operation on the river.

15.4. Project Costing Template

Cost type	Cost categories	Components to be itemized
Capital costs	Waterway Infrastructure	□ Land, compensation and resettlement: No □ Capital dredging:01.78 lakhs cu.m Ordinary soil – 4.36cr □ River training/bank protection: No □ Locks: No □ Barrages: No □ Channel market: No □ Night navigation: No □ Other: Communication system – 0.20 cr
Terminal Infrastructure		Terminal facility □ Fixed infrastructure: berths, moorings, hard-standing etc. (itemized) □ Loading/uploading and other equipment (itemized) □ Buildings: Considered in infrastructure □ Other: --
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

Cost type	Cost categories	Components to be itemized
	Vessel: (NB vessel operating costs/tons-km fall sharply with larger capacity vessel, when there is sufficient traffic to utilize them)	□ Crew □ Fuel □ Maintenance □ Registration & insurance □ Fees and charges □ Vessel capital amortization (or leasing cost equivalent) □ Total costs □ (Cost/tons-km 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 at price level till June: 2021
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 marketplace: Considered as per standard

15.5. 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 5.06 crore (b) Terminal Cost - INR 13.31 crore **O & M costs:**

	(a) Terminal Cost - INR 1.94 crore Savings in transport resource costs between IWT and rail and/or road transport **Saving on Fuel:** (a) Terminal Cost - INR 3.7 crore **Saving on Vehicle Operating Cost:** (a) Terminal Cost - INR 3.45 crore · **Savings in road/rail accident costs:** (a) Terminal Cost - INR 0.2 crore · **Saving in carbon emissions:** (a) Terminal Cost - INR 0.7 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 □ Rail 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, FY: 23-24).
EIRR	Development of Kabini 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 Kabini is also likely to generate overall benefits to the project. Economic IRR of Ferry Terminal is 23.9%.
Checking and Replicability	Systematic checks of spreadsheets and logic trail have been done keeping in mind the input data, assumptions and calculations.

15.6. 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 Kabini 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 0.00 cr. in FY40 Project Capital Cost (with escalation): INR 5.06 cr. **Returns for Terminal operations are:** Total Revenue: INR 7.79 cr. in FY40 O&M Cost: INR cr. 1.94 in FY40 Tax: INR 1.46 cr. In FY40 (@ 30% on EBITDA) EBIDA: INR 5.85 cr. In FY40 Project Capital Cost (with escalation): INR 13.32 cr. Net Cash Flow: INR 4.39 cr. In FY40

Disaggregation	Cash flow streams and FIRRs have been attached as annexures in Financial Evaluation chapter-13 for Navigation Structure and terminals separately. **Returns for Navigation infrastructure are:** Total Revenue: INR 0.00 cr. in FY40 Project Capital Cost (with escalation): INR 5.06 cr. **Returns for Terminal operations are:** Total Revenue: INR 7.79 cr. in FY40 O&M Cost: INR cr. 1.94 in FY40 Tax: INR 1.46 cr. In FY40 (@ 30% on EBITDA) EBIDA: INR 5.85 cr. In FY40 Project Capital Cost (with escalation): INR 13.32 cr. Net Cash Flow: INR 4.39 cr. In FY40
Evaluation period	Waterway utilization is assumed to start from FY24 till FY40, with development of navigational infrastructure and 2 terminals (development period of 2 years, FY: 23-24).
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: The project for development of ferry service for tourism on Kabini River has positive returns on investment (FIRR) cumulative. This additional project has been suggested for following reasons: • Cargo prospect are nil on Kabini River. Tourism is the only viable

	option of commercializing the waterway. • Existing tourism potential is negligible and does not justify creation of an infrastructure like ferry terminal or investment towards fairway development. New initiatives required to supply the initial push, which should translate into more tourism going forward. • Once tourism generated due to the proposed infrastructure (ferry terminal and Deeping of river stretch) in the future, tourist critical volume may be reached, prompting creation of tourism infrastructure like floating restaurants and similar facilities.
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.: The project has not been found commercially viable on standalone basis. Tariff considered for fairway is low. The financial analysis undertaken for the fairway shows non-existent EIRR and IRR. However, Terminal development shows healthy return. Fairway and Terminal do not exist in isolation, both of them have to be developed together. The cumulative returns from both the terminals and fairway is positive.
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 WATER AND BOTTOM SAMPLES

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 COLLECTION OF TOPOGRAPHICAL FEATURES

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 SURVEY CHART PREPARATION

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
	b)	Submission of Draft Feasibility Report (3 copies)	9	12	13	14	11	11	18
	c)	Comments from IWAI	11	14	15	16	13	13	20
	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
	b)	Submission of Hydrographic Survey Charts and report (3 copies)	23	30	29	31	24	26	38
	c)	Submission of Draft Detailed Project Report (3 copies)	31	38	37	39	32	34	46
	d)	Receipt of comments of IWAI on Draft DPR.	33	40	39	41	34	36	48
	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.

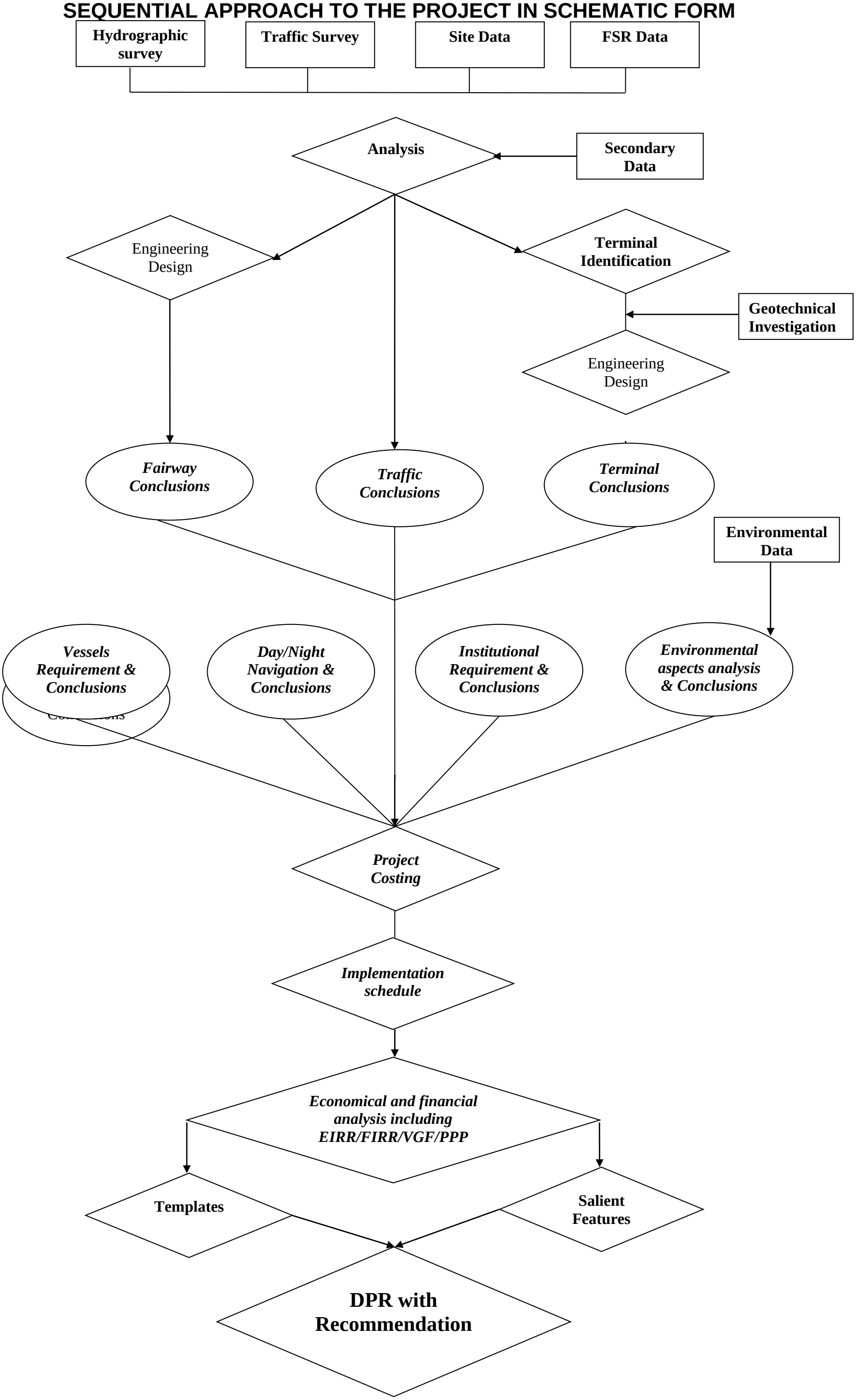
Note 4:- Since two clusters only will be awarded to one bidder, the same CVs cannot be proposed for at least two clusters. The same CV's can be proposed if the bidder is bidding for more than two Clusters.

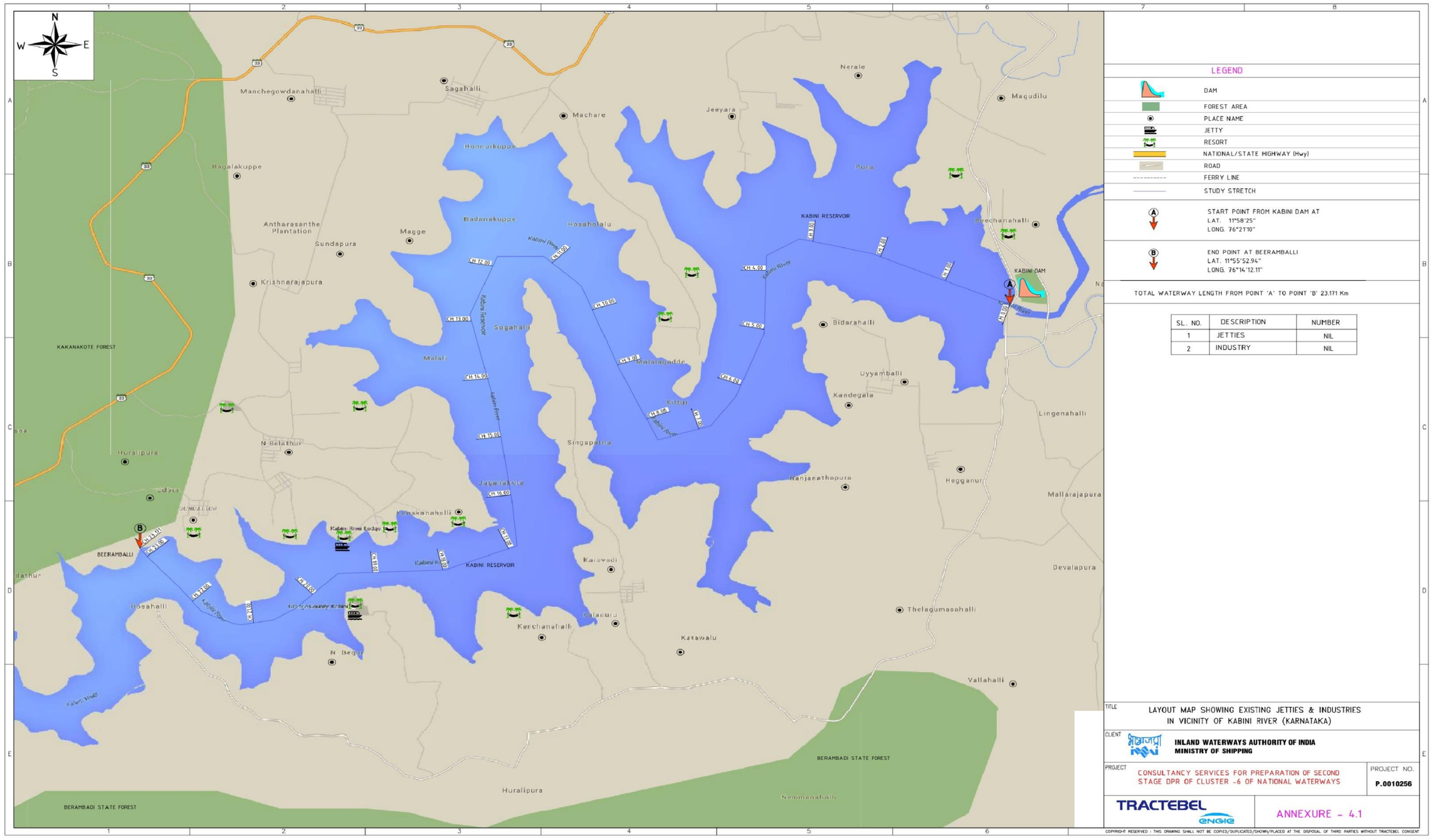
Note 5:- Role and responsibilities of the Key Professional shall be as per the requirement of the project and Terms of Reference of the tender document and the same has to be access by prospective bidder.

ANNEXURE 1.2 – SEQUENTIAL APPROACH TO THE PROJECT IN SCHEMATIC FORM

ANNEXURE 1.2

SEQUENTIAL APPROACH TO THE PROJECT IN SCHEMATIC FORM





ANNEXURE 4.2 – SUMMARY OF INTERVIEWS

Resort Name	Person Name	Designation
Red Earth Kabini	Ravi	MD
Kabini Lake View Resort	Gautam	-
Orange County Kabini	Ravindra	-
Kabini Spring Resorts	-	-
The Serai Resorts Kabini	Radeesh	-
Waterwoods Kabini	-	-
Kabini River Lodge	-	-

Red Earth Kabini

Name: Ravi

Designation: Managing Director

The Resort is the only resort, which is situated near the reservoir. It doesn't face the problem of receding water levels in the river during summer season at its location. It manages 5-6 resorts at the same location and draws in 12,000 tourists monthly operating at 70% capacity of its accommodation. The local tourists that visit the resort are mainly from the metro cities of Mumbai, Pune, Bengaluru, Chennai and Hyderabad and from states like Gujarat. The International tourists come to visit in the month Of December during the winter season. The resort operates 1 speedboat and 1 motorboat each on the reservoir just to ferry the people across on to the other side. The resort also operates coracle rides.

Discussions regarding the development of water sport activities and deployment of houseboats on Kabini river has evoked positive response as the resort looks forward to have its own houseboats on the river and could conduct water sports and activities on the river provided the resort get speedy clearances. The reservoir of the Kabini river comes under the jurisdiction of Kaveri Neeravari Nigam Ltd., while the mouth of the river that enters the forest comes under the jurisdiction of Karnataka Forest Department. A 2012 court ruling barred the resorts (private players) to use their own private vehicles for wildlife safari. The court has permitted only Jungle Lodges and Resorts (JLR), which is a Government organization to operate their vehicles for safari on rent basis. JLR's vehicles would start from Kabini River Lodge and would take tourists for jungle safari.

Kabini Lake View Resort

Name: Gautam

The resort gets both local as well as international tourists. The locals visit the resort throughout the year. The International tourists visit specially during the months of October to March. Around 1500 local tourists visit the resort every year, whereas the international tourists' count is a meager 150 per year.

The resort, during the discussions, has pointed out that the red tapism involving the speedy clearance and acquisition of license applications put forward to the government. The resort is in favor of putting up its houseboats on the river and conducting water sport activities on Kabini River if granted license. The resort is also in favor of using the berthing facility by IWAI, if developed, for its own boats. It was also pointed out that the H D Kote Taluka doesn't promise any scope for tourism other than limited scope that exist around Kabini River.

Orange County Kabini

Name: Ravindra

The resort gets its traffic from the local tourists, who comprise around 80% of total visitors. The local tourists visit the resort throughout the year from places like Bengaluru, Mumbai. The international tourists visit the resort during the months of November to February. These tourists are mostly from U.S.A., U.K. and Germany and contribute to the rest 20% of the resort's visitors.

Discussions with the resort have yielded that the visitors of the resort show more interest in wildlife safaris as more than 50% of the H D KOTE taluka area covered by forests. It also wants the Karnataka Forest Department to put in an extra session for Safari visit, in addition to the existing two sessions, as only 18 people can be taken in one session through the waterway mode. They want the extra session to accommodate all the tourists to the wildlife safari, as presently the supply of sessions is less than the demand. There are security issues concerning the deployment of houseboats on the river, as the river is surrounded by two national parks on both sides.

Kabini Spring Resorts

The resort caters to domestic and international tourists. The resort also caters to corporate clients, particularly from Bengaluru. The tourists for the resort mainly hail from the southern part of India. The interstate traffic occurs from the states of Gujarat and Maharashtra, from cities of Mumbai, Pune and Nashik. The summer season in particular contributes to the spurt in tourism traffic for the resort.

The Serai Resorts, Kabini

Name: Radeesh

Owned by the Coffee Day chain, the resort sees majority of domestic tourists from all over India. Apart from local tourists, International tourists also form the clientele.
As per the discussion with the concerned person, the water from the river is supplied to Bengaluru. Hence there is less water for most water sport activities other than Kayaking. The visitors who visit the resort prefer to go for wildlife safaris.

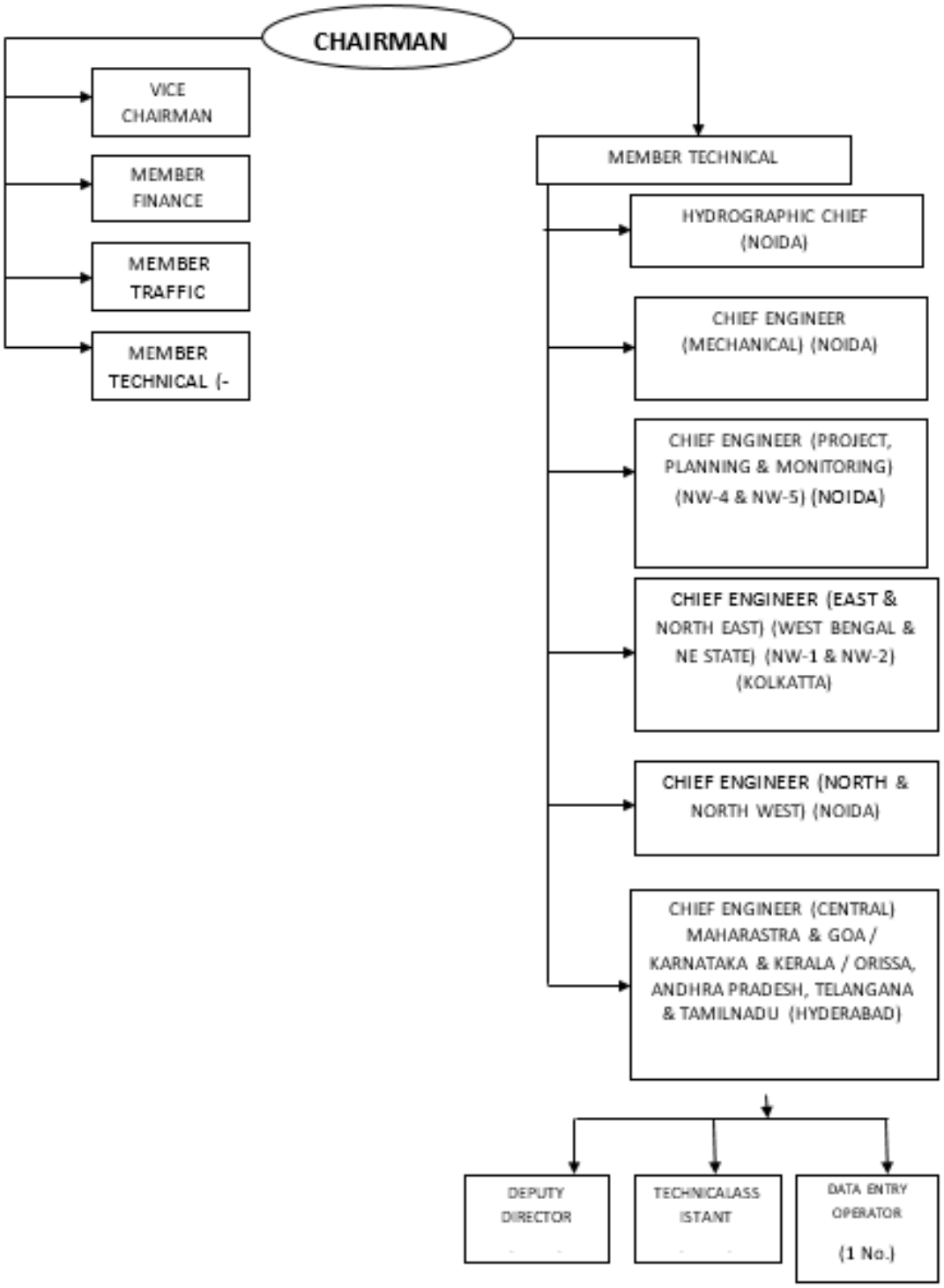
Waterwoods Kabini

Majority of the visitor traffic generated at the resort comprises of domestic tourists. The domestic tourist traffic mostly comes from the states of Karnataka, Gujarat and Maharashtra and also from the metro cities of Kolkata, Chennai, Mumbai and Bengaluru. The river gets dried up during the months of April- May.
According to the resort spokesperson, buying and deploying houseboats incur high expenditure and it is financially unviable from the owner's standpoint. The resort affords to operate just one motorboat cruise to Bheemankoli. Also, the area shows more potential as a wildlife destination.

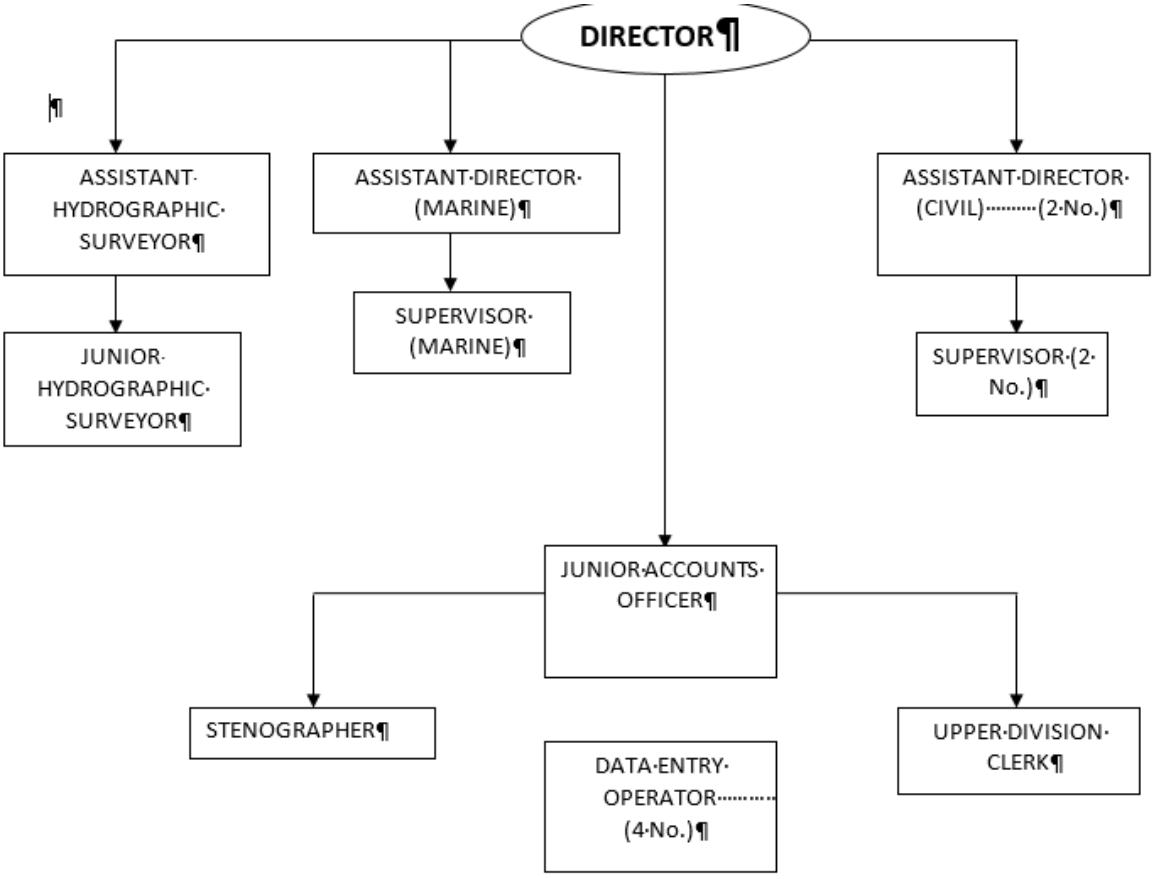
Kabini River Lodge

The visitor traffic at the lodge is mostly domestic and especially from Southern India. The domestic tourists come to the resort throughout the year. The international tourism traffic has a share of mere 5% to the total visitor count at the resort.
The resort has shared its tourism traffic for the months of April to October (6 months) i.e. 12,000. The current year witnessed severe rainfall shortage. The water from the River reservoir is used for irrigation and also the river gets dried up in the months of February and March.

ANNEXURE 10.1– INSTITUTIONAL REQUIREMENT HEAD OFFICE COMPONENTS



ANNEXURE 10.2– INSTITUTIONAL REQUIREMENT IN KARNATAKA AND KERALA



ANNEXURE 11.1 – COSTING/FINANCIAL ASSUMPTIONS

Note: *The present organizational setup at IWAI Kochi will look after the existing NW-3 and NW-51 with due modifications at the time of implementations of proposed Cluster-6 activities.*

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 –WHOLE PRICE INDEX FOR THE MONTH OF JULY 2020

			Computation for Applicable WPI (Jan-2019 to June-2021)										
Year -2019													
WPI Index Value													
Month/ Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
2019	119.2	119.5	119.9	121.1	121.6	121.5	121.3	121.5	121.3	122.0	122.3	123	121.2
WPI in Jan - 2019			119.2										
WPI in Dec - 2019			123										
Increase			+ve				Multiplying Factor			(1 + 3.19/100) =		1.032	
% Increase - 2019 = (123-119.2)/119.2					3.190	%							
Year -2020													
WPI Index Value													
Month/ Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
2020	123.4	122.2	120.4	119.2	117.5	119.3	121	122	122.9	123.6	125.1	125.4	121.8
WPI in Jan - 2020			123.4										
WPI in Dec - 2020			125.4										
Increase			+ve				Multiplying Factor =			(1 1.62/100) =		1.016	
% Increase - 2020 = (125.4-123.4)/123.4					1.620	%							
Year -2021													
WPI Index Value													
Month/ Year	Jan	Feb	Mar	Apr	May	Jun							
2021	126.5	128.1	129.9	132	132.7	133.7							
WPI in Jan - 2021			126.5										
WPI in June - 2021			133.7										
Increase			+ve				Multiplying Factor =			(1 5.69/100) =		1.057	
% Increase - 2020 = (133.7-126.5)/126.5					5.690	%							
Combined Effect (Jan-2019 to June-2021)							1.0319 X 1.0162 X 1.0569			1.11	%		

ANNEXURE 11.3 –ABSTRACT OF COST FOR FAIRWAY DEVELOPMENT FOR NW 51-RIVER KABINI

Sl No.	Item Description	Amount (in Lakh Rs.)
A	**Fairway**	
1	Dredging	
(i)	General Soil	436.10
(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	0.00
(ii)	Bank Protection Works for river	0.00
(iii)	Porcupine	0.00
4	Night Navigation	
(i)	Channel Marking Buoy, Mooring Gear & Lighting Equipments	0.00
5	Land Acquisition	0.00
	Sub-total (A)	**436.10**
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**	
(i)	RIS Centre	20.00
(ii)	AIS Base Station	
(iii)	Vessels - Survey vessel & Other Vessel	
(iv)	Buoys	
	Sub-total (C)	**20.00**
	Sub-total (A)+(B)+(C)+(D)	**456.10**
D	EMP Cost @ 5% of Prime cost as per Chap 9 of DPR	22.81
E	Project Management & consultancy Charges @3% of Prime cost	13.68
F	Contingencies and Unforseen Items of Works @ 3% of Prime cost	13.68
	Project total Hard Cost	**506.27**

Cost of Dredging in Kabini River - (NW-51)

S.No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
1	Dredging in General Soil	Cum	1,78,000	245	436.10
2	Dredging in Hard Soil	Cum	0	900	0.00
	Total Cost of Dredging				**436.10**

ANNEXURE 11.5 – ABSTRACT OF COST FOR FERRY DEVELOPMENT FACILITY FOR NW 51 (RIVER KABINI)

Sl No.	Item Description	Amount (in Lakh Rs.)
A	**Terminals**	
	Beechanahalli Terminal (T1)	
(i)	Land	31.78
(ii)	Riverine Components	305.89
(iii)	Infrastructure Components including internal roads	186.50
(iv)	Bank Protection Works for terminal	54.73
	Sub-total (A1)	**578.89**
	Beeramaballi Terminal (T2)	
(i)	Land	31.78
(ii)	Riverine Components	305.89
(iii)	Infrastructure Components including internal roads	186.50
(iv)	Bank Protection Works for terminal	54.73
	Sub-total (A2)	**578.89**
	Sub-total (A)	**1157.79**
B	**Vessels**	
(i)	Vessel Size	0.00
(ii)	Vessel Capacity	0.00
	Sub-total (B)	**0.00**
C	**Institutional Requirement**	
(i)	Office Development Cost	23.75
	Sub-total (C)	**23.75**
	Sub-total (A)+(B)+(C)	**1181.54**
D	**Equipments for Both Terminals**	
(i)	Ambulance - 1 no.	18
(ii)	Dumper Trucks 16 T Capacity - 1 no.	0
(iii)	Cranes with 50 T Capacity - 1 no.	0
(iv)	Fork lift trucks 20 T Capacity - 1 no.	0
	Sub-total (C)	**18.00**
	Sub-total (A)+(B)+(C)+(D)	**1199.54**
E	Enviornmental Management Plan Cost @ 5% of Prime cost as per Chapter 9 of DPR	59.98
F	Project Management & consultancy Charges @3% of Prime cost	35.99
G	Contingencies and Unforseen Items of Works @ 3% of Prime cost	35.99
	Project Total Hard Cost	**1331.48**

ANNEXURE 11.6 –COST OF LAND FOR FERRY TERMINAL

Sl No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
A	**Beechanahalli Terminal (T1)**				
1	Land Area Cost				
(i)	Land inside the terminal area	m^2	1691.68	1103.31	18.66
(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	1120.00	0.00
2	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 Ro-Ro terminal side. as per 5.22 of SOR, Karnataka	m^3	107.97	6825.39	7.37
3	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	863.73	365.19	3.15
4	Carraiage of Material for item 2 & 3 @ 5% of the total cost of these items	%	---	5.00	0.53
5	Land Cutting/Excavation for 1.0 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	m^3	1691.68	122.10	2.07
	Sub-total 1				**31.78**
	Total Cost of Land & its Development				**31.78**
B	**Beeramballi Terminal (T2)**				
1	Land Area Cost				
(i)	Land inside the terminal area	m^2	1691.68	1103.31	18.66

Sl No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
(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 (None)	m^2	0.00	1120.00	0.00
2	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 Ro-Ro terminal side. as per 5.22 of SOR, Karnataka	m^3	107.97	6825.39	7.37
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4	Carraiage of Material for item 2 & 3 @ 5% of the total cost of these items	%	---	5.00	0.53
5	Land Cutting/Excavation for 1.0 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	m^3	1691.68	122.10	2.07
	Sub-total 1				**31.78**

ANNEXURE 11.7 –COST OF PONTOON STRUCTURES AT KABINI FERRY FACILITY AT BEECHANAHALLI (TERMINAL 1)

Sl no.	Description of work	SOR Ref	Units	Total Qty.	Rate (INR)	Amount	Total Amount (incl. CESS & GST)
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	50,000
b	Bankseat - Land piles		No	2	8,000	16,000	16,000
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	11,92,679
b	Bankseat - Land piles		MT	6	1,01,400	5,96,340	5,96,340
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	21,00,800
b	Bankseat - Land piles	Karnataka SOR-4.35	M	60	21,008	12,60,480	12,60,480
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	11,81,627
b	Bankseat - Land piles	DSR-20.5.6	CUM	47	12,537	5,90,813	5,90,813
c	Bankseat - Pile cap platform	DSR-20.5.6	CUM	36	12,537	4,51,348	4,51,348
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	13,23,710
b	Bankseat - Land piles		MT	7	70,225	4,96,391	4,96,391
c	Bankseat - Pile cap platform		MT	5	70,225	3,79,215	3,79,215
2	**PONTOON**						
	Procure, supply , fabricate ,install & commissioning of Pontoon with structural steel work (structural steel Fy 250MPa) welded in built up sections, framed 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	Karnataka 18.2.3					
	Berthing Pontoon size - 30 m X 8 m	Karnataka 6.12	KG	1,70,893	97	1,65,59,564	1,65,59,564
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	35,70,000
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	3,20,000
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	5,00,000
					Total =		**3,05,88,968**

ANNEXURE 11.8 – COST OF PONTOON STRUCTURES AT KABINI FERRY FACILITY AT BEERAMBALLI TERMINAL 2

Sl no.	Description of work	SOR Ref	Units	Total Qty.	Rate (INR)	Amount	Total Amount (incl. CESS & GST)
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	50,000
b	Bankseat - Land piles		No	2	8,000	16,000	16,000
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	11,92,679
b	Bankseat - Land piles		MT	6	1,01,400	5,96,340	5,96,340
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	21,00,800
b	Bankseat - Land piles	Karnataka SOR-4.35	M	60	21,008	12,60,480	12,60,480
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	11,81,627
b	Bankseat - Land piles	DSR-20.5.6	CUM	47	12,537	5,90,813	5,90,813
c	Bankseat - Pile cap platform	DSR-20.5.6	CUM	36	12,537	4,51,348	4,51,348
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	13,23,710
b	Bankseat - Land piles		MT	7	70,225	4,96,391	4,96,391
c	Bankseat - Pile cap platform		MT	5	70,225	3,79,215	3,79,215
2	**PONTOON**						
	Procure, supply , fabricate ,install & commissioning of Pontoon with structural steel work (structural steel Fy 250MPa) welded in built up sections, framed 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	Karnataka 18.2.3					
	Berthing Pontoon size - 30 m X 8 m	Karnataka 6.12	KG	1,70,893	97	1,65,59,564	1,65,59,564
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	35,70,000
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	3,20,000
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	5,00,000
					Total =		**3,05,88,968**

ANNEXURE 11.9 –COST OF INFRA STRUCTURES AT BEECHANAHALI TERMINAL 1

Cost of Ferry Terminal Infrastructure at Beechanahalli Terminal (T1)						
Sl no.	**Facility**	**Nos.**	**Size**	**Area (in m^2)**	**Rate (in Rs.)**	**Amount (in Lakh Rs.)**
1	Open Mobility Area	1	-	50	8,754	4.38
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	3.5m x 3m	10.5	9,435	0.99
5	Electrical facility, Transformer etc.	1	4m x 3.5m	14	30,525	4.27
6	Fuel Bunkers	1	5m x 4m	20	6,167	1.23
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 x4m	20	14,819	2.96
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
	Total Area			**1691.68**	**Sq-m**	
	Total cost of Other Components inclusive of GST					**186.50**

ANNEXURE 11.10 –COST OF STRUCTURES AT BEERAMBALLI TERMINAL 2

Cost of Ferry Terminal Infrastructure at Beeramballi Terminal (T2)						
Sl no.	**Facility**	**Nos.**	**Size**	**Area (in m^2)**	**Rate (in Rs.)**	**Amount (in Lakh Rs.)**
1	Open Mobility Area	1	-	50	8,754	4.38
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	10.5	9,435	0.99
5	Electrical facility, Transformer etc.	1	4m x 3.5m	14	30,525	4.27
6	Fuel Bunkers	1	6m x 4m	20	6,167	1.23
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 x4m	20	14,819	2.96
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
	Total Area			**1691.68**	**Sq-m**	
	Total cost of Other Components inclusive of GST					**186.50**

ANNEXURE 11.11 –COST OF BANK PROTECTION AT TERMINALS

Cost of Bank Protection at Kabini Ferry Terminal						
S.No.	**Item Description**	**Unit**	**Estimated Quantity**	**Rate (in Rs.)**	**Amount (in Lakh Rs.)**	**Remarks**
A	**Beechanahalli Terminal (T1)**					
1	Providing and laying gabion for erosion control, river training works and protection works as per technical specifications	Cum	1333.50	3942.90	52.58	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	1600.20	134.20	2.15	
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	
	Sub-total 1				**54.73**	
B	**Beeramballi Terminal (T2)**					
1	Providing and laying gabion for erosion control, river training works and protection works as per technical specifications	Cum	1333.50	3942.90	52.58	
2	Providing and laying geotextile as per technical specifications	Sqm	1600.20	134.20	2.15	
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	
	Sub-total 2				**54.73**	
	Cost of Bank Protection & Allied Works (Both the Terminal Location)				**109.45**	

ANNEXURE 12.1 –IMPLEMENTATION SCHEDULE (FAIRWAY DEVELOPMENT)

KABINI RIVER (Fairway Development) - Annexure 12.1

Sl.No.	Items	(24 Months Ending 2024)																						
		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.a) Dredging																								
	Ordinary Soils (Approval & Tendering)																								
	Ordinary Soils (Execution of 1,78,000 Cu. M)																								
B	**River Training Work/ Bank Protection at Terminal Location**																								
	Approval & Tendering																								
C	**Modification of Structures (NIL)**																								
D	**Communication System**																								
	Day/ Night Navigation Buoys/ Lights (Approval & Tendering)																								
	Day/ Night Navigation Buoys/ Lights (Procurement)																								
	Day/ Night Navigation Buoys/ Lights (Deployment)																								
	Lump Sump Provision																								
E	**Institutional Requirement (Along with Cl 6 development)**																								
	Office / Manpower (Establishment & Recruitment)																								
	Office / Manpower (Deployment)																								
	Vessels (Approvals & Tendering)																								
	Vessels (Procurement & Deployment of 2 SLs; 2 Tugs; 2 IBs)																								
	Lump Sump Provision (23.75 Lakhs)																								
F	**Environmental Management Plan**																								

*** Fairway Development (along with 2 Ferry Terminals) is to be taken up in FY: 2023-24. Implementation will be in 24 months ending 2024. Recommended for implementation after obtaining necessary approvals from State Govt./ MoEF&CC and other authorities as needed.**

ANNEXURE 12.2 –IMPLEMENTATION SCHEDULE (FERRY TERMINAL DEVELOPMENT)

KABINI RIVER (Ferry Terminal Development) - Annexure 12.2																									
Sl. No.	Items	(24 Months Ending 2024)																							
		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	**Ferry Terminal - 2 Nos. (Beechanahalli & Beeramballi)**																								
	Land Acuisition																								
	Riverine Components																								
	Infrastructure Components internal roads (Approvals & Tendering)																								
	Infrastructure Components internal roads (Execution)																								
	Approach Road Cost																								
	Bank Protection Works for terminal (Approvals & Tendering)																								
	Bank Protection Works for terminal (Execution)																								
B	**Cargo Handling Equipments**																								
	1 No. Ambulance																								
C	**Environmental Management Plan**																								

*** Fairway Development (along with 2 Ferry Terminals) is to be taken up in FY: 2023-24. Implementation will be in 24 months ending 2024. Recommended for implementation after obtaining necessary approvals from State Govt./ MoEF&CC and other authorities as needed.**

LIST OF DRAWINGS

Sl. No	DRAWING NAME	DRAWING NUMBER
1.	LAYOUT PLAN OF KABINI RIVER (3 SHEETS)	P.010256-W-20301-A03
2.	KABINI RIVER – LOCATION OF BORE HOLE (2 SHEETS)	P.010256-W-20351-X03
3.	KABINI RIVER – TERMINAL LAYOUT PLAN (3 SHEETS)	P.010256-W-20311-A03
4.	KABINI RIVER – BEECHANHALLI & BEERAMBALLI FEERY GHAT DETAILS (5 SHEETS)	P.010256-W-20309-A03
5.	KABINI RIVER - TERMINAL BUILDING DETAILS (2 SHEETS)	P.010256-W-20364-A03
6.	BANK PROTECTION TYPICAL SECTION (1 SHEET)	P.010256-W-20303-X03

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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