INLAND WATERWAYS AUTHORITY OF INDIA (IWAI)

CONSULTANCY SERVICES FOR PREPARATION OF SECOND STAGE DETAILED PROJECT REPORT (DPR) OF CLUSTER 8 OF NATIONAL WATERWAYS

FINAL DETAILED PROJECT REPORT OF TAPI RIVER NATIONAL WATERWAY – 100 STRETCH - 0 Km TO 174.587 Km

VOLUME-I MAIN REPORT

WAPCOS Limited
(A GOVERNMENT OF INDIA UNDERTAKING – MINISTRY OF WATER RESOURCES, RIVER DEVELOPMENT & GANGA REJUVENATION)
76-C,Sector-18, GURGAON – 122015, INDIA
☎ : +91-124 - 2397395 / 2397388 / 2348028
Fax : +91-124 – 2349180 / 2397392 / 2399224
Email : ports@wapcos.co.in / wapdelhi@rediffmail.com
Web : www.wapcos.co.in

18 October 2018 (Revision-2)

Acknowledgement

This Final Detailed Project Report is the outcome of detailed study of existing Hydrography, topography and traffic assessment along River Tapi. This vision is shared jointly by IWAI and WAPCOS Limited.

This report gives the present status of water-ways assets, topographic features, climatic variability, land use / land cover pattern, details of all cross structures along with socio-economic information of the waterway. Report also gives information Traffic and market assessment along the river for development of waterway. Report includes Preliminary Design, cost estimates and financial analysis of the project.

WAPCOS LTD. expresses their gratitude to **Mrs. Nutan Guha Biswas, IAS, Ex Chairperson** for sparing their valuable time and guidance for completing this Project. We would also like to thanks **Shri Pravir Pandey, Chairman (IA&AS); Shri Alok Ranjan, Member (Finance), Shri S.K.Gangwar, Member (Technical) and Shri Shashi Bhusan Shukla Member (Traffic)**

We also wish to express our gratitude to **Capt. Ashish Arya, Hydrographic Chief** for their guidance and inspiration for this project. We would also like to thank **Shri Rajiv Singhal, A.H.S.** for invaluable support and suggestions provided throughout the survey period. WAPCOS is pleased to place on record their sincere thanks to other staff and officers of IWAI for their excellent support and co-operation throughout the project period

WAPCOS Team

Sector -18, Gurugram
Haryana- 122015

FINAL DETAILED PROJECT REPORT (DPR) OF NATIONAL WATERWAY NO. 100, RIVER TAPI (174.587km) IN THE STATE OF GUJARAT

VOLUME-I: MAIN REPORT

ANNEXURES

LIST OF TABLES

LIST OF FIGURES

LIST OF ANNEXURES

SALIENT FEATURES-TAPI RIVER (NW-100)

Sr. No.	Particulars	Details		
A.	**GENERAL**			
1.	***Location***	***Tapi River (NW-100)***		
a)	Cluster	Cluster-8		
b)	State(s)	Gujarat		
c)	Co-ordinates& Name of Place	**Start**	**End**	
	Place	Gulf of Khambhat	Upstream of Ukai Dam.	
	Latitude	21°2'15.911"N	21°24' 43.988"N,	
	Longitude	72°39'22.718"E	73°50' 3.000"E	
B.	**TECHNICAL**			
1.	***Waterway***			
a)	National Waterway Number	100		
b)	Class	Proposed vessel 13m x 3.8m x 1.0m for Phase-1		
		IV for Phase-2		
c)	Type (Tidal/Non-Tidal)	Tidal & Non-Tidal		
	Length (Km.)	**Total**	**Tidal**	**Non-Tidal**
		174.58	34.67	139.91
d)	Average Tidal Variation, if applicable	6 m		
e)	Chart Datum	Essar Port & Nehru Bridge for Tidal Zone. The non- tidal stretches are sub-divided as downstream and upstream stretches of Singanpore Weir, Kakrapar Weir and Ukai Dam.		
	Description/Basis	The datum for calculation of dredge volume needs to be adopted as per the gradient of the River and the average water level observed for the River in Non-Tidal Stretch and Chart datum used in Tidal Stretch. The established chart datum values are available for Tapi River of 174.58 km stretch which is from the Confluence of Tapi River at Gulf of Khambhat to upstream of Ukai Reservoir. The tidal stretch of Tapi River is from 0 to 34.67 km and the established chart datum value of 0.388 m below Chart datum at Essar Port (6.2 km) and Nehru Bridge (31.2 km) was considered for the tidal reaches. The non-tidal stretches of Tapi River are from 34.67 to 174.58 km and for fixing chart datum/sounding datum.The non- tidal stretches are sub-divided as downstream and upstream stretches of Singanpore Weir, Kakrapar Weir and Ukai Dam.		
	Value	Essar Port -0.388 Singanpore Weir D/S +1.7 Singanpore Weir cum causeway U/S +4.11		

		Kakrapar Weir D/S +30.097 Kakrapar Weir U/S +47.712 Ukai Dam D/S +48.378 Ukai Dam U/S +90.169			
f)	LAD Status (w.r.t. CD)				
		Stretch-1	**Stretch-2**	**Stretch-3**	**Stretch-4**
	Stretch (From……To……)	**0–34.67 km**	**34.67–50 km**	**50–75 km**	**75- 100km**
	Length with LAD < 1.2 m	6.618	0	0	23.294
	With LAD from 1.2-1.4 m	0.000	0.00	0.000	0.000
	With LAD from 1.5-1.7 m	0.000	0.00	0.000	0.000
	With LAD from 1.8-2.0 m	0.000	0.00	0.000	0.000
	With LAD > 2.0 m	28.056	15.3	25.00	1.706
		Stretch-5	**Stretch-6**	**Stretch-7**	**Total(Stretch 1-7)**
	Stretch (From……To……)	**100-112.303 Km**	**112.303-137.311 km**	**137.311-174.58 km**	**0–174.58 km**
	Length with LAD < 1.2 m	12.303	0.000	0.000	42.22
	With LAD from 1.2-1.4 m	0.000	0.000	0.000	0
	With LAD from 1.5-1.7 m	0.000	0.000	0.000	0
	With LAD from 1.8-2.0 m	0.000	0.000	0.000	0
	With LAD > 2.0 m	0.000	25.00	37.276	132.36
		Grand Total			174.58
g)	Target Depth of Proposed Fairway (m)	2.0m			
h)	Conservancy Works Required	-			
	Type of Work	**Phase-1**		**Phase-2**	
	Dredging Required (M. Cum.)	0.31		2.0	
	Navigation Lock	Nil		2 Nos. (Singanpore weir at Ch. 34.6 and Kakrapar weir at Ch 112.3)	
	Barrages	Nil		2 Barrages at Ch 77 and Ch 95	
	River Training/Bank Protection (Km.)	Not Required			
i)	Existing Cross Structures				
	Name of Structure	**Type**	**Nos.**	**Range of Horizontal Clearance**	**Range of Vertical Clearance w.r.t. HFL/MHWS**
	Dams/Barrages/Weirs/Aqueducts etc.	Weir	2	NA	NA
	Bridges	1 Rail & 18 Road Bridges	19	0 m to 55 m	-8 m to 14 m
	HT/Tele-communication lines	HT Lines	34	200 m to 700 m	12 m to 20 m

2.	***Traffic***					
a)	Present IWT Operations (type of services)	The channel near to the confluence with the Gulf of Khambhat (near Essar port) is used by the cargo vessels and Barges entering various terminals like L&T, Ultratech cement, Magdala Port, Ambuja cement, etc., located at Tapi River. Currently,There are no ferry services in Tapi River.				
b)	Major industries in the hinterland (i.e. within 25 km. on either side)	Large industrial units such as Reliance Industries, KRIBHCO, Larsen & Tubro, ONGC, Essar Port & Essar Steel, NTPC, Reliance Petrochemicals Ltd., Gas Authority of India Ltd. Adani Hazira Port and Shell India Ltd. are contributing into industrial growth of the Surat dist. Industries like textile, sugar mills and paper manufacturing are predominating in Tapi district. Ukai Thermal Power Plant and Nuclear Power Plant present in Tapi District.				
c)	Connectivity of major industries with Rail/Road network (Distances/Nearest Railway Stations etc.)	Surat is the major station located within 5km from the Area of interest. The other railway's stations near to the survey stretch are Utran, Kosad, Mangrolla, Ukai Songadh, lakkadkot, Bhadbhunja and Navapur. The area is well connected with road network to other cities like Vadodara and Surat.				
d)	Commodities/Passengers	**In-bound**		**Out-bound**		
	Cargo Jetty	Coal		Fly ash, SBM		
	Passenger Jetty	Tourist				
e)	Future Potential (MMT)					
	Name of Commodity	**5 years**	**10 years**	**15 years**	**20 years**	**25 years**
	Tourists (Terminal 1 and 2) **('000)**					
	Recreational Center	849	1,247	1,576	1,917	2,333
	Boat Ride	127	187	236	288	350
	Cargo (Terminal 3 and 4) **(mn Tonnes)**					
	SBM (Terminal 3)	0.1	0.2	0.3	0.4	0.8
	Coal (Terminal 4)	0.6	0.7	0.7	0.8	0.8
	Fly ash (Terminal 4)	0.3	0.3	0.3	0.3	0.3
3.	***Terminals/Jetties***					
a)	Terminal/Jetty - 1	Tourist Terminal				
	Location (Bank/city/district)	Dumas				
	Type/Services	Tourism/Passenger Ferry				
	Facilities	Jetty, Buildings, Water Supply, Toilets, Parking Area and Recreational Activities				
	Land Ownership	Forest Land				
	Area (ha.)	**Govt.**		**Private**		
		1.5 Ha		NA		
b)	Terminal/Jetty – 2	Tourist Terminal at CH 31.3 Km				
	Location (Bank/city/district)	Old Fort, Chowk Bazar				
	Type/Services	Tourism/Passenger Ferry				

	Facilities	Floating Jetty	
	Approach	-	
	Land Ownership	Govt Land	
	Area (ha.)	**Govt.**	**Private**
		NA	NA
c)	Terminal/Jetty – 3	Cargo Terminal at CH 18 Km	
	Location (Bank/city/district)	KRIBHCO Jetty	
	Type/Services	Cargo Jetty	
	Facilities	Jetty, Buildings, Material handling equipments, Storage Area, Water Supply, Toilets, Parking Area	
	Approach	-	
	Land Ownership	Govt Land	
	Area (ha.)	**Govt.**	**Private**
		1.5 Ha	NA
d)	Terminal/Jetty – 4	Cargo Terminal at CH 134 Km	
	Location (Bank/city/district)	Ukai	
	Type/Services	Cargo Jetty	
	Facilities	Jetty, Buildings, Material handling equipments, Storage Area, Water Supply, Toilets, Parking Area	
	Approach	-	
	Land Ownership	Govt Land	
	Area (ha.)	**Govt.**	**Private**
		1.5 Ha	NA
4.	***Design Vessel***		
	Phase-1		
a)	Type	Proposed Vessel	
b)	No. & Size	13m x 3.8m	
c)	Loaded Draft	1.0m	
d)	Capacity	18 pax	
	Phase-2		
a)	Type	Self-propelled vessel	
b)	No. & Size	70m X 12m	
c)	Loaded Draft	1.8 m	
d)	Capacity	1000 DWT	
5.	***Navigation Aids***		
a)	Type	-	
b)	Nos.	Marine Lantern/Buyos, RIS (10 nos. in Phase-1 and 48 nos. in Phase-2)	
b)	Communication Facilities	DGPS, VTMS and RIS in Phase-2	
C.	**FINANCIAL**		
1.	***Project Cost***		
a)	Capital Cost	Phase-1	Phase-2
	Cost (Rs in Crores)	54.19	2090.92
b)	O & M Cost	Phase-1	Phase-2
	Cost (Rs in Crores)	10.54	39.41
2.	***Financial Internal Rate of Return (%)***		
a)	For IWAI	Phase-1 :	

		FIRR 11.76% Cap. Cost (+) 10% 10.40% Cap. Cost (-) 10% 12.05% ANNUAL O &M COST (+) 10% 10.21% ANNUAL O &M COST (-) 10% 13.22% REVENUE (+) 10% 13.97% REVENUE (-) 10% 9.20%
3.	***Any other Important Feature***	Nil

EXECUTIVE SUMMARY

1.0 Project Background and Introduction

The Govt. of India desires to explore the commercial navigation potential on year round basis in inland waterways. Ministry of Shipping (MoS), Govt. of India had directed Inland Waterways Authority of India (IWAI) to identify the viable waterways in India for their phased development.

Accordingly, to make provisions for existing national waterways and to provide for the declaration of certain inland waterways to be national waterways and also to provide for the regulation and development of the said waterways for the purposes of shipping and navigation, National waterway act, 2016 has received the assent of the President on the 25th March, 2016 declaring a total of 111 National Waterways. All the River stretches/Canals have been divided in different clusters for carrying out the study. Four Rivers in Gujarat & Maharashtra viz. Mahi, Narmada, Tapi and Sabarmati has been identified in Cluster-8 for development of waterways

M/s Inland Waterways Authority of India (IWAI) has entrusted WAPCOS with the responsibility for preparation of two stages DPR for 4 inland waterways (Sabarmati, Mahi, Narmada and Tapi) in the states of Gujarat & Maharashtra. During the stage -1 following activities was carried out.

A. Reconnaissance Survey

B. Collection and Review of available data

C. Feasibility studies

After the Stage-1 (feasibility studies) following stretch of the rivers were found feasible for further detailed studies.

Sl. No.	Waterway Details	Stretch Details
1.	River Mahi (NW-66)	246.989 km from Lat 22°10'34.71"N, Long 72°30'36.31"E
2.	River Narmada (NW-73)	226.343 km from Lat21°38'26.81"N, Long 72°33'28.24"E
3.	River Tapi (NW-100)	174.587 km from Lat21°2'15.51"N, Long 72°39'29.63"E

In this report we are providing the inferences of study in River Tapi as per the TOR of IWAI.

2.0 Hydrographic Survey & Data Collection

Detailed hydrographic survey was carried out determine the hydraulic features and existing conditions of the Tapi River from confluence of the Tapi with the Arabian Sea at Gulf of Khambhat to upstream of Ukai Reservoir of 174.587 km length. The purpose of the survey was for assessing the river stretch for the development of water transport facilities in the new National Waterway (NW-100).

Tidal Stretch is 0 to 34.67 Km and Non Tidal Stretch is 34.67 km to 174.587 km. The nearest Port is Essar Port and Hazira. The Average Tidal Variation is about 6 m.

The waterways from 0 to 22 km of Tapi River is used for navigation (during High-tide only) by cargo vessels transiting to Essar Port, L&T, Reliance, Magdalla port, Ambuja Cement jetty etc. The upper stretches are navigable for small fishing and passenger boats at different stretches. The dry area is observed from 33.7 km to 34.67 km chainage. The stretches upstream to the downstream of Kakrapar weir from 77 km to 112.303 km chainage are very shallow and rocky in nature. The Riverbanks are well connected with the road network and are moderately connected with Railway Network.

Water availability

The Waterway of Tapi River for 174.58 Km river stretch is divided into different stretches for LAD status. The details of the stretches are as follows:-

Table 1 – LAD status of Tapi River

LAD (m) Reduced to Chart Datum	0-34.67 km	34.67-50 km	50-75 km	75- 100 km	100-112.303 Km	112.303-137.311 km	137.311-174.58 km	Total
< 1.2 m (km)	6.618	0	0	23.294	12.303	0.000	0.000	42.215
1.2m to 1.4m (km)	0.000	0.00	0.000	0.000	0.000	0.000	0.000	0
1.5m to 1.7m (km)	0.000	0.00	0.000	0.000	0.000	0.000	0.000	0
1.8m to 2.0m (km)	0.000	0.00	0.000	0.000	0.000	0.000	0.000	0
> 2.0 m (km)	28.056	15.3	25.00	1.706	0.000	25.00	37.276	132.36
Total	34.674	15.3	25.00	25.00	12.303	25.00	37.276	174.58
Grand Total								**174.58**

Soil and Water samples were collected at different locations. Soil is mainly composed of silt. Average bed Slope is 1m in 1.745 km (1:1745).

Dredging

Project has been proposed to be developed in two phases as per the outcome of the decision taken in the meeting held on 11.10.2017. Phase wise Dredging quantities of Tapi River for as per design class are given in Table-2.

Dredging will be carried out into two phases i.e from Terminal 1(Dumas) to Terminal 2 (Old Fort) in Phase 1 & upto Terminal 4 (Ukai) in Phase-2.Based on hydrographic survey report dredging quantities are mentioned below:

Table 2 - Dredging Summary of Tapi River

Sr.No	Phase	Stretch	Design Vessel	Quantity
1	Phase-1	Dumas Jetty- Old Fort Jetty	13m X 3.8m X 1.0m	**311990.38 cum**
2	Phase-2	Upto Ukai Terminal	Class-IV	**2000000 cum**

For Dredging Self-propelled Cutter Section Dredger (CSD) is recommended to maintain above mentioned stretches for phase-1 & Phase-2.

Existing Cross Structures

- Weirs- 2 nos. at 34.67 & 112.30 km
- Bridges- 19 Nos.
- Horizontal Clearance- 0 m to 55 m
- Vertical Clearance w.r.t. HFL/MHWS - 8* m to 14 m
- Power Cable – 34
- Horizontal Clearance- 200 m to 700 m
- Vertical Clearance w.r.t. HFL/MHWS 12 m to 20 m

  *Umarsadi-Haripura bridge (causeway type) at 92.89 km

3.0 Fairway Development

In India, the inland waterways are classified into seven categories for rivers as well as canals by the Inland Waterways Authority of India (IWAI).WAPCOS has studied the possibility of developing waterway as Class III, Class IV, and Class V. WAPCOS recommends Class III and Class-IV type of waterway may be provided through in phase development.

Table 3: Proposed class of waterway

Sr.No	Phase	Stretch	Length of Waterway	Class of Waterway
1	Phase-1	Dumas beach jetty to Old Fort Jetty	19Km	-
2	Phase-2	Terminal 3 (KRIBHCO) to Terminal 4 (Ukai Jetty)	CH 18 to CH 134 km	Class-IV

River bank protection should be provided where the banks are susceptible to erosion. River training works are required for proper maintenance of fairway. However river banks are already established in Tapi River hence no river training works are required for river banks. Two barrages and four navigational locks are proposed as river training for navigation in the stretch.

Demolition and reconstruction of bridges not having required clearance is proposed. Four navigational locks are proposed at the site of Kakrapar Weir, Singanpore Weir-cum – Causeway, proposed barrages at CH 77 and CH 95 km.

4.0 Traffic Studies

Region within 25 km on either side of the river falls under the primary catchment area. Districts of Surat and Tapi in Gujarat and Nadurbar in Maharshtra fall under this primary catchment area. There are two ports located on the mouth of the River Tapi, namely Hazira and Magdalla. The primary catchment area is considered for hinterland analysis.

Figure 1- Talukas and connectivity around River Tapi

Gujarat contributes nearly 16% to country's industrial production. Its industrial growth has averaged to about 15% in the last couple of years. The state has the highest industrial production share in Soda Ash, Salt, Castor Seeds, POL, and Drugs & Pharmaceuticals. Gujarat has a manufacturing share of over 50% in POL, 31% in chemical and 45% in pharmaceuticals. On the back of such large-scale production in a wide range of industrial segment, Gujarat has been able to contribute almost 19% to India's total exports of merchandised goods and services.

Table 4 Industries in the Catchment Area of River Tapi

Major Industries	Location	Distance(Km) Hazira Port		
		Roadways	Railways	River Tapi
Surat Lignite Power Plant	NaniNaroli	74	62	81
Ukai Thermal Power	Ukai	135	117	123
Sugen Power	Kamrej	57	30	58
Utran Gas Based Power	Surat	38	28	37
Hazira LNG (SHELL)	Hazira	0	0	0
Reliance	Hazira	10	0	20
Vyara Tiles	Vyara	9	93	100
Larsen & Toubro	Hazira	4	0	17
Essar Steel	Hazira	5	0	10
Gujarat Ambuja Cements	Magdalla	26	N/A	20

Major Industries	Location	Distance(Km) Hazira Port		
		Roadways	Railways	River Tapi
JK Paper Units (CPM)	Songadh	114	110	123
KHRIBHCO	Hazira	16	0	20
GSFC	Kosamba	61	47	55
Hindustan Chemical	Surat	24	36	34

The commodities handled at Tapi catchment area are Iron Ore, Coal, Steel, Cotainers, Naphtha, fertilizer, LNG, Para- Xylene, limestone, cement clinker, fertilizer etc. The volume of these commodities are shown in the below table. Iron Ore is handled majorly here, followed by Coal and Naphtha.

Table- 5 Details of companies in the catchment and the commodities handled

Commodities	Volume (mnTonnes)	Trade	Usages	Company
Iron Ore	5.06	Coastal	Captive	Essar
Coal	9.01	Coastal/EXIM	Captive/Multiuser	Essar/NTPC/Others
Naphtha	3.15	Coastal	Captive	Reliance
LNG	2.98	Import	Multiuser	Others
Para-xylene	1.20	Coastal/EXIM	Captive	Reliance
Lime Stone	1.03	Coastal/EXIM	Captive	Others
Container	2.19	EXIM	Multiuser	Others
Steel	1.11	Coastal/EXIM	Captive	Essar
Fertilizer	0.43	Import	Captive	KRIBHCO
Cement+Clinker	1.57	Coastal	Captive	AmbujaCemet
Others	2.85	Coastal/EXIM	Captive/Multiuser	Essar/Reliance
Total Volume	**30.56**			

Source: GMB

Table- 6 Potential Commodity Traffic for River Tapi

Commodity	Traffic (Mn T)	Owner	IWAI Perspective	Reasoning
Iron Ore	4.8	Essar Jetty	No	Essar imports coal and iron ore for its steel plant at its Captive Jetty in Hazira. This cargo is unlikely to shift anywhere else. The unloaded coal gets consumed in plant.
Coal - Essar	6.5	Essar Jetty	No	
Coal - Adani		AHPPL	No	Coal imported by Adani port is mostly used by local industries
Coal - GMB		GMB Jetty	No	GMB jetty at Magdalla handles coal which is used by the industrial belt in the region such as Surat, Valsad, Hazira. Being a dirty cargo, IWAI can't handle it at the proposed facility.

Commodity	Traffic (Mn T)	Owner	IWAI Perspective	Reasoning
Project Cargo	0	L&T	No	Larsen & Toubro has its heavy engineering division and cell at Hazira. It has a captive loadout jetty. The Project cargo fabricated are load out and sent using coastal routes
Cement+ Clinker	1.6	Ambuja Cement	Maybe	Though Ambuja Cement has a captive jetty, the company is evaluating possibility of moving bulk cement in containers. Based on the economic advantage over transportation mode, it could either use KRIBHCO jetty or expand its own captive jetty to handle these containers.
Clinker	3.3	Vadraj Cements (Fomerly ABG Cements)	Yes	The company is anticipating initiation of cement manufacturing at their Mora plant soon, and they have plans to import clinker, of up to 3.3 MMTPA. Close proximity to KRIBHCO jetty is an opportunity for handling this import cargo using the River Tapi waterway.
Liquid	3.6	Reliance	No	Captive Jetty and SPM of reliance for handling liquid cargo. Liquid cargo can't be handled at the new facility
Fertilizers	0.4	KRIBCHO	Yes	Fertilizer is handled at KRIBCHO jetty. This jetty has been categorised as private jetty. It could handle
LNG	3	HPPL	No	The company has dedicated LNG terminal. This cannot handle any other cargo. Nor could LNG, due to the sophistication involved, be shifted to any other place. Evacuation of LNG is mostly using pipelines. Hence, there is no role for river transportation at this stage
Container	2.2	AHPPL	No	Adani group has developed a deep draft container terminal. This is used for trade of containers in EXIM and coastal trade.
Others	8.6	Essar Jetty/Relia nce	No	Includes commodities like Steel & HR Coils, which is handled at Essar's captive jetty. Therefore, they can't be catered to by IWAI
Total	**33.9**			

Current origin-destination particulars for all the cargo that can be moved using River Tapi post required infrastructure development:

Table 7- O-D particulars for potential cargo

Name of companies	Commodity	Volume (mn T)	Origin	Destination
Ukai Thermal Power Plant	Coal	0.5	Hazira Anchorage	Ukai
	Fly Ash	0.2	Ukai	Surat
Ruchi Soya Industries Ltd	Soya	0.1	MP	KRIBHCO

Erstwhile, imported variety of coal was moved via rail from Hazira Port to the Ukai TPP. Now Ukai TPP uses only domestic coal via rail route from Chhattisgarh mines. Once coal import resumes, the import coal variety can be moved using River Tapi, and unloaded at a terminal alongside the plant. Fly ash, as return cargo, can also be moved along the same route. Currently, around 70% of the fly ash generated at the plant is utilized by domestic consumers. This distribution is either carried out using road or rail. Every thermal power plant intends to achieve 100% utilization of the fly ash they generate. Currently, Ukai TPP is left with an unutilized fly ash volume of 20%-30%, which it disposes off. River Tapi can help this fly ash volume reach several cement manufacturers in Surat district.

Forecasting & Potential IWT Assumption

The navigational development of Tapi river will be performed in 2 different phases. In the first phase, development of Tapi from mouth, Dumas to Old Fort, Chowk Bazar will be done whereas second phase will include Old Fort, Chowk Bazar to Ukai TPP. Phase 1 will finish by 2020, while Phase 2 will start from Fy 2025 and finish by Fy 2027.

Table 8- Terminal Locations

Phases	Terminals	Chainage (kms)	Type of Develop.	Type of Terminal	Locations	Phase Schedule
1	Terminal 1	4	Terminal & Stretch	Tourism	Dumas Beach	FY19 - FY20
	Terminal 2	31.3			Old Fort, Chowk bazaar	
2	Terminal 3	18		Cargo	KRIBHCO Jetty	FY25 - FY27
	Terminal 4	134			Ukai	

Passenger Traffic

There is no passenger traffic on the rivers of Gujarat, yet. All the rivers are well connected with roads running parallel to it. Several bridges line these rivers at regular intervals. Hence, there is no passenger movement across any rivers. This leaves little-to-no scope for developing passenger traffic infrastructure on River Tapi

Tourism traffic at the Terminals

Tourism in Surat is driven mostly by business visitors. In 2015, the city saw close to 2 million visitors, of which nearly 90% were on business visits. This leaves a smaller section of the visitors to engage in recreational and leisure activities in and around the city of Surat. This section of the tourists visiting the district is likely to use the ferry services at the terminals.The projected tourism traffic at Old Fort, Chowk Bazar for recreational centre is shown in table-9.1 and projected terminal traffic for ride from Dumas to Old fort is shown in table-9.2 below.

Table 9.1 Projected tourism traffic at the terminals ('000 visitors)

Tourism Traffic	Fy 21	Fy 25	Fy 30	Fy 35	Fy 40	Fy 45
Recreational Centre	624	849	1,247	1,576	1,917	2,333

Table 9.2-Terminal traffic

Terminal Traffic	Fy 21	Fy 25	Fy 30	Fy 35	Fy 40	Fy 45
Boat Ride (Dumas to Old Fort)	94	127	187	236	288	350

***Cargo Traffic at Terminal 3 Analysis* (Phase 2)**

The terminals suggested for handling probable cargo for Vadraj Cement and clean cargo for Ruchi Soya, will be flanking KRIBHCO's existing jetty. The following image is a tentative location suitable for developing Terminal 3.

A captive cargo handling facility for Vadraj Cement is proposed alongside KRIBHCO jetty for clinker import. The company is already on the lookout for a facility to undertake its marine-related operations. The existing KRIBHCO jetty is a suitable location, on account of the cement plant's proximity to the jetty. Another cargo handling facility (Terminal 3) is proposed alongside KRIBHCO jetty to handle SBM for Ruchi Soya. Other traders or manufacturers looking to handle clean cargo can target this facility in future. The following table provides an estimate of the initial traffic Terminal 2may handle if Ruchi Soya decides to use it to export SBM:

Table-10 Commodity wise traffic estimate for Terminal 3

Industries	Commodities	Traffic Estimates (mn T)	Reasoning
Ruchi Soya	SBM	0.1	This conservative estimate is driven by the last known SBM volume handled by Magdalla, which was around 80,000 MT in FY01.

Source : Ruchi Soya Industries

Preliminary estimate suggests that Terminal 3 can attract SBM traffic of around 0.1 mn T in the foreseeable future (Fy 28). However, it is imperative that proper clean-cargo handling facilities are set up first.The following table depicts projections for Terminal 3:

Table -11 Traffic projections for Terminal 3

Commodity (mn Tonnes)	Fy 20	Fy 25	Fy 30	Fy 35	Fy 40	Fy 45
Soyabean	0.1	0.1	0.2	0.3	0.4	0.8

A very low volume is being targeted for SBM traffic via River Tapi. Here, the major assumption is that the proposed Terminal 3 will be able to replicate SBM traffic handling once seen at Magdalla Port. Over a period of time, the Terminal should witness some growth by attracting a small share from the volume that gets shipped via Kandla Port. By FY45, Terminal 3 is expected to handle 0.8 mn T, growing at a 26-year CAGR of 11% throughout

Cargo Traffic at Terminal 4 Analysis **(Phase 2)**

The following table lists the cargo, and preliminary estimates of the cargo volume Terminal 4 can target:

Table-12 Commodity wise traffic estimate at Terminal 4

Industries	Commodities	Traffic Estimates (mnT)	Reasoning
Ukai Thermal Power Plant (1350 MW)	Coal	0.6	4.5 mn T of coal is used in Ukai TPP. At present, only domestic coal is used for power generation. Earlier, a mixture of indigenous and imported coal was used. In the event import resumes at the plant, transport of this cargo volume can be done by using River Tapi.
	Fly ash	0.3	For 100% fly ash utilization, the company can transport the leftover fly ash, currently around 20% - 30% of the total generated volume, using River Tapi.

Source : GSEC, 2016

Ukai TPP will be the main customer for Terminal 4. The plant consumes 4.5 mn T coal per annum, as per the estimates from Central Electrical Authority (CEA). The Terminal will commence operations by targeting 10% of the total imported-coal requirement (0.5 mn T), growing to a maximum share of 20% (0.9 mn T) by FY45. This is applicable only when import operation resumes in the near future. This volume can be moved on River Tapi using by. Also, there are no immediate expansions planned at the power plant. Therefore, Terminal 4 is likely to handle only 0.9 mn T of coal for the foreseeable future.

The Ministry of Environment & Forests had issued a direction, requiring all the coal/lignite based thermal power plants to achieve 100% utilization of fly ash they generate. An environmental hazard, the byproduct finds use in construction-related industries. As of 12th Five Year Plan, such plants were unable to achieve 100% utilization. Specific to Ukai TPP, 1.5 mn T and 1.3 mn T of fly ash was generated in FY15 and FY16, respectively.

During these periods, the plant could achieve a utilization level of 67% and 79%, respectively. In FY15, close to 25% of fly ash was used in making fly-ash based bricks, blocks, tiles, etc. This utilization share rose to nearly 50% in FY16. Almost 25% of the fly ash was utilized in production of Portland Pozzolan Cement (PPC) in both the years. The leftover fly ash, around 0.5 mn T in FY15 and FY16, respectively, is likely to have been disposed off. Instead, this small volume can be transported using River Tapi to the cement manufacturers in Surat region. Cement plants have also been making efforts to increase fly ash volume in manufacturing PPC. With plans to make Surat a smart city and to combine it with Navsari into a twin city, Surat district should witness an increase in infrastructure development projects. One such ambitious project involves development of a state-of-the-art Multimodal Transportation Hub (MMTH). The project entails redevelopment of Surat railway station, the state transport bus terminal, and development of common facilities. The project includes commercial development on a 0.25 mn sq. mt. land in the central part of Surat city. A joint venture special purpose vehicle (SPV) will be formed among Indian Railways, Gujarat State Transport Corporation Limited, and Surat Municipal Corporation for the project. This project serves as another business opportunity for the Ukai plant, where it could supply the leftover fly ash by moving it via River Tapi. In the current context, this is a prospective cargo. So, the volume estimation cannot exceed the fly ash volume Ukai plant is unable to utilize in a given year.

The following table depicts projections for Terminal 4 along River Tapi:

Table-13 Traffic projections for Terminal 4

Commodity (mn Tonnes)	Fy 28	Fy 30	Fy 35	Fy 40	Fy 45
Coal (Terminal 4)	0.6	0.7	0.7	0.8	0.8
Fly ash (Terminal 4)	0.3	0.3	0.3	0.3	0.3

The major underlying assumption for coal traffic projections is import volume not exceeding 25% of the total requirement at Ukai TPP. The peak traffic volume of 0.9 mn T is likely to be moved by FY45 using River Tapi. The Terminal is estimated to handle 0.7 mn T coal by Fy 30, crossing 0.9 mn T by FY45.

Applying moderation, River Tapi will represent movement of 0.4 mn T of fly-ash volume by FY45. With no additional source of this cargo, fly ash will constitute a meager share to the overall traffic at Terminal 4, if the traffic on River Tapi were to at a 20-year CAGR of 3%.

5.0 Terminals

Based on the traffic studies following terminal locations has been proposed which is shown in figure below:

Terminals	Location	Chainage (Km)	Purpose	Development
Terminal 1	Dumas	-	Tourism	Phase 1
Terminal 2	Old Fort Chowk Bazar	31.3	Tourism	Phase 1
Terminal 3	KRIBHCO Jetty	18	Clean Cargo	Phase 2
Terminal 4	Ukai	134	Coal/FlyAsh	Phase 2

Fig. 2 Proposed Terminals on River Tapi

Description of selected sites

Terminal – 1 (Dumas)

Proposed Terminal 1 will be situated at Dumas Beach which is famous for scenic beauty. It is centre of attraction for tourist. It is located around 21 km from Surat city. The promenade of the beach has several food stalls attracting more people. There is a temple of Dariya Ganesh adjacent to the beach.

Terminal – 2 (Old Fort, Chowk Bazar)

Site for proposed terminal 2 is at Old Fort, Chowk Bazar on the left bank of Tapi River. It serves as a tourist destination and was made by the Gujarat Sultanate as a safeguard against Portuguese. The fort is now used by the government as their office, the top of the fort provides a marvelous view of the city and River Tapi.

Terminal – 3 (KRIBHCO Jetty)

Krishak Bharati Cooperative Limited (KRIBHCO) owns and operates a jetty near its plant. This is a fair-weather lighterage jetty located on the south of Gujarat. It is located at latitude 21°08’48.17” N and longitude 72°42’38.26” E in Surat district. KRIBHCO jetty falls under Magadalla port of Gujarat Maritime Board. The jetty of KRIBHCO is located in the South Gujarat, surrounded by some of key industries of Gujarat. The jetty was developed back in 1980 for loading/unloading of heavy equipment required for the construction of KRIBHCO’s fertilizer complex in Hazira. The jetty was soon rendered useless due to heavy siltation at the site. In 2009, the facility was reopened following revamping. It has setup a fertilizer complex to manufacture Urea, Ammonia & Bio-fertilisers at Hazira on banks of river Tapi. Its manufacturing unit is located 15 kms from Surat on Surat – Hazira state highway. It has Reliance Petrochemical plant located west of it.

The Jetty is primarily being used for importing Urea from Oman's OMIFCO, a JV promoted by IFFCO and KRIBHCO with the Oman Government. The jetty also caters to exim requirement of the western region. The reconstruction of the jetty includes dredging of the approach channel to allow lighterage. The 147-m-long and 30-m-wide wharf will also be repaired and refurbished. The wharf will handle barges of 3,000 DWT. KRIBHCO is handling & marketing 50% of the urea produced by OMIFCO. Private jetty of KRIBHCO is operational and presently handles OMIFCO vessels .The Jetty has competitive advantage of rail/road link for faster evacuation. GOI has signed a long term agreement to purchase urea produced by OMIFCO. In Fy -16 OMIFCO production was 2 mn T. This is an assured cargo.KRIBHCO handled close to 0.4 million tonnes of Fertiliser at its Jetty. Unlike Magdalla Jetty KRIBHCO has the rail connection; it also has its own rakes.

Terminal – 4 (Ukai)

This site is located at approximately 3km downstream of Ukai Dam on the right bank of river. Site is near to the Hindustan Road Bridge on State Highway No. 174. Site is well connected with State Highway No. 174 which connects NH-6 at Sonagarh. Ukai Thermal power Plant is located near Ukai Dam on the banks of Tapi River in Tapi district. Imported coal can be transported from Hazira to Ukai via waterways. Fly ash can be transported to various cement plants at Surat via waterways.

6.0 Preliminary Engineering Design

In order to create depth at downstream of Kakrapar Weir, 2–barrages along with navigational locks have been recommended. Preliminary Engineering Design is given in Chapter. Details of Type of jetties are as follow:

Table 18- Type of Jetty

Sr. No	Phase	Type of Jetty
1	Phase-1	Terminal 1- Floating & Terminal 2- Floating
2	Phase-2	Terminal 3- Piled Jetty & Terminal 4- Piled jetty

Construction schedule
PHASE-1

Table 19-For Floating jetties (Terminal 1 & Terminal 2)

Sr.No.	Activity	Time in weeks from LoA
1	Submission of Detailed Engineering Drawing & Methodology for Installation	03 Weeks
2	Pre-dispatch third party inspection	04 Weeks
3	Supply of Primary units(Float)	09 Weeks
4	Onsite Inspection of supplied unit	15 Weeks

5	Installation of Gangway	17 Weeks
6	Installation of Jetty along with Accessories	19 Weeks
7	Testing, commissioning & trial	26 Weeks

Table 20- For Fixed jetties (Terminal 3 & Terminal 4)

Sr.No.	Activity	Time in weeks from LoA
1	Submission of Detailed Construction Drawing & Methodology	04 Weeks
2	Proof Checking of construction drawing	08 Weeks
3	Construction of dyke/Filling/Approach Trestle	20 Weeks
4	Construction of piles	20 Weeks
5	Installation of Precast Beam	30 Weeks
6	Installation of Precast Slab	35 Weeks
7	Laying of cast in-situ slab	43 Weeks
8	Installation of accessories	47 Weeks
9	Testing, commissioning& handing Over of site	55 Weeks

7.0 Vessel Design

The classification of vessels described by IWAI requires certain length and certain draft of vessel to be maintained for optimum use. Under this condition, there are other factors that will also influence the specific class of vessels that should be deployed on the River to handle traffic. Vessels listed in Table 21 are the entire allowed fleet of river-class vessels that IWAI has classified. Among these, the highlighted ones are the vessels that are recommended to be deployed on River Tapi.

Table 21 Assumption for different class vessel design and logistics cost analysis

Class	Size (m)		Loaded Draft (m)	Capacity (DWT)	Charter Rates - Barge (Rs./Day)	Power (KW)	Consumption			Speed (Knots)
	L	B					Fuel		Ltr/Hr	
I	32	5	1.0	100	18,000	-	DO	1.0	42	6-7
II	45	8	1.2	300	30,000	337	DO	1.6	67	6-7
III	58	9	1.5	500	60,000	-	DO	2.0	83	6-7
IV	70	12	1.8	1,000	80,000	432	DO	2.4	100	6-7
V	70	12	1.8	1,000	80,000	432	DO	2.4	100	6-7
VI	86	14	2.5	2,000	110,000	597	DO	4.4	220	6-7
VII	86	14	2.9	4,000	130,000	-	DO	8.4	350	6-7

Source: IWAI

Class III, IV, and VI are all pliable on the river, primarily because the river has enough draft to accommodate all of these vessels. Even Class V vessels are a good contender, as their specifications are identical to Class IV vessels. Also, these are all self-propelled type vessels.

8.0 Navigation & Communication System

Navigational system is considered as an important aid for any vessel movement in coastal and river channel. Navigational Safety in Port's Committee was formed in India known as NSPC to ensure navigational safety in waterways. DGPS, VTMS and Marine Lantern/Buyos (10 nos. in Phase-1 and 48 nos. in Phase-2) has been proposed to be installed for safe navigation of vessels and to have complete control on traffic handled at terminal.

9.0 Environmental and Social Aspects

The impact of project on surrounding environment is not much as it will not produce any harmful wastes. The project will provide the employment to the local villagers nearby to the terminal area and barrages during construction as well as in operational phase.This will improve the social and economic conditions of the nearby commuters. Also by shifting of traffic from distant ports or terminals, mode of operation like from road to waterway to these terminals will reduce the overall carbon emission.

There is no wild life sanctuary nearby 10 km radius of the present scope of study of river stretch i.e 0-174.58 km.

Impacts due to construction activities

Pre-construction activities generally do not cause significant damage to environment. Preparatory activities like the use of existing access road, construction of storage sheds, etc. being spread over a large area, would have no further significant impact once the land is acquired and its existing use changes. Clearing, stripping and leveling of sites, construction of bunds for protection from flooding, earth filling and excavation for foundations, will lead to some disturbance to the habitat. The level of construction activities in the proposed project is not of such level and nature, to cause any significant adverse impact on this account.

Operation phase

<u>Generation of garbage at Terminal area</u>

The problem envisaged during operation phase could be the disposal of garbage. This could comprise floating materials, packaging, polythene or plastic materials, etc. accumulated from the fishing trawlers and boats. Garbage accumulated on the deck also needs to be suitably disposed. Therefore, a system needs to be developed, whereby undue quantity of garbage is not permitted to accumulate in the fishing harbour area and the same could be disposed off on the low lying areas in a scientific manner.

Other Major Clearances / Approvals / Permits Applicable to the Project

- Coastal Regulation Zone(CRZ) ,MoEF & CC
- Consent to Establish and operate from state pollution control board, Gujarat
- Gujarat Maritime Board(GMB)

CRZ clearance is required since the terminals are falling in the tidal zone and salinity of water. Consent to establish is required for the project execution and Consent to operate is required at operation stage of terminals.The necessary clearance for navigation needs to be taken from GMB.The Rapid EIA is suggested for the Project.

This covers the consultancy fee at pre-construction stage along with implementation of EMMP (EMP & EMoP) during construction and operational stages of the project. The statutory fee along with the cost of private and government land acquisition shall be borne by the project proponent. This has been summarized in Table given below:

Table-22: Summary of Estimated Environmental & Social Costs for various Stages

Sl. No.	Project Stages	Cost (Rs.Lakhs)
1.	Pre-Construction Stage	67.13
2.	Construction Stage	38.39
3.	Operational Stage	8.63
Total Estimated Budget (Except Statutory Fee & Land Acquisition & R&R Costs)		**114.15**

Hence Total Cost say 114* Lakhs.
***** The basis of cost is on our previous experiences of the project but the actual cost will be based on the Approved TOR by MoEF & CC.

10.0 Institutional Requirements

The Authority envisaged is Navigational waterway maintenance, transportation enterprise dealing with passenger and cargo handling, transit and transfer as well as being an administrative unit and an organ of Government which implements Government policies.

This envisages setting up of Inland Waterway Authority construction and maintenance division for Tapi River with its headquarters at Surat.It is proposed to terminals for Tapi, Narmada and Mahi River are run under this set up.The Inland waterway authority will specifically control and will be responsible for functioning of setup inTapi River (NW-100).

11.0 Project Costing

The cost arrived at are based on the budgetary quotes and the in house database available on cost estimates. The rates for various items of work have been prepared on the basis of current rates for various items of work prevailing in the region. Gujarat

Maritime Board Schedule of Rate, 2013-14 has been followed and escalated by 5% per annum to arrive at for year 2017-18 to arrive at the cost of the project.
The estimate of capital cost is made for the various items of civil, mechanical, electrical and utilities works for the development of terminals in the waterway stretch.
Project has been proposed to be developed in two phases as per the outcome of the decision taken in the meeting held on 11.10.2017. Total capital cost estimate for the phase-1 and phase-2 worked out to **Rs. 54.19 Crore** and **Rs. 2090.92 Crore** respectively.
The annual operation and maintenance cost on different components of the project will be dependent on a number of variables such as the life of the component, repair and maintenance requirements, wages of crew of consumables etc. Approximate Operation & Maintenance cost estimate for the project worked out to for the phase-1 and phase-2 worked out to Rs. **10.64** Crore and Rs. **36.75** Crore respectively .Based on the capital cost estimate and implementation schedule, the phasing of expenditure is as done for Three years.

Preliminary design of the terminals and other components has been revised after incorporating the results of Geo-Technical investigations; accordingly project cost has been revised.

12.0 Implementation Schedule

Implementation (Construction, Operation & Maintenance) will be done IWAI. However, in case of lack of funds IWAI can go for PPP mode. Presently, DBFOT model is in practice.

13.0 Financial Analysis

A major source of revenue will arise from Tourism. Traffic projection is given in the table below.

Table 23: Traffic projection- Boat ride

Terminal Traffic (Boat ride)	Fy 21	Fy 25	Fy 30	Fy 35	Fy 40	Fy 45
Weekend	1.1	1.4	2.1	2.7	3.2	3.9
Weekdays	0.8	1.0	1.5	1.9	2.3	2.8
Annual Traffic	94	127	187	236	288	350

Table 24: Traffic projection- Recreational Traffic

Recreational Tourism Traffic	Fy 21	Fy 25	Fy 30	Fy 35	Fy 40	Fy 45
Weekends	7.0	9.5	14.0	17.7	21.5	26.2
Weekdays	5.0	6.8	10.0	12.6	15.4	18.7
Annual Recreational traffic	624	849	1247	1576	1917	2333

Table 25: Tariff

Rate	INR
Terminal Traffic (Boat ride)	100
Recreational Tourism Traffic	120

Table 26: Revenue from Boat ride & Recreational Tourism Traffic

Boat ride (Dumas Jetty- Old Fort Jetty) & Recreational facilities						
	FY 21	FY 25	FY 30	FY 35	FY 40	FY 45
Tourism Revenue	818	1113	1635	2066	2514	3058
Grand Total	**1487**	**1812**	**2357**	**2921**	**3555**	**4427**

In Lakhs

Considering life of project to be 30 years, the **FIRR comes out to be 11.76%** in phase I.

Phase-II is not viable from financial point of view.

14.0 Conclusions & Recommendations

WAPCOS has proposed 4 terminal locations at various sites on the basis of traffic potential. We have studied four terminal locations in two phases at various sites on the basis of traffic potential, water availability and land availability. The details of these terminals are given in table 27 below:

Table 27: Phase-wise details of terminals

Phase	Terminal	Location	Type	Land details
Phase-1	Terminal 1	Dumas Jetty	Tourism	Forest land
	Terminal 2	Old Fort Jetty	Tourism	Govt. land
Phase-2	Terminal 3	KRIBHCO Jetty	Cargo	Govt. land
	Terminal 4	Ukai Jetty	Cargo	Govt. land

Phase wise dredging is given below in Table 28.

Table 28: Phase-wise details of length, dredging quantity, proposed class and bridges

Phase	Length of waterway	Dredging Quantity	Proposed Class	Bridges to be demolished
Phase-1	19 km	0.31 Mm^3	-	Nil
Phase-2	134 km	2.0 Mm^3	Class-IV	16

Phase-1 is technically viable. However, Phase-II is not viable from technical, economical & financial point of view.

Also, Phase-1 can be executed only after complete renovation of Old Fort (Near Chowk Bazaar) and other facilities proposed by State Government like water front development & recreational facilities.

Recommendations:

Following studies should be carried out prior to any development for broad view of implications:

i. Conduct a comprehensive geomorphic study and review and analyse sedimentation processes. The sedimentation study shall be aimed at developing an improved understanding of the significant sedimentation processes within the entire river basin. The major emphasis of this work shall be on analysing major channel morphology and the sedimentation phenomenon during the last 10 year period. the sedimentation study shall include:

a. Document the variations in sediment transport (size and quantity);
b. Identify and quantify all major sources of sediments (bed and banks, tributaries)
c. Identify degrading, aggrading, and stable reaches, and
d. Establish the range of flows transporting the major of sediments.

ii. Correlate the results of the sedimentation study with historical changes in the basin (channel improvements, land use, barrage and reservoir construction, etc.) enabling the development of a firm understanding of past and present sedimentation processes. This information shall be used to

(a) Qualitatively analyse the effects of anticipated project features. This information shall be used to determine what may or may not work when designing navigation improvements.
(b) Determination of those reaches that are stable in depth and width and thus provide the basis for all subsequent preliminary design works.
(c) Analysis of the bend-ways to determine the siltation and erosion process in the same and the minimum radius required for navigation of the reference vessels.

iii. Undertake various types of model studies to verify and / or enhance all design parameters. As a minimum this shall include a numerical model to produce detailed pictures of flow in the river system under current and future flow conditions and also the required flow/ discharge to maintain 1.2 m LAD throughout the year with or without interventions like (barrages) in River.

LIST OF ABBREVIATIONS

CD	Chart Datum
BM	Benchmark/Local Reference Level
CH	Chainage
CRZ	Coastal Regulation Zone
CWC	Central Water Commission
DGPS	Differential Global Positioning Systems
ETS	Electronic Total Station
GPS	Global Positioning Systems
HC	Horizontal Control
HFL	Highest Flood Level
INT	International Hydrographic Organization
km	Kilometer
LAD	Least Available Depth
LBM	Local Bench Mark
m	Meter
MSL	Mean Sea Level
NTPC	National Thermal Power Corporation
RL	Reference Level
SBAS	Satellite-Based Augmentation System
SBES	Single Beam Echosounder
SD	Sounding Datum
TBC	Trimble Business Center
UTM	Universal Transverse Mercator
VC	Vertical Control
WGS	World Geodetic System

List of all Team Members (In-House & Empanelled Key Experts)

Sl. No.	Name of the Key Expert	Proposed Position
1.	Sh. D. N. Deshmukh	Team Leader
2.	Sh. Prakash Krishnaji Khare	Port Planning and Infrastructure Specialist
3.	Dr. Santosh K. Sati	GIS/Remote Sensing Expert
4.	Sh. R. N. Bansal	Floodplain Specialist
5.	Sh. Bidyadhyar Thakur	Hydrographic Expert
6.	Sh. Prasanta Kumar Kundu	Soil Engineer/Foundation Engineer
7.	Capt. Gary Vaz	Traffic Surveyor
8.	Sh. M Ganesan	Transport Economist

Contact Authority:

Shri Jatinder Kumar
General Manager (PH & IW)
WAPCOS Limited
76-C, Sector-18,
Institutional Area,
Gurgaon - 122 015 (Haryana)

CHAPTER – 1

INTRODUCTION

1.0 Introduction

1.1 Project Background and Summary of previous study

The Govt. of India desires to explore the commercial navigation potential on year round basis in inland waterways. Ministry of Shipping (MoS), Govt. of India had directed Inland Waterways Authority of India (IWAI) to identify the viable waterways in India for their phased development.

Accordingly, to make provisions for existing national waterways and to provide for the declaration of certain inland waterways to be national waterways and also to provide for the regulation and development of the said waterways for the purposes of shipping and navigation, National waterway act, 2016 has received the assent of the President on the25th March, 2016 declaring a total of 111 National Waterways. All the River stretches/Canals have been divided in different clusters for carrying out the study. Four Rivers in Gujarat & Maharashtra viz. Mahi, Narmada, Tapi and Sabarmati has been identified in Cluster-8 for development of waterways

M/s Inland Waterways Authority of India (IWAI) has entrusted WAPCOS with the responsibility for preparation of two stages DPR for 4 inland waterways (Sabarmati, Mahi, Narmada and Tapi) in the states of Gujarat & Maharashtra. The lengths of all four river stretches under the feasibility studies were as given below:

Sl. No.	Name of the River	Description of National Waterway	From:	Up to:
1.	Mahi River, Gujarat	248 km length of the river from Kadana Dam to confluence with Gulf of Khambhat near Kavi railway station **(National Waterway 66)**	23°18'22.35"N 73°49'37.45"E	22°10'34.71"N 72°30'36.31"E
2.	Narmada River, Gujarat & Maharashtra	227 km length of the river from Pandhariya to confluence of Narmada with Arabian Sea at Gulf of Khambhat **(National Waterway 73)**	21°57'10.37"N 74° 8'27.46"E	21°38'26.81"N, 72°33'28.24"E
3.	Sabarmati River, Gujarat	212 km length of the river from Barrage near Sadoliya to confluence with Gulf of	23°26'49.66"N 72°48'34.85"E	22°9'17.99"N 72°27'27.81"E

		Khambhat near Khambhat **(National Waterway 87)**		
4.	Tapi River, Gujarat & Maharashtra	436 km length of the river from Hatnur Dam near Mangalwadi Long to confluence with Gulf of Khambhat (Arabian Sea) (National Waterway 100)	21°4'21.99"N 75°56'44.88"E	21°2'15.51"N, 72°39'29.63"E

Table 1: National Waterways in Gujarat & Maharashtra

The Google Map showing all river stretches is enclosed as Figure 1.1

Figure-1.1: Google Map showing four rivers in Gujarat & Maharashtra

Accordingly, WAPCOS Ltd. has undertaken the feasibility studies for 4 national waterways (Mahi, Narmada, Sabarmati and Tapi River) in Gujarat & Maharashtra during stage-1. During the stage -1 following activities were carried out

A. Reconnaissance Survey
B. Collection and Review of available data

C. Feasibility studies

After the Stage-1 (feasibility studies) following stretch of the rivers were found feasible for further detailed studies.

Sl. No.	Waterway Details	Stretch Details
1.	River Mahi (NW-66)	246.989 km from Lat 22°10'34.71"N,Long 72°30'36.31"E
2.	River Narmada (NW-73)	226.343 km from Lat 21°38'26.81"N, Long 72°33'28.24"E
3.	**River Tapi (NW-100)**	**174.587 km from Lat 21°2'15.51"N, Long 72°39'29.63"E**

1.2 Project Location / Details of Study Area

The total length of the river from origin near Multai in Betul districts to its outfall in the Gulf of Khambhat is 724 km. The length under consideration for present studies is detailed below:

174.58 km length of the river from Gulf of Khambhat (Arabian Sea) to upstream of Ukai Reservoir. (National Waterway 100)	**From: 21°2'15.51"N, 72°39'29.63"E**	**Up to: 174.587 km**

Present studies stretch passes through Surat, Tapi and Narmada district of Gujarat state.

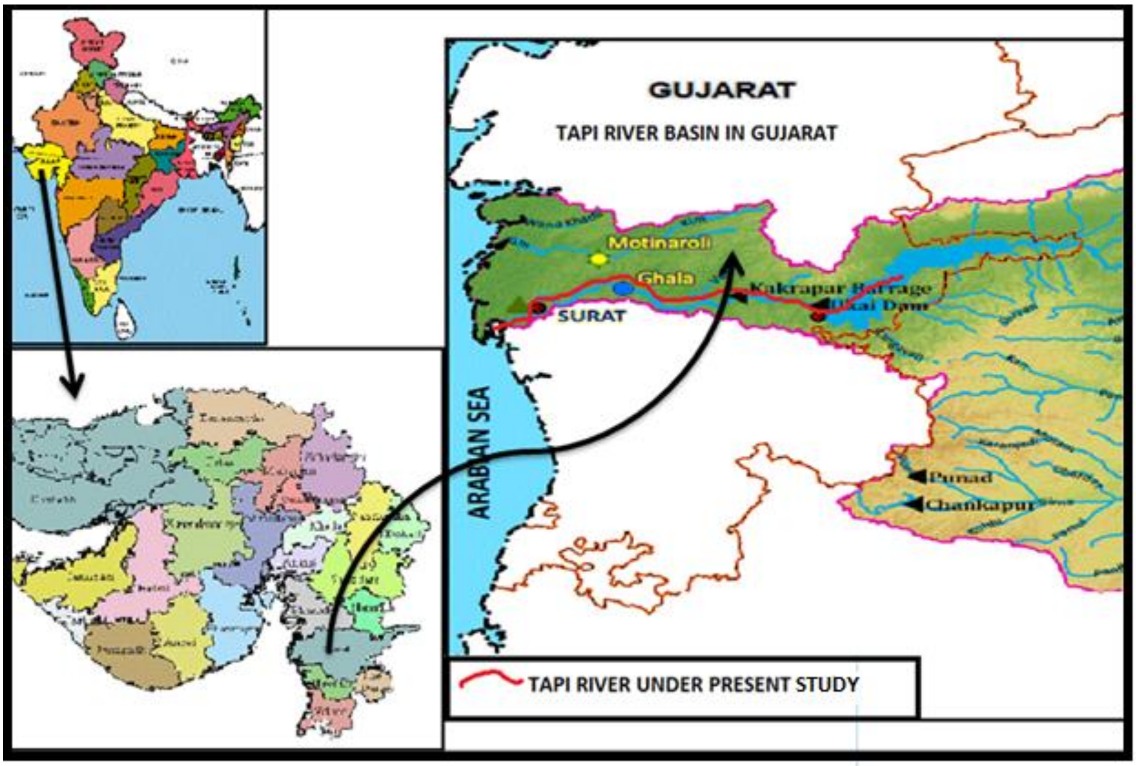


Figure 1.2: Project location/Study area

1.3 Brief Scope of Work and Compliance statement

The brief scope of work is depicted as under:

A. Detailed Hydrographic Survey
B. Traffic Survey & Techno economic feasibility
C. Geotechnical Investigations
D. Preparation of Detailed Project Report

The Compliance statement is mentioned below:

A. Completed and given in Volume-III
B. Completed and mentioned in Volume-I Main Report
C. Geotechnical Investigations has been carried out at site and included in Volume-IV
D. DPR has been prepared after incorporating all studies mentioned in scope of work.

1.4 Brief Methodology & Approach

The detailed studies shall be carried out for all the feasible stretches.

The present studies consist of three inland waterways in rivers of Gujarat and Maharashtra having a total length of 646.278 kms:

1. Mahi River – 246.989 km
2. Narmada River – 226.343 km
3. **Tapi River – 174.587 km**

Stage -2 involves detailed surveys and studies; therefore it has been done in two tasks; First Field Surveys & Investigations and then Project Studies.

i. ***FIELD SURVEYS & INVESTIGATIONS:*** It comprises of the Data collection from site, Bathymetry, Topographic and Traffic Surveys, Measurements (Current and discharge measurements), collection and analysis of water and soil samples, Benchmark construction.

ii. ***PROJECT STUDIES:*** Project studies are carried out from the collected data, surveyed data and observed data to attain navigation and water transport facility in the potentially feasible stretches.

STAGE -2 : Field Surveys & Investigations

- Benchmark Establishment
- Hydrographic survey & Topographical details
- Water level (Gauge Measurements)
- Current measurements
- Water & soil samples
- Traffic surveys
- Geotechnical Surveys

STAGE-2 : Project Studies

- Analysis of Hydrographic survey data & Existing infrasturucture
- Traffic Studies
- Vessel analysis & dredging
- Proposed location for terminals /Ports Loading and unloading terminals
- Environmental Impact studies
- Waterway crossings, Navigational Aids, Locks, communication facilities
- River training, Shore /Bank protection measures
- Locations requiring detailed geotech Investigations
- Preliminary designs of proposed facilities & infrastructure , alternatives
- Economic analysis & Financial Evaluation (EIRR, SWOT, CASH FLOWS, NPV)
- Detailed Project Report , BOQ &Cost Estimates

CHAPTER – 2

WATERWAY/DETAILED HYDROGRAPHIC SURVEY

2.1 Hydrographic Survey

The purpose of detailed hydrographic survey was to determine the hydraulic features and existing conditions of the Tapi River from confluence of the Tapi with the Arabian Sea at Gulf of Khambhat to upstream of Ukai Reservoir of 174.58 km length. To assess the navigability in Tapi River WAPCOS conducted a detailed hydrographic survey during December 2016 – February 2017.

2.1.1 Waterway in General and Hydro-morphological Characteristics

The Tapi River is the second largest westward draining interstate river of the Peninsula. Tapi originates near Multai reserve forest in Betul district of Madhya Pradesh. The total length of the river from origin to outfall into the Arabian Sea is 724 km for the first 282km the river flows in Madhya Pradesh, out of which 54 km forms the Common boundary with Maharashtra State. It flows for 228 km in Maharashtra before entering Gujarat. Traversing the length of 214 km in Gujarat, the Tapi River joins Arabian Sea in the Gulf of Khambat after flowing past the Surat city.

The present study covers area in the State of Gujarat and falls in Lower Tapi basin.

The length of the Tapi River under present study is 174.58 Km. It passes through Surat and Tapi districts.35 km upstream of Ukai dam includes Ukai Dam Reservoir and 137 km length of river is in downstream of Ukai dam.

The length under consideration for present studies is detailed below:

174.58 km length of the river from confluence with Gulf of Khambhat (Arabian Sea) to Upstream of Ukai Dam (National Waterway - 100)	**From: 21°2'15.911"N, 072°39'22.718"E**	**Up to: 21°24' 43.988"N, 073°50' 3.000"E**

2.1.2 Existing Hydrological / Topographical Reference levels

The reference Bench Mark for Hydrography survey, Topographic survey and Pillars establishment is based on the information provided by officials of Ukai dam authority. The Reference bench mark (GTS Benchmark) was installed at Left bank of Tapi River at upstream of Ukai dam axis with Lat21°14' 12.1727"N Long73°35' 27.7047"E and level erected (114.022m from MSL) on Bench Mark provided. Tide poles were set up along the River stretches, for the duration of survey. The tide poles remained vertical during the course of survey and no shift was observed in the poles for the duration of survey. New Bench Mark Pillars (Naming as TP) were constructed and erected along the River stretches from Upstream of Ukai dam to

Arabian Sea/ Gulf of Khambat.

MSL was the vertical datum used for deducing the heights for spot levels obtained as part of the topographic survey.

The Reference Level values of the recovered benchmarks are accepted as the Initial reference point for the transfer of horizontal and vertical control point to the newly established control points through baseline processing method. All values of spot levelling during the topographic survey are referred to Mean Sea Level. The final accepted WGS 84 coordinates and details of all newly established control points used for baseline processing during the conduct of survey area as follows:-

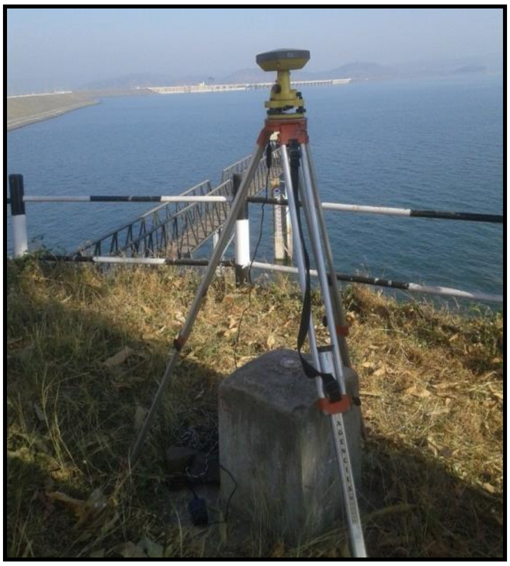


Figure *2.1* – Bench Mark (GTS BM-1) at Upstream of Ukai Dam used for Control point

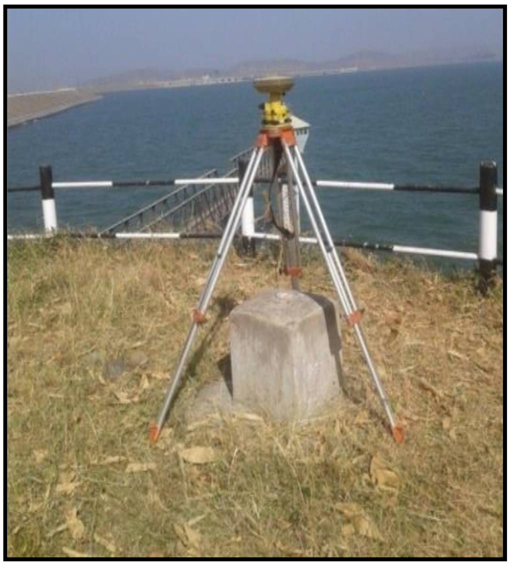


Table2.1– Bench Mark (GTS BM-1) at Upstream of Ukai Dam used for Control point

Accepted Station Coordinates (WGS-84)

Sl. No.	Station	Chainage (km)	Latitude (N)	Longitude (E)	BM Height above MSL (m)	Source/ Type
1	GTS BM-1	137.549	21°14' 12.17"N	73°35' 27.70"E	114.022	48 hours Obs/Baseline Processed
2	TP-01	174.656	21°23' 37.99"N	73°53' 3.98"E	105.644	6 hours Obs/Baseline Processed
3	TP-02	167.23	21°19' 53.06"N	73°48' 35.27"E	137.159	6 hours Obs/Baseline Processed
4	TP-03	148.692	21°12' 39.63"N	73°44' 53.71"E	122.911	6 hours Obs/Baseline Processed
5	TP-04	142.12	21°11' 39.55"N	73°37' 18.83"E	128.833	6 hours Obs/Baseline Processed
6	TP-05	137.92	21°15' 46.34"N	73°35' 59.08"E	111.846	6 hours Obs/Baseline Processed
7	TP-06	132.415	21°15' 53.38"N	73°33' 0.09"E	65.228	6 hours Obs/Baseline Processed
8	TP-07	122.391	21°15' 58.90"N	73°27' 22.01"E	53.271	6 hours Obs/Baseline Processed
9	TP-08	112.527	21°16' 17.60"N	73°21' 56.74"E	57.108	6 hours Obs/Baseline Processed
10	TP-09	101.226	21°14' 49.83"N	73°16' 39.45"E	39.339	6 hours Obs/Baseline Processed
11	TP-10	92.925	21°13' 5.48"N	73°12' 16.38"E	30.897	6 hours Obs/Baseline Processed
12	TP-11	81.604	21°16' 4.90"N	73°7' 5.29"E	14.938	6 hours Obs/Baseline Processed
13	TP-12	70.061	21°17' 49.15"N	73°1' 6.02"E	24.505	6 hours Obs/Baseline Processed
14	TP-13	59.253	21°16' 54.67"N	72°57' 2.84"E	19.430	6 hours Obs/Baseline Processed
15	TP-14	44.345	21°14' 0.05"N	72°50' 30.29"E	18.869	6 hours Obs/Baseline Processed

Sl. No.	Station	Chainage (km)	Latitude (N)	Longitude (E)	BM Height above MSL (m)	Source/ Type
16	TP-15	34.505	21°13' 12.44"N	72°48' 25.56"E	12.517	6 hours Obs/Baseline Processed
17	TP-16	23.664	21°9' 17.79"N	72°45' 38.64"E	6.810	6 hours Obs/Baseline Processed
18	TP-17	12.21	21°8' 51.03"N	72°39' 40.27"E	5.808	6 hours Obs/Baseline Processed
19	TP-18	5.761	21°5' 27.28"N	72°38' 58.41"E	5.165	6 hours Obs/Baseline Processed

2.1.3 Chart Datum / Sounding Datum

The datum for calculation of dredge volume needs to be adopted as per the gradient of the River and the average water level observed for the River in Non-Tidal Stretch and Chart datum used in Tidal Stretch. The established chart datum values are available for Tapi River of 174.58 km stretch which is from the Confluence of Tapi River at Gulf of Khambhat to upstream of Ukai Reservoir.

Tidal stretches

The tidal stretch of Tapi River is from 0 to 34.67 km and the established chart datum value of 0.388 m below Chart datum at Essar Port (6.2 km) and Nehru Bridge (31.2 km) was considered for the tidal reaches.

Non-Tidal stretches

The non-tidal stretches of Tapi River are from 34.67 to 174.58 km and for fixing chart datum/sounding datum. The non- tidal stretches are sub-divided as downstream and upstream stretches of Singanpore Weir, Kakrapar Weir and Ukai Dam.

Chart Datum / Sounding Datum and Reductions details

The water level observation was carried out at the erected gauges during the conduct of a bathymetric survey of Tapi River. The details of Topographic spot leveling values converted as Depth for volume calculation are forwarded as soft copy along with the report. The details of the chart Datum/Sounding Datum and reduction details are as tabulated below:-

Table 2.2 – Sounding Datum (Chart Datum) Calculation for Tapi River

S. No.	CWC gauge / Dam / Barrage / Weir / Anicut / Bench Mark / tide gauges	Chainage (km)	Stretch for corrected soundings and topo levels (km) C		Established Sounding Datum w.r.t. MSL (m)	Sounding Datum (m) from MSL	Sounding Datum (m) w.r.t CD	Correction in WL data for Bathymetric survey (m)	Topo level data to be converted as depth for volume calculation wrt SD (m)
	A	B	(50% stretch is to be selected on both side of tide gauge)		D+ve indicates above MSL -ve indicates below MSL	E	E-1	F = (E- WL data in MSL)	G = (E- topo levels in MSL)
			From	To					
1	Essar Gauge	6.2	0	9.4	0.402		-0.388	Details at Annexure-3.	A separate xyz file is to create (not to plot).
2	Reliance Gauge	12.6	9.4	17.2	0.459		-0.331		
3	ONGC Bridge	21.83	17.2	26.5		1.094	0.204		
4	Nehru Bridge	31.2	26.5	33.69		1.342	0.452		
5	Singanpore Weir D/S	33.69	33.69	34.674	1.7	1.7			
6	Singanpore Weir cum causeway U/S	34.674	34.674	39.51	4.11	4.11			
7		39.51	39.51	51.785		4.18			
8		51.785	51.785	64.755		4.223			
9		64.75	64.75	76.8		4.437			
10		76.8	76.8	77.5		4.58			
11		78	77.5	78.5		4.604			
12		79	78.5	79.5		4.607			
13		80	79.5	80.5		4.72			
14		81	80.5	81.5		4.82			
15		82	81.5	82.5		4.91			
16		83	82.5	83.5		5.1			
17		84	83.5	84.5		7.21			
18		85	84.5	85.5		9.398			

S. No.	CWC gauge / Dam / Barrage / Weir / Anicut / Bench Mark / tide gauges	Chainage (km)	Stretch for corrected soundings and topo levels (km) C		Established Sounding Datum w.r.t. MSL (m)	Sounding Datum (m) from MSL	Sounding Datum (m) w.r.t CD	Correction in WL data for Bathymetric survey (m)	Topo level data to be converted as depth for volume calculation wrt SD (m)
	A	B	(50% stretch is to be selected on both side of tide gauge)		D+ve indicates above MSL -ve indicates below MSL	E	E-1	F = (E- WL data in MSL)	G = (E- topo levels in MSL)
19		86	85.5	86.5		11.203			
20		87	86.5	87.5		15.366			
21		88	87.5	88.5		17.425			
22		89	88.5	89.5		20.366			
23		90	89.5	90.5		20.871			
24		91	90.5	91.5		21.674			
25		92	91.5	92.5		23.585			
26		93	92.5	93.5		23.641			
27		94	93.5	94.5		23.781			
28		95	94.5	95.5		24.54			
29		96	95.5	96.5		24.89			
30		97	96.5	97.5		25.1			
31		98	97.5	98.5		25.22			
32		99	98.5	99.5		25.28			
33		100	99.5	100.5		25.33			
34		101	100.5	101.5		25.42			
35		102	101.5	102.5		26.696			
36		103	102.5	103.5		27.13			
37		104	103.5	104.5		27.19			
38		105	104.5	105.5		27.257			
39		106	105.5	106.5		27.32			
40		107	106.5	107.5		27.39			
41		108	107.5	108.5		27.42			

S. No.	CWC gauge / Dam / Barrage / Weir / Anicut / Bench Mark / tide gauges	Chainage (km)	Stretch for corrected soundings and topo levels (km) C		Established Sounding Datum w.r.t. MSL (m)	Sounding Datum (m) from MSL	Sounding Datum (m) w.r.t CD	Correction in WL data for Bathymetric survey (m)	Topo level data to be converted as depth for volume calculation wrt SD (m)
	A	B	(50% stretch is to be selected on both side of tide gauge)		D+ve indicates above MSL -ve indicates below MSL	E	E-1	F = (E- WL data in MSL)	G = (E- topo levels in MSL)
42		109	108.5	109.5		27.47			
43		110	109.5	110.5		27.52			
44		111	110.5	111.5		27.55			
45	Kakrapar Weir D/S	112.2	111.5	112.2	30.097	30.097			
46	Kakrapar Weir U/S	112.303	112.2	117.3	47.712	47.712			
47		117.3	117.3	127.4		48.055			
48	Ukai Dam D/S	127.4	127.4	137.311	48.378	48.378			
49	Ukai Dam U/S	137.311	137.311	142.4	90.169	90.169			
50		142.4	142.4	153.1		90.169			
51		153.1	153.1	163.8		90.169			
52		163.8	163.8	174.587		90.169			

2.2 Existing Cross Structures

2.2.1 Bridges

There are total 19 no bridges across the River Tapi (studies length 174.58 km) including on Railway Bridge and two no. road bridges under construction.

Table 2.3: Bridges

Sl No	Structure Name and for road / rail	Chainage (km)	Type of Structure (RCC / Iron / Wooden)	Location	Position (Lat Long)		Position (UTM)		Length (m)	Width (m)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	Vertical clearance w.r.t. HFL / MHWS (m)	Remarks (complete / under - construction), in use or not, condition
					Left Bank	Right Bank	Left Bank	Right Bank						
1	Magadalla Hazira Bridge/ ONGC Bridge	21.845	RCC	Magadalla	21°14'56.92"N, 73°35' 9.31"E	21°15' 1.89"N, 73°35' 13.10"E	353270.726, 2350378.022	353381.233, 2350530.00	900	16	17	50	5.44	complete
2	Bridge U/C	27.124	RCC	Adajan Gam	21°10'47.03"N, 72°47'49.82"E	21°11'6.44"N, 72°47'38.72"E	271296.97, 2343628.61	270984.06, 2344229.58	-	-	-	-	-	under - construction
3	Sardar Bridge	30.254	RCC	Adajan	21°15' 32.92"N, 73°33' 57.40"E	21°15' 44.87"N, 73°34' 0.66"E	351207.736, 2351503.691	351305.02, 2351870.29	700	22.4	14	50	4.89	complete
4	Swami Vivekanand Bridge	31.103	RCC	Adajan	21°15' 54.78"N, 73°21'	21°16' 18.27"N, 73°21'	330269.284, 23523	330383.473, 2353100.61	620	19.5	25	25	4.23	complete

Sl No	Structure Name and for road / rail	Chainage (km)	Type of Structure (RCC / Iron / Wooden)	Location	Position (Lat Long)		Position (UTM)		Length (m)	Width (m)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	Vertical clearance w.r.t. HFL / MHWS (m)	Remarks (complete / under - construction), in use or not, condition
					Left Bank	Right Bank	Left Bank	Right Bank						
	(Makkaipool)				50.80"E	54.51"E	79.318							
5	Nehru Bridge	31.562	RCC	Adajan	21°15' 5.42"N, 73°17' 21.30"E	21°15' 24.86"N, 73°17' 19.22"E	322483.782, 2350943.940	322430.285, 2351542.431	550	18	17	50	5.34	complete
6	Fulwari Bridge U/C	32.771	RCC	Adajan Patiya	21°12'25.83"N, 72°49'7.15"E	21°12'10.88"N, 72°48'32.88"E	273568.82, 2346636.28	272574.14, 2346190.88	-	-	-	-	-	under - construction
7	Dabholi Jahangirpura Bridge	36.587	RCC	Dabholi Village	21°14' 52.20"N, 73°7' 36.28"E	21°14' 55.374"N, 73°7' 40.578"E	305612.322, 2350728.541	305737.347, 2350824.48	1000	21	30	35	2.25	complete
8	Amroli Bridge	44.332	RCC	Katargam (Near Hanuman Temple)	21°15' 7.80"N, 73°7' 22.16"E	21°15' 11.21"N, 73°7' 31.13"E	305210.838, 2351213.243	305470.816, 2351314.946	655.2	20	15	50	1.75	complete
9	Railway Bridge	45.373	Iron	Utran Railway Station	21°16' 45.07"N 73°5'	21°17' 4.5288"N, 73°5' 4.59"E	301160.016, 2354253.798	301287.952, 2354850.669	570	12	11	55	0.75	complete

Sl No	Structure Name and for road / rail	Chainage (km)	Type of Structure (RCC / Iron / Wooden)	Location	Position (Lat Long)		Position (UTM)		Length (m)	Width (m)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	Vertical clearance w.r.t. HFL / MHWS (m)	Remarks (complete / under - construction), in use or not, condition
					Left Bank	Right Bank	Left Bank	Right Bank						
					0.40"E									
10	Kapodra-Utran Bridge	47.061	RCC	Utran	21°16' 54.02"N 72°57' 4.49"E	21°17' 7.002"N, 72°57' 5.210"E	287444.192, 2354701.455	287469.962, 2355100.35	600	20	11	50	5	complete
11	Savjibhai korat Bridge	50.01	RCC	Sarthana Nature Park	21°16' 53.92"N 72°57' 3.48"E	21°17' 6.88"N, 72°57' 4.10"E	287414.974, 2354698.708	287438.117, 2355097.091	544.6	21.5	13	40	1.5	complete
12	Service Road Bridge (Tapi River)	59.238	RCC	Kamrej	21°16' 53.85"N 72°57' 2.33"E	21°17' 6.57"N, 72°57' 2.95"E	287381.713, 2354697.134	287404.817, 2355087.91	320	5	9	30	6.6	complete
13	Kholvad Bridge (Tapi River)-2	59.27	RCC	Kamrej	21°13' 59.38"N 72°53' 32.57"E	21°14' 16.62"N, 72°53' 21.89"E	281263.203, 2349410.142	280962.085, 2349944.672	470	10	10	40	7.3	complete
14	Kholvad Bridge (Tapi River)-1	59.299	RCC	Kamrej	21°13' 5.42"N, 72°51' 58.96"E	21°13' 35.52"N, 72°51' 58.35"E	278545.324, 2348094.363	278535.94, 2348712.748	470	12	10	40	6.9	complete

Sl No	Structure Name and for road / rail	Chainage (km)	Type of Structure (RCC / Iron / Wooden)	Location	Position (Lat Long)		Position (UTM)		Length (m)	Width (m)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	Vertical clearance w.r.t. HFL / MHWS (m)	Remarks (complete / under - construction), in use or not, condition
					Left Bank	Right Bank	Left Bank	Right Bank						
15	Bodhan Flyover (SH-165)	77.259	RCC	Bodhan Village Near Galteshwar Temple	21°13' 35.51"N 72°50' 57.87"E	21°13' 49.44"N 72°51' 10.72"E	276791.771, 2348736.093	277168.26, 2349159.443	580	8	12	40	14	complete
16	Umarsadi Haripura Bridge	92.891	RCC	Kadot	21°13' 13.69"N, 72°48' 24.43"E	21°13' 2.85"N, 72°48' 5.41"E	272357.172, 2348125.49	271804.041, 2347799.896	560	7	-	-	-8	complete
17	Mandvi Bridge (SH-5)	102.63	RCC	Mandvi	21°11' 48.52"N, 72°49' 6.24"E	21°11' 52.77"N, 72°48' 41.67"E	273526.867, 2345489.059	272819.92, 2345629.694	600	6	15	40	12	complete
18	Mandvi Bridge	104.388	RCC	Mandvi	21°14'39.79"N, 73°18'6.01"E	21°14'48.73"N, 73°18'13.60"E	323764.27, 2350141.53	323986.83, 2350414.74	-	-	-	-	-	damaged
19	Hindustan Bridge (SH-174)	134.168	RCC	Limbi Village	21°11' 15.22"N, 72°48' 33.03"E	21°11' 27.47"N, 72°48' 20.94"E	272554.781, 2344478.182	272211.313, 2344859.823	360	7	9	40	7.5	complete

Terminals	Location	Chainage (Km)	Purpose	Development
Terminal 1	Dumas	-	Tourism	Phase 1
Terminal 2	Old Fort Chowk Bazar	31.3	Tourism	Phase 1
Terminal 3	KRIBHCO Jetty	18	Clean Cargo	Phase 2
Terminal 4	Ukai	134	Coal/FlyAsh	Phase 2

2.2.2 Electric Lines / Communication Lines

A total 32 nos. of High Tension lines and 02nos. electric cables were crossing the Tapi River.

Table 2.4 – High Tension Lines / Electric Lines / Tele-communication Lines

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long)		Position (UTM)		No of Piers	Horizontal clearance (clear distance Between piers) (m)	Vertical clearance w.r.t. HFL / MHWS (m)	Remarks (complete / under - construction)
				Left Bank	Right Bank	Left Bank	Right Bank				
1	HT Line Cross	12.584	Hazira	21°9' 0.0691"N, 72°40' 1.9414"E	21°9' 0.5842"N, 72°39' 45.0922"E	257748.719, 2340530.885	257262.719, 2340553.885	2	500	23.1	complete
2	HT Line Cross	23.647	Adajan	21°9' 18.6509"N, 72°45' 37.7837"E	21°9' 35.7144"N, 72°45' 22.0692"E	267448.281, 2340962.869	267002.251, 2341494.159	2	600	25.1	complete
3	HT Line Cross	34.372	Singnapore	21°13' 5.7609"N, 72°48' 27.7433"E	21°12' 49.0112"N, 72°48' 5.2235"E	272449.156, 2347880.252	271792.468, 2347374.045	2	700	18.00	complete
4	HT Line Cross	34.503	Singnapore	21°13' 10.1229"N, 72°48' 26.6819"E	21°12' 53.1317"N, 72°48' 3.2211"E	272420.403, 2348014.853	271736.473, 2347501.592	2	700	18.00	complete
5	HT Line Cross	39.240	Katar Gam	21°14' 48.7076"N, 72°48' 33.4827"E	21°15' 8.8608"N, 72°48' 15.928"E	272658.566, 2351044.596	272160.953, 2351671.537	2	500	15.00	complete
6	HT Line Cross	39.926	Katar Gam	21°14' 59.9737"N, 72°48' 42.3851"E	21°15' 23.2557"N, 72°48' 39.5198"E	272920.083, 2351387.587	272847.382, 2352104.886	2	550	12.00	complete
7	HT Line	45.338	Utran	21°13' 35.4525"N,	21°13' 51.4955"N,	276776.891,	277123.842,	2	550	18.00	complete

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long)		Position (UTM)		No of Piers	Horizontal clearance (clear distance Between piers) (m)	Vertical clearance w.r.t. HFL / MHWS (m)	Remarks (complete / under - construction)
				Left Bank	Right Bank	Left Bank	Right Bank				
	Cross			72°50' 57.3609"E	72°51' 9.1586"E	2348734.325	2349223.175				
8	HT Line Cross	47.428	utran Bridge	21°13' 17.0196"N, 72°52' 9.9531"E	21°13' 35.6409"N, 72°52' 12.0045"E	278862.835, 2348139.015	278929.713, 2348710.99	2	550	16.00	complete
9	HT Line Cross	47.476	utranBridge	21°13' 17.0724"N, 72°52' 11.6253"E	21°13' 35.9787"N, 72°52' 13.6262"E	278911.085, 2348139.988	278976.623, 2348720.752	2	550	15.00	complete
10	HT Line Cross	47.724	utran Bridge	21°13' 20.7816"N, 72°52' 26.3512"E	21°13' 37.0078"N, 72°52' 14.9847"E	279337.331, 2348248.368	279016.226, 2348751.877	2	450	18.00	complete
11	HT Line Cross	54.162	Abrama Village	21°15' 49.537"N, 72°54' 52.229"E	21°15' 57.284"N, 72°54' 30.1729"E	283604.901, 2352767.853	282972.13, 2353014.551	2	450	17.00	complete
12	HT Line Cross	59.682	Abrama Village	21°16' 0.0338"N, 72°54' 57.6956"E	21°16' 6.0349"N, 72°54' 24.0356"E	283766.777, 2353088.636	282798.749, 2353286.062	2	450	14.00	complete
13	HT Line Cross	54.452	Kamrej	21°16' 54.6944"N, 72°57' 18.8753"E	21°17' 5.8801"N, 72°57' 16.8091"E	287858.967, 2354716.667	287803.86, 2355061.489	2	350	16.00	complete
14	HT Line Cross	60.765	Kamrej	21°16' 56.79"N, 72°58' 0.1409"E	21°17' 12.407"N, 72°57' 50.2859"E	289049.405, 2354765.751	288771.504, 2355249.76	2	400	18.00	complete
15	HT Line Cross	62.289	Bherav Village	21°17' 51.3531"N, 72°58' 9.0346"E	21°17' 43.3038"N, 72°57' 50.1627"E	289327.399, 2356440.692	288780.222, 2356200.125	2	400	16.00	complete

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long)		Position (UTM)		No of Piers	Horizontal clearance (clear distance Between piers) (m)	Vertical clearance w.r.t. HFL / MHWS (m)	Remarks (complete / under - construction)
				Left Bank	Right Bank	Left Bank	Right Bank				
16	HT Line Cross	66.260	Bherav Village	21°18' 39.0808"N, 72°59' 11.464"E	21°18' 57.0515"N, 72°59' 17.8242"E	291145.665, 2357885.604	291336.037, 2358435.998	2	400	20.00	complete
17	HT Line Cross	68.113	Keyur Patel	21°18' 5.5235"N, 73°0' 5.5233"E	21°18' 24.2262"N, 73°0' 9.1941"E	292690.678, 2356833.635	292803.772, 2357407.539	2	400	14.00	complete
18	HT Line Cross	73.271	Ghala Gam	21°17' 11.727"N, 73°2' 53.5032"E	21°17' 25.4396"N, 73°2' 51.8573"E	297511.957, 2355118.371	297469.73, 2355540.715	2	400	18.00	complete
19	HT Line Cross	74.082	Ghala Gam	21°17' 14.549"N, 73°3' 20.9252"E	21°17' 32.119"N, 73°3' 19.7957"E	298303.492, 2355195.407	298277.595, 2355736.201	2	200	18.00	complete
20	HT Line Cross	81.149	Baudhan	21°16' 15.0648"N, 73°6' 57.645"E	21°16' 26.5921"N, 73°7' 8.3114"E	304528.693, 2353290.13	304840.41, 2353640.994	2	200	14.00	complete
21	HT Line Cross	81.408	Baudhan	21°16' 9.6892"N, 73°7' 0.7569"E	21°16' 18.7232"N, 73°7' 16.8643"E	304616.43, 2353123.73	305084.091, 2353396.044	2	476	18.00	complete
22	HT Line Cross	102.431	Tarsada	21°15' 4.0554"N, 73°17' 11.3567"E	21°15' 25.9083"N, 73°17' 14.4666"E	322196.629, 2350904.779	322293.57, 2351575.859	2	300	16.00	complete
23	HT Line Cross	109.110	Tarsada	21°15' 23.4363"N, 73°20' 32.0015"E	21°15' 26.8102"N, 73°20' 11.4285"E	327987.432, 2351439.094	327395.437, 2351549.087	2	400	16.00	complete
24	HT Line Cross	114.069	Kanja Village	21°16' 8.8629"N, 73°22' 58.4173"E	21°16' 24.8437"N, 73°22' 44.9966"E	332222.646, 2352792.33	331840.832, 2353287.746	2	400	16.00	complete

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long)		Position (UTM)		No of Piers	Horizontal clearance (clear distance Between piers) (m)	Vertical clearance w.r.t. HFL / MHWS (m)	Remarks (complete / under - construction)
				Left Bank	Right Bank	Left Bank	Right Bank				
25	HT Line Cross	114.427	Kanja Village	21°16' 10.4877"N, 73°23' 6.8326"E	21°16' 29.489"N, 73°22' 59.935"E	332465.733, 2352839.815	332272.889, 2353426.187	2	450	15.00	complete
26	HT Line Cross	114.856	Kanja Village	21°16' 15.3642"N, 73°23' 19.143"E	21°16' 36.1118"N, 73°23' 15.0191"E	332822.115, 2352986.155	332709.759, 2353625.407	2	300	15.00	complete
27	HT Line Cross	123.336	BoriSavar	21°15' 51.2098"N, 73°27' 58.7551"E	21°16' 3.7315"N, 73°27' 52.0639"E	340874.65, 2352163.098	340685.515, 2352550.037	2	400	16.00	complete
28	HT Line Cross	127.817	Vadi Bhensrot	21°16' 12.6693"N, 73°30' 27.6199"E	21°16' 27.0411"N, 73°30' 27.9525"E	345171.981, 2352781.897	345185.747, 2353223.758	2	250	18.00	complete
29	HT Line Cross	128.928	Vadi Bhensrot	21°16' 14.3676"N, 73°31' 6.9967"E	21°16' 27.3909"N, 73°31' 5.7924"E	346307.47, 2352823.435	346276.516, 2353224.241	2	350	18.00	complete
30	Electric Line Cross	134.189	Hinduastan Bridge	21°15' 33.0155"N, 73°33' 57.8363"E	21°15' 44.7492"N, 73°34' 1.7152"E	351220.15, 2351506.38	351335.234, 2351866.181	2	350	12.00	complete
31	Electric Line Cross	134.257	Hinduastan Bridge	21°15' 32.3125"N, 73°34' 0.6697"E	21°15' 44.4131"N, 73°34' 3.034"E	351301.629, 2351484.021	351373.156, 2351855.501	2	350	12.00	complete
32	HT Line Cross	134.361	Ukai	21°15' 31.3604"N, 73°34' 3.4113"E	21°15' 43.1259"N, 73°34' 7.6294"E	351380.393, 2351454.026	351505.26, 2351814.72	2	350	15.00	complete
33	HT Line Cross	134.531	Ukai	21°15' 29.7404"N, 73°34' 9.1271"E	21°15' 41.7243"N, 73°34' 13.1675"E	351544.703, 2351402.718	351664.505, 2351770.172	2	400	15.00	complete

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long)		Position (UTM)		No of Piers	Horizontal clearance (clear distance Between piers) (m)	Vertical clearance w.r.t. HFL / MHWS (m)	Remarks (complete / under - construction)
				Left Bank	Right Bank	Left Bank	Right Bank				
34	HT Line Cross	136.981	Ukai	21°15' 4.9259"N, 73°35' 6.4943"E	21°15' 2.1426"N, 73°35' 12.4152"E	353191.525, 2350624.771	353361.441, 2350537.656	2	500	12.00	complete

2.2.3 Pipe Lines / Cables

There is one water pipeline passing along the Amroli Bridge (44.332km).

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

The details of existing Dam and weir are given as below:

Table 2.5 – Details of Dam, Barrages, Weirs, Anicut

S. No.	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				
1	Singnapore Weir -cum-Causeway	34.674	Singnapore	21°13' 4.8445"N, 73°12' 15.9581"E	21°13' 23.5574"N, 73°12' 19.6089"E	313638.485, 2347333.065	313750.291, 2347907.374	580	7.0	6.00	Working but navigational Lock not present
2	Kakrapar Weir	112.303	Kakrapar	21°11' 34.9726"N, 72°48' 56.6408"E	21°11' 43.7324"N, 72°48' 37.1564"E	273244.106, 2345076.097	272685.756, 2345353.308	633.50	3.05	15.50	Working but navigational Lock not present
3	UKAI DAM	137.311	Ukai	21°13'55.11"N, 73°35'31.27"E	21°15'46.64"N, 73°35'59.40"E	353886.620, 2348471.540	354728.800, 2351894.210	4927	6.5	68.58	Working but navigational Lock not present

2.3 Bends

There are 23 nos of bends noticed in river Tapi in a length of 174.58km.

2.3.1 Radius of Curvatures

The bends along with radius of curvature are tabulated below:

Sr. No.	Chainage (in Km)	Radius of Curvature(in m)
1	13	1870
2	20	2750
3	26.5	1120
4	32	960
5	36.5	1080
6	40.8	820
7	46.5	1610
8	55.6	900
9	61.5	980
10	65	890
11	73	860
12	74.5	870
13	79	880
14	88	1150
15	93.6	1060
16	102.6	1160
17	105.2	1470
18	107.8	1250
19	110.2	810
20	121.9	920
21	148	2300
22	157	2410
23	168.9	1600

2.4 Velocity and Discharge Details

The cup type current meter was used to measure the flow rates of the river. The observations were undertaken on the cross section near the BM/ Tide Gauge established during the Hydrographic survey. The current meter observation at some stretches could not be observed due to unavailability of sufficient water level.

Table 2.6 – Current Meter and Discharge Details

Stretch No.	Chainage (km)	Position				Observed Depth (m) (D)	Velocity (m/sec.)	Average Velocity (m/sec.)	X-Sectional area (sq. m.)	Discharge (Cum/sec)
		Latitude	Longitude	Easting (m)	Northing (m)		0.5 D			
1	174.531	21°24' 36.76"N	73°49' 8.73"E	379041.402	2367997.8	11.27	0.016	0.016	X sectional area was not calculated due to dry area/ shallow water, ponding at Signapore weir, Kakraparwier and Ukai Dam.	Nil Discharge due to dry area/ shallow water, ponding at Signapore weir, Kakraparwier and Ukai Dam.
2	164.177	21°21' 2.77"N	73°47' 8.22"E	374081.017	2361454.98	21.64	0.008	0.008		
3	151.236	21°15' 44.06"N	73°42'20.03" E	365698.727	2351721.22	29.37	0.006	0.006		
4	141.45	21°14' 29.81"N	73°37'48.53" E	357853.340	2349504.00	32.2	0.006	0.006		
5	137.649	21°14' 59.22"N	73°35' 0.68"E	354175.439	2350440.59	32.44	0.005	0.005		
6	132.343	21°15' 50.13"N	73°32' 6.04"E	349443.929	2352049.05	78.31	0.049	0.049		
7	122.452	21°15' 55.19"N	73°27' 4.49"E	339888.321	2352295.28	12.25	0.032	0.032		
8	112.617	21°16' 5.39"N	73°22' 2.66"E	330614.436	2352702.36	6.37	0.032	0.032		
9	Current meter reading was not taken due to Dry area/very shallow water.									
10										
11										
12	70.088	21°18' 0.28"N	73°1' 13.13"E	294637.587	2356648.07	6.86	0.046	0.046		
13	59.391	21°17' 0.60"N	72°57' 7.86"E	287543.781	2354902.63	9.26	0.061	0.061		
14	44.279	21°14' 6.46"N	72°50' 6.06"E	276175.655	2349696.62	6.97	0.086	0.086		
15	34.717	21°13' 7.91"N	72°48' 11.7"E	271988.172	2347952.86	4.72	0.144	0.144		
16	23.712	21°9' 26.03"N	72°45' 3.91"E	267339.840	2341191.63	5.11	2.861	2.861		
17	12.180	21°8' 48.85"N	72°39' 4.97"E	257253.905	2340193.12	6.68	3.003	3.003		
18	5.722	21°5' 21.07"N	72°39' 8.80"E	256981.94	2333804.04	13.60	3.146	3.146		

2.5 Waterway description

Hydrographic Survey was done on selected River stretch. 19 bridges are located (including one Railway bridge) and heights of these bridges were enough to cross the survey boat. We have divided waterways of Tapi River into7 different stretches and details of stretches given below from Para 2.5.1 to 2.5.7.

2.5.1 Stretch 1 Essar Port to Singanpore Causeway (Ch. 00.00 km – 34.674 km)

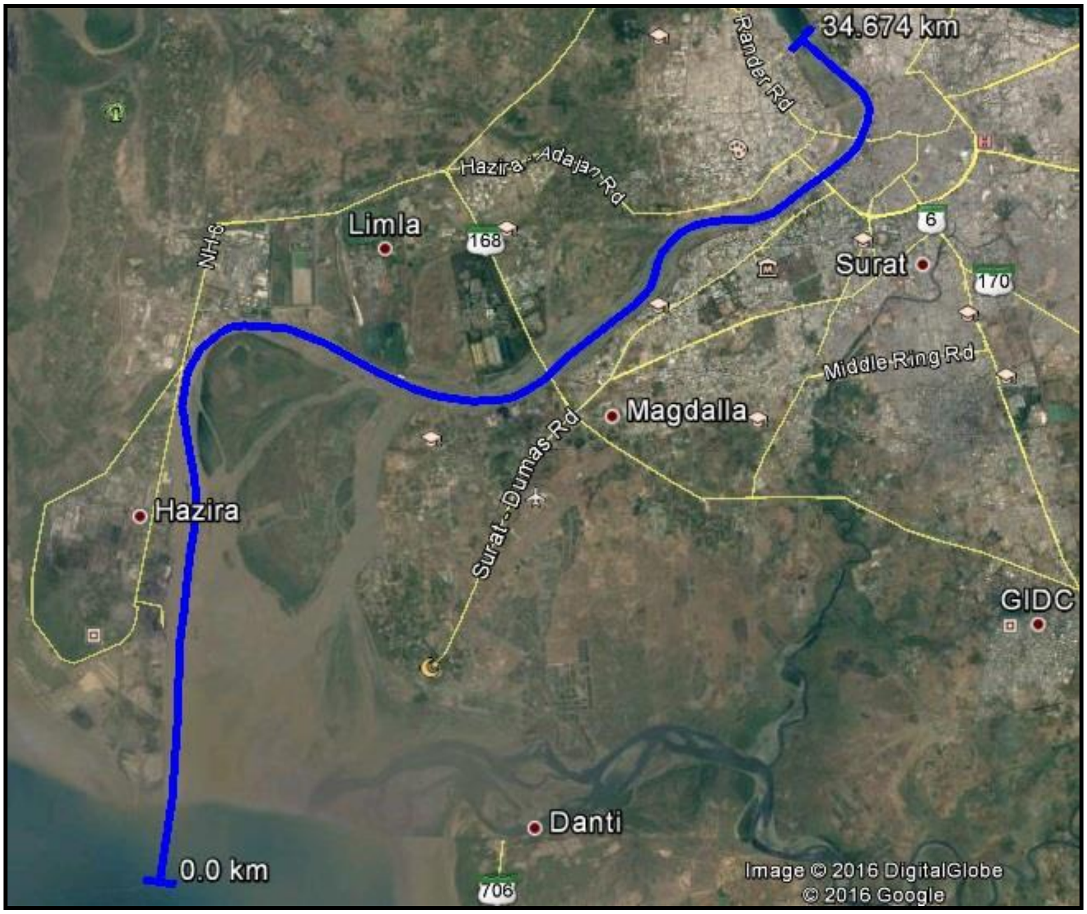


Figure 2.2 – Essar Port to Singanpore Causeway

Table 2.7 –Dredging quantity of Stretch 1, Essar Port to Singanpore Causeway

Class	Chainage		Reduced w.r.t. Sounding Datum			
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)
III	0	34.674	-0.3	11.6	18.20	1081554.94
IV	0	34.674	-0.3	11.6	19.80	1380037.38
V	0	34.674	-0.3	11.6	20.60	2080613.30

This stretch is from the confluence of Tapi River at Gulf of Khambhat to Singanpore weir (0 to 34.674 km at Tapi River). This full stretch is tidal in nature with a variation of 0m to 6m. The river bed is flat and sandy in nature; several sand patches are present in the mouth. The width of the river in this stretch varies from 500m to 2km. The river banks are unprotected in nature and are lined very prominently with marshy and loose clay mud present on the intertidal portion throughout the river banks. The gradient of the river is very gentle and there are no rapids or obstructions in this stretch.

Bathymetry Survey was done for whole length of this Stretch. Tidal range of this stretch is up to 33.72km in high tide. Navigation is possible up to Ch.33.72 km to this stretch of the River at high tide because depth required for navigational channel is quite good and horizontal and vertical clearance of Bridges is quite suitable. Width of river from Ch 0.0 to 33.72 km is about 500 m and a depth observed is1m to 14.9mof deepest channel in high tide. Water current is very high during low tide to high tide and vice Versa. Discharges are quite high in between low to high tide and vice Versa. Banks are mainly unprotected but jetties of different industries were seen along both bank of this stretch. There is no encroachment of waterway present.

Essar port, Reliance port, L&T port, NTPC power Plant, ONGC, GIDC GAIL, KRIBHCO, Ambuja Cement and Magadalla Port are present on bank of the Tapi River. Raw Material (coal, cement, iron, chemical, etc.,) by these ports/plants is transported via this stretch of river. Total 6 Bridges are present in this stretch of River appearing in Table- 3.NH-6 crosses the stretch at chainage 27.124 km. State Highway No. 168, crosses the stretch at chainage- 30.254 km and many roads crosses River. Main villages in this stretch are Hazira, Dumas, Magadlla, Limla, Athwa and Surat City. Mangroves present on both bank of the river and on Island. Land is generally used for Industries, Ports and Residential area. There are number of jetties present on both bank of river. This stretch of river is well connected by road to different ports and Industries. Photographs of field observation and cross structures are available in **Annexure -13 of Volume IIIA (Hydrographic Survey Report)**.Surat railway station is in the vicinity of this stretch. Land use is generally private land and purchased by different port authorities. Some of land is under Surat Municipal Corporation (SMC) and some land is under forest land where mangroves are present. Crops/ Agriculture not present in this stretch.

There is no ferry services are present in this stretch but cargo activity is available from 0 to 21.8 km of Tapi River during High-tide only by vessels transiting to Essar Port, L&T, Reliance, Magdalla port, Ambuja Cement jetty etc. fishing activities by using small motor boats are observed in this stretch. Sand mining is prominent in this stretch. No Irrigation canal and outlet present in this stretch of River. Water is salty and not used for drinking, Irrigation or industries purpose. Many Nalas/drains are directly falling into this stretch of river.

Figure 2.3 – Ch. 21.845 km ONGC Bridge between Surat City and Hazira

Figure 2.4 – Ch. 27.124 Under Construction Bridge at Adajan Gam

Figure 2.5 – Ch. 30.254 Sardar Bridge

Figure 2.6 – Ch. 31.103 Makaipool Bridge (Swami Vivekanand Bridge)

Figure 2.7 – Ch. 31.562 Nehru Bridge

Figure 2.8 – Ch. 32.771 Adajan Patiya Bridge under Construction

2.5.2 Singanpore Weir to Savjibhai Korat Bridge (Ch. 34.674 km – 50.00 km)

Figure 2.9 – Singanpore Weir to SavjibhaiKorat Bridge (Ch. 34.674 km – 50.00 km)

Table 2.8 – Dredging quantity of Stretch 2, Singanpore Weir to Savjibhai Korat Bridge

Class	Chainage		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)
III	34.674	50	1.5	11.3	0.800	148.34	1.37	10.49	1.2	3008.58
IV	34.674	50	0.8	11.3	2.00	2766.24	1.22	10.49	2.0	8917.02
V	34.674	50	0.8	11.3	2.00	11002.75	1.22	10.49	2.8	17542.50

This stretch starts from Singnapore Weir to Savjibhai Korat Bridge. Singnapore weir (Under Surat Municipal Corporation) is present at the start of this stretch. This Weir is used for supply of fresh water to different industries and Surat City. This stretch of river is Non-Tidal. Horizontal and vertical clearance of Bridges is quite suitable for navigation. Width of the river from 500 to 700m and depths observed is 4 m to 7m of deepest channel of the river. Whole area falls under Singnapore wear reservoir. Water current is quite low. Discharges are high in monsoon season and low in lean period. Banks are mainly unprotected. There is no encroachment of waterway present. This stretch of river is well connected via road. Total 5 nos. State road Bridges and 1noRailway Bridge falls in this stretch of River, given in Table- 3.

Main villages in this stretch are Jahangir pura, Katargam and Harinandan society of Surat City. Land is generally used for Residential area. There was Number of Irrigational water lift tanks located parallel to the both banks of the river. Photographs of field observation and cross structure are available in **Annexure-13 of Volume IIIA (Hydrographic Survey Report).** Surat railway station is in the vicinity of this stretch. Banana and Sugarcane are main crops near to singnapore weir. Full availability Bulk/Construction materials as cement factories are present near to the stretch. Passengers ferry service not available in this stretch. Fishing of fresh water is available on small scale. Outlet was present for supply of drinking water to surrounding industries present in this stretch of River. Sand mining is not present. Water is fresh and used for drinking, Irrigation and industries purpose. Many Nalas are falling into the river. One thermal power station is located on the right bank of river at chainage 48.8 km. Hyacinth from chainage 43 km to 47.0 km was noticed.

Figure 2.10 – Ch. 34.6 km Singnapore Weir cum causeway

Figure 2.11 – Ch. 36.587 km Dhaboli Jahangirpura Road Bridge

Figure 2.12 – Ch.44.332 km Amroli Bridge

Figure 2.13 – Ch.45.373 km Railway Bridge and Hyacinth Cover on Surface of Water

Figure 2.14 – Ch.47.061 km Kapodra-Utran Road Bridge

Figure 2.15 – Ch.50 km Savjibhai Korat Bridge

2.5.3 Stretch 3 Savjibhai Korat Bridge to Ghala (Ch. 50.00 km – 75.00 km)

Figure 2.16 – Savjibhai Korat Bridge to Ghala

Table 2.9 – Dredging quantity of Stretch 3,Savjibhai Korat Bridge to Ghala

Class	Chainage		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)
3	50	75	0.3	16.3	4.000	234150.81	-0.3	14.43	7.20	357538.37
4	50	75	0.3	16.3	4.40	290284.29	-0.3	14.43	7.40	451125.62
5	50	75	0.3	16.3	5.20	433331.82	-0.3	14.43	8.40	679644.18

This stretch (Ch. 50.00 to 75.00 km) starts from Savjibhai Korat Bridge and end at Ghala Village. This stretch of river is Non-Tidal. Horizontal and vertical clearance of Bridges is quite suitable for Navigation. Width of river from 500 to 700 m. and depths observed is 3 m to 10m of deepest channel of the river. At Chainage 64.6 km Singnapore weir, reservoir is located. Water current is very low in this stretch of the river. Discharges are high in monsoon season and low in lean period. Banks are mainly unprotected. There is no encroachment of waterway present. This stretch of river is well connected via road. National Highway No. 8 is crossing this stretch with 3 nos. of bridges falling in this stretch, as given in Table- 3.

Main villages in this stretch are Abrama, Kamrej, Amboli, Bharv, Choryasi, Dhoran Pardi, Kholeshwar, Karjan, Dungra, Jior, Dhatva and Ghala. Land is generally used for Agriculture. Banana, Sugarcane and Wheat are main crops near to this stretch. There was Number of Irrigational water lift tanks located on parallel to the both banks of river. Photographs of field observation and cross structure are available in **Annexure-13 of Volume IIIA (Hydrographic Survey Report).**There is no Railway station in the vicinity of this stretch. Full availability Bulk/Construction material because sand extraction is prominent in this stretch. Passengers ferry services are not available. Fishing of fresh water is available on small scale. Water is fresh and used for drinking; Irrigation and industries purpose Outlet was present for supply of drinking water, Irrigation purpose to surrounding villages. Many Nalas are present which are directly put water into the river. Nature Park and zoo is also available near to this stretch.

Figure 2.17 – Ch.59.27 Km National Highway No. 8 Bridge

Figure 2.18 – Ch.59.27 Km National Highway No. 8 Bridge

2.5.4 Ghala Village to Jakhla Village (Ch. 75.00 km – 100.00 km)

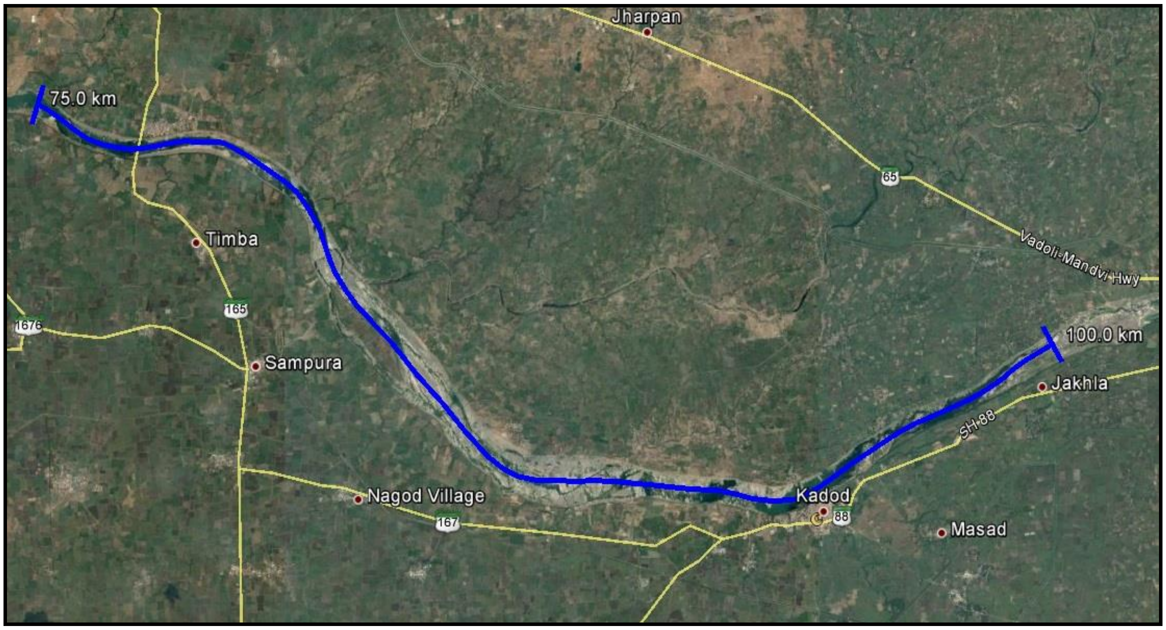


Figure 2.19– Ghala Village to Jakhla Village

Table 2.10 – Dredging Quantity for stretch 4, Ghala Village to Jakhla Village

Class	Chainage		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)
3	75	100	0.0	9.6	23.400	2272458.33	-0.3	15.19	23.30	2407331.53
4	75	100	0.0	9.6	23.40	2742963.88	-0.3	15.19	23.40	2884647.93
5	75	100	0.0	9.6	23.60	4116426.95	-0.3	15.19	23.60	4296134.37

This stretch (Ch. 75.00 to 100.00 km) starts from Ghala end at Jakhla. This stretch of river is Non-Tidal. Navigation is not possible in whole stretch in present condition. Width of river varies from 300 to 900 m. Bathymetry survey was done only for 2.2 km length of this stretch up to chainage of 77.2. Depth observed is 4 m to 8m of deepest channel of river for first 2.2 km of length. Further bathymetry survey was not possible due to Dry River/Shallow Depths of water/Rocks outcrops in this stretch of river. Only Topographic survey was done for this stretch of the river. Deployment of current meter was not done due to still water/ small packet of water present/pound in river less than 1m depth. Banks are mainly naturally protected. 4 nos. of bridge crossing was present in this stretch of River of names are given in Table-3 with details. Main villages in this stretch are Macchi, Galteshwar Bodhan, Khanjroli, Kamlapor, Umarsadi, Vagecha, Kadod, Haripura and Jakhla. Land is generally used for Agriculture. Banana, Sugarcane and Wheat are main crops near to this stretch. There was no Irrigational water lift tank present to this stretch of river. This stretch of river is well connected via road to national highway at bardoli. Photographs of field observation and cross structure are available in **Annexure-13 of Volume IIIA (Hydrographic Survey Report).**There is no Railway station in vicinity of this stretch. River bed is mainly rocky.

Figure 2.20 – Ch. 83.332 Km Sampura,Reshamwala Island-2

Figure 2.21 – Ch.92.891 Km Kojwa, Kadod Bridge

2.5.5 Jakhla Village to Kakrapar Weir (Ch. 100.00 km – 112.303 km)

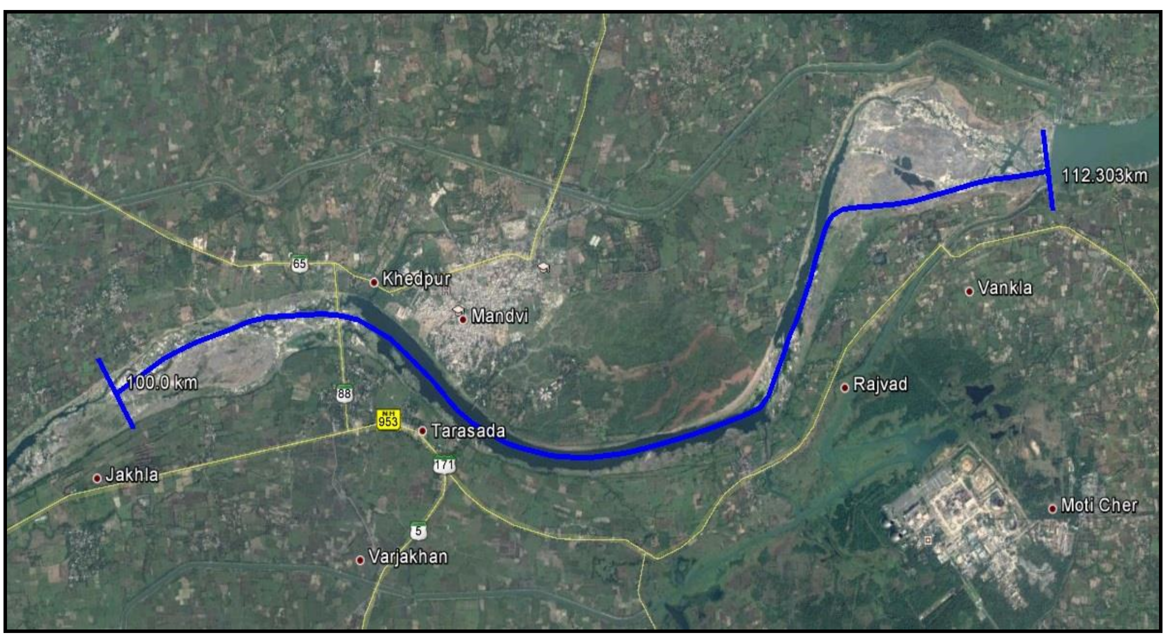


Figure 2.22 – Jakhla Village to Kakrapar Weir

Table 2.11 – Dredging Quantity for Stretch 5, Jakhla Village to Kakrapar Weir

Class	Chainage		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)
3	100	112.303	0.0	8.3	12.200	1205629.87	-0.3	3.0	12.303	1441174.76
4	100	112.303	0.0	8.3	12.200	1490650.69	-0.3	3.0	12.303	1752583.58
5	100	112.303	0.0	8.3	12.20	2236079.03	-0.3	3.0	12.303	2605739.31

This stretch (Ch. 100.00 to 112.303 km) starts from Jakhla Village and end at Kakrapar Weir. This stretch of river is Non-Tidal. Navigation is not possible in whole stretch in present condition. Width of river varies from 250 to1300m. Bathymetry survey was not done due to Dry River/Shallow water Depth/Rock outcrops in this stretch of the river. Only Topographic survey was done for this stretch of river. Current meter measurement was not done due to shallow water/ small packet of water present/pond in river. Banks are mainly naturally protected. 2 nos. of bridge crossing was present in this stretch of River, given in Table- 3. Main villages in this stretch are Mandvi, Tarasada, Rajvad and Vankla. Land is generally used for Agriculture. Sugarcane and Wheat are main cropsnear to this stretch. There was no Irrigational water lift tank present to this stretch of river. This stretch of river is well connected via road to national highway at Vyara. Photographs of field observation and cross structure are available in **Annexure-13 of Volume IIIA (Hydrographic Survey Report).**There is no Railway station in vicinity of this stretch. River bed is mainly rocky.

Figure 2.23 – Ch. 102.63 Km Mandvi Bridge

Figure 2.24 – Ch.104.0 Km Damaged Bridge

2.5.6 Kakrapar Weir to Ukai Dam Axis (Ch. 112.303 km – 137.311km)

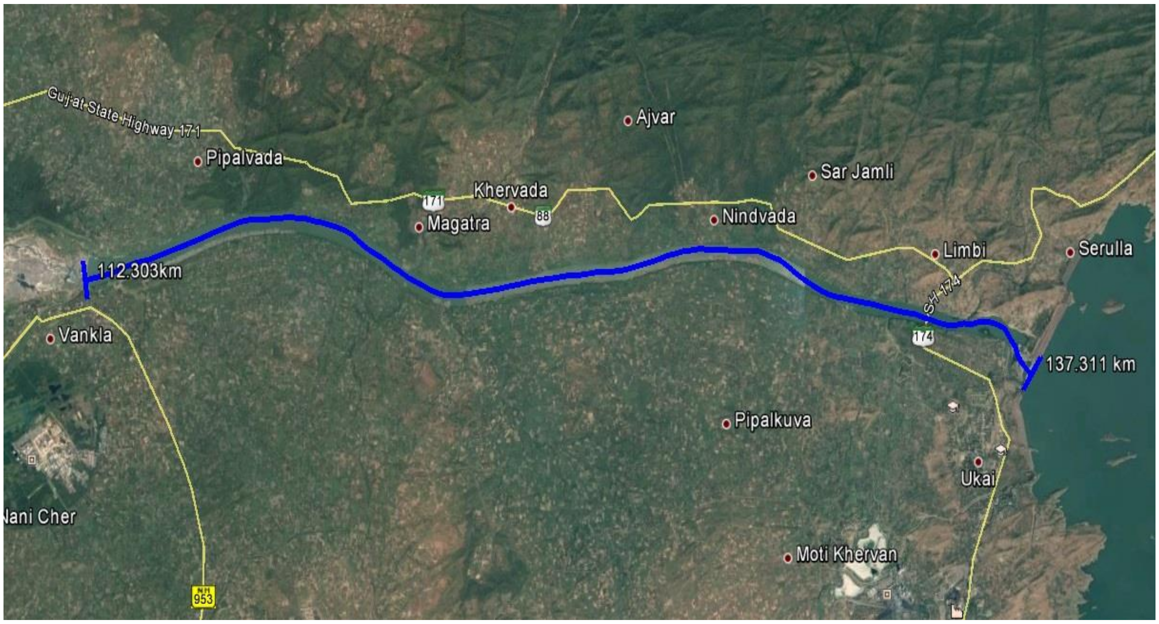


Figure 2.25 – Kakrapar Weir to Ukai Dam Axis

Table 2.12 – Dredging Quantity for Stretch 6, Kakrapar Weir to Ukai Dam Axis

Class	Chainage		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)
3	112.303	137.311	0.0	32.6	0.400	89413.74	-0.17	28.60	1.2	84070.01
4	112.303	137.311	0.0	32.6	0.800	71996.04	-0.3	28.60	0.8	50196.20
5	112.303	137.311	0.0	32.6	1.00	107995.03	-0.3	28.60	1.8	77375.49

This stretch (Ch.112.303 to 137.31 km) starts from Kakrapar Weir and ends at downstream of Ukai Dam axis. At the start of this stretch, Kakrapar weir is located. This Weir is used for supply water to Irrigation and Drinking Purpose. This stretch of river is Non-Tidal. Navigation is possible in whole stretch in present condition. Bathymetry survey was done for whole length of this stretch. Navigation is possible in whole stretch and horizontal and vertical clearance of Bridges is quite suitable. Width of the river varies from 350 to 400m and depths observed are 4 m to 11m of deepest channel of the river. Whole area falls under Kakrapar wear reservoir. Water current is quite low. Discharges are high in monsoon season and low in lean period. Banks are mainly unprotected. Total 3 road Bridges crossing the river in this stretch as given in Table- 3.

Main villages in this stretch are Balanga, Mahudi, Magatra, Khervada, Bhatwada, Nindwada, BoriSavar and Limbi. Land is generally used for Agriculture purpose. Main crops are Sugarcane and wheat. This stretch of river is well connected via road. Photographs of field observation and cross structure are available in **Annexure-13 of Volume IIIA (Hydrographic Survey Report).** Songarh railway station is in vicinity of this stretch. Full availability Bulk/Construction material as Sand extraction was present in this whole stretch of river. Passengers ferry service not available. Fishing of fresh water is available on small scale. 2 canals originate from Kakrapar Weir, one from left bank and second are from right bank. Water is fresh and used for drinking, Irrigation and industries purpose. One nuclear power plant is also located near Kakrapar Weir. Right side canal is used for water requirement of this plant.

Figure 2.26 – Ch. 112.303 Km Kakrapar Weir

Figure 2.27 – Ch. 112.303 Km Kakrapar Weir with Canal on both bank of River

Figure 2.28 – Sand Extraction from River

Figure 2.29 – Ch. 134.168 km Hindustan Bridge

Figure 2.30 – Ch. 136.935 km Ukai Dam Canal Bridge

2.5.7 Ukai Dam Axis to Vadgam Village (Ch. 137.311 km – 174.587 km)

Figure 2.31 – Ukai Dam Axis to Vadgam Village

Table 2.13– Dredging Quantity for Stretch 7, Ukai Dam Axis to Vadgam Village

Class	Observed						Reduced w.r.t. Sounding Datum			
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)
3	137.311	174.587	11.2	32.8	0.000	0.00	-0.3	32.50	**4.0**	**336894.40**
4	137.311	174.587	11.2	32.8	0.00	0.00	-0.3	32.50	4.0	413065.00
5	137.311	174.587	11.2	32.8	0.00	0.00	-0.3	32.50	4.2	620518.75

This stretch (Ch. 137.31 to 174.587 km) starts from Ukai Dam axis and ends at Vadgam village. At the start of this stretch, Ukai Dam axis is located. This Dam is used for Electricity generation as well as Irrigation purpose and drinking purpose. This stretch of river is Non-Tidal. Navigation is possible in whole stretch in present condition. Bathymetry survey was done for whole length of this stretch. Ukai Reservoir is present in whole length of river. Depths observed are 11 m to 32 m of deepest channel of river. No water current is present. Discharges are high in monsoon season and low in lean period. Banks are mainly unprotected and high rise/ hilly. There is no Bridge is available in this stretch of River. Main villages in this stretch are Ukai, Ucchal and Tokrva. Land is generally used for Agriculture purpose. Main crops are Sugarcane and wheat. This stretch of river is well connected via road. Photographs of field observation and cross structure are available in **Annexure-13 of Volume IIIA (Hydrographic Survey Report).** Songarh railway station is in the vicinity of this stretch. Fishing of fresh water is available on small scale. Water is fresh and used for drinking, Irrigation and industries purpose.

Figure 2.32 – Ch. 137.311 Km Ukai Dam with side canal

2.6 Water and Soil Samples analysis and Results

2.6.1 Water Samples analysis and Results

Water samples were collected from the following locations during the hydrographic survey of the Tapi River and tabulated as under:

Sample No.	Chainage (km)	Latitude	Longitude	Total Depth (d) (m)	Mid-Depth (0.5d) (m)
1	174.531	21°24' 36.76"N	73°49' 8.73"E	11.27	5.64
2	164.177	21°21' 2.77"N	73°47' 8.22"E	21.64	10.82
3	151.236	21°15' 44.06"N	73°42'20.03"E	29.37	14.69
4	141.450	21°14' 29.81"N	73°37'48.53"E	32.2	16.10
5	137.649	21°14' 59.22"N	73°35' 0.68"E	32.44	16.22
6	132.343	21°15' 50.13"N	73°32' 6.04"E	78.31	39.16
7	122.452	21°15' 55.19"N	73°27' 4.49"E	12.25	6.13
8	112.617	21°16' 5.39"N	73°22' 2.66"E	6.37	3.19
9	101.266	21°15' 9.71"N	73°16' 33.90"E	0.50	0.25
10	92.976	21°13' 12.55"N	73°12' 20.25"E	0.80	0.40
11	81.570	21°16' 9.61"N	73°7' 11.58"E	0.50	0.25
12	70.088	21°18' 0.28"N	73°1' 13.13"E	5.83	2.92
13	59.391	21°17' 0.60"N	72°57' 7.86"E	9.26	4.63
14	44.279	21°14' 6.46"N	72°50' 6.06"E	6.97	3.49
15	34.717	21°13' 7.91"N	72°48' 11.7"E	4.72	2.36
16	23.712	21°9' 26.03"N	72°45' 3.91"E	5.11	2.56

Sample No.	Chainage (km)	Latitude	Longitude	Total Depth (d) (m)	Mid-Depth (0.5d) (m)
17	12.180	21°8' 48.85"N	72°39' 4.97"E	6.68	3.34
18	5.722	21°5' 21.07"N	72°39' 8.80"E	13.60	6.8

Analysis and results of water samples are as follows:

BIRASINI TEST HOUSE

Govt. Approved / NABL-ISO 9001 : 2015 Certified Laboratory

AN ISO 9001 - 2015

TEST REPORT

Issued To,
M/s TOJO VIKAS INTERNATIONAL (P) LTD
1st Floor 4, Adchini, Mehrauli Road,
New Delhi - 110017

Report No.	100-08022017-06-23
Report Date	17/02/2017
Sample Received On	08/02/2017
Analysis Date	08/02/2017
Report Prepared On	17/02/2017
Submitted By	Customer

Sample Description : Water
Sample ID : WS 1 To WS 18
Work Order No. : WAP/P&H/H3006/IWAIC8-II/2016-17/DSHM/TAPI/01
Subject : Detailed Survey (Hydrographic Survey and Hydraulic Measurement) in National Waterways (Tapi River) in the state of Gujarat & Maharashtra

Page No.1/3

S. NO.	PARAMETER	RESULT		
		Report No.-06	Report No.-07	Report No.-08
		Sample ID: WS 1	Sample ID: WS 2	Sample ID: WS 3
1.	Sediments Constitutes, %	0.018	0.022	0.011
	Total concentration Of Manganese (as Mn), mg/l	0.12	0.14	0.09

Used Protocol: IS: 3025 (Part-59), 2006

S. NO.	PARAMETER	RESULT		
		Report No.-09	Report No.-10	Report No.-11
		Sample ID: WS 4	Sample ID: WS 5	Sample ID: WS 6
1.	Sediments Constitutes, %	0.016	0.010	0.018
	Total concentration Of Manganese (as Mn), mg/l	0.08	0.10	0.04

Used Protocol: IS: 3025 (Part-59), 2006

****

Authorised Signatory
Tech. Manager

Note :
1. The test results listed pertain to the sample tested and applicable parameters.
2. Total liability of this lab is limited to Invoice amount
3. Any discrepancy found in the test report may be communicated with in seven days from the date of issue to Test Report.
4. Remanants of Sample tested may be collected within 15 days from the date of issue of te
e test report should not be produced as an evidence for any legal purpose without the prior permission of the director, BTH.

Laboratory Office: 20/6/5, Site- IV, Sahibabad Industrial Area, Ghaziabad - 201010 U.P.
E-mail : birasinitesthouse@gmail.com, Website : www.birasinitesthouse.in
Ph:- 0120- 4541358, 8377986617, 8377986619
Govt. Approved / NABL-ISO 9001 : 2015 Certified Laboratory

BIRASINI TEST HOUSE

Govt. Approved / NABL-ISO 9001 : 2015 Certified Laboratory

AN ISO 9001 - 2015

TEST REPORT

Issued To,
M/s TOJO VIKAS INTERNATIONAL (P) LTD
1st Floor 4, Adchini, Mehrauli Road,
New Delhi - 110017

Report No. 100-08022017-06-23
Report Date 17/02/2017
Sample Received On 08/02/2017
Analysis Date 08/02/2017
Report Prepared On 17/02/2017
Submitted By Customer

Sample Description : Water
Sample ID : WS 1 To WS 18
Work Order No. : WAP/P&H/H3006/IWAIC8-II/2016-17/DSHM/TAPI/01
Subject : Detailed Survey (Hydrographic Survey and Hydraulic Measurement) in National Waterways (Tapi River) in the state of Gujarat & Maharashtra

Page No.2/3

S. NO.	PARAMETER	RESULT		
		Report No.-12	Report No.-13	Report No.-14
		Sample ID: WS 7	Sample ID: WS 8	Sample ID: WS 9
2.	Sediments Constitutes, %	0.012	0.015	0.017
	Total concentration Of Manganese (as Mn), mg/l	0.07	0.05	0.08

Used Protocol: IS: 3025 (Part-59), 2006

S. NO.	PARAMETER	RESULT		
		Report No.-15	Report No.-16	Report No.-17
		Sample ID: WS 10	Sample ID: WS 11	Sample ID: WS 12
2.	Sediments Constitutes, %	0.017	0.014	0.018
	Total concentration Of Manganese (as Mn), mg/l	0.10	0.05	0.06

Used Protocol: IS: 3025 (Part-59), 2006

****

BIRASINI TEST HOUSE
Tech.

Authorised Signatory

Note : *1. The test results listed pertain to the sample tested and applicable parameters.*
2. Total liability of this lab is limited to Invoice amount
3. Any discrepancy found in the test report may be communicated with in seven days from the date of issue to Test Report.
4. Remanants of Sample tested may be collected within 15 days from the date of issue of te
e test report should not be produced as an evidence for any legal purpose without the prior permission of the director, BTH.

Laboratory Office: 20/6/5, Site- IV, Sahibabad Industrial Area, Ghaziabad - 201010 U.P.
E-mail : birasinitesthouse@gmail.com, Website : www.birasinitesthouse.in
Ph:- 0120- 4541358, 8377986617, 8377986619
Govt. Approved / NABL-ISO 9001 : 2015 Certified Laboratory

BIRASINI TEST HOUSE

Govt. Approved / NABL-ISO 9001 : 2015 Certified Laboratory

AN ISO 9001 - 2015

TEST REPORT

Issued To,		**Report No.**	100-08022017-06-23
M/s TOJO VIKAS INTERNATIONAL (P) LTD		**Report Date**	17/02/2017
1st Floor 4, Adchini, Mehrauli Road,		**Sample Received On**	08/02/2017
New Delhi - 110017		**Analysis Date**	08/02/2017
		Report Prepared On	17/02/2017
		Submitted By	Customer

Sample Description : Water

Sample ID : WS 1 To WS 18

Work Order No. : WAP/P&H/H3006/IWAIC8-II/2016-17/DSHM/TAPI/01

Subject : Detailed Survey (Hydrographic Survey and Hydraulic Measurement) in National Waterways (Tapi River) in the state of Gujarat & Maharashtra

Page No.3/3

S. NO.	PARAMETER	RESULT		
		Report No.-18	Report No.-19	Report No.-20
		Sample ID: WS 13	Sample ID: WS 14	Sample ID: WS 15
3.	Sediments Constitutes, %	0.95	0.013	0.68
	Total concentration Of Manganese (as Mn), mg/l	0.22	0.07	0.16

Used Protocol: IS: 3025 (Part-59), 2006

S. NO.	PARAMETER	RESULT		
		Report No.-21	Report No.-22	Report No.-23
		Sample ID: WS 16	Sample ID: WS 17	Sample ID: WS 18
3.	Sediments Constitutes, %	0.95	1.75	0.11
	Total concentration Of Manganese (as Mn), mg/l	0.21	0.27	0.04

Used Protocol: IS: 3025 (Part-59), 2006

END OF REPORT

Authorised Signatory

Note : 1. The test results listed pertain to the sample tested and applicable parameters.
2. Total liability of this lab is limited to Invoice amount
3. Any discrepancy found in the test report may be communicated with in seven days from the date of issue to Test Report.
4. Remanants of Sample tested may be collected within 15 days from the date of issue of te
e test report should not be produced as an evidence for any legal purpose without the prior permission of the director, BTH.

Laboratory Office: 20/6/5, Site- IV, Sahibabad Industrial Area, Ghaziabad - 201010 U.P.
E-mail : birasinitesthouse@gmail.com, Website : www.birasinitesthouse.in
Ph:- 0120- 4541358, 8377986617, 8377986619
Govt. Approved / NABL-ISO 9001 : 2015 Certified Laboratory

2.6.2 Soil Samples analysis and Results

River bed soil sampling was undertaken using Vanveen Grab at respective locations. Details of sample locations are as below:-

Sample No.	Chainage (km)	Latitude	Longitude	Depth (m)
1	174.531	21°24' 36.76"N	73°49' 8.73"E	11.27
2	164.177	21°21' 2.77"N	73°47' 8.22"E	21.64
3	151.236	21°15' 44.06"N	73°42'20.03"E	29.37
4	141.450	21°14' 29.81"N	73°37'48.53"E	32.2
5	137.649	21°14' 59.22"N	73°35' 0.68"E	32.44
6	132.343	21°15' 50.13"N	73°32' 6.04"E	78.31
7	122.452	21°15' 55.19"N	73°27' 4.49"E	12.25
8	112.617	21°16' 5.39"N	73°22' 2.66"E	6.37
9	101.266	21°15' 9.71"N	73°16' 33.90"E	0.50
10	92.976	21°13' 12.55"N	73°12' 20.25"E	0.80
11	81.570	21°16' 9.61"N	73°7' 11.58"E	0.50
12	70.088	21°18' 0.28"N	73°1' 13.13"E	5.83
13	59.391	21°17' 0.60"N	72°57' 7.86"E	9.26
14	44.279	21°14' 6.46"N	72°50' 6.06"E	6.97
15	34.717	21°13' 7.91"N	72°48' 11.7"E	4.72
16	23.712	21°9' 26.03"N	72°45' 3.91"E	5.11
17	12.180	21°8' 48.85"N	72°39' 4.97"E	6.68
18	5.722	21°5' 21.07"N	72°39' 8.80"E	13.60

RESULTS: Soil sample test results show that river bed material is mainly composed of silt and Test Report is given below:

BIRASINI TEST HOUSE

Govt. Approved / NABL-ISO 9001 : 2015 Certified Laboratory

AN ISO 9001 - 2015

TEST REPORT

Issued To,
M/s TOJO VIKAS INTERNATIONAL (P) LTD
1st Floor 4, Adchini, Mehrauli Road,
New Delhi - 110017

Report No.	100-08022017-04-21
Report Date	17/02/2017
Sample Received On	08/02/2017
Analysis Date	08/02/2017
Report Prepared On	17/02/2017
Submitted By	Customer

Sample Description : Silt
Sample ID : SS 1 To SS 18
Work Order No. : WAP/P&H/H3006/IWAIC8-II/2016-17/DSHM/TAPI/01
Subject : Detailed Survey (Hydrographic Survey and Hydraulic Measurement) in National Waterways (Tapi River) in the state of Gujarat & Maharashtra

Page No.1/6

S No.	PARAMETERS	RESULT		
1	**Grain Size Analysis**	Report No.-04	Report No.-05	Report No.-06
	Sieve size , % Passing	Sample ID: SS 1	Sample ID: SS 2	Sample ID: SS 3
	4.75 mm	100	100	100
	2.00 mm	100	100	99.2
	0.425 mm	83.8	84.2	79.2
	0.075 mm	72.9	71.5	69.4
(i)	Gravel %	0	0	0
(ii)	Sand size particles, %	22.4	28.5	30.6
(iii)	Fine size particles, %	77.6	71.5	69.4
	(a) Silt Size particles, %	61.4	56.3	61.2
	(b) Clay Size particles, %	16.2	15.2	8.2
2	Coefficient of uniformity, *Cu	22.7	18.7	14.3
3	Coefficient of curvature, *Cc	1.19	1.3	1.8
4	Specific gravity, g/cc	2.582	2.57	2.59
5	Ph Value	6.98	6.79	6.86

*Cu= D60/D10, *Cc= $(D30)^2/(D10 \times D60)$

Used Protocol: IS: 2720 (Part-4), IS: 2720 (Part-3), IS: 2720 (Part-26), IS: 1489

****

Authorised Signatory

Note :
1. The test results listed pertain to the sample tested and applicable parameters.
2. Total liability of this lab is limited to Invoice amount
3. Any discrepancy found in the test report may be communicated with in seven days from the date of issue to Test Report.
4. Remanants of Sample tested may be collected within 15 days from the date of issue of te
e test report should not be produced as an evidence for any legal purpose without the prior permission of the director, BTH.

Laboratory Office: 20/6/5, Site- IV, Sahibabad Industrial Area, Ghaziabad - 201010 U.P.
E-mail : birasinitesthouse@gmail.com, Website : www.birasinitesthouse.in
Ph:- 0120- 4541358, 8377986617, 8377986619
Govt. Approved / NABL-ISO 9001 : 2015 Certified Laboratory

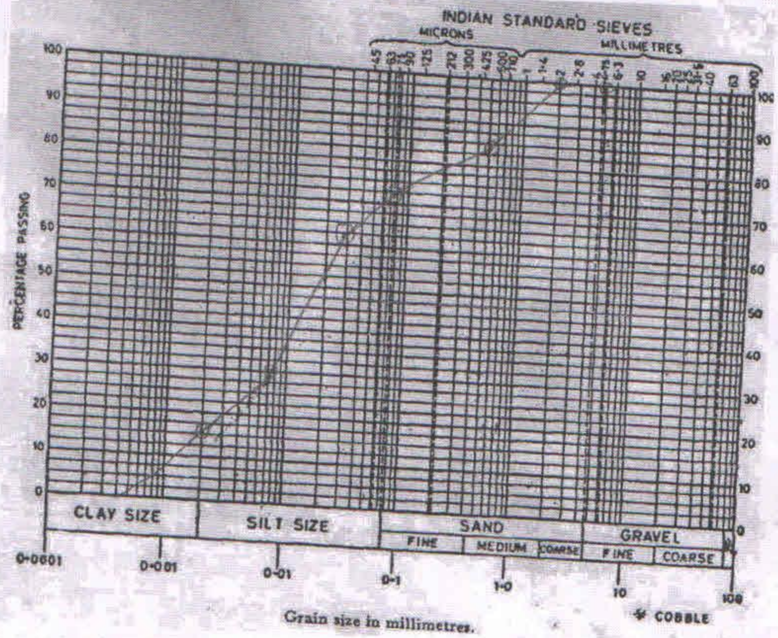
BIRASINI TEST HOUSE

Govt. Approved / NABL-ISO 9001 : 2008 Certified Laboratory

AN ISO 9001 - 2008

Report NO: 100-08022017-04-21

ReportNO - 100 - 08022017-04 Sample: Soil (Tapi River)



Calculation:

$D_{10} = 0.0012$

$D_{60} = 0.0272$

$D_{30} = 0.00622$

$C_u = \frac{0.0272}{0.0012} = 22.7$

$C_c = (0.00622)^2 / (0.0012 \times 0.0272) = 1.19$

Laboratory Office: 20/6/5, Site- IV, Sahibabad Industrial Area, Ghaziabad - 201010 U.P.
E-mail : birasinitesthouse@gmail.com, Website : www.birasinitesthouse.in
Mob.: 8377986617, 8377986619
Govt. Approved / NABL-ISO 9001 : 2008 Certified Laboratory

BIRASINI TEST HOUSE

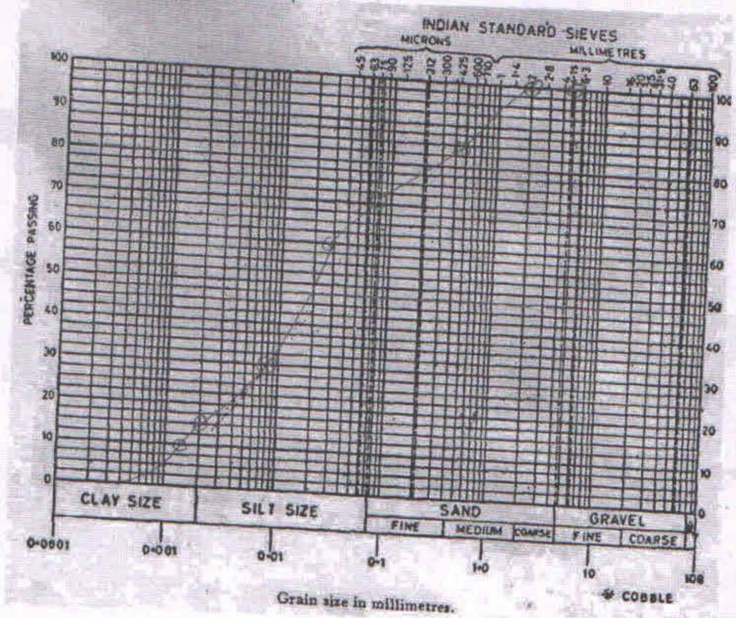
Govt. Approved / NABL-ISO 9001 : 2008 Certified Laboratory

AN ISO 9001 - 2008

Report NO: 100-08022017-04-21

Report no: 100 – 08022017 – 05

Sample Soil (Tapi River)



$D_{10} = 0.0015$

$D_{60} = 0.02805$

$D_{30} = 0.00739$

$$C_u = \frac{0.02805}{0.0015} = 18.7$$

$$C_c = \frac{(0.00739)^2}{(0.02805 \times 0.0015)} = 1.30$$

Laboratory Office: 20/6/5, Site- IV, Sahibabad Industrial Area, Ghaziabad - 201010 U.P.
E-mail : birasinitesthouse@gmail.com, Website : www.birasinitesthouse.in
Mob.: 8377986617, 8377986619
Govt. Approved / NABL-ISO 9001 : 2008 Certified Laboratory

BIRASINI TEST HOUSE DELHI-NCR NATIONAL LABORATORY

BIRASINI TEST HOUSE

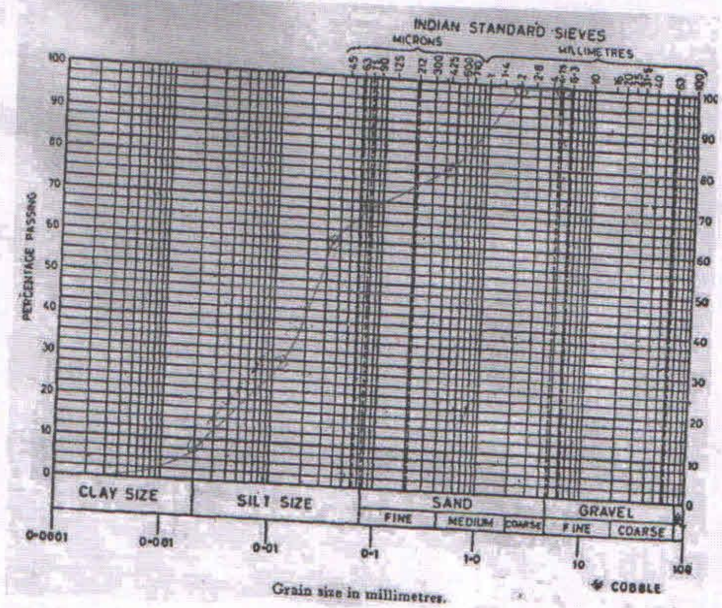
Govt. Approved / NABL-ISO 9001 : 2008 Certified Laboratory

AN ISO 9001 - 2008 PSA CERT Certificate No. CQ-1917 QMS ACCREDITED

Report NO: 100-08022017-04-21

Report No - 100-08022017-06

Sample: Soil (Tapi River)



$D_{10} = 0.00245$

$D_{60} = 0.0350$

$D_{30} = 0.0124$

$$C_u = \frac{0.0350}{0.00245} = 14.3$$

$$C_c = \frac{(0.0124)^2}{0.00245 \times 0.0350} = 1.79$$

Laboratory Office: 20/6/5, Site- IV, Sahibabad Industrial Area, Ghaziabad - 201010 U.P.
E-mail : birasinitesthouse@gmail.com, Website : www.birasinitesthouse.in
Mob.: 8377986617, 8377986619
Govt. Approved / NABL-ISO 9001 : 2008 Certified Laboratory

BIRASINI TEST HOUSE

Govt. Approved / NABL-ISO 9001 : 2015 Certified Laboratory

AN ISO 9001 - 2015

TEST REPORT

Issued To,
M/s TOJO VIKAS INTERNATIONAL (P) LTD
1st Floor 4, Adchini, Mehrauli Road,
New Delhi - 110017

Report No.	100-08022017-04-21
Report Date	17/02/2017
Sample Received On	08/02/2017
Analysis Date	08/02/2017
Report Prepared On	17/02/2017
Submitted By	Customer

Sample Description : Silt
Sample ID : SS1 To SS18
Work Order No. : WAP/P&H/H3006/IWAIC8-II/2016-17/DSHM/TAPI/01
Subject : Detailed Survey (Hydrographic Survey and Hydraulic Measurement) in National Waterways (Tapi River) in the state of Gujarat & Maharashtra

Page No.2/6

S No.	PARAMETERS	RESULT		
1	**Grain Size Analysis**	Report No.-07	Report No.-08	Report No.-09
	Sieve size , % Passing	Sample ID: SS 4	Sample ID: SS 5	Sample ID: SS 6
	4.75 mm	100	100	97.8
	2.00 mm	100	100	92.6
	0.425 mm	87.6	87.8	78.8
	0.075 mm	69.6	68.1	69.4
(i)	Gravel %	0	0	0
(ii)	Sand size particles, %	30.4	31.9	30.6
(iii)	Fine size particles, %	69.6	68.1	69.4
	(a) Silt Size particles, %	60.0	57.5	61.6
	(b) Clay Size particles, %	9.6	10.6	7.8
2.	Coefficient of uniformity, *Cu	24.2	16.2	22.5
3	Coefficient of curvature, *Cc	1.03	1.54	1.87
4	Specific gravity, g/cc	2.588	2.58	2.598
5	Ph Value	6.84	6.84	6.89

*Cu= D60/D10, *Cc= $(D30)^2/(D10\times D60)$

Used Protocol: IS: 2720 (Part-4), IS: 2720 (Part-3), IS: 2720 (Part-26), IS: 1489

****

BIRASINI TEST HOUSE
Tech. Manager
Authorised Signatory

Note : 1. The test results listed pertain to the sample tested and applicable parameters.
2. Total liability of this lab is limited to Invoice amount
3. Any discrepancy found in the test report may be communicated with in seven days from the date of issue to Test Report.
4. Remanants of Sample tested may be collected within 15 days from the date of issue of te
e test report should not be produced as an evidence for any legal purpose without the prior permission of the director, BTH.

Laboratory Office: 20/6/5, Site- IV, Sahibabad Industrial Area, Ghaziabad - 201010 U.P.
E-mail : birasinitesthouse@gmail.com, Website : www.birasinitesthouse.in
Ph:- 0120- 4541358, 8377986617, 8377986619
Govt. Approved / NABL-ISO 9001 : 2015 Certified Laboratory

BIRASINI TEST HOUSE

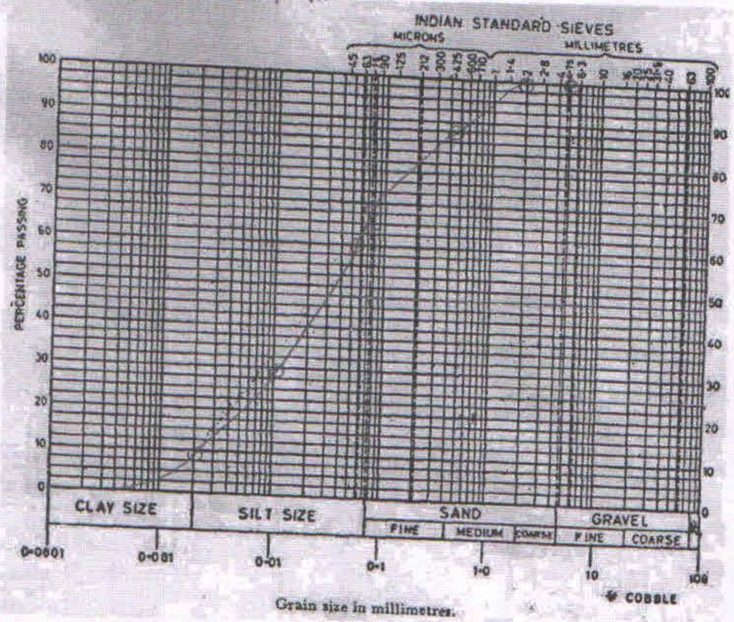
Govt. Approved / NABL-ISO 9001 : 2008 Certified Laboratory

AN ISO 9001 - 2008

Report NO: 100-08022017-04-21

Report NO - 100 - 08022017 - 07

Sample Soil (Tapi River)



$D_{10} = 0.0022$

$D_{60} = 0.0532$

$D_{30} = 0.01098$

$$C_u = \frac{0.0532}{0.0022} = 24.2$$

$$C_c = \frac{(0.01098)^2}{0.0022 \times 0.0532} = 1.03$$

Laboratory Office: 20/6/5, Site- IV, Sahibabad Industrial Area, Ghaziabad - 201010 U.P.
E-mail : birasinitesthouse@gmail.com, Website : www.birasinitesthouse.in
Mob.: 8377986617, 8377986619
Govt. Approved / NABL-ISO 9001 : 2008 Certified Laboratory

BIRASINI TEST HOUSE

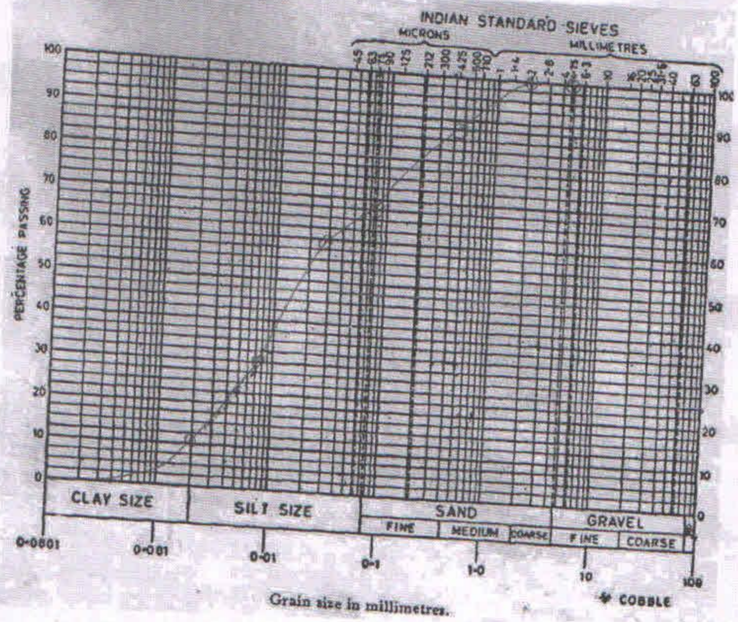
Govt. Approved / NABL-ISO 9001 : 2008 Certified Laboratory

AN ISO 9001 - 2008

Report NO: 100-08022017-04-21

Report NO - 100 - 08022017 - 08

Sample Soil (Tapi River)



$D_{10} = 0.0012$

$D_{60} = 0.0290$

$D_{30} = 0.0073$

$C_u = \dfrac{0.0290}{0.0012} = 16.2$

$C_c = \dfrac{(0.0073)^2}{0.0290 \times 0.0012} = 1.54$

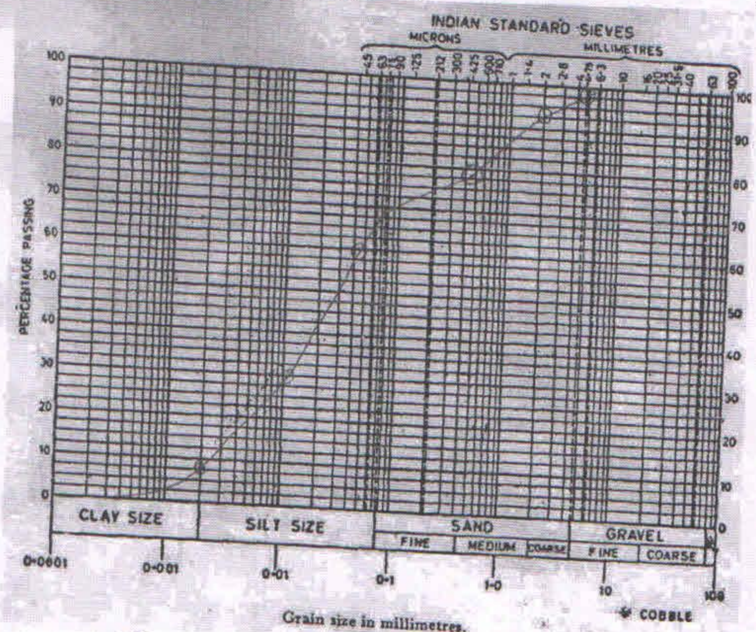
Laboratory Office: 20/6/5, Site- IV, Sahibabad Industrial Area, Ghaziabad - 201010 U.P.
E-mail : birasinitesthouse@gmail.com, Website : www.birasinitesthouse.in
Mob.: 8377986617, 8377986619

Govt. Approved / NABL-ISO 9001 : 2008 Certified Laboratory

Report NO: 100-08022017-04-21

Report no: 100-08022017-09

Sample : Soil (Tapi River)



$D_{10} = 0.002$

$D_{60} = 0.045$

$D_{30} = 0.01299$

$$C_u = \frac{0.045}{0.002} = 22.5$$

$$C_c = \frac{(0.01299)^2}{(0.045 \times 0.002)} = 1.87$$

Laboratory Office: 20/6/5, Site- IV, Sahibabad Industrial Area, Ghaziabad - 201010 U.P.
E-mail : birasinitesthouse@gmail.com, Website : www.birasinitesthouse.in
Mob.: 8377986617, 8377986619

BIRASINI TEST HOUSE

Govt. Approved / NABL-ISO 9001 : 2015 Certified Laboratory

AN ISO 9001 - 2015

TEST REPORT

Issued To,
M/s TOJO VIKAS INTERNATIONAL (P) LTD
1st Floor 4, Adchini, Mehrauli Road,
New Delhi - 110017

Report No.	100-08022017-04-21
Report Date	17/02/2017
Sample Received On	08/02/2017
Analysis Date	08/02/2017
Report Prepared On	17/02/2017
Submitted By	Customer

Sample Description : Silt
Sample ID : SS1 To SS18
Work Order No. : WAP/P&H/H3006/IWAIC8-II/2016-17/DSHM/TAPI/01
Subject : Detailed Survey (Hydrographic Survey and Hydraulic Measurement) in National Waterways (Tapi River) in the state of Gujarat & Maharashtra

Page No.3/6

S No.	PARAMETERS	RESULT		
1	**Grain Size Analysis**	Report No.-10	Report No.-11	Report No.-12
	Sieve size , % Passing	Sample ID: SS 7	Sample ID: SS 8	Sample ID: SS 9
	4.75 mm	91.8	96.8	96.4
	2.00 mm	86.7	94.7	92.1
	0.425 mm	80.6	80.2	82.5
	0.075 mm	67.8	69.7	71.2
(i)	Gravel %	0	0	0
(ii)	Sand size particles, %	32.2	30.3	28.8
(iii)	Fine size particles, %	67.8	69.7	71.2
	(a) Silt Size particles, %	62.0	63.8	62.2
	(b) Clay Size particles, %	5.8	5.9	9.0
2	Coefficient of uniformity, *Cu	22.7	22.0	23.6
3	Coefficient of curvature, *Cc	2.10	1.64	2.07
4	Specific gravity, g/cc	2.60	2.598	2.59
5	Ph Value	6.79	6.83	6.86

*Cu= D60/D10, *Cc= $(D30)^2$/ (D10×D60)

Used Protocol: IS: 2720 (Part-4), IS: 2720 (Part-3), IS: 2720 (Part-26), IS: 1489

****

BIRASINI TEST HOUSE
Tech. Manager
Authorised Signatory

Note :
1. The test results listed pertain to the sample tested and applicable parameters.
2. Total liability of this lab is limited to Invoice amount
3. Any discrepancy found in the test report may be communicated with in seven days from the date of issue to Test Report.
4. Remanants of Sample tested may be collected within 15 days from the date of issue of te
e test report should not be produced as an evidence for any legal purpose without the prior permission of the director, BTH.

Laboratory Office: 20/6/5, Site- IV, Sahibabad Industrial Area, Ghaziabad - 201010 U.P.
E-mail : birasinitesthouse@gmail.com, Website : www.birasinitesthouse.in
Ph:- 0120- 4541358, 8377986617, 8377986619
Govt. Approved / NABL-ISO 9001 : 2015 Certified Laboratory

CHAPTER – 3

FAIRWAY DEVELOPMENT

3.1 Proposed Class / Type of Waterway

In India, the inland waterways are classified into seven categories for rivers as well as canals by the Inland Waterways Authority of India (IWAI) vide GOI Gazette Notification dated 26 January 2007 & 07 November 2016 including amendments for safe passage of self-propelled vessels up to 2000 dead weight tonnage (DWT) and tug barge formation in push tow units of carrying capacity up to 8000 tonnes.

The classification of waterways is discussed below.

A. *Classification of Inland waterways for Rivers*

Table 3.1: Inland Waterway classification for Rivers

Class of Waterway	Rivers				
	Minimum Depth	Bottom Width	Bend Radius	Vertical Clearance	Horizontal Clearance
I.	1.2 m	30 m	300 m	4 m	30 m
II.	1.4 m	40 m	500 m	5 m	40 m
III.	1.7 m	50 m	700 m	6 m	50 m
IV.	2.0 m	50 m	800 m	8 m	50 m
V.	2.0 m	80 m	800 m	8 m	80 m
VI.	2.75 m	80 m	900 m	10 m	80 m
VII.	2.75 m	100 m	900 m	10 m	100 m

B. *Classification of Inland waterways for Canals*

Table 3.2: Inland Waterway classification for Canals

Class of Waterway	Canals				
	Minimum Depth	Bottom Width	Bend Radius	Vertical Clearance	Horizontal Clearance

Class of Waterway	Canals				
	Minimum Depth	**Bottom Width**	**Bend Radius**	**Vertical Clearance**	**Horizontal Clearance**
I.	1.5 m	20 m	300 m	4 m	20 m
II.	1.8 m	30 m	500 m	5 m	30 m
III.	2.2 m	40 m	700 m	6 m	40 m
IV.	2.5 m	50 m	800 m	8 m	50 m
V.	-	-	-	-	-
VI.	3.50 m	60 m	900 m	10 m	60 m
VII.	-	-	-	-	-

The above classification for Rivers and Canals shall be effective if:

- Minimum depth of channel should be available for about 330 days in a year (about 90% days in a year).
- Vertical clearance at cross structures over the waterway should be available at least in central 75% portion of each of the spans in entire width of the waterway.

C. Vertical Clearance for Power Cables / Telephone Lines for all Classes

- Telephone lines and Low Voltage lines 16.5 m
- High Voltage Transmission lines not exceeding 110 KV – 19 m
- High Voltage Transmission lines exceeding 110 KV – 19 m + 1 cm per each KVIn case of underground pipe / power lines and other cables norms to be decided as per conditions and navigational requirement

D. Reference level for vertical clearance for different types of channels

- For rivers – over navigational HFL which is highest flood level at frequency of 5% in any year over a period of last 20 years
- HTL for tidal channels
- For channels design FSL

E. Type of vessels to be used in different class waterways

Table 3.3: Type of vessels to be used in different class of waterways

Class	Self-propelled vessel	Tug with barges
I.	Self-propelled, carrying capacity 100 DWT, Size (32m X 5m), Loaded draft 1m	1 Tug + 2 barges – 200 DWT, length 80m X breadth 5m , loaded draft 1m
II.	Self-propelled, carrying capacity 300 DWT, Size (45m X 8m), Loaded draft 1.2m	1 Tug + 2 barges – 600 DWT, length 110m X breadth 8m , loaded draft 1.2m
III.	Self-propelled, carrying capacity 500 DWT, Size (58m X 9m), Loaded draft 1.5m	1 Tug + 2 barges – 1000 DWT, length 141m X breadth 9m , loaded draft 1.5m
IV.	Self-propelled, carrying capacity 1000 DWT, Size (70m X 12m), Loaded draft 1.8m	1 Tug + 2 barges – 2000 DWT, length 170m X breadth 12m , loaded draft 1.8m
V.	Self-propelled, carrying capacity 1000 DWT, Size (70m X 12m), Loaded draft 1.8m	1 Tug + 2 barges – 2000 DWT, length 170m X breadth 24m , loaded draft 1.8m (moulded with 24 m)
VI.	Self-propelled, carrying capacity 2000 DWT, Size (86m X 14m), Loaded draft 2.5m	1 Tug + 2 barges – 4000 DWT, length 210m X breadth 14m , loaded draft 2.5m
VII.	Self-propelled, carrying capacity 4000 DWT, Size (86m X 14m), Loaded draft 2.9m	1 Tug + 4 barges – 8000 DWT, length 210m X breadth 28m , loaded draft 2.5m

All structures to be constructed across waterway classified should conform to respective requirement of vertical clearance and horizontal clearance. Before construction of any structure across the national waterway

As per office memorandum IWAI/NW-5/64/Nav. Clearance/2017 dtd.08/12/17, River Tapi is classified as under:-

1) Class -VI from sea (Ch. 0.0) to Magdalla (Ch-21.0 km)
2) Class -IV from Magdalla (Ch-21.0 km) to Singanpore Weir (Ch. 34.7 Km)
3) Class-III from Singanpore Weir (Ch. 34.7 Km) to Hatnur Dam (Ch. 436 Km)

Proposed class of waterway: WAPCOS has studied the possibility of developing waterway, WAPCOS recommend the waterway to be developed as per following class & phases:

Sr.No	Phase	Stretch	Length of Waterway	Class of Waterway
1	Phase-1	Dumas beach jetty to Old Fort Jetty	19Km	-
2	Phase-2	Terminal 3 (KRIBHCO) & Terminal 4 (Ukai Jetty) from Sea Mouth	CH 18 & CH 134 km	Class-IV

However, above mentioned phases are based on current traffic studies. Waterways sector are in developing state, keeping that in view, NW-100 can be matured further as mentioned in the notification IWAI/NW-5/64/Nav. Clearance/2017 dtd.08/12/17.

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

During hydrographic survey of the river stretch it was found that there are number of shoals in Tapi River. Details of these shoals are as follows:

Chainage		Length(km)	Proposed Development Works
From	To		Dredging is required as per proposed class of waterway
0	34.67	19.80	
34.67	50	2	
50	75	7.40	
75	100	23.40	
100	112.36	12.2	

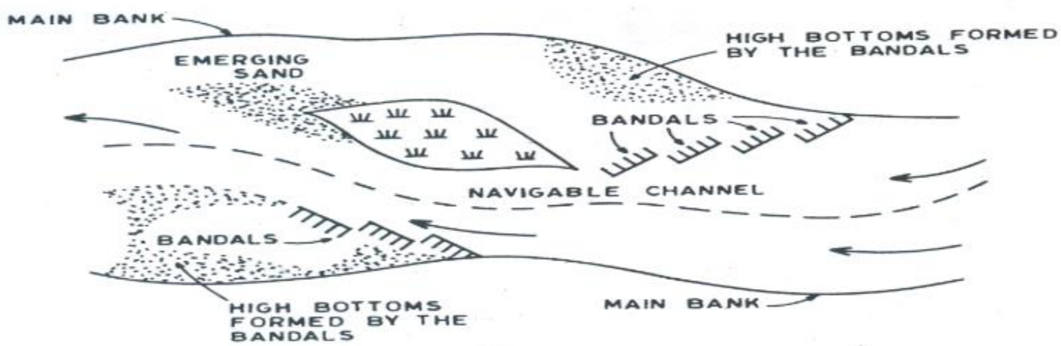
3.3 Conservancy Activities-General

3.3.1 Low Cost structures

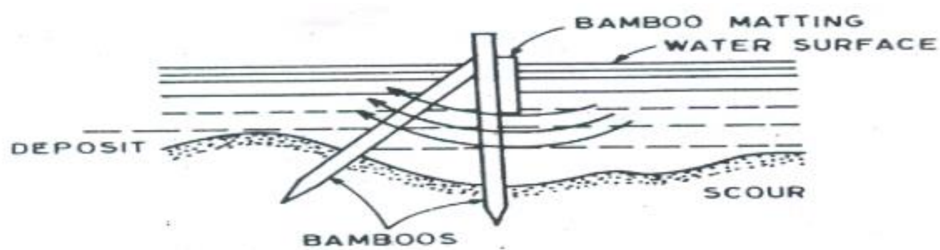
a) Bandalling

Bandals are commonly used low cost structures for improvement of navigation depth in rivers. Bandals are designed to confine the low water flow in a single channel for maintaining required navigation depth. A bandal consist of framework of bamboos driven in to the river bed, set 6m apart by means of horizontal ties and supported by struts at every 1.2 m. Bamboo matting are tied with coir ropes at water levels to the bamboo framework. The bamboo used on the framework are generally 3 to 6m in length and the matting is 0.9m wide strengthened at the edges bye strips of split bamboo.

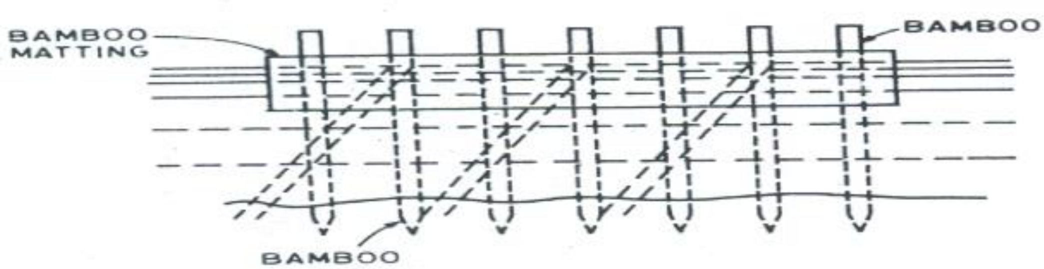
Bandals are placed at an angle of 30^{0} to 40^{0} inclined downstream. They check the flow and cause sand to be deposited parallel to and behind the bandals. Thus a channel confined between bandals is formed with sand banks on either side and the whole discharge of the river is directed through this channel.



LAYOUT PLAN OF BANDALS



SIDE VIEW OF A BANDAL



ELEVATION OF A BANDAL

b) **Sub-merged vanes**

Submerged vanes are frequently used as vortex generating for maintaining depth in navigation channel. The vanes are small flow-training structures designed and installed on the riverbed to modify the near-bed flow pattern and redistribute flow and sediment transport within the channel cross section. The structures are laid out so they create and maintain a flow and bed topography that is consistent with that of a stable channel creating optimum conditions for managing the river.

Significant changes in depth can be achieved without causing significant changes in cross-sectional area, energy slope, roughness and downstream sediment transport. As per literature, number, size and layout of the vanes depend on the channel morphology, velocity and depth at a meander bend. Vanes stabilize a channel reach without inducing changes upstream or downstream of that reach. Vanes may not be visible in time as they become buried by depositing sediment and aid the stream in doing the work by redistributing the flow energy to produce a more uniform cross-section without an appreciable increase in the energy loss through the reach.

The structures are installed at an angle of attack of typically 10^0 to 20^0 with the flow and their initial height is 0.1 to 0.4 times the local water depth at design stage. Typically, vanes are installed in arrays along one side or both sides of a river channel long enough to create a desired flow and bed redistribution. The advantage over traditional training structures, such as dikes and groins is that they can produce a given redistribution of flow at less resistance to the flow and less cost.

.

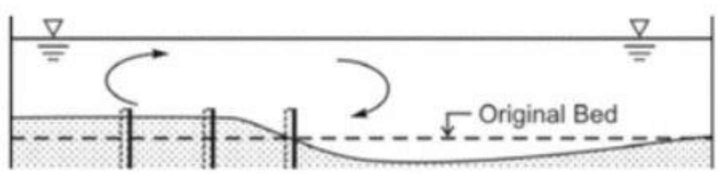


Figure 3.1 Schematic showing changes in bed profile induced by an array of three vanes

3.3.2 Dredging

Among the methods of regulation of rivers for navigation and removal of natural obstructions, dredging is a common remedy. With all training measures it becomes necessary, sometimes to keep the channel open for navigation by resorting to dredging. Natural scour is useful in its own way, but it may not be able maintain depths throughout the year, mainly because the condition in rivers change from season to season. Dredging is a useful auxiliary method, and there are few ports and navigational channels which are maintained without the aid of systematic dredging.

Dredging Plan:

Dredging will be carried out into two phases i.e from Terminal 1(Dumas) to Terminal 2 (Old Fort) in Phase 1 & upto Terminal 4 (Ukai) in Phase-2.

Sr.No.	**Stretch**	**Phase**	**Chainage**	**Length(KM)**
Phase-1	Dumas Jetty- Old Fort Jetty	1	Ch.0 to ch. 31.3	19
Phase-2	Upto Ukai Terminal	Phase-2	Anchorage to Ch.134	134

Based on hydrographic survey report dredging quantities are mentioned below:

Sr.No	**phase**	**Stretch**	**Design Vessel**	**Quantity**
1	Phase-1	Dumas Jetty- Old Fort Jetty	13m X 3.8m X 1.0m	**311990.38 cum**
3	Phase-2	Upto Ukai Terminal	Class-IV	**2000000** cum

For Dredging Self-propelled Cutter Section Dredger (CSD) is recommended to maintain above mentioned stretches for phase-1 & Phase-2.

Below milestone is subjected to the condition that contractor should mobilize all the dredgers, allied vessels, equipments and manpower within 45 days from award.

Dredging Work Milestone for Phase-1 **(**Dumas Jetty- Old Fort Jetty**)**

Milestones	**Milestone Quantity (m^3)**	**Cumulative Quantity (m^3)**	**Milestone Month**	**Cumulative Month**
Jan-mar 19	200000	200000	3	3
Apr-jun 19	111990	311990	1.5	4.5

Sr. No.	Equipment type and characteristics			Minimum number Period
	Equipment	Minimum Capacity	Max. Age (Years)	
1	Cutter Suction Dredger	250 m^3/hr of solids	15 years	2.0
2	Work Boats/Tugs	For towing dredging unit/anchor shifting etc.	15 years	2.0
3	Accommodation Boats (if required)	To accommodate crew and supervisory staff separately (if required)	15 years	2.0
4	Any other vessel	As required	15 years	As required
5	Vessel and equipment for survey works	As required	15 years	As required

Parameters for Dredger, Allied Vessels &Equipment

Approximate Principal dimension and other particulars

The principal dimensions & other particulars as mentioned below are purely indicative

Length overall	:	27 m
Breadth	:	12 m
Depth	:	2.5 m
Maximum draught	:	1.5 m loaded draft with full Bunkers
Trial speed (deep water)	:	8.5 knots (calm water)
Dredge Pump capacity	:	Mixture capacity of 1250 cub. mt/hr at 20% concentration of solid by volume and mixture density of 1.3 t/cub mt and capable of discharging at 500 m distance using floating pipelines and throw of about 80m with side cast facility on either side (5% variation allowed). Discharge coupling at the aft for pumping to be provided.

Fuel Oil Bunker Capacity	:	15 days of operation of the dredger of which 10 days of dredging for 12 hours and 5 days of steaming for 10 hours
Endurance	:	15days
Accommodation	:	For eight persons in 3 cabins, galley, mess cum recreation room, two bio bathrooms cum toilet to be provided Deviation allowed from specified dimensions (length, breadth and depth) in principal particulars shall be+5% &-5%. No deviations allowed for maximum draught and minimum trial speed.

Material to be dredged

As per geotechnical investigations, soil is clayey of high plasticity with fine sand has been observed.

Disposal of dredged material:

A total of 3.1 lakhs m3 of material in phase-1 & 20 lakhs in phase-2 has been calculated as described above. In principle, dredged material is being dumped in 3 ways:

(i) Into the river
(ii) Outside the river
(iii) On the bank of the river

From economical consideration the dredged material is proposed to be dumped in the bank with the provision of dowel/ Parapet wall so that dredged material may not slipped back into the river. Clearance would be taken from the competent authorities before dumping the dredged material.

3.3.3 River Training

River training works are used for bank protection and river regulation for improvement of channel. Training structures generally used for river regulation are as:

Spur and Longitudinal training walls

Spurs are structures constructed transverse to the river flow and extend from the bank in to the river. These structures are known by several names, the most popular being spurs, spur dikes, groynes and transverse dikes and constitute probably the most widely used training works.

The spurs may be either of piles, stones, rock-fill or sand and may be either submersible or non submersible. Spurs are very helpful in constricting a wide river channel for the improvement of depth for navigation

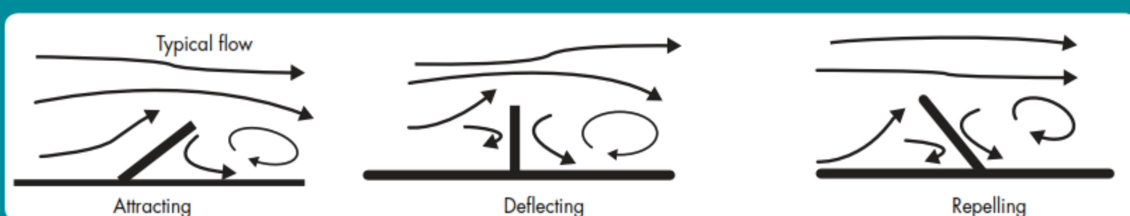
Type of spurs

Attracting spur: These are the spurs which attract flow towards the bank and are aligned in a direction pointing downstream. In a river where there is a heavy attack on one bank, it may be desirable to construct the attracting spurs on the opposite bank in conjunction with a repelling spur on the affected bank

Repelling spur: A spur pointing upstream has the property of repelling the river flow away from it and hence it is termed as repelling spur.

Deflecting spur: Where the spur, usually of short length changes only the direction of flow without repelling it, is known as a deflecting spur and gives only local protection.

Figure 47: Different orientation of spurs



Experience of rivers in many countries shows similarly that groynes facing downstream cause trouble. These groynes endanger adjacent banks, since silting between successive groynes is absent and hence are not recommended. Repelling groynes are usually successful in achieving desired results if they are properly located with due regard to their position in relation to meander length. It is recommended to test them in hydraulic models before adopting them in practice.

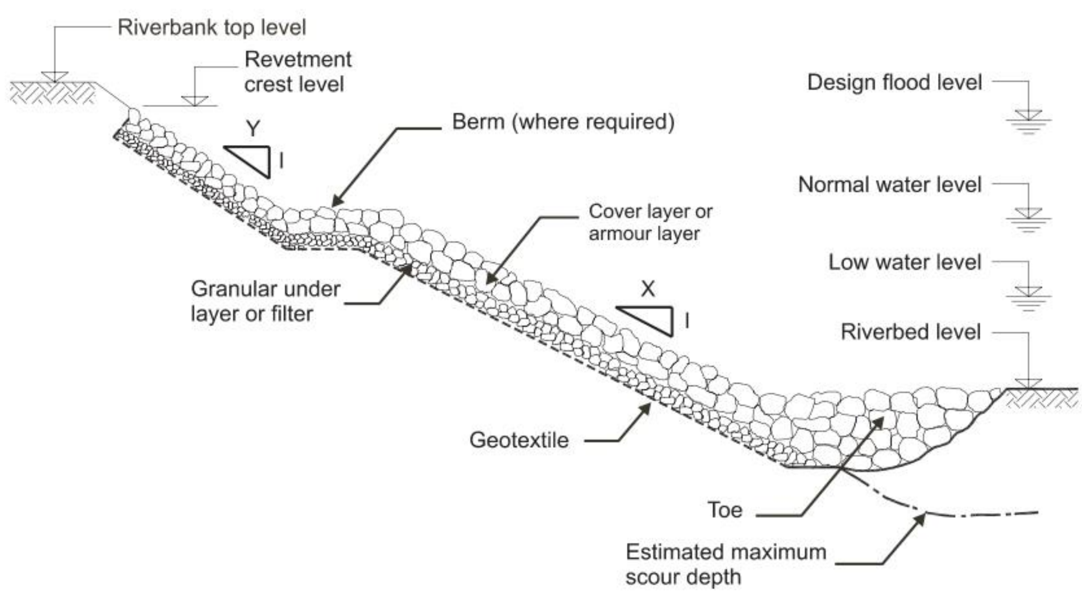
a) Bottom Panels

A new technique improving river channel has been investigated by the Chatou Research and Test Centre of France. Bottom panels are vertical screens wholly immersed and set on the river bed at falling stage when the depth in the channel is about three times the height of panels. They form angle of 100 to 45 with the current diverting the bottom currents out of the navigational channel. The panel are about 25m long and spaced by about two and half times their own length these are left in the river even during floods.

b) Revetment

The most common form of river training structure is the revetment or bank protection. It is composed of a layer of erosion-resistant material that covers the erodible material of the river banks, and sometimes also the bed of the river. Various materials may be used for this purpose, including grouts and geotextiles. The choice of the most suitable material should be made at an early stage in the project. Armour stone can be directly placed onto the bank or bed to be protected.

However, it is generally good practice to place it on an under layer that provides a transition between the coarse armour stone of the cover layer and the fine erodible material of the foundation. The under layer may be made of crushed rock or gravel that prevents subsoil from being eroded through the voids of the protection. Geo-textiles may be used as a part of the filtering system, either with or instead of the granular filter. The under layer reduces both the risk of the foundation material being washed through the armour layer and of the cover layer punching into the subsoil.



c) Retards

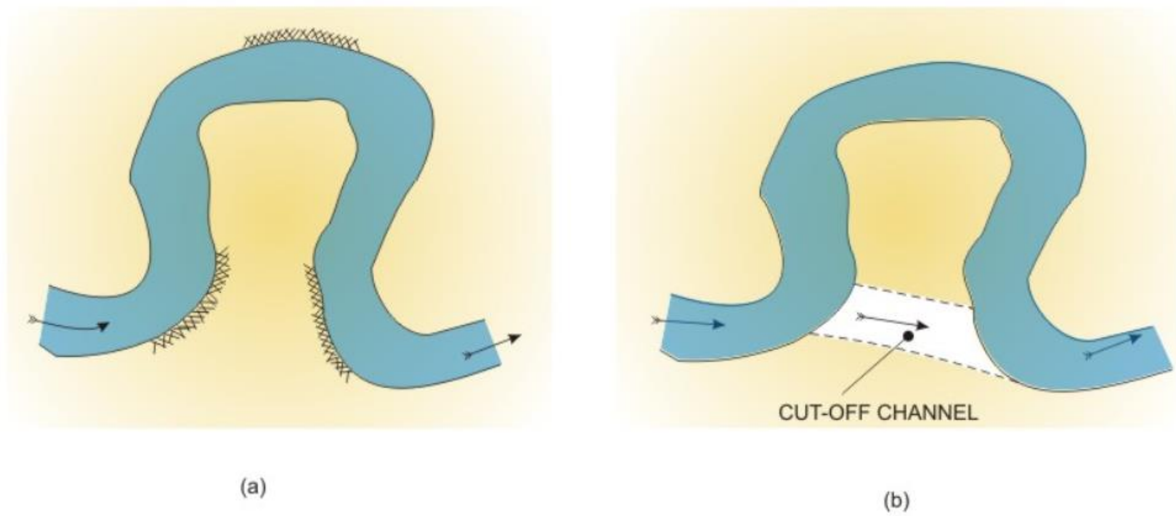
These are the structures constructed spanning a river section. They are used principally to protect eroding concave banks and are constructed by sinking old barges weighted with stones by putting woven wire fence supported on wooden parts or by putting bundles of poles across the river cross section. The structures may be maintained by wires tied to anchors placed upstream. Retarders are lower in cost than spurs and revetment, but are not equally definite in operation. Care in placement and understanding of river behaviour is required for their use.

d) Cut-offs

Cut offs have also been extensively used for improvement of navigation. A cut off is developed by river meandering to acute condition in the form of hair-pin bends. Under favourable condition these bends becomes large loops with narrow necks. The narrowing of the neck reaches a limit when, a break trough occurs and chute channel known as cut-off forms across the neck.

Cut off results in violent changes in river regime. As the river totuosity is decreased the river slope upstream of the cut off steepens and flood levels are lowered. The cut-offs are not enough by themselves. While they correct the instability and in efficiency at sharp bends and loops, where much head is lost by excessive river length, they do little to correct conditions in the reaches between these bend. It becomes necessary therefore to do extensive work between cut offs to improve the alignment width and depth of the channel by supplementary training works. Such works involves two procedures viz., directing the flow and closing of pockets found at unduly wide points of the channel by training groynes of dredged sand fill. Revetment at places, where erosion is likely to take place, should also be provided. The objective is the creation of a uniform river width and establishment where feasible of a central river channel, deep enough to maintain itself by normal scour action.

A typical instance of cut off is shown in fig. below



(a) Meandering river with possible threat of bank erosion(marked as xxxxx)
(b) An engineered cut-off channel

Proposed river training works (stretch wise): River banks are already established in Tapi River hence no river training works for bank protection are required.

3.4. Identification of stretches for bank protection works

During Hydrographic survey no embankment was found damaged. Hence no strengthening of embankment is required on Tapi River wherever the waterway is wide and movement of vessels will not affect the bank, no protection is proposed. The banks in vulnerable region should be inspected after introduction of mechanised vessels and any damaged section should immediately be protected as part of regular maintenance.

3.4.1 Existing Protection works

Stretch No.	Latitude Longitude	Start Chainage	River Bank	Condition	Distance	Remarks
1	21° 3'32.37"N 72°39'34.83"E	02.0km	Right+Bank	protected	10.0km	Bank is protected from chainage 02.0km to 10.0 km upstream. (Left Bank unprotected)
2	21° 7'44.57"N 72°39'42.00"E	12.0km	Left+Right	Protected	15.0km	Bank is Protected from chainage 10.0km to 15.0km upstream. (Left Bank unprotected)

Stretch No.	Latitude Longitude	Start Chainage	River Bank	Condition	Distance	Remarks
3	21°11'50.85"N 72°48'56.40"E	33.0km	Left Bank	protected	35.0km	Bank is protected from chainage 33.0km to 35.0km upstream (Right Bank unprotected)
4	21°13'7.45"N7 2°48'13.51"E	35.0km	Right+Bank	protected	40.0km	Bank is protected from chainage 35.0km to 40.0km upstream
5	21°15'16.03"N 72°48'50.66"E	40.0km	Left+Right	Protected	45.0km	Bank Protected from chainage 40.0km to 45.0km upstream
6	21°16'6.97"N7 3° 7'10.47"E	80.0km	Left+Right	Protected	85.0km	Bank is natural protected from chainage 80.0km to 85.0km upstream
7	21°13'55.19"N 73° 8'55.03"E	85.0km	Left+Right	Protected	90.0km	Bank is natural protected from chainage 85.0km to 90.0km upstream
8	21°13'14.05"N 73°12'17.63"E	90.0km	Left+Right	Protected	95.0km	Bank is natural protected from chainage 90.0km to 95.0km upstream
9	21°15'15.40"N 73°35'15.88"E	134.0km	Left+Right	protected	135.0km	Bank is Protected from chainage 134.0km to 135.0km upstream

3.4.2 Proposed bank protection

On the basis of topographic and hydrographic survey of Tapi River no bank protection is required in such a big river.

3.5 Navigation Marking/ Navigation Aids

The terms Aids to Navigation, Nav-aids and Navigational aids used interchangeably, are all meant to convey marks, including floating marks, such as buoys and beacons, transit and clearing marks as well as signalling systems, radio aids and communications, electronic systems, radar etc. which are installed on land or in water for guidance to all ships for safe and regulated navigation in the channels, anchorages, berths, docks etc. It is envisaged that navigation will be carried out throughout the year, by day and night except during times of high wind speeds and low visibility. For day navigation, channel is demarcated by conventional bamboo marks but when frequency of IWT mode increases it becomes essential to provide night navigation facilities.

Marine Lantern @ 2km C/C is recommended along the river Tapi. Designed aid is on the basis of light intensity, soil condition and wind direction and velocity

General assembly of proposed buoy is shown in Fig. 6.1 (A) & 6.1(B)

RIS (River Information System):

LIST OF EQUIPMENTS:

Base Station

1) AIS Base Station with Hot stand
2) Mono pole tower
3) Porta Cabin 20'X 8'X8'
4) VHF sets with Antenna
5) Leased Line – Wide Area Network
6) Metrological Equipment
7) Gen Set 10 KVA
8) UPS (UPS APC- SRC6KUXI-6KVA
9) BSNL Leased line

Control Station Servers

1) Central RIS Operating Processor
2) Central Monitoring and Storage Processor
3) Web Server & Time Server
4) Workstation
5) Operator Display 52" LED Wide Screen + With operator display
6) RIS Software
7) Installation, testing, Training and commissioning

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

There are total 17 bridges on the River Tapi under proposed waterway including 2 under construction Road Bridge and 1 railway bridge. Vertical clearance above HFL varies -8 to 14 meter.

In Phase-1, small ferries from dumas beach jetty to Old Fort jetty will be deployed.

Therefore, there is no need to demolish or modify any bridges in that stretch.

In Phase-2, for the proposed IV of waterway minimum vertical clearance requirement is 8m. Two no. of road bridges are having vertical clearance more than 8 m required for class IV. Modification of bridges are not practically feasible. Demolition & reconstruction is the only option. 31 nos. of HT lines passes through the proposed waterway. Vertical clearance ranges from 12m to 20m above HFL. As there is sufficient vertical clearance available, there is no need of modification in HT line structures. Weir cum causeway is at Singanpore village, 34.6 km chainage from river mouth. During floods the causeway is submerged and flooded with river flow. A navigational lock will be required at weir cum causeway for passage of vessels. Kakrapar weir and Ukai Dam are at 112.3 km and 137.3 km chainage respectively from river mouth. Provision of navigational lock is suggested at Kakrapar weir through a bypass navigational channel at the right side of the weir.

Details of bridges which require modification/dismantled is mentioned below:

1 Magdalla/ONGC Bridge

Horizontal clearance is available up to class-IV of waterway but Vertical clearance is not available even of Class-I of waterway. It has to be demolished and reconstructed.

2 Sardar Bridge

Horizontal clearance is available up to class-IV of waterway but Vertical clearance is not available even of Class-I of waterway. It has to be demolished and reconstructed.

3 Swami Vivekananda Bridge

This bridge is a low level bridge and it has to be demolished and reconstructed.

4 Nehru Bridge

Horizontal clearance is available up to class-IV of waterway but Vertical clearance is not available even of Class-I of waterway. It has to be demolished and reconstructed.

5 Dabholi Jahangirpura Bridge

This bridge does not comply the requirement of horizontal and vertical clearance for even class-I of waterway. It has to be demolished and reconstructed.

6 Amroli Bridge

Horizontal clearance is available up to class-IV of waterway but Vertical clearance is not available even of Class-I of waterway. It has to be demolished and reconstructed.

7 Railway Bridge

Railway Bridge near Utran constructed in 1915 is 572.3 m in length. The bridge is having a 55m horizontal clearance and 0.75 m vertical clearance above HFL. It has to be demolished and reconstructed.

8 Kapodra-Utran Bridge

Horizontal clearance is available up to class-IV of waterway and Vertical clearance is available for Class-II of waterway. It has to be demolished and reconstructed.

9 SavjiBhai Korat Bridge

This bridge does not comply the requirement of vertical clearance for even class-I of waterway, horizontal clearance is available for up to Class-II of waterway. It should be demolished and reconstructed as modification will require both in horizontal and vertical clearance.

10 Service Road Bridge

Horizontal clearance is available up to class-I of waterway and Vertical clearance is available for Class-III of waterway. It has to be demolished and reconstructed.

11 Kholvad Bridge-1

Horizontal clearance is available up to class-II of waterway and Vertical clearance is available for Class-III of waterway. It has to be demolished and reconstructed.

12 Kholvad Bridge-2

Horizontal clearance is available up to class-II of waterway and Vertical clearance is available for Class-III of waterway. It has to be demolished and reconstructed.

13 Bodhan Flyover

Horizontal clearance is available up to class-II of waterway and Vertical clearance is available for Class-VII of waterway. It has to be demolished and reconstructed.

14 Umarsadi Haripura Bridge

This is a low level RCC bridge connecting Umarsadi and Haripura near Kadod. It has to be demolished and reconstructed.

15 Mandvi Bridge

Horizontal clearance is available up to class-II of waterway and Vertical clearance is available for Class-VII of waterway. It has to be demolished and reconstructed.

3.7 Proposed Dams / Barrages / Locks / Weirs to improve depth

Proposed Barrages (Phase-II)

Two barrages are proposed at CH 77 km & 95 km to maintain the required water depth in downstream stretch of Kakrapar Weir. From bodhan to Kakrapar dry stretches were observed, these barrages will help in retaining the water depth required for vessel movement.

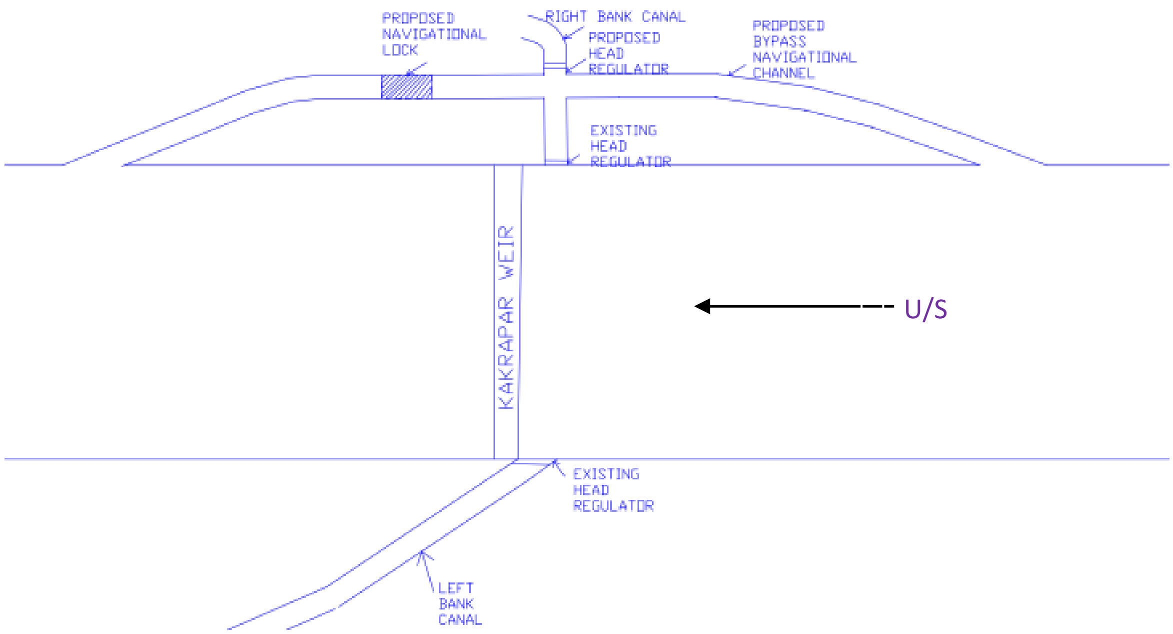
Proposed Navigational Locks (Phase-II)

Navigational Lock will be necessary for navigation in waterway at weir and barrage site. Structures falling under waterway are as follows:

Chainage	Structure
34.6	Weir cum causeway
77.0	Proposed barrage 1
95.0	Proposed barrage 2
112.3	Kakrapar Weir

Navigational lock at Ukai Dam is not required as there is no proposed terminal at upstream of Ukai Dam. Navigational lock will be required only at weir cum causeway and Kakrapar weir and at proposed barrages.

As it is not feasible to construct a navigational lock at across the Kakrapar weir, a bypass navigational channel is proposed at Kakrapar weir. The schematic diagram is as follow:



3.8 Land Acquisition

Navigational channel is within the boundary of river throughout the stretch. Hence land acquisition is not required for fairway development in River Tapi. However, specifically at kakrapar weir land acquisition will be required.

3.9 Implications of Ongoing studies

3.9.1 Location of Barrage-Rubber Barrage

The location of barrage was 10.44 km downstream of Singanpore weir cum causeway and 2.7 km upstream of Magdalla Bridge. The Bay of Khambhat is about 17 km away downstream from the Location of Barrage. The Port Magadalla is about 3.7 km downstream of the Barrage location.

The location of the barrage has been finalized considering studies regarding availability of the storage capacity at different Pond Level. The Pond level has been fixed at EL.5.0 m such that the afflux of the storage water is well within 0.5 m and remains within river channel, defined by embankments on both banks. Also, with Pond Level at EL.5.0 m, the storage of the reservoir will be 16.39 MCM as per studies carried out by WAPCOS.

3.9.2 Purpose of Barrage

During over flow of weir excess water from weir is wasted in to sea in monsoon every year. In the years 2013, 2014 & 2015 overflow was observed on the weir for 93 days, 35 days and 10 days respectively. To utilize this water and create additional storage capacity of reservoir about 10 km downstream of weir cum causeway the SMC had proposed Rubber Balloon Barrage near (FRL 5.0 m) Piplod in addition to overcome the above stated problems.

The main purpose of the barrage is to have the storage reservoir of water to meet the **water supply demand for the Surat city based on the development for the year 2035.** Also, at present, the tidal water from sea reaches near to Singanpore weir location and makes ground water of river bed and surrounding area saline. Due to this barrage, a storage reservoir will form and tidal effect will be moved further downstream of the barrage. Also, **salinity ingress in the river bed will be prevented**. This will also benefit to further **recharge the ground water around** the reservoir.

3.9.3 Salient features of the Rubber Balloon Barrage

1. Storage capacity of reservoir at FRL of +5.0 m 160000 TCM
2. Length of reservoir: - 9.80 Km
3. Average width of reservoir: - 500 m
4. Maximum Depth of reservoir at FRL: - 6.0 m
5. Minimum depth of reservoir at FRL: - 2.0 m

3.9.4 Tentative Cost

Tentative cost of the project is 305 Crores.

3.9.5 Implications on NW-100

Dredging quantity from Singanpore weir to 10km d/s will not be required. Water depths will be improved.

3.9.6 Action to be taken by IWAI

As of now, navigation lock is not proposed in this barrage. IWAI should convey their intentions to SMC for provision of Navigational lock at this stage only.

Other Projects in Pipeline:

Development of DUMAS beach by Dumas Development Authority:

EoI has already been floated for to carryout development of sea face, Entertainment park, leisure tourism, laser show, food joint etc. Also, 102 ha. Land area is available for master planning out of which 78 ha. Land is government land & 24 ha. Land is forest land. The land acquisition will be done by SMC.

RO-RO Jetty By GMB

GMB has also proposed jetty near dariya ganesh temple site. This is approximately 700m from jetty proposed by WAPCOS.

3.10 Fairway Costing

3.10.1 Capital Cost

Cost estimates for fairway development components viz. Dredging, Aids to Navigation, Bridge demolition & construction etc. has been worked out based on prevailing rates in the adjoining area and placed in table.

Phase-1

Fairway Development Cost	In Crores
Navigation Locks	-
Demolition & Reconstruction of bridges	-
Dredging (0.31 Mm3)	9.36
Navigation & Communication Cost	5.00
Total Fairway Development Cost	**14.36**

*Excl. Contingency, Supervision Charges & IDC

Phase-2

Fairway Development Cost	In Crores
Navigation Locks	180.00
Construction of barrages	700.00
Demolition & Reconstruction of bridges	834.48
Dredging (2.0 Mm3)	60.00
Navigation & Communication Cost	8.04
Total Fairway Development Cost	**1782.52**

*Excl. Contingency, Supervision Charges & IDC

3.10.2 O&M Cost

The total operating cost for development of waterway has been worked out based on prevailing rates in the state/country. The total operating cost includes maintenance of dredging, bank protection, aids to navigation, manning operation and management of waterway.

Phase 1:

II	O & M Cost	In Crores
(i)	Dredging @ 10%	0.94
(ii)	Civil works @ 1%	0.34
(iii)	Mechanical & Electrical Cost @ 5%	0.11
(iv)	Ports Crafts/Nav. Aids @ 5%	0.25
	Total	**1.64**

Phase 2:

II	O & M Cost	In Crores
(i)	Dredging @ 10%	6.00
(ii)	Civil works @ 1%	19.88
(iii)	Mechanical & Electrical Cost @ 5%	1.221
(iv)	Ports Crafts/Nav. Aids @ 5%	0.40
	Total II	**27.501**

CHAPTER – 4

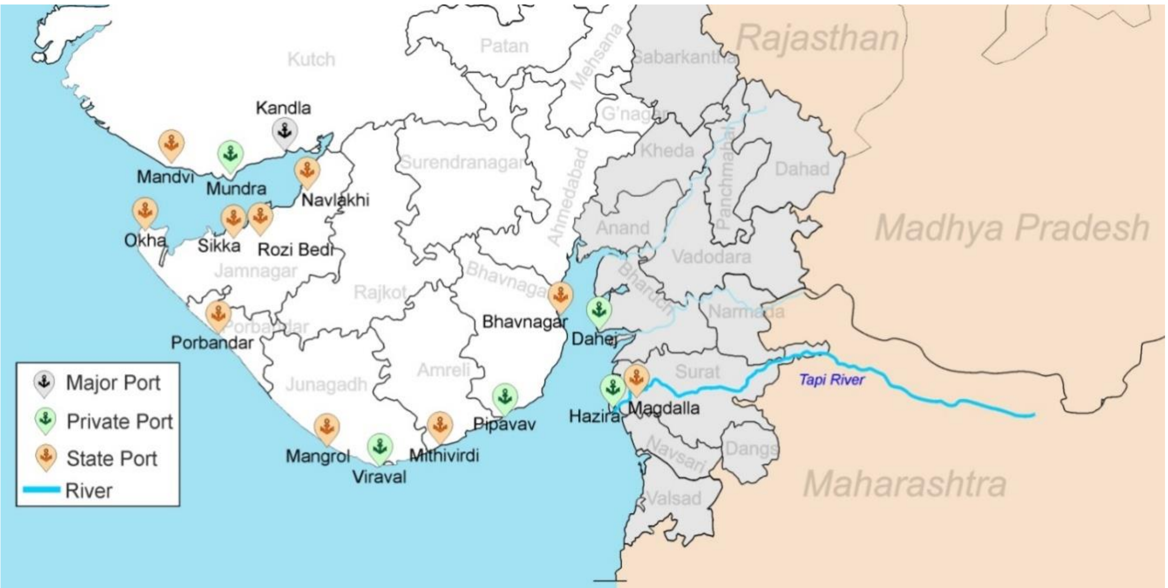
TRAFFIC STUDY

4.1 General

Tapi is one of the westward flowing rivers. It originates at Chandora Dam in the Betul district of Madhya Pradesh, at an elevation of about 752 m, and flows for about 724 km before falling into the Arabian Sea through the Gulf of Cambay. The river is bound on the three sides by the hill ranges. River Tapi, along with its tributaries, flows over the plains of Vidharbha, Khandesh, over large areas in the state of Maharashtra, and a small area in Madhya Pradesh and Gujarat. The drainage area of River Tapi in Madhya Pradesh is 9,804 sq. km., in Maharashtra 51,504 sq. km., and in Gujarat 3,837 sq. km. The river covers a large area in Maharashtra besides the areas in the states of Madhya Pradesh and Gujarat. The total length of the river is 724 km. However, only 173 km stretch is considered for the study. This stretch will be developed in multiple phases to derive a sustainable commercial return from the entire stretch.

Region within 25 km on either side of the river falls under the primary catchment area. Districts of Surat and Tapi in Gujarat, and Nadurbar in Maharashtra fall under this primary catchment area. River Tapi falls in south Gujarat. There are two ports located on the mouth of the River Tapi, namely Hazira and Magdalla.

Figure 4-1 Tapi Overview Map



4.2 Hinterland Analysis Influence area / Hinterland (within 25km on either side of the waterway)

The primary catchment area is considered for hinterland analysis. The districts along this river considered for the study are Surat, Tapi and Nandurbar.

Surat

Surat is a district in the state of Gujarat with Surat city as the administrative headquarters of this district. It is surrounded by Bharuch; Narmada (North), Navsari (South) districts and east Tapi district to the west is the Gulf of Cambay. It is the second-most advanced district in Gujarat. It is one of the major Industrial districts in Gujarat. It has good connectivity and proximity to Magdalla and Hazira ports.

Tapi

Tapi District was formed out of some talukas separated from erstwhile Surat District. Vyara is head quarter of Tapi District, which comprises five Talukas – Vyara, Songadh, Valod, Uchhal and Nizar. It has it's headquarter in Vyara. It is on the Southern eastern fringe of Gujarat. On its west is Surat district and on its east is Maharashtra State border. Tapi is, practically, an industrial backward region, and is mostly known for its bamboo products.

Nandurbar

The Nandurbar district is one of the smallest districts of Maharashtra, located at the edge of Maharashtra's northern boundary enveloped by Madhya Pradesh on the north and the east and Gujarat on the west. The district is recognized for its tribal population and undulating landscapes of the Satpura ranges on the northern end of the district. The district enjoys water supply from two major sources, Tapi running across the district and Narmada in the north. Nandurbar city is the district headquarters and is the only town in the district connected by a railway line. The district is divided into 6 tehsils, namely, Dhadgaon (Akrani), Nandurbar, Akkulkwa, Taloda, Shahada and Navapur.

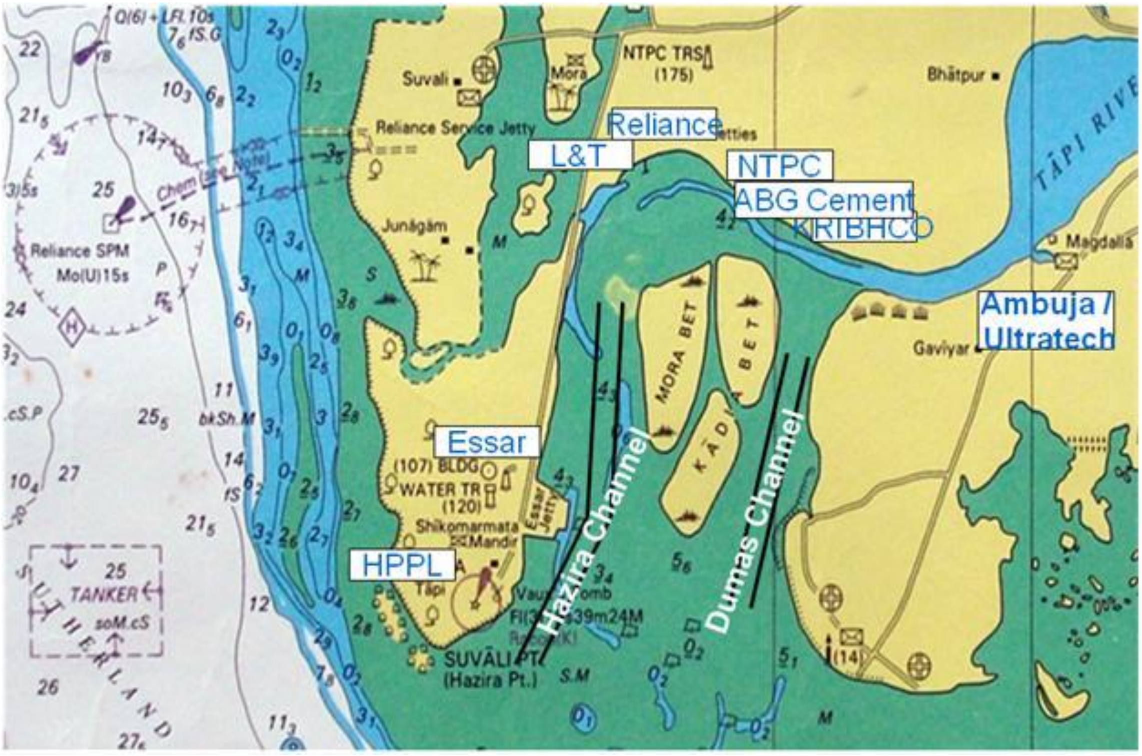
There are many industrial plants located on the banks of Tapiriver like Reliance, Essar, Larsen & Toubro, ONGC, NTPC and KRIBHCO. KRIBHCO is a small jetty capable of handling cargo by way of lighterage.

4.2.1 *Tapi River Flow (Anchorage & Channel)*

River Tapi has multiple bends in its flow. It also widens near its mouth before falling into Arabian Sea. This coupled with tidal variations leads to slowing of water flow resulting in heavy siltation in the river. Due to lower draft the vessel movement in the river is restricted. Barges of 2,000 DWT are mostly used in Tapi river upto Magdalla; their movements in the river are restricted only twice a day only during high tide.

The river at Mora belt splits into Hazira channel and Dumas Channel, the water flow, depth and siltation patterns at Dumas channel is favourable for ports and barge movement. Hence, Dumas channel is predominantly used. The following image shows the channels in Tapi River and the existing industrial plants. The major industries are Reliance, KRIBHCO, ABG Cement, Ambuja/ Ultratech, Essar& HPPL.

Figure 4-2 Channels in Tapi river and Industrial Plants



Hazira Anchorage

Hazira anchorage and the co-ordinates of the anchorage are as follows:

- Latitude 21° 02’ north
- Longitude 72° 36’ east

The Hazira anchorage has no draft and dimensional restrictions, and vessels of 1,00,000 DWT could anchor there. The approximate transit time for a barge from Magdalla port to the Hazira anchorage is about 4 hours. Hazira is a fair-weather port. So it remains closed during the monsoon season, particularly between May 15thand September 15th every year.

Essar Channel

Essar has dredged an 8.8 km channel on River Tapi to facilitate its cargo movement. The channel is mostly used by Essar, L&T, Reliance, KRIBHCO, etc. There are several patches of highland upstream, towards KRIBHCO. Moreover, Magdalla and other ports located upstream are in close proximity to the anchorage if using Dumas channel. So, Dumas channel is preferred to the Essar channel. The channel draft between the Essar Jetty and KRIBHCO jetty is 2 m at low tide.

Dumas Channel

Dumas Channel is formed due to the split in River Tapi from Mora Bet. The channel has developed due to natural flushing of silt. Earlier, only Magdalla port was using Dumas channel. As per GMB, the coal traffic at Magdalla in Fy15 was nearly 6.5 Million tonnes, which has grown to 6.7 Million tonnes in Fy16. Recently, other entities such as Ambuja Cement and UltraTech Cement have also begun using the Dumas channel. KRIBHCO has been using Dumas channel for lighterage movement of fertilisers.

Currently, the draft at Dumas channel at low tide is about 3 m to 4m,and this depth has been increasing on a regular basis. One of the anticipated causes of the rising depth is the natural flushing of silt, an effect of the Ukai dam upstream. Consequently, the channel depth is likely to increase further. However, the only constrain at the Dumas channel is an overhead wire passing across the channel. This restricts the air draft over the channel. Measures are being taken to increase the height of the overhead wire passing over the Dumas channel.

4.2.2 Population of Hinterland area

Only the talukas that are located in the primary catchment are considered for this study. The following table shows the population of these talukas:

Table 4-1 Taluka wise Population

District	Taluka	Population
Surat	Surat	44,67,797
	Olpad	1,96,846
	Chorasi	46,97,074
	Kamrej	1,84,554
	Bardoli	2,24,164
	Mandvi	1,95,949
	Mangrol	2,09,054
	Umarpada	83,723
Tapi	Valod	90,566
	Vyara	2,68,289
	Songadh	2,03,267
	Uchchal	88,416
Nandurbar	Akkalkuva	2,45,861
	Talode	1,59,654
	Nandurbar	3,67,446
	Navapur	2,71,852
	Shahada	4,07,728

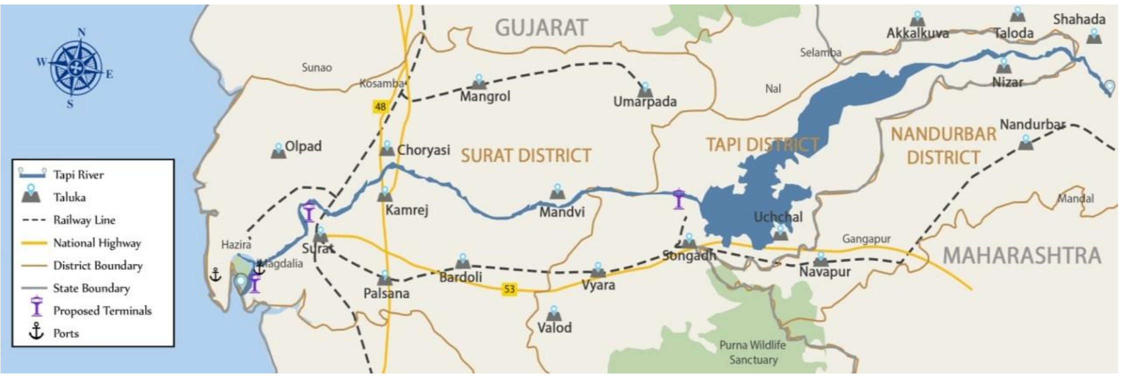
Source: Census 2011

According to the census of 2011, the total population of Gujarat is 60.4 million. The population of Gujarat forms constituted nearly 5% to the country's total population in 2011. Of the total state population, there were 31.5 million males and nearly 29 million females. The sex ratio of the state of Gujarat is 919, which is lower than the national average of 940.

As of 2011, Surat had a population of 6.1 million, of which 79.68% were urbanites. After Ahmedabad, Surat is the most populous city in Gujarat. It represents nearly 10.1% of the total state population. Of the total population of Surat, there are 34 million males and around 24 million females. This results in a sex ratio of 787, which has declined from 810 in 2001. The district of Tapi contributes a measly 1.3% to the state's population. Tapi's total population is around 8.1 million, with 4.02 million males and a slightly higher female population of 4.04 million. This brings Tapi's sex ratio to 1007, which is better than the national average. The population of Nandurbar contributes merely 1.46% to the Maharashtra's total population. Its population density is 327 persons per sq. km. around 84% of the district's population live in rural areas. The district has a, relatively, healthy sex ratio of 978.

The following figure shows talukas around River Tapi, which may contribute to business opportunities for the proposed waterway. The figure also depicts road and rail connectivity around the river.

Figure 4-3 Talukas and connectivity around River Tapi



According to the census of 2011, Choryasi is the most populated taluka in the district of Surat. This is mainly because of its industrialization. Hazira, Sachin, and Icchapore are some of the developed industrial areas in this taluka. The second most populated Taluka on this stretch is Surat. The city of Surat has a flourishing textile and diamond industry. Therefore, a lot of people have migrated to these areas. Umarpada, Valod, and Uchchal are the least populated areas in the region. These areas have fewer industries and are less developed. In Nandurbar district, Shahada is the most populated Taluka, as many industries operate there. Talode is the least populated city in this district.

4.2.3 Economy Profile of Gujarat

Gujarat is one of the most developed states of India, in terms of economic growth. It also has a high potential for further growth. Average annual Gross State Domestic Product (GSDP) growth rate of Gujarat from 2004-05 to 2015-16 was 12.02%. The state contributes about a quarter to the total exports of India. The following table shows historic GSDP for the state of Gujarat between FY12 and FY16. The secondary sector has seen a consistent uptick, while other sectors have been inconsistent in their growth.

Table 4-2 Historic GSDP of Gujarat at Constant price

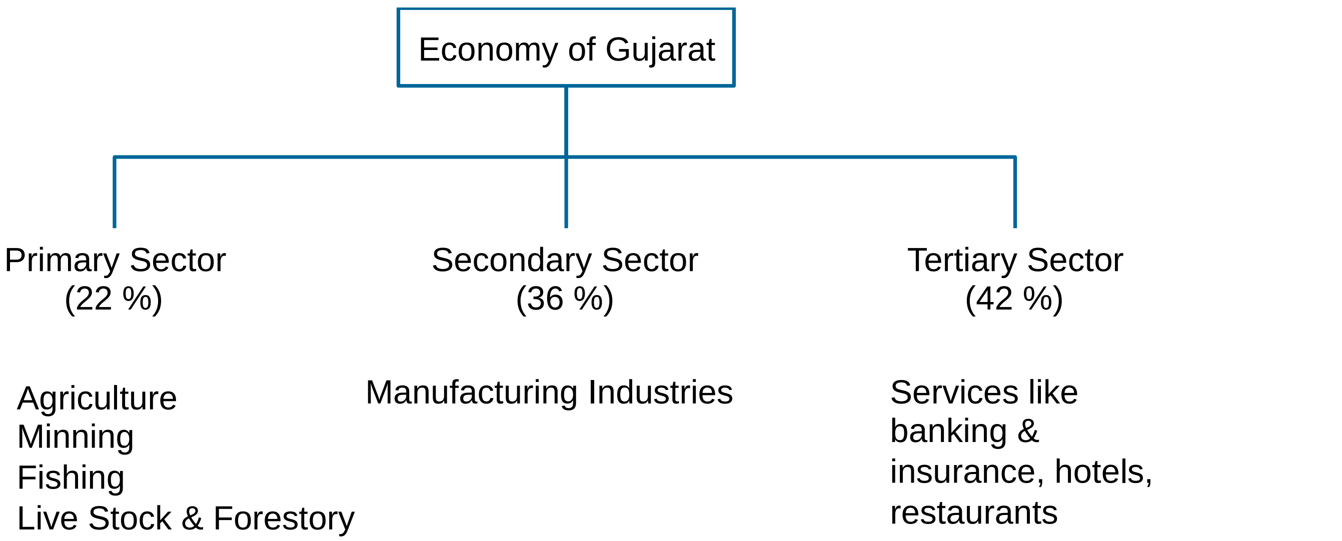
(Cr.)

Sector	Fy -12	Fy-13	Fy -14	Fy-15	Fy -16
Primary Sector	1,25,87,023	1,15,51,319	1,36,41,921	1,36,34,220	1,35,94,319
Secondary Sector	2,23,41,741	2,63,72,643	2,73,82,642	2,93,02,542	3,23,51,343
Tertiary Sector	1,63,63,225	1,85,14,483	1,95,65,582	1,33,53,874	1,44,61,281
Total	5,12,91,989	5,64,38,446	6,05,90,145	5,62,90,636	6,04,06,943

Source: Socio-economic report, 2016

The economy of Gujarat is divided into three sectors, viz. primary sector, secondary sector, and tertiary sector. The primary sector includes activities like agriculture, fishery, animal husbandry, and mining. The secondary sector includes manufacturing industries like power generation, fertilizer, textiles, etc. The tertiary sector includes service-based activities like banks and other financial institutions, educational institutes, IT sector, etc. In Gujarat, the primary sector contributes only 22% to the state's total GDP, while secondary sector and tertiary sector contribute 36% and 42%, respectively. The following figure is a snapshot of the demarcation of the economy sector of Gujarat, as discussed above:

Figure 4-4 Economy sector in Gujarat



Primary Sector

The primary sector includes occupations and activities like agriculture, fisheries, mining, animal husbandry, and forestry. It accounts for 22% of the total GDP contribution to the state of Gujarat. Gujarat has shown maximum growth in the agriculture sector, though the state has vast regions of arid and semi-arid land. Areas like Marpada are more focused on agriculture. Agriculture flourishes here due to River Tapi.

4.2.3.1 Agriculture

Major crops produced in Surat, Tapi, and Nandurbar districts are discussed in this section. The following table lists all the major crops and major fruits and vegetables these districts are known to produce:

Table 4-3 District wise major crop production

Districts	Major crops	Major Fruits and Vegetables
Surat	Rice, Wheat, Sugarcane and Cotton	Mango, Banana, Papaya, Okra and Brinjal
Tapi	Wheat, Paddy, Maize and Bajra	Okra, Banana, Mango, Chiku and lemon
Nandurbar	Kharif Jowar, Rice, Maize, Bajra, Cotton, Sugarcane and Soyabean	Mango, Banana, Coconut, Papaya

Source: MSME, 2015

4.2.3.2 Surat

Table 4-4 Crops productions in Surat (Fy-15)

Commodities	Area (Hector)	Production (MT)
Crops	1,02,419	1,14,242

Source: MSME, 2015

Crops include rice, wheat, jowar, maize, val, tur, moong, chana, groundnut, sugarcane and castor seeds.

Surat, the area under production of crops is 1,02,419 hectares while the production is 1,14,242 MTPA. Crops include rice, wheat, jowar, maize, val, tur, moong, chana, groundnut, sugarcane and castor seeds. Rice and cereals dominate more than half of the net sown area. Sugarcane is another major crop having 30% of the net sown area in the district. The sugarcane production stood 7493 thousand tones. Rice, wheat, sorghum and Jowar are major food crops cultivated in the area .The major cash crops produced in the area are cotton and sugarcane.

Table 4-5 Horticulture Production in Surat

Commodity	2013-14		2014-15	
	Area (Hector)	Production (MT)	Area (Hector)	Production (MT)
Fruits	18,730	5,95,955	19,966	6,66,866
Vegetables	25,289	3,74,624	27,855	4,22,634
Spices	436	5,884	494	841

Fruits include Mango, chiku, citrus, banana, papaya, pomegranate, guava and coconut. Vegetables include brinjal, cabbage, cow pea, tomato, cauliflower, cucurbits, cluster beans and okra. Spices include coriander, ginger, turmeric and fenugreek.

In Surat, the area under cultivation of crops has increased by 6.19% in 2014-15. The production increased by 10.63%. The area under production of vegetables increased by 9.21% and the production increased by 11.35%. The area under production of spices increased by 11.74%. However, the production has decreased by 85.70%.

4.2.3.3 Tapi

Table 4-6 Production of Crops, Vegetables & Spices in Tapi (Fy-15)

Commodities	Area (Hector)	Production (MT)
Crops	1,02,419	1,14,242
Vegetables	32,785	5,15,072
Spices	494	8,141

Source: MSME, 2015

Paddy and cereals dominate more than half of the net sown area. Sugarcane is another major crop having 6% of the net sown area in the district. The sugarcane production stood 516 thousand tones. Paddy, Sorghum, Groundnut and cereals are major food crops cultivated in the area .The major cash crops produced in the area are cotton and sugarcane.

Fruits include mango, chiku, citrus, ber, banana, guava, pomergranate, papaya, custard apple, and aonla. Vegetables include potato, brinjal, cabagge, okra, tomato, cauliflower, cluster bean, cowpea, and cucurbits. Spices include cumin, fennel, chilli, garlic, coriander, ginger, turmeric and fenugreek.

The area under cultivation of crops is 1,02,419 hectares and the production is 1,14,242 MTPA. The area under cultivation of vegetables is 32,785 hectares and the production 5,15,072 MTPA. The area under cultivation of spices is 494 hectares and the production is 8,141 MTPA.

4.2.3.4 Nandurbar

Table 4-7 Production of Crops in Nandurbar

Commodities	Area (Hector)	Production (MT)
Crops	2,02,200	1,35,900

Source: Agriculture Contingency Plan for District- Nandurbar, 2011

Crops include Jowar (both Kharif and Rabi), Cotton, Rice, Pearl Millet, Maize, Soyabean and Wheat.

Normal area under kharif crop is 252300 ha. Kharif season is the most predominant season. Kharif jawar, cotton, Bajara, kharif paddy are the main crops. Whereas tur, green gram, black gram, sunflower and groundnut are second important crops. Maize and Soyabean is fast emerging crop of the district. In rabbi season rabbi Jawar, wheat and gram are predominant crops. Groundnut, Bajara and sunflower are taken in summer season. In hilly area of the various district and other hill millets are predominant crops. The productivity of hill millet is very negligible. Paddy is taken in both irrigated as well as rain fed condition. No other factor is as critical to paddy production as the moisture stress at the reproductive stage of the crop. Yield reduction from lack of water during reproductive stage can lead to serious losses in paddy productivity. Tur is mostly taken as inter crop in paddy, jawar, cotton and maize crop. Horticulture crops like mango, Papaya, banana chilly, cauliflower, cabbage, brinjal, onion and beans are important crops. The agricultural production and productivity of principal crops is low and fluctuating as compare with state as well regional level. District as a whole only 20.50 % area is under cash crop/high valued crops and 5.21% area under horticulture crops.

4.2.3.5 Minerals

- *Surat*

Table 4-8 Mineral Production in Surat District (Fy-15)

Minerals	Production (MT)
Lignite	33,68,120
Limestone	36,250
Silica sand	9,010
Black trap	63,35,815
Brick Earth	6,89,833
Murram	1,20,097

Source: Directorate of Geology and Mining, Surat

Surat has very huge lignite reserves. The annual production of lignite is 3.3 MMT. Black trap is another mineral found on large scale with an annual production of 6.3 MMT. Murram also has a good production of 1, 20,097 MTPA. Brick earth produced on good scale is helpful for construction, brick and tiles factory.

* *Tapi*

Table 4-9 Minor Mineral Production in Tapi District (Fy -15)

Mineral	Production (MT)
Black Trap	32,91,964
Ordinary Sand	8,17,454
Ordinary soil	1,18,070
Murram	32,000
Total	42,59,488

Source: Department of Mines & Geology, Vadodara

Tapi has no major minerals. However, Tapi has good reserves of black trap. The annual production for black trap is 3.2 MMT. It is followed by sand, which has a production of 8.17 lakh TPA. The reserves of Murram are very low here.

Hence, extraction of minerals does not offer any opportunity to IWAI in Tapi.

* *Nandurbar*

No major mineral is found in this district. Clay for making bricks, sand and metal stones are the minor minerals found in this district.

Secondary Sector

Manufacturing industries, registered and unregistered industries, Electricity, Gas, Water supply providing and construction companies come under secondary sector. There are coal based Power Plants, Iron & Steel, Chemical& Fertilizer manufacturing industries in the catchment area.

* *Surat Cluster*

There are about 40,000 small-scale industries in Surat District. The major ones in Surat are textiles, Chemicals dying & printing, Diamond processing, Jhari (silver) making and manufacturing of machinery and equipment. Textile industries have maximum number of Small scale industries, about 24000 units. Textile industry contributes to close to 60% of revenue.

Table 4-10 Revenue Distribution by Small Scale Industries in Surat

Components	% Share
Textile	59
Repairing, Servicing & Others	28
Machinery	3
Metal related	2
Food products	2
Rubber, Plastic & its products	1

Components	% Share
Wood	1
Others	4
Total	**100**

Source: Surat District Profile

These export oriented textile industries could be potential customers for SKS Logistics coastal barge. Currently, these industries send their export cargo in Bulk form through roadways to ICD/CFS in Mumbai.

Textile being light cargo has a lower Full Container Load of about 8 tonnes to 10 tonnes. Therefore, exporting factory stuffed containers from Surat adds to their disadvantage by increasing transportation cost. Textile exporters are carrying higher amount of cargo in trucks than can be taken in containers at same cost. The industries could divert their cargo from roadways to the waterway.

- *SMEs Cluster in Surat*

Surat has more than 600 medium and large enterprises and close to 40,000 small enterprises. Some of these industries are export focused and uses JNPT as their gateway port for export. Majority of them, due to lack of volume of cargo, send their cargo is break-bulk form to ICD/CFS based in Mumbai. These are containerised and exported via JNPT port.

As can be seen in the table below and map below Choryasi has the largest number of industries. Looking at the large number of scattered industrial base, they can be approached through freight forwarders as they send their cargo through them.

Table 4-11 Local Industrial Cluster in Surat

Location	MSI/LSI	SSI
Choryasi	230	34,844
Kamrej	2	301
Mahuva	8	401
Mandvi	116	651
Mangrol	131	1,967
Olpad	22	815
Palsana	116	651
Total	**625**	**39,630**

Figure 4-5 Industrial Cluster and their distance

As shown in the above map, there are many industrial clusters in the catchment area of Tapi river. These industries could be evaluated for IWT waterway to transport their raw material and finished products.

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 the state is slowly turning into developed economy.

Infrastructure Analysis

It consists of analysis of roadways infrastructure, railways and airways. Following are detailed analysis of existing infrastructure

4.2.3.6 Connectivity Analysis

Connecting infrastructure is crucial in the development of a region. It is also essential to understand various types of existing and upcoming infrastructure around Mahi River, as they would provide support and connectivity for waterway with other modes of transportation. It becomes backbone for any new development.

- *Roadways*

The state of Gujarat is home to a huge transportation network comprising national highways, state highways, district highways, district roads and rural roads. Gujarat boasts of total 3,245 km of National Highway and 19,761 km of State Highways. Our

Stretch has a couple of industrial hubs.

Surat has good road connectivity as the network of National and State highways is good. The smooth road connectivity serves the industries of the region to transport their goods and services. The district road coverage is quite vast and is helpful for commuters and agro-based industries. The proposed DMIC - Delhi Mumbai Industrial Corridor passes through Surat and it focuses on the Surat- Navsari industrial belt. There is no national highway passage in Tapi district; however the district has a good state highway coverage. Nandurbar has a moderate network of national highway. Its state highways has total network of 610 km. The district roads connect all talukas and major towns. The below table shows the length of roadways in the districts that fall in the catchment of River Tapi.

Table 4-12 District Wise Length of Roadways

Districts	National Highway (km)	State Highway (km)	District roads (km)
Surat	149	507	962
Tapi	NA	407	381
Nandurbar	44	610	1,746

Source: MSME, 2015

- *Railways*

The rail connectivity in Surat is good in the developed areas of Surat and Choryasi districts. Mandvi Taluka is completely deprived of any railway network. The rail coverage in Tapi is less compared to other districts, but it is sufficient. The railway connects most of the major towns and industrial areas. The railway network in Nandurbar is good in the southern region. It connects the two major towns of Navapur and Nandurbar. The rest of the central and northern part of the district has no railway passage at all.

Table 4-13 Distribution of Railways

Rail connectivity	Km
Surat	242
Tapi	82
Nandurbar	90

Source: Msme 2015

- *Airways*

There is a domestic airport at Surat near Magdalla. Though the airport was not in operation a few years back, now it has been revamped. There are daily flights to connect to Delhi.

Surat is a port city having 2 ports. Both the ports are intermediate and operate under the Gujarat Maritime Board. One is in Hazira, the industrial hub of Surat and other is in Magdalla near the airport.

4.2.4 Existing Infrastructure

Gujarat state owing to its geographical location, which caters to a very large hinterland in the land located regions of Central India and Northern India, creates natural advantage for port sector. Additionally the industrialisation of the state of Gujarat has generated opportunity for dedicated ports. The ports in the state are also conveniently located in close proximity to the Middle East, European and African countries, facilitating international trade with these nations. The state is involved in exporting to countries like UAE, Europe, Singapore, Indonesia, China, Japan, etc. POL, Chemical, Minerals, Food-grains & Agricultural products and General cargo are the export commodities. The ports in the state import LNG & LPG, Coal, Crude Oil & POL. These goods are sourced from countries like UAE, Qatar, Panama, South Africa, Indonesia, Australia, China, Mexico, etc. In general, the ports in the state are mostly focussed in handling Ores, especially Coal, Crude Oil and POL.

River Tapi has several small ports and jetties across its bank. Most of these port infrastructures are for captive use. Following table describes the basic principles of these ports and jetties located at the back of river Tapi in Surat region.

Figure 4-6 Existing Jetty on the mouth of the river

The table below shows the infrastructure details of the existing port and jetties in the catchment area of River Tapi.

Table 4-14 Existing port / Jetty infrastructure

Port / Jetty	Draft (m)	Traffic (M T) Fy-15	Cargo Handled	Operation Type
AHPPL	11.5	1.15	Container	Direct Berthing
HPPL	11.5	2.98	LNG	Direct Berthing
Essar Jetty	12	-	Iron Ore, Coal	Lighterage
L & T Jetty	3.5	0.1	OD Cargo	Barging
Reliance Jetty	6	-	POL & Chemical	Pumping
KRIBHCO Jetty	3	0.4	Fertiliser	Lighterage
Magdalla Port	3	6.48	Coal	Lighterage

Source : GMB

The commodities handled by the above mentioned ports and jetties are using River Tapi in some way or the other. In future, the expansion of these ports and jetties would enable them to handle more cargo, which could be potential traffic for the proposed waterway.

Hazira Port

Hazira Port is located around 25 kms. From Surat city and 250 km. from Mumbai. The port is built by Hazira Port Pvt. Ltd. which is a joint venture between Shell Gas B.V. and Total Gaz Electricite Holdings France. It handles the LNG terminal. Adani Hazira Port Pvt Ltd (AHPPL) operates all non-LNG facilities in Hazira Port under the terms of the agreement with Hazira Port Pvt. Ltd. (HPPL). It handles container, bulk cargo and other liquid terminal. AHPPL and HPPL together constitute the Hazira Port. Hazira Port handles all types of cargo including bulk, break-bulk, bulk liquid chemicals, petroleum products & edible oil, containers, automotive and crude. It is a trade gateway to America, Europe, Africa and the Middle East.

Facilities at AHPPL

- Three terminals each for dry cargo, liquid cargo and containers.
- It has total of 5 berths with 14 metre draft for all the three terminals
- The capacity of the cargo terminal is 11.42 MMTA, liquid terminal is 3.65MMTA and that of container terminal is 10.65MMTA.

Facilities at the LNG Terminal (HPPL)

- The LNG Terminal has an 800 meter long trestle.
- The LNG jetty consists of four breating and 5 mooring dolphins.

Magdalla Port

Magdalla port is a minor Port on the west coast of Southern Gujarat. It is about 150 miles north of Mumbai and 15 km from Surat city. This port is situated on the bank of River Tapi, where large industries such as Reliance, Essar, Larsen & Toubro, ONGC, NTPC and KRIBHCO are located.

Magdalla Port is owned by Gujarat Maritime Board. The port has 4 GMB jetties and several small captive jetties under it. However, most of the jetties of Magdalla handle dirty cargo and are captive in nature. Of the total cargo mix handled in 2015, about 27% was clean cargo. Furthermore, only about 11% of the total cargo handled at the Port was non-captive in nature.

Magdalla Port has good road and rail connectivity. Surat railway station is 15 km from the port and NH-8 is 5 km. from it. Future developments in the port include SPMs by Reliance and ONGC. ABG has proposed a Cement jetty.

Existing facilities at Magdalla Port

- ✓ The Deep Water Anchorage is 15 nautical miles southwest from Magdalla Port. The approach channel is 16,000 meter in length and 150 meter in width.
- ✓ The equipments used are patrol boat for patrolling operation under ISPS code 470 BHP, Work Barge (Dumb) 100 MT and cranes of 100 MT capacity.
- ✓ There are 2 nos. of GMB owned Jetties and Captive Jetties of Essar, Reliance, L & T, KHRIBHCO and Gujarat Ambuja Cements.
- ✓ There are two shipyards of ABG Shipyard Ltd. and L&T shipyard.

GMB Jetties

GMB operates 4 jetties at the Magdalla Port. The jetty handles cargo that is distributed among the industrial units operating in South Gujarat regions like Surat, Hazira, Valsad, etc. However, in the recent years due to rise in coal traffic, the GMB jetty is exclusively handling Coal. Handling other clean cargo along with coal leads to contamination of clean cargo, which is not allowed. Following are some of the third-parties that has been handled at this Jetty.

- GSFC
- GNFC
- Gujarat Alkalies& Chemicals Ltd. (GACL)
- Bhatia Coal Industries
- Adani Exports
- Ruchi Soya Industries

GMB's second jetty is acquired by Aditya Birla Group. The company imports bulk Cement via coastal mode from Pipavav and Clinker from Jaffrabad. Finished cement in bulk form is shipped to Mumbai region using coastal mode of transportation.

These are captive goods and hence cannot be targeted by the proposed waterway.

The GMB jetty doesn't handle any captive cargo, and is, therefore, open for competition. Coal is the largest and only commodity handled in considerable volume at the port. Traders like Bhatia Coal Industries and Adani Exports are involved in trading of Coal, which is imported at this jetty. Even GNFC is involved in trading of imported Coal from this jetty.

Apart from GMB jetties the rest are for captive use. GMB has leased one of its jetties to NCCL for cement and clinker. Around 2 million tonnes of coal is being handled at GMB jetty. The Table 4-15 provides the description for the GMB jetties.

Table 4-15 GMB Jetties description

Description	Jetty (m x m)
Jetty 1	110 x 23.5
Jetty 2	143.5 x 11
Jetty 3	66 x 24.4
Jetty 4	33.6 x 18.4
Draft at Jetty	3
Cargo	Coal

Source : GMB

GMB Jetty and HPPL are the only point of import of Coal for industrial belt in Surat. Due to lack of draft, coal is transported to port in barges of 2,500 DWT. It's a fair weather port. Coal handling is halted during monsoon. Coal being contaminated cargo, port cannot handle any other cargo

Essar Jetty

Essar has set up an all-weather deep water berth located along River Tapi at Hazira. The berth is capable of handling bulk carriers of up to 100,000 dead weight tonnes (DWT). The channel has been dredged with 12 mtrs. draft to facilitate import of iron ore, pellets, coal, met coke, limestone and other dry bulk cargoes and export of finished steel products.

The berth is connected to the high seas of the Gulf of Khambat by a 7.2 km long Navigation Channel. The width and depth of the channel is being further increased to accommodate cape size vessels up to 130,000 DWT. The terminal facility includes a deep water berth with ship un-loaders connected to the stackyard by mechanical conveyor system. The terminal has storage facilities for bulk and break bulk cargo. Essar has its Steel Plant in Hazira. It has a captive jetty for import of iron ore and Coal on barges through lighter operation. Essar has got its channel deepened for direct berthing of bulk ships. Channel faces siltation due to high tide and cross currents.

In addition to its iron ore jetty, Essar also has an LPG jetty, which is small with a length of around 14 meters. Hence this jetty cannot be used for handling containers.

The company operates 3 jetties for handling captive cargo like Iron Ore, Coal, Limestone and other break bulk cargo such as pipes and coils and project cargo. Around 40% of the goods produced by the company's steel plant is shipped worldwide along with distributing to domestic markets. The company exports mainly HR Coils, Sheets, etc. Coal and Iron Ore represent the maximum share of cargo handled at the Essar jetties. This captive, dirty cargo cannot be shifted to any other port. The potential for IWAI in this cargo category does not exist.

The below table shows the details of Essar Jetty at Hazira. The major commodities handled are Sponge Iron, Coal, Gases etc.

Table 4-16 Particulars of Essar Jetty at Hazira

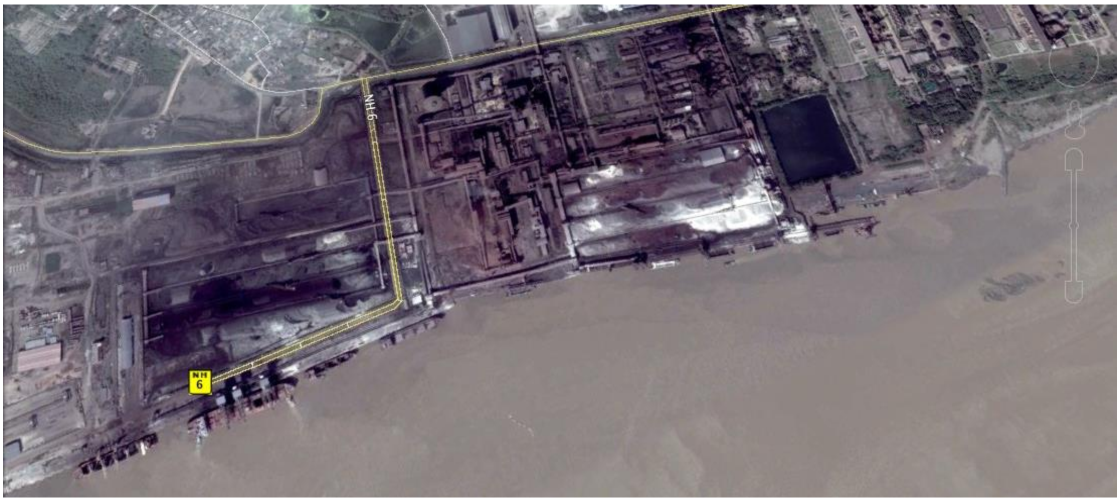
Description	Bulk Jetty	LPG Jetty
Length (m)	550	14
Width (m)	30	10
Draft (m)	15	4
Equipment	Quay crane + Grab +Conveyor	Pumping
No of Crane	2	1
Equipment Capacity (tph)	420	500
Principal Commodity	Sponge Iron, Coal, etc	Gases

Source : GMB

Figure 4-7 Essar Jetty

Essar has developed an all-weather deep draft port (Draft 15 m and length 550m) at Hazira. This is capable of handling 1.05 lakh DWT bulk carriers to import iron ore, coal and limestone. It has also created a dedicated approach channel for its 550-metre jetty.

Figure 4-8 Google image of Essar Jetty



L & T Jetty

L&T has its heavy engineering division and shipbuilding facility in Hazira. It has two jetties one load out jetty for export of its heavy engineering over dimension cargo and one 'L' shaped jetty for export of cargo. These jetties are used for export of over dimension cargo. L&T has a Modular Fabrication Yard, for which the company imports Machinery and Steel from Mumbai, Abu Dhabi etc.

The fabricated product at the plant is then shipped back to Mumbai via coastal waters. L&T operates 3 jetties at the Magdalla Port. All three are used for importing and exporting Machinery and Steel. Due to captive nature, this cargo can't be converted into business prospect for proposed jetty by IWAI.

Figure 4-9 L & T Jetty at Hazira

The above image shows L&T Jetty at Hazira. It shows L&T facilities in detail, i.e. L&T manufacturing unit, L&T jetty, load out jetty and the Shipyard.

Table 4-17 L&T Jetty at Hazira

Description	Particulars
Length (m)	72
Width (m)	16
Principal Commodity	ODC, BreakBulk

Source : GMB

L&T, Hazira Division is more and more progressive towards defence constructions. Hence would not be allowing commercial activities by third parties to its premises. Sometimes occasionally Reliance uses these jetties for unloading their cargo.

Reliance Jetty

Reliance is currently handling its liquid cargo from its Hazira jetty. It also has an SBM at its Hazira jetty in the River Tapi at a draft of 24 m. Reliance Industries Ltd. had installed SBM connected with pipelines from SBM to their plant at Suwali (in sea) for import and export of liquid cargoes.

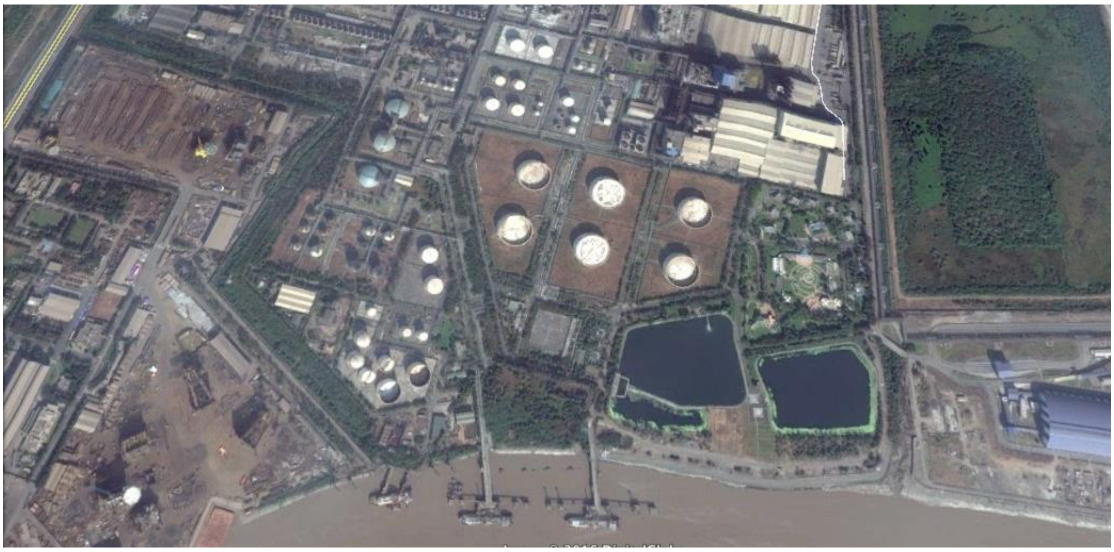
Table 4-18 Particulars of Reliance jetty at Hazira

Description	Ethelene Jetty	EDC / Ro Ro	Gas Jetty
Length (m)	30	9.5	20
Width (m)	20	8.5	20
Draft (m)	6	2	6
Equipment	Pumping	Pumping	Pumping
Equipment Capacity (tph)	500	500	500
Principal Commodity	Pol & Chemical	EDC / Ro Ro	Gases

Source: GMB

The below image shows the jetty of Reliance located at Hazira.

Figure 4-10 Reliance Jetty at Hazira



KRIBHCO Jetty

On the bank of River Tapi, Krishak Bharati Cooperative Limited (KRIBHCO) owns and operates a jetty near its plant. This is a fair-weather lighterage jetty located on the south of Gujarat. It is located at latitude 21°08’ 46” N and longitude 72°42’44” E in Surat district. KRIBHCO jetty falls under Magadalla port of Gujarat Maritime Board. The jetty of KRIBHCO is located in the South Gujarat, surrounded by some of key industries of Gujarat. The jetty was developed back in 1980 for loading/unloading of heavy equipment required for the construction of KRIBHCO’s fertilizer complex in Hazira. The jetty was soon rendered useless due to heavy siltation at the site. In 2009, the facility was reopened following revamping.

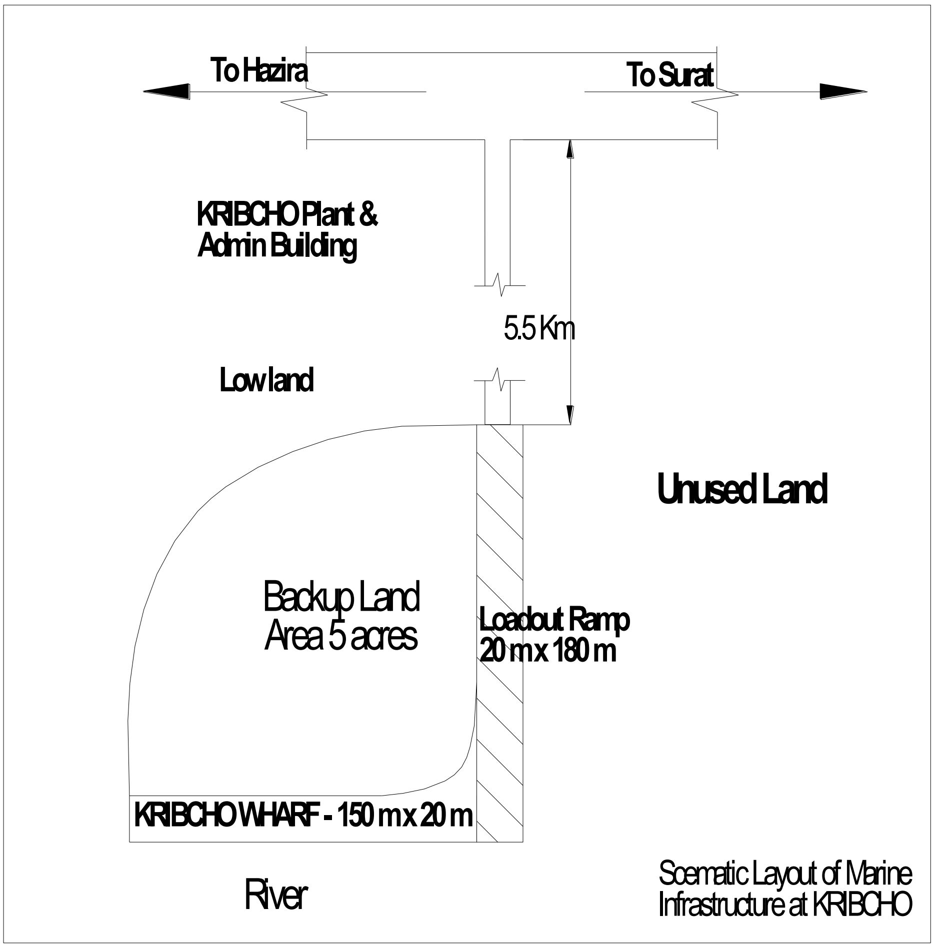
Figure 4-11 Layout of revamping land of KRIBHCO

It has setup a fertilizer complex to manufacture Urea, Ammonia & Bio-fertilisers at Hazira on banks of River Tapi. Its manufacturing unit is located 15 kms from Surat on Surat – Hazira state highway. It has Reliance Petrochemical plant located west of it.

Figure 4-12 KRIBHCO Jetty

- KRIBHCO has a wharf and a load-out ramp at its Hazira plant.
- A Wharf and a load out jetty were designed for import of equipments and machinery during setting up KRIBCHO plant.
- Facility has been refurbished with installation of mechanised bagging plant for handling of imported fertilsier. The load-out ramp has not been used for last 20 yrs.
- The load-out ramp has handled a reactor of 450 tonnes of cargo while commissioning of KRIBHCHO plant
- Heavy silting near wharf and load-out ramp restricts creating infrastructure for handing of large vessels.
- It is located 5.5 km away from Surat-Hazira road. The upper surface of road has eroded due non maintenance
- KRIBHCO was evaluating handling other clean cargo using this jetty, but not anymore.

Figure 4-13 Jetty and its surrounding layout



The Jetty is primarily being used for importing Urea from Oman's OMIFCO, a JV promoted by IFFCO and KRIBHCO with the Oman Government. The jetty also caters to EXIM requirement of the western region. The reconstruction of the jetty includes dredging of the approach channel to allow lighterage. The 147-m-long and 30-m-wide wharf will also be repaired and refurbished. The wharf will handle barges of 3,000 DWT. KRIBHCO is handling & marketing 50% of the urea produced by OMIFCO. Private jetty of KRIBHCO is operational and presently handles OMIFCO vessels .The Jetty has competitive advantage of rail/road link for faster evacuation. GOI has signed a long term agreement to purchase urea produced by OMIFCO. In Fy -16 OMIFCO production was 2 Million T. This is an assured cargo.

KRIBHCO handled close to 0.4 million tonnes of Fertiliser at its Jetty. Unlike Magdalla Jetty KRIBHCO has the rail connection, it also has its own rakes.

Gujarat Ambuja Cements

Ambuja cement is one of the leading cement manufacturers in India. The total cement manufacturing capacity of the company is 25 Million tonnes per annum. Ambuja Cement has its plant in Kodinar & Magdalla, which is involved in the coastal shipping of finished cement in customised cement carriers. The Magdalla unit of

Ambuja cement has an installed capacity of 6 Million tonnes per annum. There is also a coastal movement of 0.5 mm tonnes of cement to Magdalla from Kodinar.

Ambuja cement also ships close to 1.5 Million tonnes of finished cement in bulk form to Mumbai from its Kodinar plant. These shipments are in customised cement tankers. Following is the fleet of 8 customised cement tankers, which are used to transport cement using coastal route.

- ✓ 3 vessels of 2500 DWT
- ✓ 2 Vessels of 2600 DWT
- ✓ 3 Vessels of 3900 DWT

Figure 4-14 Ambuja Keerti crossing channel view from Jetty

As can be seen in the above image, vessel Ambuja Keerti, a cement carrier of 2667 DWT is passing KRIBCHO jetty at a distance of about 400 m.

Ambuja cement has witnessed a modest growth in volume of close to 5% year on year. This is mostly due to over capacity in the industry.

From Ambuja cements perspective, for next 4 to 5 years the company has enough infrastructure to accommodate additional demand for cement handling capacity at Magdalla.

Presently there is regular shipment from Kodinar to Hazira for distribution in Surat region. In future to handle incremental volume of cement at captive jetty of Gujarat Ambuja in Magdalla.

Hazira Port -Shell

Hazira Port, is a deep-water, all-weather, direct berthing port, which currently handles LNG Hazira Port has an approach channel of about 1000 m, turning radius of 600 m and dredged depth of (-12) m chart datum with a capacity to accommodate larger vessels using tidal variance.

Hazira port jointly owned by Shell Gas BV and Total Gaz Electricite Holdings France. They entered into an agreement with Adani group for development of a full pledged port, containing container handling facilities, bulk handling facilities with a partnership of container liner. The project is already commissioned. The port is situated in the middle of one of the Industrialized areas of country, which is in the vicinity Surat, Ankleshwar, Dahej, Bharuch, which is several manufacturing units in Chemicals, Pharmaceuticals, Textiles, Polymers and other light engineering product. This has generated large volumes of container trade using this port.

Figure 4-15 Hazira port – Shell Jetty

Bridges & Dams

Bridges

There are many bridges in the identified stretch of River Tapi, which are listed below.

- *ONGC Magdalla Bridge*- The bridge was built by ONGC. This bridge is of particular importance as it connects Hazira and Magdalla port. It also helps to connect two important GIDC areas of Ichapore and Sachin.

- *Sardar Bridge*- It was built in 1991. The total length of the bridge is 1000 mtr. It is one of the busiest bridges in Surat. It connects two major residential areas of Athwa Gate and Adajan.
- *Kholvad Bridge (Kamrej03)*-NH-48 passes through the Tapi at this point. It connects Kamrej to Choryasi.
- *Makkai Bridge* – It is also known as Vivekananda bridge. It is bridge connecting downtown and uptown. It is facing Tapi River Front View.
- *Nehru Bridge* – It is constructed in 1966. It is situated near to Old Fort, Surat / Surat Castle i.e Centre of attraction to Tourist
- *Jhangirpura- Dabholi Bridge* – It is situated near Akshardham Temple.
- *Amroli Bridge* – It is near to Katargam which is one of the prominent bus stop.
- *KopodraUtran Bridge* – It is located near Utran Gas based power station.
- *Savijibhai Korat Bridge* -It is also known as Varchan bridge.
- *Bodhan Bridge*
- *Varjakhan Bridge*
- *UkaiLimbi Bridge*
- *Kavtha Bridge*
- *Weir Cum Causeway*

There are few more bridges in River Tapi, but they are out of the navigable stretch of IWT proposed waterway.

Dams

There are two dams in the navigable stretch; they are Kakrapar Dam and Ukai Dam. Another dam, Hatnur Dam is out of the study stretch.

ICD

- ICD Sachin

ICD Sachin is promoted and operated by Diamond and Gem Development Corporation (DGDC). It is located about 26 km away from KRIBCHO Jetty in Hazira and about 260.km from Mumbai It is located close to Surat Railway station and adjacent to Surat Special Economic Zone. It exports close to 140 TEU every month to JNPT. ICD Sachin is the only ICD located in Surat and Hazira. There is no other CFS or ICD in the region. Second nearest ICD is Concord ICD located at Ankleshwar. It handles mostly domestic cargo.

Cargo at ICD is mostly exported to Middle East, Far East and African Market. Pipavav port does not offer regular service to these countries so all of containers are exported through JNPT.

ICD Sachin has vested interest in Hazira – JNPT service for coastal feeder. This would enable cargo moving to ICD/CFS in Mumbai from Surat shift to ICD Sachin. ICD

Sachin container volume will increase and it would be an opportunity for the proposed waterway.

SEZ

The table below shows the SEZs in Surat.

Table 4-19 SEZ in Surat

Name	Location	Product	Area (Ha)
Surat SEZ	Sachin, Surat	Multi-product	49.90
SuratApparal SEZ	Vanj, Surat	Apparel	56.64
Essar Power SEZ	Suvali, Surat	Power	180.00

Source :msme

The three existing SEZ could be an opportunity for the proposed waterway. Apart from these SEZs, there were two proposed SEZ, Gems &Jewelry SEZ and Essar Hazira SEZ, which was an Engineering SEZ. However, both these SEZs are denotified from the SEZ status due to recession and Government's decision of removing tax benefits.

Upcoming Infrastructure

- Fulwari Bridge- This bridge is under construction.

4.3 Existing and proposed Industries

Gujarat contributes nearly 16% to country's industrial production. Its industrial growth has averaged to about 15% in the last couple of years. The state has the highest industrial production share in Soda Ash, Salt, Castor Seeds, POL, and Drugs & Pharmaceuticals. Gujarat has a manufacturing share of over 50% in POL, 31% in chemical and 45% in pharmaceuticals. On the back of such large-scale production in a wide range of industrial segment, Gujarat has been able to contribute almost 19% to India's total exports of merchandised goods and services.

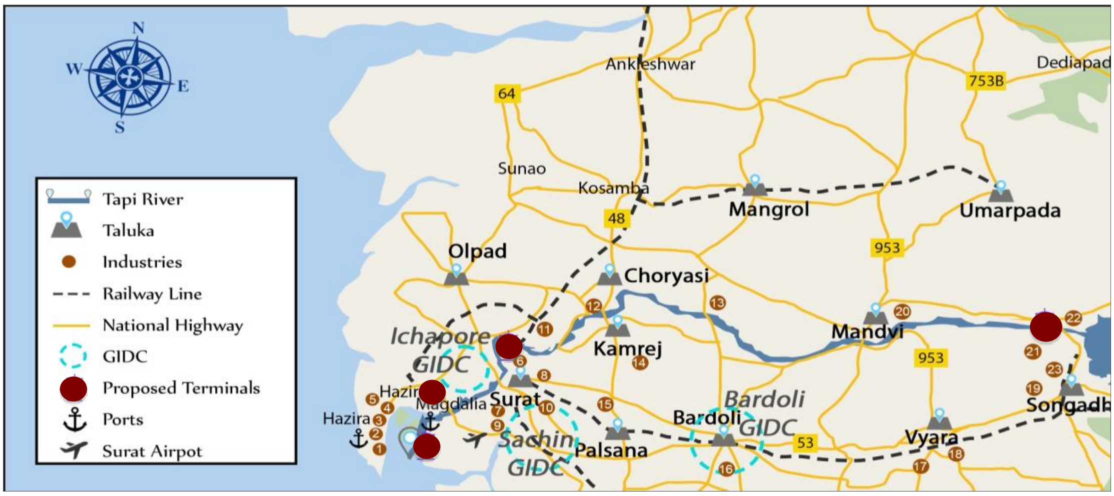
There exist several medium and large scale industries in the districts located in the catchment area of River Tapi. The table below presents a list of industries in these districts.

Table 4-20 Industries in the Catchment Area of River Tapi

Major Industries	Location	Distance(Km) Hazira Port		
		Roadways	Railways	River Tapi
Surat Lignite Power Plant	NaniNaroli	74	62	81
Ukai Thermal Power	Ukai	135	117	123
Sugen Power	Kamrej	57	30	58
Utran Gas Based Power	Surat	38	28	37

Major Industries	Location	Distance(Km) Hazira Port		
		Roadways	Railways	River Tapi
Hazira LNG (SHELL)	Hazira	0	0	0
Reliance	Hazira	10	0	20
Vyara Tiles	Vyara	9	93	100
Larsen & Toubro	Hazira	4	0	17
Essar Steel	Hazira	5	0	10
Gujarat Ambuja Cements	Magdalla	26	N/A	20
JK Paper Units (CPM)	Songadh	114	110	123
KHRIBHCO	Hazira	16	0	20
GSFC	Kosamba	61	47	55
Hindustan Chemical	Surat	24	36	34

Figure 4-16 Industries in the catchment area



Name of Industries marked :1 – Essar, 2 – L & T, 3 – Reliance, 4 -ABG Cement, 5 – NTPC, 6 – KRIBHCO, 7 – GSFC, 8 – Sudhir Power Plant, 9 – Kejriwal Industries, 10 – Satyam Traders, 11-Utran Gas Power Plant, 12 – Sugen Gas Power Plant, 13 – Mandvi Sugar Factory, 14 -Sunpack Industries, 15 – Manglam Industries, 16 – Honest Machinery, 17 – Ramesh Chemicals, 18 – Vyara Tiles, 19 – Golden Era Group, 20 – Kakrapar Atomic Power Station, 21 – Ukai Thermal Power Station, 22 -Ukai Hydro Power Plant, 23 - JK Paper Plant.

Gujarat State Fertilizer Corporation Ltd. (GSFC)

The manufacturing unit is located at Kosamba. The unit produces Nylon yarn and Nylon-6 chips & Engineering Plastic grade chips. The production capacity for nylon yarn is 6000 MT and that of nylon-6 chips is 2000 MT. The capacity of engineering plastic grade chips is 2000 MT.

Hindustan Chemical Company

The manufacturing unit is located at Surat. It produces hydrogen cyanide and cyanide based products such as Sodium Cyanide, Potassium Cyanide, Diphenyl Guanidine, Sodium Ferro cyanide etc. It exports the products all over the world.

Ukai Thermal power Plant

It is located near Ukai Dam on the banks of Tapi River in Tapi district. It is maintained by Gujarat State Electricity Corporation Ltd. It has total 5 units i.e 2 units of 120 MW each, 2 units of 200MW each &5th unit of 210 MW and the 6th unit of 500 MW. The total power generation capacity is 1350 MW.

Surat Lignite Power Plant

It is located in Mangrol Taluka of Surat. It is a coal lignite based power plant. It has 2 plants with 2 units each. Each unit has a capacity of 125 MW. The total capacity of both plants is 500 MW. The plant is maintained by GIPCL. The plant has a captive mine GIPCL has acquired mines in Mangrol-Vatsal mines for extraction of coal. The approved annual coal consumption is 4.2 MMTPA. The power generated is then supplied to Gujarat Urja Vikas Nigam Ltd through a power purchase agreement.

Essar group

Essar Power has 2 units in Hazira. The units have a capacity of 135 MW each. These units are run by fuels like coal, correxgas simultaneously. Also, Essar steel uses pulverized coal for PCI (Pulverized Coal Injection) technology for their blast furnace. The Pulverized Coal proportion used as fuel is up to 160 kg/thm (ton of hot metal).Essar Steel is located at Hazira in Choryasi. It is located on the banks of the river Tapi. It is one of the largest producer of flat steel in India. The annual production of the Hazira plant is 10MMTPA. It also has a captive port, power plant, lime and oxygen plant.It also consists steel plate mills and pipe mills.Essar Power has 2 units in Hazira. The units have a capacity of 135 MW each. These units are run by fuels like coal, correx gas simultaneously.

J K Paper Units

It is located in Songadh. It has 2 paper-manufacturing units in Gujarat and in Orissa. The combined capacity is 4,55,000 TPA.

JK Paper is exporting paper to Middle East and pan Asia. Between FY15 and FY16, its exports jumped by nearly 300% from 12,900 MT to 48,533 MT. The company has been scouting for means to expand its operations, chief being their effort to increase the area under plantation in Myanmar and at home. If these future expansions were to take shape, export may receive further boost.

Currently, on the western coast, the company uses Mundra Port, Nhava Sheva at JNPT, and Cochin Port to export their cargo. Some volume also gets exported via air using Delhi and Bombay airports, and ICDs like the ICD Ludhiana. Most of this export volume is shipped from the company's Gujarat unit.

JK Paper also imports raw materials like pulp from countries such as Indonesia, Sweden, Finland, and USA. For treating paper, the company imports chemicals like Hydrogen peroxide, Hydragloss-90 Kaolin Clay from countries like Thailand, Turkey, Brazil, and China. Also, the company has been improving its plants' efficiency, resulting in lower utilization of chemicals required for the finished paper treatment. It is container cargo therefore not considered as cargo for River Tapi.

Vyara Tiles Pvt. Ltd

It is into manufacturing of concrete flooring solutions. It has 2 plants in the catchment area i.e. at Vyara in Tapi District and Palsana in Surat district. The combined production capacity is 100000 sq. mt. per month. Some of its products are paving blocks, concrete cobbles, flagstones, kerbstones etc. It supplies its products to Govt. authorities, Malls, Multiplexes, container Yards, real estate developers, temples, SEZs and industries like Reliance, KHRIBCO, Adani, NTPC etc.

HIL Ltd.

The manufacturing plant is situated at Golan, Valod. It manufactures green building materials, producing roofing solutions, panels, walling blocks, plywood substitutes, high-quality pipes and fittings, and industrial insulation. The production capacity of this plant is 3 lakh cubic metres. The company exports its products under the brand Charminar to the Middle East, Far East, Asia and Africa.

Reliance Industries

It is located at Mora Village, Choryasi. It has a multiproduct plant, which handles various petrochemicals, polymers, polyester and polyester intermediates. It consists of a naphtha cracker plant. It also has a 360 MW captive cogeneration power plant which uses coal and gas for power generation.

Larsen and Toubro

The Hazira manufacturing division of L&T has 3 subsidiaries- L&T Heavy Engineering, L&T Special Steels and Heavy Forgings and L&T MHPS Boilers Pvt. Ltd. It caters to manufacturing large sized equipment for Process Plant, Nuclear and Defence sectors. LTSSHF is a joint venture between L&T and NPCIL (National Power Corporation of India) It caters to specialized requirements of Nuclear, Refinery, Petrochemical, Power, Ship Building and Heavy Engineering Industries. L&T MHPS Boilers Pvt Ltd. provides Pressure Parts and Pulverisers for super critical boilers at Hazira in Gujarat.

KRIBHCO

Krishak Bharati Cooperative Ltd (KRIBHCO) is a Multi-State Cooperative Society. The plant is located at Hazira. It is engaged in the production of fertilizers. The annual production capacity of Urea is 2.19 MMTPA and that of Ammonia is 1.24 MMTPA. They produce both solid and liquid bio-fertilizers at Hazira plant.

ABG Cements

ABG Cements is a subsidiary of ABG shipyards. It has a plant located at Hazira. The annual production capacity of the cement plant is 6 MMTPA. It also has a captive jetty here, which can handle cargo upto 4.95 MMTPA. ABG Energy-a sister concern, provides power to the facility by developing a plant of 2x 50MW especially for the cement plant.

ABG Cement has set up 4 MMTPA clinker plant at Thumri, Bhuj in Gulf of Kutch. As per ABG plans, it would bring 4 Million tonnes of clinker from Thumri to Hazira using barges of 10,000 DWT. The entire clinker would be transported using barges from Jetty in Thumri to Jetty in Hazira.4 Million tonnes of clinker coupled with limestone, fly ash, etc would produce 6 Million tonnes of cement. The finished goods i.e. Cement will be dispatched by various modes of transportation viz Road, Rail & ships to various markets of India.

ABG Cement (rechristened to Vadraj Cements) has set up a 6 MMTPA Cement Plant in the village of Mora in Hazira. The location of the plant shares boundary wall with KRIBHCO plant. KRIBHCO jetty is the nearest jetty as of today for ABG cement for any marine related cargo handling. Vadraj Cement has acquired approx 50 Ha. of land consisting of 17 Ha. private land as well as 33 Ha. of government land for this project. The company is planning to import clinker for this cement plant. Although the plant is already set up, but due to financial reasons, it is yet to become operational. It is anticipated that the company will start operations soon, and will be importing clinker regularly from its clinker plant in Kutch. The company has plans to setup its own captive jetty for all marine operations. So, they are likely to move clinker using coastal movement from Tumri to Hazira.

ABG cement could be a prospective customer for the proposed waterway on RiverTapi. The finished cement could be distributed in the region using inland route and the waterway. If needed, a part of it could be moved through coastal route for a small period of time. Moreover, clinker for the plant in Mora village can also be targeted, and unloaded at a facility alongside the existing KRIBHCO jetty.

4.4 Commodity Composition / Categorization

The commodities handled at Tapi catchment area are Iron Ore, Coal, Steel, Containers, Naphtha, fertilizer, LNG, Para- Xylene, limestone, cement clinker, fertilizer etc. The volume of these commodities are shown in the below table. Iron Ore is handled majorly here, followed by Coal and Naphtha.

Figure 4-17 Total trade in Tapi Catchment

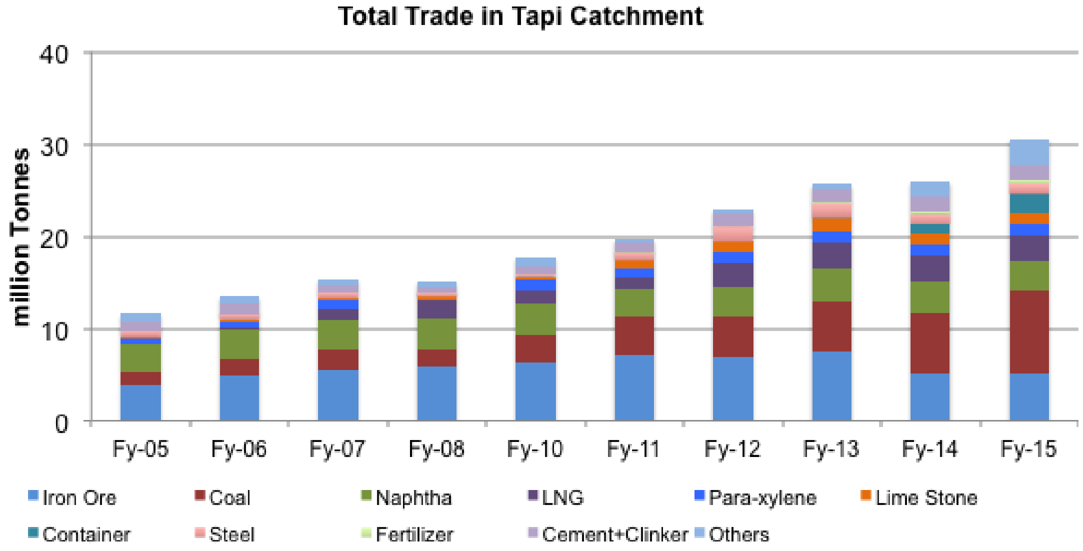


Table 4-21 Commodities handled at the catchment area of Tapi

million tonnes

	Fy-5	Fy-6	Fy-7	Fy-8	Fy-10	Fy-11	Fy-12	Fy-13	Fy-14	Fy-15
Iron Ore	3.9	5.0	5.5	6.0	6.4	7.1	6.8	7.4	5.1	5.1
Coal	1.4	1.8	2.3	1.8	3.0	4.1	4.4	5.4	6.6	9.0
Naphtha	3.0	3.1	3.1	3.3	3.3	3.0	3.3	3.6	3.4	3.1
LNG	0.0	0.2	1.1	2.0	1.3	1.1	2.5	2.8	2.8	3.0
Para-xylene	0.7	0.7	1.0	0.1	1.2	1.1	1.2	1.2	1.2	1.2
Lime Stone	0.2	0.3	0.2	0.3	0.4	0.8	1.2	1.5	1.2	1.0
Container	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	2.2
Steel	0.7	0.6	0.7	0.4	0.3	0.8	1.6	1.6	1.1	1.1
Fertilizer	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.3	0.4
Cement+Clinker	1.0	1.1	0.8	0.7	0.9	1.0	1.4	1.5	1.6	1.6
Others	0.8	0.8	0.6	0.6	0.9	0.3	0.4	0.5	1.7	2.8
Total	**11.6**	**13.5**	**15.4**	**15.1**	**17.7**	**19.7**	**22.9**	**25.6**	**26.0**	**30.6**

Source : GMB

Table 4-22 Details of companies in the catchment and the commodities handled

Commodities	Volume (M Tonnes)	Trade	Usages	Company
Iron Ore	5.06	Coastal	Captive	Essar
Coal	9.01	Coastal/EXIM	Captive/Multiuser	Essar/NTPC/Others
Naphtha	3.15	Coastal	Captive	Reliance
LNG	2.98	Import	Multiuser	Others
Para-xylene	1.20	Coastal/EXIM	Captive	Reliance

Commodities	Volume (M Tonnes)	Trade	Usages	Company
Lime Stone	1.03	Coastal/EXIM	Captive	Others
Container	2.19	EXIM	Multiuser	Others
Steel	1.11	Coastal/EXIM	Captive	Essar
Fertilizer	0.43	Import	Captive	KRIBHCHO
Cement+Clinker	1.57	Coastal	Captive	Ambuja Cemet
Others	2.85	Coastal/EXIM	Captive/Multiuser	Essar/Reliance
Total Volume	30.56			

Source : GMB

Table 4-23 Potential Commodity Traffic for River Tapi

Commodity	Traffic (M T)	Owner	IWAI Perspective	Reasoning
Iron Ore	4.8	Essar Jetty	No	Essar imports coal and iron ore for its steel plant at its Captive Jetty in Hazira. This cargo is unlikely to shift anywhere else. The unloaded coal gets consumed in plant.
Coal - Essar	6.5	Essar Jetty	No	
Coal - Adani		AHPPL	No	Coal imported by Adani port is mostly used by local industries
Coal - GMB		GMB Jetty	No	GMB jetty at Magdalla handles coal which is used by the industrial belt in the region such as Surat, Valsad, Hazira. Being a dirty cargo, IWAI can't handle it at the proposed facility
Project Cargo	0	L&T	No	Larsen & Toubro has its heavy engineering division and cell at Hazira. It has a captive loadout jetty. The Project cargo fabricated are load out and sent using coastal routes
Cement + Clinker	1.6	Ambuja Cement	Maybe	Though Ambuja Cement has a captive jetty, the company is evaluating possibility of moving bulk cement in containers. Based on the economic advantage over transportation mode, it could either use KRIBHCO jetty or expand its own captive jetty to handle these containers.
Clinker	3.3	Vadraj Cements (Fomerly ABG Cements)	No	The company is anticipating initiation of cement manufacturing at their Mora plant soon, and they have plans to import clinker, of up to 3.3 MMTPA. Close proximity to KRIBHCO jetty is an opportunity for handling this import cargo using the River Tapi waterway.
Liquid	3.6	Reliance	No	Captive Jetty and SPM of reliance for handling liquid cargo. Liquid cargo can't be handled at the new facility

Commodity	Traffic (M T)	Owner	IWAI Perspective	Reasoning
Fertilizers	0.4	KRIBCHO	No	Fertilizer is handled at KRIBCHO jetty. This jetty has been categorised as private jetty. It could handle
LNG	3	HPPL	No	The company has dedicated LNG terminal. This cannot handle any other cargo. Nor could LNG, due to the sophistication involved, be shifted to any other place. Evacuation of LNG is mostly using pipelines. Hence, there is no role for river transportation at this stage
Container	2.2	AHPPL	No	Adani group has developed a deep draft container terminal. This is used for trade of containers in EXIM and coastal trade.
Others	8.6	Essar Jetty/Reliance	No	Includes commodities like Steel & HR Coils, which is handled at Essar's captive jetty. Therefore, they can't be catered to by IWAI
Total	**33.9**			

Coal & Lignite

Gujarat has very high reserve of lignite. The total reserve of the whole state is 2,722 MMT. Coal is mainly used for power generation. There are many power plants in Gujarat, which use coal and lignite for generating power. The lignite reserves in Surat are 663.20 MMT. The Ukai Thermal Power Plant consumes 4.49 MMTA of coal. Surat Thermal power plant uses 3.33 MMT lignite for power generation. There are captive power plants with Essar Power and Nakoda Industries Ltd.

Others

Fly Ash

Main sources of fly ash are the coal based power plants. Fly ash is a fine powder, which is a by-product from burning pulverized coal in power generation plants. Fly ash is an important raw material in producing cement, tiles and blocks. It can also be used for paving of roads and can be blended in concrete. Ukai thermal power plant generates 1.53 MMTA of fly ash. Surat Lignite Thermal power plant generates 0.43 MMTA of fly ash. Fly ash can be utilized by various nearby cement manufacturing plants such as ABG Cements, Gujarat Ambuja Cements, Lafarge Cements, Vadraj Cements, and Ultratech Cements.

Soyabean Meal & Molasses

Earlier, Ruchi Soya Industries used to export Soyabean Meal (SBM) using GMB Jetty. Similarly, Ashwani Shipping used to export Molasses from the GMB Jetty. The last time Molasses export was handled at this jetty was in FY09. Ashwani Shipping had exported around 6,000 MT of commodity. Both Molasses and SBM handling have been discontinued at the jetty. The chief reason was excess focus on handling dirty cargo, with compatible handling facilities and infrastructure in place for such commodities. Also, Molasses is a by-product of Sugar production. Sugar trade is extremely cyclical in nature, and bulk of this exim volume is dictated by government policy. SBM was discontinued in order to avoid mixing with other dirty cargo during handling. These clean cargoes could resume exports using the River Tapi waterway, provided facilities are created to handle clean cargo. With such an infrastructure in place, these companies can be pursued and persuaded to handle their export volume at the clean cargo jetty.

Ruchi Soya Industries is the largest exporter and trader of SBM. If Ruchi Soya decides to resume export from the proposed facility, their cargo can be targeted by the proposed waterway. Other manufacturers and traders of SBM may also consider moving their traffic via the waterway. In case only Ruchi Soya shows interest, their export volume would be adequate enough to make a terminal on River Tapi commercially viable. On the other hand, molasses' availability will be driven by sugar production. Bumper production would most likely provide small share of molasses for export purposes. However, volatility in the sugar market and government policies cannot ensure this volume either.

Chemical & Fertilizers

Chemicals are used by almost every manufacturing company some way or the other for producing their finished goods. These chemicals are used by rubber, plastics, paints, textiles, and petroleum refinery pulp and paper industries. Therefore chemicals are always in high demand and have a good export value. India is an agrarian country. Therefore the use of fertilizers is on a very large scale. Some of the chemical and fertilizer producing companies in this stretch are GSFC, Prabhat Chemicorganics and Hindustan Chemical Company.

Black Trap

Black trap is a minor mineral, which has huge reserves in Gujarat. The total annual production of black in this stretch is 9.6 MMTA. Black trap has a huge market for it has various uses. It is used of construction activities of roads and railways. And there is a tremendous growth in the infrastructure activities. Therefore black trap has a good market value in Gujarat as well as other states. However, it does not offer any opportunity for Tapi Waterways.

4.5 Originating / Terminating Commodities

The following table depicts the current origin-destination particulars for all the cargo that can be moved using River Tapi post required infrastructure development:

Table 4-24 O-D particulars for potential cargo

Name of companies	Commodity	Volume (M T)	Origin	Destination
Ukai Thermal Power Plant	Coal	0.6	Hazira Anchorage	Ukai
	Fly Ash	0.3	Ukai	Surat
Ruchi Soya Industries Ltd	Soya	0.1	MP	KRIBHCO

Erstwhile, imported variety of coal was moved via rail from Hazira Port to the Ukai TPP. Now Ukai TPP uses only domestic coal via rail route from Chhattisgarh mines. Once coal import resumes, the import coal variety can be moved using River Tapi, and unloaded at a terminal alongside the plant. Fly ash, as return cargo, can also be moved along the same route. Currently, around 70% of the fly ash generated at the plant is utilized by domestic consumers. This distribution is either carried out using road or rail. Every thermal power plant intends to achieve 100% utilization of the fly ash they generate. Currently, Ukai TPP is left with an unutilized fly ash volume of 20%-30%, which it disposes off. River Tapi can help this fly ash volume reach several cement manufacturers in Surat district.

Ruchi Soya and other SBM refiners in Madhya Pradesh have their units located in west and southwest parts of the state. Kandla Port Trust and JNPT are the preferred port for these companies. Until FY01, these refiners exported small volume of SBM from Magdalla Port. Availability of a clean cargo handling facility along River Tapi can persuade these companies to resume their export operations. Such infrastructures at or near KRIBCHO jetty can serve these export volumes.

4.6 Passenger Traffic

There is no passenger traffic on the rivers of Gujarat, yet. All the rivers are well connected with roads running parallel to it. Several bridges line these rivers at regular intervals. Hence, there is no passenger movement across any rivers. This leaves little-to-no scope for developing passenger traffic infrastructure on River Tapi.

4.7 Tourism Traffic

Surat and Tapi, collectively, account for nearly 4.3% of the total tourist traffic in Gujarat. Surat is home to exotic places of worship like Parsiagiaris and Europian tombs. It offers tourist attractions like Surat Castle, Sardar Vallabh bhai Patel Museum, Andrews Library, and Planetarium. The district is also in close proximity to famous beaches like Dumas beach and Hazira beach. The district offers recreational activities like Water Fun Park, Aquacity Water Park, Joy-n-Joy Amusement park, all of which are easily accessible from Surat City. At a distance of 90 Km from the city, Ukai Dam on the bank of River Tapi has the potential of attracting tourists. The district provides many classes of accommodation at hotels like Holiday Inn, Lords Park Inn International, Central Excellency, and Hotel Embassy.

Nandurbar district also holds potential for attracting tourist on account of 108 temples in just one village Prakasha. Located alongside River Tapinear Maharashtra border, around 5 lakh tourists visit the village, especially, between June and August every year. The district has tourism attractions like religious sites of Asthambha and Gorakhnath Temple; natural attractions like Toranamal Forest and Khadki Point; and lakes like Yashwant Lake and Lotus Lake. However, since this district is beyond the waterway-designated stretch of River Tapi designated, these tourism opportunities are immaterial.

Table 4-25 Tourism Traffic – Gujarat (‘000 units)

Origin	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Within Gujarat	12,285	13,077	15,062	17,176	19,536	22,161
Other Indian States	3,227	3,624	4,355	4,728	5,356	6,061
NRI	181	203	257	285	316	338
Foreign	114	107	139	175	201	228
Total	15,808	17,011	19,812	22,364	25,409	28,788

Source: Ministry of Tourism, Gujarat

The above table depicts the growth in tourism traffic in Gujarat since FY09. Influx of tourists has almost doubled, driven mostly by domestic tourists. There has also been a constant uptick in the visits by travelers from outside the state and foreign visitors.

The table below gives a yearly breakup of tourist inflow in districts relevant to River Tapi. Tourism industry in the Maharashtra district of Nandurbar isn’t as exhaustively documented as those of districts in Gujarat. Hence, tourist traffic for certain years has been estimated based on the trend between FY09 and FY14.

Table 4-26 Tourist Traffic in Catchment area of Tapi

District	2008-2009	2009-10	2010-11	2011-12	2012-13	2013-14
Surat&Tapi	6,80,763	7,65,473	13,33,123	14,10,563	17,05,117	18,42,109
Nandurbar	2,738,738*	2,360,582	1,982,425*	1,647,685	1,383,732*	1,162,063*

Source: Various state’s Ministry of Tourism, “” means estimates*

It can be inferred from the above table that Surat has best prospects for tourism. The district has several tourist attractions and close proximity to other tourist spots in the region, including Tapi. This should continue to contribute to the state’s flourishing tourism industry.

4.7.1 *Tourist Attraction – Surat*

There are plenty of tourist hotspots, particularly in and around Surat city. The following figure depicts the site of the recently opened floating restaurant on River Tapi near Weir Cum Causeway. A first for the state of Gujarat, this restaurant is designed with pirates theme, named 'Pirates Voyage'. Owned by the city-based PP Savani Group, the restaurant can accommodate 200 patrons.

A company called Blue Adventure, an adventure sports arm of Diamond Trading Company (DTC), provides similar floating facilities upstream at Singanpore near Weir Cum Causeway. Its infrastructure comprises a water sports facility, a floating restaurant, and boating services. The company has launched another similar facility at Mota Varachha. This facility targets a larger population, particularly from regions like Varachha, Katargam, Simada, Kamrej, Sarthana and Amroli.

Figure 4-18 Existing Tourism activity in River Tapi

Figure 1 : Restaurant on water surface

Figure 2 : Boating Service

Figure 3 : Location for Dining at Causeway

Figure 4 : Open Place for Future Development

Figure 4-19 Amusement Parks around River Tapi

The figure above shows sites of some of the parks around River Tapi. Some of the major attractions are Water Fun Park (a.k.a. Chab Chaba Chab Water Park), Aquacity Water Park, and Neverland Water Park. Amaazia Water Park was launched in December 2016, and is purported to accommodate close to 3,000 visitors per day.

The following table lists some famous tourist spots in the catchment area of River Tapi. This region has an assortment of facilities and services to attract tourists, including places of worship, recreational facilities, restaurants, gardens, parks, and museum.

Table 4-27 Tourist spots in the catchment area of River Tapi

Tourist Place	Distance (Km)
Surat Dutch Garden	0
Sardar Patel Museum	1.3
Chintamani Jain temple	1.7
Surat Castle	0
Blues Adventure	0
River front walkway	0
Dandi	22
Kapileshwar Temple	24
Lake Gopi	2.7
Dumas Beach	Mouth of the river
Sarthana Nature Park	1

Source : Gujarat Tourism

Surat Dutch Garden

The Dutch garden in Surat is essentially cemeteries of the officers who landed and settled in Gujarat on their business ventures. Dutch garden is one of the most significant gardens in Surat. The striking features of the English and Dutch cemeteries are their huge and imposing tombs. Tombs of Christopher Oxenden and George Oxenden, two English traders who took charge of the English Factory in Surat, are the biggest ones in the English cemetery. The tomb of Baron Adrian Van Reede, who was director of the Dutch Company in India, stands out in the Dutch cemetery.

Sardar Patel Museum

The Sardar Patel Museum in Surat is a multipurpose museum, which is located in Sonifalia. It plays host to several pieces of antiques such as that made of wood, metal, ivory, stone, sandalwood, porcelain and terracotta. Several old oil paintings, miniatures, textiles, manuscripts and many such other items are also displayed in the exhibition organized by this museum. This is the only museum in Surat that has gained a lot importance owing to its rich collection of ancient historical items, which are important part of the national heritage too. One will come across 10, 000 specimen of various arts and crafts at this place. There is also an open-air theater that can accommodate about 4000 people at a time. A visit to this museum will bring forth the dormant history of Surat.

Chintamani Jain temple

Built in 1699 AD during the rule of Aurangzeb this temple is one of the oldest temple in Surat. Located in Moraji Nagar area of Surat, it is easily accessible from any part of Surat. Chintamani Jain Temple is a brilliant piece of creativity and skill with intricately and beautifully carved designs on the wood; the ceilings bore paintings made from natural vegetable colour. The paintings depict Acharya Hemachandraji, King Kumapal and other Solanki kings. Being a religious place of worship, this Jain temple is also a specimen of the 17th century art. This temple is well connected by the roadways.

Surat Castle

One of the popular heritage monuments in the city; it is also known as Old fort. Located on the banks of River Tapi it serves as a tourist destination and was made by the Gujarat Sultanate as a safeguard against Portuguese. The fort is now used by the government as their office, the top of the fort provides a marvelous view of the city and River Tapi. One can avail bus services to reach this place.

Blues Adventure

Located at the basin of Tapi on the Singanpore side of Weir-cum-Causeway, this place offers water sports adventure such as Jet-Ski, Kayaking, Speed Boats, Pedal Boats, Leisure Boats, Banana Boat ride, Bumper Rides, it offers water park as well as amusement and also food stop. This place is a popular attraction among children and teenagers.

River front walkway

With River Tapi as the view, this walkway is famous among local people for the occasional leisure walks. It serves as Public recreation and entertainment and is project done by Surat Municipal Corporation.

Dandi

A village in Jalapore district, Dandi has become one of the tourist attractions because of the place it finds in India's historic independence struggle. The village was the epicentre in Mahatma Gandhi's fight against the British regime while protesting their salt laws. In today's time, the village attracts tourists, primarily, at the Dandi beach.

Kapileshwar Temple

Situated on the confluence of Tapi and Panzara River, Kapileshwar Temple was built by Ahilyabai Holkar of Indore in 17th Century. Situated at the village of Mudawad in the Dhule district, Maharashtra, the deity of Lord Shiva is worshipped at this temple.

Galteshwar Mahadev Temple

Located a few metres away from River Tapi, this temple is accessible by roads and is next to Bodhan Flyover.

Lake Gopi

Gopi Talav is a lake in the Gopipura locality in the city of Surat in Gujarat state of India. In 2012, the lake was renovated by Surat Municipal Corporation and the area surrounding it was redeveloped as a recreational facility. The area has been divided into seven zones; the diamond zone, food zone, environment zone, history zone, communal harmony zone, textile zone and Surat nu Jaman. There is an upcoming amusement park called Future Zone.

Dumas Beach

It is a popular tourist destination in Surat. It is located around 21 km from Surat city. The promenade of the beach has several food stalls attracting more people. There is a temple of Dariya Ganesh adjacent to the beach. The beach is rumoured to be haunted as there a Hindu Crematorium nearby. Another attraction here is the floating restaurant- Pirates Voyage. The vessel has a lower and upper deck and can accommodate upto 200 people at a time. It also has permission to sail in the deep sea to provide a unique experience to the tourists.

Figure 4-20 Location near Dumas Beach

Sarthana Nature Park

It is a zoo located in near Kamrej, Surat Dist. It is spread across 81 hectares adjoining the Tapi River from the north. It is the first zoo in Surat. It has a variety of species of mammals, birds and reptiles. The zoo is segmented in three zones- entrance zone, central habitat zone and hospital and amenities zone.

4.7.2 Tourist Attraction – Tapi

The following table lists some of the major tourist attractions in the district of Tapi. The district has plenty of places of worship that attracts domestic visitors, and has the potential of drawing in foreign visitors, too.

Table 4-28 Tourist place in the catchment area of River Tapi

Tourist Place	Distance (Km)
Fort of Songadh	12
Gaumukh Temple	23
Ukai Dam	0
Dosvada Dam	22
Parsuramji and Suryatapeshwar Temple	2
Kalyanraiji Temple	11
Gayatrimata Temple	63

Source : Gujarat Tourism

Fort of Songadh

The King Pillaji Rao Gaekwad between 1729 and 1766 built the Fort. The fort was built atop a high hill to serve as a vantage point to monitor enemy movements. Located in the Songadh town of the Tapi district, the fort's architecture borrows influences from both the Mughals and the Marathas. To improve the fort's accessibility, currently marred by bad roads, the district administration has proposed revamping of the fort. Ukai Dam nearby serves as a complementary tourist attraction for people visiting the fort. Additionally, a lake along with walkway is also being developed at the foot of the fort for tourism.

Gaumukh Temple

Situated in the town of Songadh, Gaumukh Temple is the oldest Lord Shiva temple. The temple is enveloped by forest on all sides, lending to its popularity among the local masses. Monsoon is the best period to visit the temple.

Ukai Dam

Constructed on the bank of River Tapi, Ukai Dam is the largest reservoir in Gujarat, and is purported to hold nearly 46% of the total storage capacity of the state. It was built in 1972, and is meant for irrigation, power generation, and flood control. Also known as Vallabh Sagar, the Dam has good road and rail connectivity. It is an earthen dam constructed out of sand and stones, and serves as a great tourist attraction.

4.8 Passenger Ferry Terminal Ro-Ro Traffic

There is no existing or upcoming passenger ferry terminal on Tapi River

4.9 Growth Trend

In the current context, business prospects for the envisaged waterway on River Tapi are modest, especially with respect to cargo traffic. River Tapi waterway has a high probability of catering to tourism traffic. In terms of cargo traffic, there exists low to moderate possibility of attracting some exim cargo.

Cargo Growth

Major companies like ABG Cements (Vadraj Cements), Ambuja, Essar, Reliance, and L&T have their plants in the River Tapi catchment. However, these companies have their own captive/private jetty already in place for handling cargo.

A major source of cargo traffic could be the coal requirements for Ukai Thermal Power Plant. Around 80% of their requirements are met by procuring coal from Chhattisgarh mines. The plant currently utilizes Bhusawal-Surat route to transport this coal. These are transported via rail, and unloaded at the plant's own rail siding. However, Bhusawal is beyond the stretch of River Tapi waterway earmarked for commercial operations. Therefore, this volume from domestic mines cannot be targeted by River Tapi. Besides indigenous coal, Ukai TPP used to meet its remaining requirements from imported coal variety. This coal landed at Hazira Port, and was moved to the plant via railway. Once import resumes, this 10% share of coal traffic could be a cargo handling opportunity for River Tapi.

Fly ash, a byproduct of burning coal at power plants and an essential constituent in manufacturing cement, can also be moved via River Tapi. Requirements for fly ash in the catchment area exist for companies like Gujarat Ambuja Cement, Lafarge Cement, Vadraj Cement, and UltraTech Cement. Currently, Gujarat Ambuja Cement sources fly-ash from its power plant in Kodinar. Similarly, ABG Cement meets its fly ash requirements from its power unit ABG Energy Ltd. The company also has some major expansion plans in the pipeline and has proposed a captive handling facility for the same. This leaves out any scope for ABG to use River Tapito move its cargo.

If a terminal is set up that can cater to clean cargo, then Ruchi Soya can use River Tapi for exporting SBM. Adopting the logistics it once used for exporting SBM using Magdalla Port, a clean-cargo handling facility may enable the company to resume export. The draft restriction across River Tapi permits movement of only 2,000 DWT barges. Therefore, Ruchi Soya would use this waterway for lighterage operations only. For Ruchi Soya, KRIBHCO jetty could be the most suitable location. The jetty is currently handling fertilizers by way of lighterage. However, KRIBHCO is not interested anymore in handling a third-party cargo at its jetty. So, another jetty right next to KRIBHCO's would be the best possible alternative.

Tourism Growth

There is no passenger terminal operating on the river at the moment. Roadway and railway connectivity around the river leaves limited scope for developing Ro-Ro terminal for handling passenger traffic. Therefore, at present and in future, there exists no possibility for starting a Ro-Ro service on River Tapi.

There are a lot of famous tourist spots along River Tapi. Such places attract more than 5,000 visitors every weekend. A developed city like Surat has a high concentration of high-income individuals. This population tends to frequent tourist hubs in and around the city on a weekly and daily basis. With all-round development plans, chief being the plans to transform Surat into a smart city, tourism should receive a tremendous fillip in the near future.

Comparison between FSR and DPR Traffic

The following table gives a brief comparison between the potential cargo for River Tapi waterway, as judged by the FSR and DPR:

Table 4-29 Comparative Analysis of FSR with DPR

Commodity	Source	Considered in FSR	Potential	Reasoning
Coal	Imported Coal from Hazira	✓	✓	Only domestic coal is considered in FSR. Domestic coal is obtained from Chhattisgarh mines, which doesn't fall in the proposed River Tapi stretch. Ukai TPS earlier used15% - 20% imported coal. This volume can be transported from Hazira to Ukai via waterways once import resumes.
Fly Ash	Ukai TPS	✕	✓	It is obtained from Ash Handling plant at Ukai TPS. It can be transported to various cement plants in Surat via waterways.
Black Trap	Mines in the catchment area	✓	✕	It is used as a construction material, and totally consumed locally.
Fertilizer	Industries in the catchment area	✓	✕	Fertilizer Industries are very far from the proposed cargo terminal.
Sand	Sand Mining	✓	✕	Sand mining is illegal in the state
SBM	Ruchi Soya & other MP Refiners	✕	✓	Magdalla has a history of handling SBM, now discontinued. This volume can be moved on River Tapi by handling it at an alternative facility alongside KRIBHCO jetty.

Coal from domestic mines for Ukai TPP will not shift to River Tapi for the reason mentioned above. The analysis suggests that only the imported coal volume can make use of River Tapi waterway. Similarly, the plant can transport its leftover fly ash using River Tapi to one of the several cement plants in the Surat district.

SBM was not considered in FSR, but analysis herein indicates potential for this cargo. Drawing upon the past SBM handling at Magdalla Port, same operation is possible at an alternative facility that could be set up on River Tapi.

4.10 Forecasting & Potential IWT Assumption

The navigational development of Tapi river will be performed in 2 different phases. In the first phase, development of Tapi from mouth, Dumas to Old Fort, Chowk Bazar will be done whereas second phase will include Old Fort, Chowk Bazar to Ukai TPP. Phase 1 will finish by 2020, while Phase 2 will start from Fy 2025 and finish by Fy 2027.

Table 4-30 Development phases for River Tapi

<table>
<tr><th>Phases</th><th>Terminals</th><th>FY19</th><th>FY20</th><th>FY21</th><th>FY25</th><th>FY26</th><th>FY27</th><th>FY30</th><th>FY45</th></tr>
<tr><td>1</td><td>Terminals 1 & 2</td><td colspan="2">Development</td><td colspan="6">Operation</td></tr>
<tr><td>2</td><td>Terminals 3 & 4</td><td colspan="3"></td><td colspan="3">Development</td><td colspan="2"></td></tr>
</table>

Source: Mantrana Maritime Advisory Pvt. Ltd.

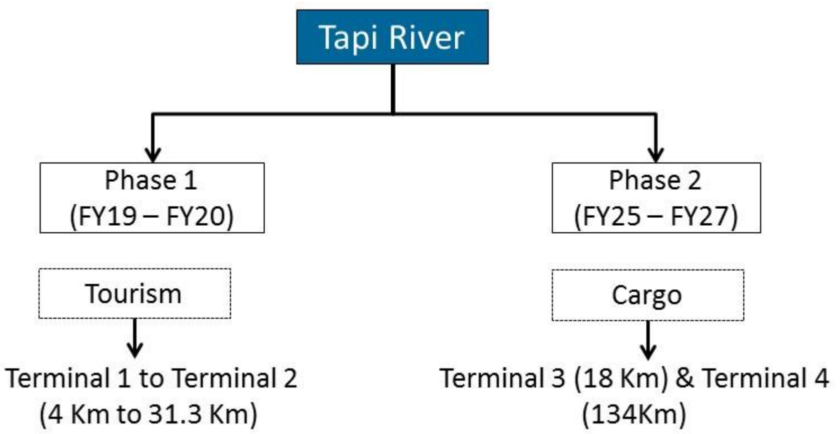
Table 4-31 Detailed Phase-wise Development of Tapi River

Phases	Terminals	Chainage (kms)	Type of Development	Type of Terminal	Locations	Phase Schedule
1	Terminal 1	-	Terminal & Stretch	Tourism	Dumas Beach	FY19 - FY20
	Terminal 2	31.3			Old Fort, Chowk bazaar	
2	Terminal 3	18		Cargo	KRIBHCO Jetty	FY25 - FY27
	Terminal 4	134			Ukai	

Source: Mantrana Maritime Advisory Pvt. Ltd

In phase 1, 3 terminals, first (Tourism, Chainage – 4 Km), second (Tourism, Chainage – 31.3 Km) & in phase 2, third (Cargo, Chainage – 18 Km) and fourth terminal (Cargo, Chainage-134 Km) will be developed along with navigable stretch for cargo as well as tourism movement.

Figure 4-21 Flowchart of Phase-wise development of River Tapi



The above flowchart depicts the rationale behind the traffic study, and the driving factors for the projections undertaken herein:

- Business opportunities for River Tapi is analyzed across Primary Hinterland (distance under 25 kms from River Tapi) and Secondary Hinterland (distance beyond 25 kms from River Tapi)

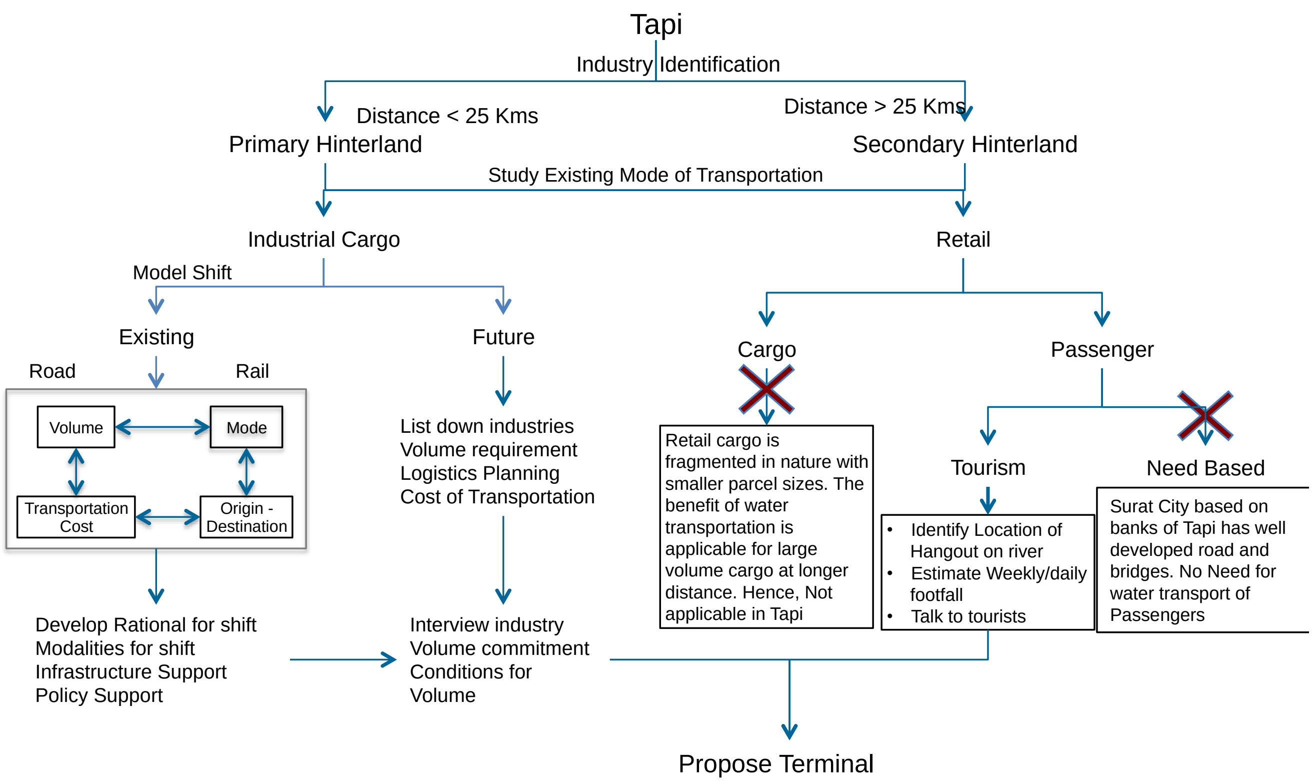
- From tourist traffic perspective, both the hinterlands were researched and analyzed. Analysis pointed at traffic potential from tourism industry. There are also some prospects from passengers who travel around the region on a daily basis, but not as tourists.

    - Specific to the tourism industry, involving domestic and foreign tourists, high-potential spots were evaluated. Probable daily and weekly footfall at these locations were determined by surveying and based on government reports.

    - For traffic driven by passengers, the city of Surat provides adequate and diverse forms of connectivity. Addition of water transport will be redundant, and unlikely to have any impact overall.

- Cargo traffic was distinguished between requirements for industries spread throughout the region (industrial cargo) and for retail businesses (retail cargo).

Figure 4-22 Rationale for the traffic study and the projections



- Retail cargo warrants smaller parcel sizes, and is extremely fragmented. River Tapi waterway is suitable for specific origin-destination nodes, and for larger cargo volume.

- Industrial cargo is studied based on the share that can be diverted from cargo that is currently moved using road and rail modes. New potential customers are also evaluated. For new customers, primary research was conducted to look for companies that could utilize River Tapi.

- Attracting traffic from existing cargo movement entails shifting from the current road or rail transport mode.

    - For cargo currently moved on road and rail, the volume and logistics cost between the designated O-D was ascertained. Analysis revealed cargo potential, and justification to attract some share of the existing cargo movement.

    - Similar line of approach was applied for new companies that could utilize the proposed waterway. Probable volume and conditions for committing to the proposed waterway was determined by interviewing these companies.

- Finally, based on the above understanding, factual certainties, and probable future developments, terminal(s) were proposed to cater the potential traffic.

There are adequate business prospects to make River Tapi a commercially viable waterway. The district of Surat has plenty of tourist attractions, contributing to the state's growing tourism industry. Water Adventure parks operated by Blue Adventure is a step in this direction. Similar facilities along the river are needed to further strengthen the region's image as a tourism hub. Concurrently, there is a need to develop passenger/tourism infrastructure for ferry movement between Old Fort, Chowk Bazar and Dumas Beach.

Existing industries have the necessary cargo-handling infrastructure at ports like Magdalla and Hazira. Adequate well-developed jetty and ports infrastructure are available for these parties. Also, these companies are unlikely to add to their existing infrastructure in the immediate future. Still, there exists cargo opportunities for a terminal near Ukai Thermal Power Plant to handle coal. Another opportunity is for a jetty near KRIBHCO jetty to handle SBM for Ruchi Soya.

Assessment of the secondary hinterland indicates uncertain and negligible prospects. This is primarily because of availability of other viable routes for industries in this hinterland. For instance, to the north of River Tapi, River Mahi and River Narmada can compete for the same cargo. Here, the distance difference is likely to work in favour of the competing routes. In the south, there aren't enough opportunities for River Tapi to target. Also, customers from these regions, including Maharashtra, will find River Tapi commercially unviable and logistically counterintuitive.

Chowk Bazar Traffic

Surat is a highly industrialized and congested city. With a population of 4.6 million, the city doesn't have enough open space for its inhabitants. For recreation and leisure, the local population frequents the banks of the river on a weekend basis. An estimated 2,500 each local residents were used to visit floating restaurant and amusement park near Singanpore Site of Weir Cum Causeway on weekends (Saturday & Sunday), and nearly 500 each on weekdays. But due to some unknown reasons, it is closed now. Surat Municipal Corporation has invited parties to develop sea face, Entertainment Park, leisure tourism, laser show, food and other recreational activities near location of Surat Old Fort / Castle, Chowk Bazaar at the bank of river Tapi. This location is almost 2 Km before Singanpore weir. There is a possibility that the locals who used to visit the blue's adventure at Singanpore weir will now visit this Old Fort site. These numbers may rise on the back of development of more and better infrastructure. We have estimated 3500 people on weekends (Saturday & Sunday) and 1000 people on week days (Monday to Friday) taking into account floating restaurant and amusement park traffic at Singanpore weir. Table 4-4-32 shows the projection for tourist traffic at the bank of Surat Old Fort site on weekend basis, weekday basis, and annual basis. Annual traffic forecast was computed by extrapolating weekly traffic for 52 weeks per year.

Table 4-32 Projected Tourist Traffic at Old Fort, Chowk Bazar ('000 units)

Tourism Traffic	Fy 21	Fy 25	Fy 30	Fy 35	Fy 40	Fy 45
Recreational Centre	624	849	1,247	1,576	1,917	2,333

Recreational Activities include sea face, Entertainment Park, leisure tourism, laser show, food. Year-over-year (y-o-y) growth in tourist footfall in the district of Surat has been climbing, but at an inconsistent growth rate. So, a reasonable assumption of 8% y-o-y growth for traffic at Weir-cum-Causeway has been applied for first 10 years then 4% growth rate is considered for rest of projected years till Fy 45. Additionally, the initial assumption stems from the current estimate of visitor traffic at the Causeway, which are around 3500 during weekends and 1000 on weekdays.

At present, recreational facilities such as water parks and amusement parks should result in a healthy tourist turnout at the Weir-cum-Causeway and around the city of Surat. Owing to this, it is proposed that river tourism along with ferry services between Dumas and Old Fort, Chowk Bazar be developed. To further enhance the tourism industry, boat rides between Old Fort, Chowk Bazar and the Dumas Beach should also be given a serious consideration. Such a service may serve the visitors well who frequent the river banks. For the aforesaid reasons, two terminals at the following locations for tourism should be developed:

- ***Dumas Beach***
- ***Old Fort, Chowk Bazar***

Tourism traffic at the Terminals

Tourism in Surat is driven mostly by business visitors. In 2015, the city saw close to 2 million visitors, of which nearly 90% were on business visits. This leaves a smaller section of the visitors to engage in recreational and leisure activities in and around the city of Surat. So, for projecting tourism traffic at the terminals, a modest 15% of the total tourism traffic, as projected in Table 4-32, has been considered. These tourists, visiting the district, are also likely to use the ferry services at the terminals.

Terminal Traffic	Fy 21	Fy 25	Fy 30	Fy 35	Fy 40	Fy 45
Boat Ride (Dumas to Old Fort)	94	127	187	236	288	350

Cargo Traffic at Terminal 3 & 4

Ukai TPP hasn't announced any expansion plans for the near future. Using this as the basic assumption, above projection maintains the current coal requirement of 4.5 Million T constant for the projected period, as per Central Electricity Authority (CEA). Government of India has circulated a guideline, imploring thermal power plants to minimize, or even abandon, import of coal in favour of domestic coal. However, this suggestion will not be translated on ground as long as import coal remains cheaper than sourcing domestic varieties. Also, importing coal is far more viable for a coastal power plant, than relying on domestic and, relatively, inferior quality coal. Ukai TPP had stopped importing coal since last few months, precisely, for this reason. There are uncertainties regarding possible resumption, and it's due to this ambiguity that we have assigned no coal import for FY18. It's very likely that the plant will continue to import coal because of the associated cost advantage. However, the import share is unlikely to exceed the recommended 30%, due to inherent design constraints. Consequently, most power plants adhere to this advised blend ratio of 30:70 in favour of domestic coal.For this purpose, the traffic projections assumes import share increasing at CAGR of 4%, peaking at 20% in FY45. The plant's import share will be assumed to be 10% by since FY29. This share is then assumed to increase to 20% at the end of Fy 45.

Fly ash is a by-product of mostly domestic coal. As per above discussion, the share of domestic coal will not differ significantly throughout the projected period. Currently, plant generates 1.3 Million T – 1.5 Million T annually, bulk of which is consumed in local manufacture of bricks and other construction materials. Unutilized fly ash volume at the plant was 0.3 Million T in FY16 and 0.5 Million T in FY15. A modest volume of 0.2 Million T of the unutilized share is assumed for projection purposes. It's estimated that it will ship this volume to cement plants in and around Surat using River Tapi. It's also assumed that the plant would gradually shift to waterway to distribute the share of fly ash it currently is able to utilize and distribute locally by other modes. An estimated 35% of the total 1.5 Million T fly ash can be moved using River Tapi by FY45. This means fly-ash traffic on River Tapi will grow at a 20year CAGR of 3%.

Projection for SBM is based on the assumption that SBM exports will be resumed by companies that once utilized Magdalla. The proposed Terminal 3 alongside KRIBHCO jetty could handle a volume of 0.2 Million T at least, which is what Magdalla normally handled. It's also assumed that a small share of cargo, currently dispatched to Kandla Port on rail, might come to this terminal. By FY45, it's assumed that Terminal 3 will handle 0.8 Million T of SBM. This translates into growth at a 26-year CAGR of 11%.

4.11 Terminal wise IWT Traffic Analysis

The figure below depicts, roughly, the locations proposed for the setup of terminals for tourism and cargo operations. In phase 1, Terminal 1 & Terminal 2 is being advocated only for tourism. Ferry services from Dumas beach to Old Fort, Chowk Bazar could act as a major tourist attraction. Tourists can enjoy the scenic beauty of Surat and the famous Dumas Beach. Various water parks and theme parks on the stretch, particularly near Old Fort, Chowk Bazar and Dumas Beach, will attract visitors looking for recreational or leisure activities. In phase 2, Terminal 3 & 4 is being advocated only for cargo purpose. Terminal 3 is being proposed to be set up to handle SBM from Ruchi Soya and other refiners from MP. Lastly, Terminal 4 should be set up near Ukai TPP to handle coal and fly ash.

Figure 4-23 Proposed Terminals on River Tapi

Terminals	Location	Lat. / Long.	Chainage (Km)
Terminal 1	Dumas	21° 5'26.86"N / 72°42'13.15"E	-
Terminal 2	Surat Old Fort, Chowk Bazar	21°11'44.04"N/ 72°48'59.72"E	31.3
Terminal 3	KHRIBHCO Jetty	21° 8'48.17"N / 72°42'38.26"E	18
Terminal 4	Ukai	21°15'26.80"N / 73°34'7.03"E	134

Table 4-33 Proposed terminal distance matrix in Phase 1

Proposed	Place	Location	Purpose	Chainage (km)
Terminal 1	Dumas	21° 5'26.86"N / 72°42'13.15"E	Tourism	-
Terminal 2	Old Fort, Chowk Bazar	21°11'44.04"N/ 72°48'59.72"E	Tourism	31.3

Table 4-34 Proposed terminal distance matrix in Phase 2

Proposed	Place	Location	Purpose	Chainage (km)
Terminal 3	Near KRIBHCO Jetty	21° 8'48.17"N / 72°42'38.26"E	Cargo	18
Terminal 4	Ukai TPP	21°15'45.64"N / 73°34'7.03"E	Cargo	134

4.11.1 Terminal 1 & 2 Analysis (Phase 1):

Dumas Beach (Terminal 1)

Among the tourists that visit the Weir-cum-Causeway, not all are likely to visit Dumas Beach. This segregation assumption informs the overall analysis of tourist traffic at Terminal 1 at Dumas Beach. The traffic estimation is driven by the future population growth in the state. Based on the past trend, state population should grow at a y-o-y rate of 8%. In the same vein, the consultant has assumed that 8% of total tourist traffic of Weir cum Causeway would visit Dumas Beach using River Tapi. This traffic is estimated to grow at a pace similar to the state's population, i.e. 8%.

Old Fort, Chowk Bazar (Terminal 2)

For Tourism projection, the consultant has considered 3,500 people visiting the place every weekend, (Saturday 3500 and Sunday 3500). On weekdays (Monday-Friday), it's estimated that 1000 people will visit proposed facilities like development of sea face, entertainment Park, leisure tourism, laser show, food & other recreational activities. Assuming 8% population growth every year, the consultant has projected 8% annual growth in tourism traffic for first 10 years and then 4% growth rate for rest of years till Fy 45.

Table 4-35 Projected tourism traffic at the terminals ('000 visitors)

Tourism Traffic	Fy 21	Fy 25	Fy 30	Fy 35	Fy 40	Fy 45
Recreational Centre	624	849	1,247	1,576	1,917	2,333

Annual traffic forecast has been estimated by extrapolating weekly traffic for 52 weeks per year.

The above projections are a modest estimate of the overall tourism traffic that the proposed terminals will witness every year. The numbers may grow manifold if the planned encapsulation of Surat and Navsari into the twin city of Surat-Navsari materializes. Gujarat's Ministry of Tourism estimates this to be completed by the year 2021. Similarly, transformation of the city of Surat into a full-fledged smart city should further add to the estimated tourism traffic in the district and the terminals.

Terminal Traffic (Terminal 1 to Terminal 2)

Table 4-36 Terminal Tourism Traffic ('000 visitors)

Terminal Traffic	Fy 21	Fy 25	Fy 30	Fy 35	Fy 40	Fy 45
Boat Ride (Dumas to Surat Old Fort)	94	127	187	236	288	350

Source: Mantrana Maritime Advisory Pvt. Ltd.

4.11.2 Terminal 3 Analysis (Phase 2)

The terminals suggested for handling probable cargo for clean cargo for Ruchi Soya, will be flanking KRIBHCO's existing jetty. The following image is a tentative location suitable for developing Terminal 3.

Figure 4-24 Potential location for Terminal 3 alongside KRIBHCO

A captive cargo handling facility for Vadraj Cement is proposed alongside KRIBHCO jetty for clinker import. The company is already on the lookout for a facility to undertake its marine-related operations. The existing KRIBHCO jetty is a suitable location, on account of the cement plant's proximity to the jetty. Another cargo handling facility (Terminal 3) is proposed alongside KRIBHCO jetty to handle SBM for Ruchi Soya. Other traders or manufacturers looking to handle clean cargo can target this facility in future. The following table provides an estimate of the initial traffic Terminal 2 may handle if Ruchi Soya decides to use it to export SBM:

Table 4-37 Commodity wise traffic estimate for Terminal 3

Industries	Commodities	Traffic Estimates (M T)	Reasoning
Ruchi Soya	SBM	0.1	This conservative estimate is driven by the last known SBM volume handled by Magdalla, which was around 80,000 MT in FY01.

Source : Ruchi Soya Industries

Madhya Pradesh (MP) accounts for nearly 2/3rd of SBM production in the country. The state is responsible for maximum SBM export in the country, shipped via ports like MbPT, JNPT, KPT, and Mundra. In Gujarat, Kandla Port Trust (KPT) handles the largest volume of SBM. In FY15, KPT handled more than 68% of the SBM exported by the country. All the export cargo that originates from Madhya Pradesh (MP) mostly gets dispatched to KPT, followed by MbPT/JNPT, Bedi, and Mundra. Besides major players like Ruchi Soya, smaller export volumes from other smaller manufacturers in MP are consolidated by traders and export houses. The consolidated cargo is then shipped to ports, preferably KPT. Most manufacturers prefer KPT and ports in Maharashtra due to the prevalent bulk SBM handling at these ports. Before discontinuing clean cargo operations at Magdalla, the port handled 83,975 MT of SBM in FY01. Prior to that, the port was handling nearly 0.2 Million T of SBM. Owing to these reasons, SBM is a prospective cargo that can be moved using the River Tapi. A significant volume can be expected from Ruchi Soya, influenced by which other smaller manufacturers may follow suit. Preliminary estimate suggests that Terminal 3 can attract SBM traffic of around 0.1 Million T in the foreseeable future (Fy 28). However, it is imperative that proper clean-cargo handling facilities are set up first.

The following table depicts projections for Terminal 3:

Table 4-38 Traffic projections for Terminal 3

Commodity (M Tonnes)	Fy 20	Fy 25	Fy 30	Fy 35	Fy 40	Fy 45
Soyabean	0.1	0.1	0.2	0.3	0.4	0.8

A very low volume is being targeted for SBM traffic via River Tapi. Here, the major assumption is that the proposed Terminal 3 will be able to replicate SBM traffic handling once seen at Magdalla Port. Over a period of time, the Terminal should witness some growth by attracting a small share from the volume that gets shipped via Kandla Port. By FY45, Terminal 3 is expected to handle 0.8 Million T, growing at a 26-year CAGR of 11% throughout.

4.11.3 Terminal 4 Analysis (Phase 2)

The following table lists the cargo, and preliminary estimates of the cargo volume Terminal 4 can target:

Table 4-39 Commodity wise traffic estimate at Terminal 4

Industries	Commodities	Traffic Estimates (MT)	Reasoning
Ukai Thermal Power Plant (1350 MW)	Coal	0.6	4.5 Million T of coal is used in Ukai TPP. At present, only domestic coal is used for power generation. Earlier, a mixture of indigenous and imported coal was used. In the event import resumes at the plant, transport of this cargo volume can be done by using River Tapi.

Industries	Commodities	Traffic Estimates (MT)	Reasoning
	Fly ash	0.3	For 100% fly ash utilization, the company can transport the leftover fly ash, currently around 20% - 30% of the total generated volume, using River Tapi.

Source : GSEC, 2016

Ukai TPP will be the main customer for Terminal 4. The plant consumes 4.5 Million T coal per annum, as per the estimates from Central Electrical Authority (CEA). The Terminal will commence operations by targeting 10% of the total imported-coal requirement (0.5 Million T), growing to a maximum share of 20% (0.9 Million T) by FY45. This is applicable only when import operation resumes in the near future. This volume can be moved on River Tapi using by. Also, there are no immediate expansions planned at the power plant. Therefore, Terminal 4 is likely to handle only 0.9 Million T of coal for the foreseeable future.

The Ministry of Environment & Forests had issued a direction, requiring all the coal/lignite based thermal power plants to achieve 100% utilization of fly ash they generate. An environmental hazard, the byproduct finds use in construction-related industries. As of 12th Five Year Plan, such plants were unable to achieve 100% utilization. Specific to Ukai TPP, 1.5 Million T and 1.3 Million T of fly ash was generated in FY15 and FY16, respectively. During these periods, the plant could achieve a utilization level of 67% and 79%, respectively. In FY15, close to 25% of fly ash was used in making fly-ash based bricks, blocks, tiles, etc. This utilization share rose to nearly 50% in FY16. Almost 25% of the fly ash was utilized in production of Portland Pozzolan Cement (PPC) in both the years. The leftover fly ash, around 0.5 Million T in FY15 and FY16, respectively, is likely to have been disposed off. Instead, this small volume can be transported using River Tapi to the cement manufacturers in Surat region. Cement plants have also been making efforts to increase fly ash volume in manufacturing PPC. With plans to make Surat a smart city and to combine it with Navsari into a twin city, Surat district should witness an increase in infrastructure development projects. One such ambitious project involves development of a state-of-the-art Multimodal Transportation Hub (MMTH). The project entails redevelopment of Surat railway station, the state transport bus terminal, and development of common facilities. The project includes commercial development on a 0.25 Million sq. mt. land in the central part of Surat city. A joint venture special purpose vehicle (SPV) will be formed among Indian Railways, Gujarat State Transport Corporation Limited, and Surat Municipal Corporation for the project. This project serves as another business opportunity for the Ukai plant, where it could supply the leftover fly ash by moving it via River Tapi. In the current context, this is a prospective cargo. So, the volume estimation cannot exceed the fly ash volume Ukai plant is unable to utilize in a given year.

The following table depicts projections for Terminal 4 along River Tapi:

Table 4-40 Traffic projections for Terminal 4

Commodity (MTonnes)	Fy 28	Fy 30	Fy 35	Fy 40	Fy 45
Coal (Terminal 4)	0.6	0.7	0.7	0.8	0.8
Fly ash (Terminal 4)	0.3	0.3	0.3	0.3	0.3

The major underlying assumption for coal traffic projections is import volume not exceeding 25% of the total requirement at Ukai TPP. The peak traffic volume of 0.9 Million T is likely to be moved by FY45 using River Tapi. The Terminal is estimated to handle 0.7 Million T coal by Fy 30, crossing 0.9 Million T by FY45.

Applying moderation, River Tapi will represent movement of 0.4 Million T of fly-ash volume by FY45. With no additional source of this cargo, fly ash will constitute a meager share to the overall traffic at Terminal 4, if the traffic on River Tapi were to at a 20-year CAGR of 3%.

4.12 Need for new Port/Jetty

The following table shows the traffic handled at the ports located in River Tapi catchment area, along with its current capacity and expansion plans for the same:

Table 4-41 Traffic, existing capacities, and expansion plans for ports around Tapi

Port	FY 16 Traffic (MT)	Current capacity (MMTPA)	Future expansion plans
Magdalla Group of Ports	21.6	(approx.) 37	Essar's bulk terminal capacity 20 MMTPA expansion
HPPL	3.4	5	Plans to double its capacity to 10 MMTPA
AHPPL	7.8	84	Increasing total capacity to 234 MMTPA
Total	**32.8**	**126**	

Source: GMB, HPPL, and other web resources

All the ports in the catchment area, viz. Magdalla Group of Ports, AHPPL, and HPPL saw a cumulative traffic of nearly 33 Million T in FY16. These ports have a total handling capacity of nearly 126 MMTPA. This indicates that the current cargo handling capacity at these ports is nearly 4 times the traffic that is being handled. Moreover, Essar bulk terminal under Magdalla Group of Ports has announced capacity expansion of 20 MMTPA. Shell, too, intends to double its current LNG handling capacity at HPPL to 10 MMTPA. Lastly, AHPPL has ambitious expansion plans, which will increase its existing capacity of 84 MMTPA to 234 MMTPA. Post expansion plans, the total cargo handling capacity will be more than double the existing capacity at these ports. At the same time, traffic handling at these ports is unlikely to satisfy these capacities, let alone outstrip it. The glut of handling capacity at these ports ensures that there will be no requirement for an additional port in this region. Besides the terminals proposed to handle cargo on River Tapi, development of a full-fledged port is not recommended.

However, Floating jetties at Dumas beach & Old Fort should be considered keeping tourism development near Surat City as there is no place for recreational activities. Following terminal can be developed based on present traffic studies.

Dumas Beach (Terminal 1)

Among the tourists that visit the Weir-cum-Causeway, not all are likely to visit Dumas Beach. This segregation assumption informs the overall analysis of tourist traffic at Terminal 1 at Dumas Beach. The traffic estimation is driven by the future population growth in the state. Based on the past trend, state population should grow at a y-o-y rate of 8%. In the same vein, the consultant has assumed that 8% of total tourist traffic of Weir cum Causeway would visit Dumas Beach using River Tapi. This traffic is estimated to grow at a pace similar to the state's population, i.e. 8%.

Old Fort, Chowk Bazar (Terminal 2)

For Tourism projection, the consultant has considered 3,500 people visiting the place every weekend, (Saturday 3500 and Sunday 3500). On weekdays (Monday-Friday), it's estimated that 1000 people will visit proposed facilities like development of sea face, entertainment Park, leisure tourism, laser show, food & other recreational activities. Assuming 8% population growth every year, the consultant has projected 8% annual growth in tourism traffic for first 10 years and then 4% growth rate for rest of years till Fy 45.

Table 4-42 Projected tourism traffic at the terminals ('000 visitors)

Tourism Traffic	Fy 21	Fy 25	Fy 30	Fy 35	Fy 40	Fy 45
Recreational Centre	624	849	1,247	1,576	1,917	2,333

Annual traffic forecast has been estimated by extrapolating weekly traffic for 52 weeks per year.

The above projections are a modest estimate of the overall tourism traffic that the proposed terminals will witness every year. The numbers may grow manifold if the planned encapsulation of Surat and Navsari into the twin city of Surat-Navsari materializes. Gujarat's Ministry of Tourism estimates this to be completed by the year 2021. Similarly, transformation of the city of Surat into a full-fledged smart city should further add to the estimated tourism traffic in the district and the terminals.
Terminal Traffic (Terminal 1 to Terminal 2)

Table 4-43 Terminal Tourism Traffic ('000 visitors)

Terminal Traffic	Fy 21	Fy 25	Fy 30	Fy 35	Fy 40	Fy 45
Boat Ride (Dumas to Surat Old Fort)	94	127	187	236	288	350

Terminal 3 **(Phase 2)**

The terminal suggested for handling probable cargo for clean cargo for Ruchi Soya, will be flanking KRIBHCO's existing jetty.

Terminal 4 **(Phase 2)**

Ukai TPP will be the main customer for Terminal 4. The plant consumes 4.5 Million T coal per annum, as per the estimates from Central Electrical Authority (CEA). The Terminal will commence operations by targeting 10% of the total imported-coal requirement (0.5 Million T), growing to a maximum share of 20% (0.9 Million T) by FY45. This is applicable only when import operation resumes in the near future. This volume can be moved on River Tapi using by. Also, there are no immediate expansions planned at the power plant. Therefore, Terminal 4 is likely to handle only 0.9 Million T of coal for the foreseeable future.

CHAPTER – 5

TERMINALS

5.1 General Review

Terminal is a place where a particular type of cargo is handled. Terminals can be classified as general cargo terminal, bulk cargo terminal and passenger terminals. Inland water terminals are different from sea terminals in the sense that water levels during flood and dry season varies considerably.

5.2 Identification and site location

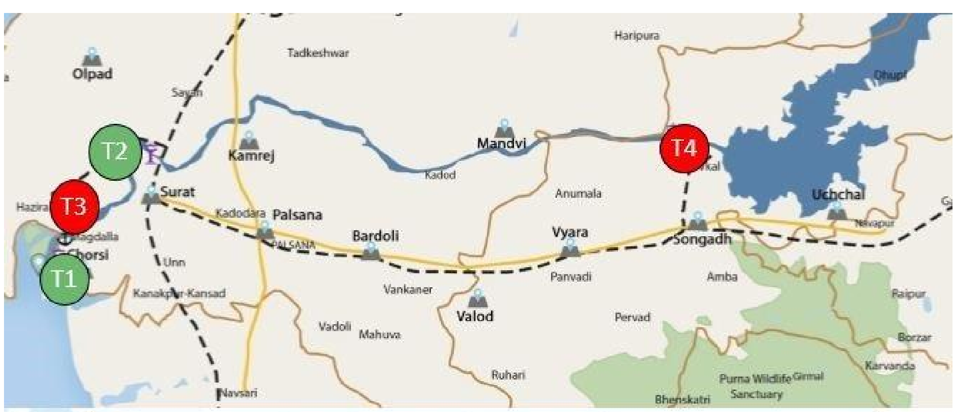
Site selection is the most important factor as it dictates investments for establishing the terminal facilities. Therefore, utmost care is taken to select most reliable locations to minimize the capital and the recurring cost for the terminals.

Ferry service from Dumas beach to Old Fort, Chowk Bazar will attract tourist. Tourist could enjoy the scenic beauty of Surat and the famous Dumas Beach. They can take ferry to reach Old Fort, Chowk Bazar to enjoy recreational activities. Terminal 4 will be developed near Ukai Thermal Power plant, which can be used for transporting imported coal.

Table 5.1 Proposed Terminals on River Tapi

Proposed Terminals	Location	Chainage(km)
Terminal 1	Dumas Beach	-
Terminal 2	Old Fort, Chowk Bazar	31.3
Terminal 3	Near KRIBHCO Jetty	18
Terminal 4	Ukai	134

Fig. 5.1 Proposed Terminals on River Tapi



Terminals	Location	Chainage (Km)	Purpose	Development
Terminal 1	Dumas	-	Tourism	Phase 1
Terminal 2	Old Fort Chowk Bazar	31.3	Tourism	Phase 1
Terminal 3	KRIBHCO Jetty	18	Clean Cargo	Phase 2
Terminal 4	Ukai	134	Coal/FlyAsh	Phase 2

5.2.1 Criteria for Selection of site

I. River morphology and behaviour
II. Stable river channel with natural depths so as to avoid problems of scouring or siltation at the terminal locations. This also reduces the capital cost as well as annual recurring cost on maintence dredging and training works.
III. Hydraulic conditions to be favourable for berthing of barges and cargo handling operations during most part of the year.
IV. Adequate backup space to be available for cargo handling operations and for providing ancillary facilities.
V. Better connectivity to rail and road transport.
VI. Location should be close to traffic centres.
VII. Site so selected should be favourable for the projected traffic as well as for future development.

5.2.2 Description of selected sites

5.2.2.1 Terminal – 1 (Dumas)

Proposed Terminal 1 will be situated at Dumas Beach which is famous for scenic beauty. It is centre of attraction for tourist. It is located around 21 km from Surat city. The promenade of the beach has several food stalls attracting more people. There is a temple of Dariya Ganesh adjacent to the beach.

5.2.2.2 Terminal – 2 (Old Fort, Chowk Bazar)

Site for proposed terminal 2 is at Old Fort, Chowk Bazar on the left bank of Tapi River. It serves as a tourist destination and was made by the Gujarat Sultanate as a safeguard against Portuguese. The fort is now used by the government as their office, the top of the fort provides a marvelous view of the city and River Tapi.

5.2.2.3 Terminal – 3 (KRIBHCO Jetty)

Krishak Bharati Cooperative Limited (KRIBHCO) owns and operates a jetty near its plant. This is a fair-weather lighterage jetty located on the south of Gujarat. It is located at latitude 21°08’48.17” N and longitude 72°42’38.26” E in Surat district. KRIBHCO jetty falls under Magadalla port of Gujarat Maritime Board. The jetty of KRIBHCO is located in the South Gujarat, surrounded by some of key industries of Gujarat. The jetty was developed back in 1980 for loading/unloading of heavy equipment required for the construction of KRIBHCO’s fertilizer complex in Hazira. The jetty was soon rendered useless due to heavy siltation at the site. In 2009, the facility was reopened following revamping. It has setup a fertilizer complex to manufacture Urea, Ammonia & Bio-fertilisers at Hazira on banks of river Tapi. Its manufacturing unit is located 15 kms from Surat on Surat – Hazira state highway. It has Reliance Petrochemical plant located west of it.

The Jetty is primarily being used for importing Urea from Oman's OMIFCO, a JV promoted by IFFCO and KRIBHCO with the Oman Government. The jetty also caters to exim requirement of the western region. The reconstruction of the jetty includes dredging of the approach channel to allow lighterage. The 147-m-long and 30-m-wide wharf will also be repaired and refurbished. The wharf will handle barges of 3,000 DWT. KRIBHCO is handling & marketing 50% of the urea produced by OMIFCO. Private jetty of KRIBHCO is operational and presently handles OMIFCO vessels .The Jetty has competitive advantage of rail/road link for faster evacuation. GOI has signed a long term agreement to purchase urea produced by OMIFCO. In Fy -16 OMIFCO production was 2 mn T. This is an assured cargo.

KRIBHCO handled close to 0.4 million tonnes of Fertiliser at its Jetty. Unlike Magdalla Jetty KRIBHCO has the rail connection; it also has its own rakes.

5.2.2.4 Terminal – 4 (Ukai)

This site is located at approximately 3km downstream of Ukai Dam on the right bank of river. Site is near to the Hindustan Road Bridge on State Highway No. 174. Site is well connected with State Highway No. 174 which connects NH-6 at Sonagarh. Ukai Thermal power Plant is located near Ukai Dam on the banks of Tapi River in Tapi district. Imported coal can be transported from Hazira to Ukai via waterways. Fly ash can be transported to various cement plants at Surat via waterways.

5.3 Terminal Layout / Master Planning including phases of development

The economic and commercial considerations for master planning are the fundamentals considerations and decision making is straight forward i.e minimizing cost of transportation. Commercial consideration is maximizing profitability of the terminal. Beyond these there are technical considerations as given below.

- **Water related**
- **Land related**
- **Transportation**
- **Traffic related**
- **Cargo related**

5.3.1 Water related

Due to seasonal precipitation there are fluctuations in river flow and the rapid changes in water flow causes shifts in the location of the deep channel and also results in erosion of banks and siltation in access channel. A basic requirement of an inland terminal is to ensure a permanent access to the navigational channel throughout the waterway. An ideal site for terminal should be located on following area:

- A deeper portion of river where channel shifting, sedimentation is less severe.
- On a concave, high bank where the deeper channel is shore line.

Water level Variations

It is also necessary to know variation of water levels in river over the year. The danger level at Shinganpur during floods is 14.1 m MSL. Keeping a freeboard of 1.5 m above the danger level the terminal will be designed with deck level of 15.6 m MSL to ensure safe operation of terminal. Similarly the terminals at other locations have been designed.

5.3.2 Land Related

For terminal planning land related considerations are as follows:

- **Availability of water front land**
- **Soil conditions and elevation**
- **Utilities connections**
- **Environmental and social Impacts**

Availability of water front land

Generally, lands adjacent to river banks are under cultivation due to availability of sweet water for crops. Acquisition of land for the inland terminal has to be done, if Government land is not available. In order to locate the terminal, a conceptualplan of terminal requiring minimum linear water frontage area along with storage area and area required for future expansion is to be planned.

Soil conditions and elevation

For designing and planning of inland terminals soil strata and its elevation from water levels are very essential. Geotechnical investigations are required to be carried out at terminal location as it can substantially affect construction costs.Land areas for loading / unloading and stacking of materials in the terminal aresubjected to high dynamic and static loads due to movement ofheavy lifting equipment along with stacking of heavy cargoes. In case of weak soil strata at the site then it will have to be properly strengthened by proper treatment.

Land elevation is a very important consideration as low lying land is exposed to periodical flooding and may need adequate protection. Another important factor is distance between navigation channel and high flood line as this will decide size offshore structure and cargo handling machinery.

Utilities connections

Utilities such as fresh water connection, sewerage facilities, effluent treatment plant, electricity and telephone connections etc. shall be provided at terminal for efficiently coordinating all activities.

Environmental and Social Impacts

The environmental impacts arising during the dredging and construction activities will be mitigated using required mitigation measures. Both direct and indirect employment potential is anticipated during construction and operations of inland terminal.

5.3.3 Transportation

The terminal should have good road and rail access for efficient connection between the water and land modes of transportation.

5.3.4 Traffic related

To undertake planning of terminal it is necessary to know the volume and type of cargo that is required to be handled. The expected cargo data from various industrialareas has been collected. The traffic data have been compiled in Chapter 4.Terminals have designed based on the traffic potential for various terminals.

5.3.5 Cargo Related

In the present case the main cargo is such as

- Coal
- fly ash
- Cement bags
- Clean cargo

5.3.6 Phasing of Development

Total 4 nos. of terminal have been identified. However, terminals will be developed phase wise.

Sr. No	Phase	Terminal	Chainage	Length of Stretch (km)
1	Phase-1	Dumas Beach – Old Fort, Chowk Bazar	Ch. 0 to Ch. 31.3	19
2	Phase-2	Anchorage – Ukai TPP	Ch. 0 to Ch.134	134

5.4 Land Details

Approximately 2 hectare of land will be required for development of terminal. The land records were collected for the proposed terminal locations.

Table. 5.2 Land Details

Terminal	Location	Land details
Terminal 1	Dumas	Forest land
Terminal 2	Old Fort, Chowk Bazar	Govt. land
Terminal 3	KRIBHCO Jetty	Govt. land
Terminal 4	Ukai	Govt. land

Locations of proposed terminal are shown in Fig. no. PT-01 to PT-03

5.5 Geotechnical Investigations

Geotechnical investigations report is enclosed as Volume-IV.

5.6 Terminal Infrastructure including equipment

Terminal facilities can be grouped into 3 main categories.

- Mooring Structures
- Storage Yard
- Gate and land Transport Access

5.6.1 Mooring Structures

The main function is to secure the vessels / barges in place and to restrain water related movements. The most common provision of mooring is tie in dolphins or tie in can also be provided by anchors buried on bank or in the river. On the piled quay bollards are provided for mooring of barges. Series offenders are provided both on pontoon as well as on piled quay to protect them from impact loads. In case of floating pontoon, the pontoon is anchored or can be secured by means of spuds.

5.6.2 Storage Yard (Phase-2)

The main function of terminal yard includes.

a) Storage of cargo before and after loading or unloading.
b) Parking of trucks.
c) Provision of general services such as equipment maintenance, administrative offices, amenities for labour etc.

5.6.3 Gate and transport access

The main function of the gate and related facilities can be divided into.

a) Cargo and equipment exchange
b) Traffic control
c) Parking
d) General Security.

The gate activities are security check. The gate and the terminal entrance should include a one lane road (in/out) with traffic bumps to slow down the terminal traffic. There must be parking lot for passenger cars.

5.6.4 Water Supply Requirement

It is assumed that 125 liter per capita per day (LPCD) will be required. A total of 100 nos. of personnel consisting of barge operators, crane operators, truck operators and maintenance operators are assumed to be working on the terminal every day. Hence the total water requirement works to be 12500 liters per day. Ground storage reservoir (GSR) and over head tank of suitable size needs to be provided for taking care of this requirement.

5.6.5 Power requirement

There will be two cranes on the terminal at Ukai, each crane will require power of 125 kW, and hence two cranes will require 250 kW of power. The general lighting on jetties, offices and stacking yard will require 60 kW of power. The sewage treatment plant, water treatment plant and water supply will require65 kW of power. Thus a total of approx. 300 kW of power will be required at this terminal. Old Fort, Chowk Bazar and Dumas terminal are passenger terminals. Approx 100 kW of power will be required at these terminals.

5.6.6 Maintenance Workshop

A maintenance workshop may be provided at all the terminals in order to facilitate maintenance of minor nature of material handling equipment and other miscellaneous machines. The workshop may be equipped with following machines.

Table. 5.3 Maintenance Workshop

Sr. No.	Name of Machine	Capacity	Quantity
1	Centre Lathe	250 mm dia job & 1.5 m long lathe	1 No.
2	Radial Drilling Machine	25 mm capacity	1 No.
3	Shaping Machine	300 mm x 300 mm x 300 mm	1 No.
4	Milling Machine	300 mm x 1000 m stroke 1 No.	1 No.
5	Welding Transformer	300 mm stroke 1 No.	1 No.
6	Cutting Machine(Hack Saw)	-	1 No.
7	Sawing Machine(Band Saw)	-	1 No.

5.6.7 Cargo Handling Equipments

Cargo handling equipments are characterized by

- Capacity – Size and type of cargo.
- Distance or reach – the distance
- Speed – the travelling, swinging and hoisting speeds of the various moving components and the resulting overall rate or productivity.

Cargo can be moved in following three principle ways –

- Trucking – rolling of cargoes on wheels
- Lifting – picking up and moving
- Conveying – carrying cargoes continuously

Each cargo handling machine includes combination of the above mentioned principlemethods. The configuration of portal cranes is based on pedestal support structure and elevated turn table. In some designs, the support structures comes with four sets of steel wheels which move on rail tracks mounted on the quay. The driver cab in most of the cranes is elevated to enable an unobstructed view of the entire vessel. The pedestal configuration allows the crane to stand closer to the vessel and use shorter boom and smaller swinging radius.
In the present case a portal mounted crawling crane is proposed. The crane has better reach and swinging ability. One more option is level luffing crane, is based on an articulated boom which allows through counter movements of the two boom segments for leveled traverse travelling because the level movement is more energy

efficient and allows the use of less hoisting cable and accuracy is better when working in small ranges.

Trailers or tippers

The cranes handle cargo vertically. In cargo transportation on land, trailers or tippers will be used.

5.6.8 General Cargo Handling Process

General cargo will involve different sizes and weights, so it is difficult to handle the cargoes efficiently and quickly they must be unitized and palletized. The dispersive units of cargo will be unitized in larger units say 5-10 tons depending on the capacity of the crane. For the forklift to pick it up, the cargo should be mounted on pallets or skids. When General cargo is unitized, cranes or forklifts can be used and transportation by trucks or wagons can be used.

5.6.9 Bulk Cargo Handling Process

The bulk cargo handling process at bulk terminals involves two systems, one island-to water, and another is water-to-land. The land-to-water system is for the unloading of the trucks to storage or direct shipment, and this system is in the use at most inland terminals. The water-to-land system is unloading the vessel to storage and then loading the trucks or railcars.

5.6.10 Cargo Handling Equipment

Cargo handling equipment is the most basic handling equipment at the inland waterway terminals. The equipment will load or unload barges / vessels directly from the truck, or another vessel. The cargo is first transferred between the vessel and dock, held or stored for short period and taken by trucks to the final destination. For cargo handling rubber tyre gantry crane, level luffing crane, fixed crane and forklift etc. are used. Details of cargo handling equipment are given below:

5.6.10.1 Rubber Tyre Gantry Crane

A rubber tyre gantry crane (Fig No. 5.3) is a multipurpose machine and is widely used in inland ports. The crane is not limited to vessel handling but can be used for handling trucks as well. The carriage system is on rubber tyres. The tyre cranes are equipped with outriggers. The capacity of these cranes is 5 to 25 tons in most cases. The crane can move to any place easily and fast which is a merit but operation is slow and lift capacity is lower than level luffing crane. However, during hoisting the tyres can not bear the load of the crane and has to be jacked for sustaining the load hence these are inferior to RMG for speedy loading and unloading.

Fig No. 5.2 Rubber Tyre Gantry Crane

5.6.10.2 Level Luffing Crane

These level luffing cranes (Fig No. 5.4) are used on small inland ports whose throughput is small. It has got four sets of wheels at each corner of structures which enables the crane to move on tracks along the dock. The pedestal configuration allows the cranes to stand closer to the vessel and use smaller boom. Improved boom design called level luffing is based on an articulated boom, which allows through counter movement of the two boom segments for leveled traverse traveling which is more energy efficient and has better maneuverability. These cranes have higher productivity and better reach than tyre cranes. These cranes are operated by electricity thus reducing operational cost.

Fig No.5.3 Level Luffing Crane

5.6.10.3 Grab Type Level Luffing Crane

All general cargo cranes, almost all these cranes can be fitted for handling bulk cargoes. The conversion to bulk cargo handling is quite simple: replacing the hook by a clam-shell or grab attachment and installing additional power (mechanical or electrical). The grab can be attached to any crane system but most commonly it is used with crawler and portal or gantry cranes. Usually, crawler cranes fitted with grabs are very versatile machines; they can both load and unload vessels, and can also load and unload trucks and trains. However, portal and Grab Type Level Luffing Crane (Fig No. 5.5) are usually limited to vessel operation.

The productivity of a grab crane in handling bulk cargo is determined by the capacity (tonnage) of the shell, the path it has to cover and the speed of hoisting, swinging and opening / closing the grabs.

The size of the grab itself is a function of the density of the material it carries; smaller grabs are used with denser and heavier materials on common inland ports. Many ports have been equipped with portal or gantry cranes fitted with grabs to unload the vessels. At present, it is the main method to unload the bulk cargo from vessels.

Fig No. 5.4 Grab Type Level Luffing Crane

5.6.10.4 Fixed Crane

The fixed cranes (Fig No. 5.6) as name suggests can't move on the dock because it has no traveling gear and as such is cheaper and lighter than traveling crane. These cranes are cheaper and are used on small inland ports and can be located on pontoon or on the dock. In the throughput is small fixed cranes are preferable.

Fig No.5.5 Fixed Crane

5.6.10.5 Crawler Crane

The crawler cranes (**Fig No.5.7**) are very versatile and can move on tracks and can both load and unload barges. They can also load and unload trucks. They can crawl on the jetty and take a position wherever loading and unloading is required to be done. This movement of the crane prevents moving of barges/vessels thus reducing the time of loading / unloading.

Fig No.5.6 crawler cranes

5.6.10.6 Forklift

The forklift (**Fig No.5.8**) combines trucking and lifting of cargo units. The inland ports use 3- 5 ton capacity forklift and for larger terminals it may use 10tons. All terminals forklifts are use for loading / unloading or storage in yard or warehouse. These are not used for transport the cargo over large distance. For large capacity transport trailers can be used over a large distance. Forklifts are probably the most common cargo handling and moving machine. Their versatility is achieved through various attachments which either go over the forks or simple replace them.

These are generally used for handling general cargo such as steel plates, paper bales, coils etc.

Fig No.5.7 forklift cranes

5.6.10.7 Belt Conveyor

The belt conveyor is probably the most common piece of equipment in material handling. The main advantage of the conveyor is that it usually offers the lowest costal tentative for horizontal movement of cargo. This is an important property in inland areas. The main disadvantage of conveyor stems from the fact that it provides only a point-to point connection and requires fixed support structures, unlike dump trucks and loader, which can move anywhere.

The belt conveyor consists of a belt and idlers, or rollers, which support the belt. The idlers and the belt are usually arranged either “flat” or “troughed”, depending on the properties of the material to be conveyed. Flat belts fit materials which have a steep repose angle (e.g. damp sand) while troughed belts fit lumpy materials (e.g. coal and ore). In addition to the belt and idlers, each conveyor has a support structure, a feeder and discharge device (for loading and unloading) and a tension-maintaining arrangement.

The capacity of the conveyor is the function of the belt width, speed and of course, the specific weight of the conveyed material. The speed is mainly determined by the size of the particles. The speed is adjusted to avoid dust in powdery material and spillage in bulky material. Energy consumption, is a function of both density and speed, and is another consideration. It is important to note that the conveyer is only a means to move materials between machines. Therefore, the conveyer capacity is not only a function of its speed but also a function of the endpoint capacities where the material is fed onto / from the belt.

5.6.10.8 Gantry Stacker and Reclaimer

The gantry stacker and reclaimer (**Fig No.5.9)** and boom stacker and reclaimer are handling and transfer machines in the inland ports, their characteristics and operations are the same, but the configuration is different. The gantry type is more efficient and economical than the boom type. The gantry stacker and reclaimer is composed of the main gantry and conveyer beam, two legs mounted at the two ends of the top beam, under which the truck can move, and two gears of the bucket wheel mounted on the conveyer beam, it is powered by electricity. The two bucket wheels can move along the conveyer beam to discharge the bulk cargo from the stockpile.

Fig No.5.8 Gantry stacker and Reclaimer

5.6.10.9 Handling Attachments

In handling the cargo, cranes or forklifts, from the hatch of the vessel or truck, special tools – Handing attachments such as,

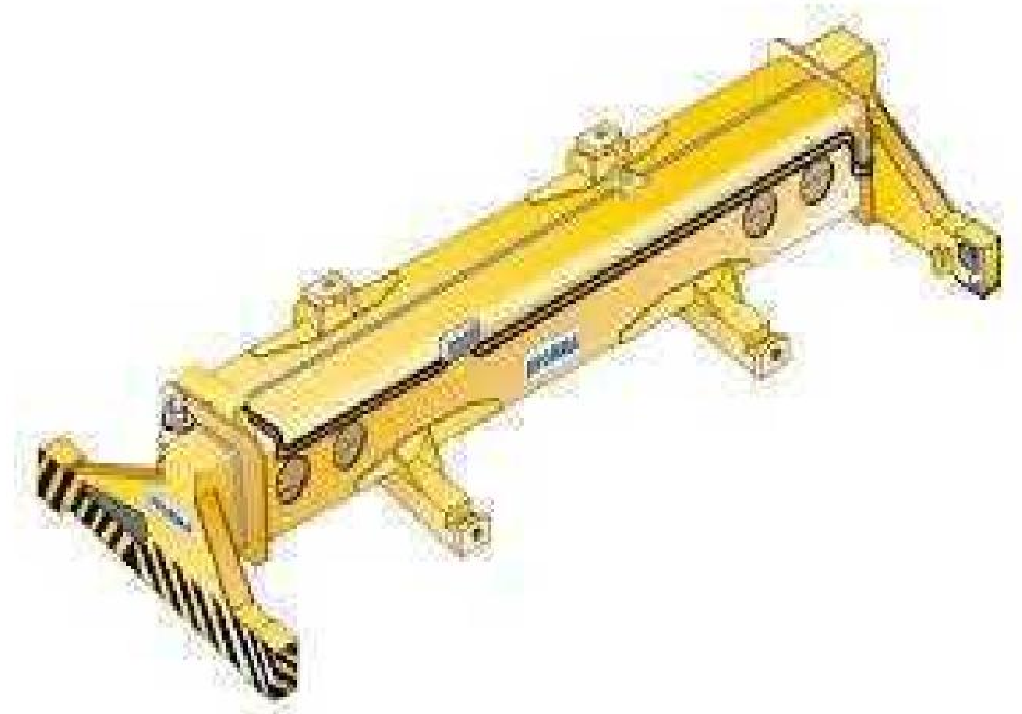
- Crane attachments
- Forklift attachment is required.

The crane attachments are very simple. They hook on to the hook of the crane, and can pick up the cargo. They are of different sizes and types for different cargoes.

The most popular of them include a side shifter for better positioning; clamps handle baled cargo, paper reels or large carton, grip and backrest devices to handle drums; hanging beam for handling cargoes with hooks; centrally mounted ram for handling reels.

- Bucket Type Grab
- Pal finger type grab
- Tong
- Spreader


CAP 45000
BRADLEY



5.6.10.10 Equipment at Terminals

2- Mobile harbour crane of 100 TPH at KRIBHCO & Ukai Jetty resp.

5.7 Berthing Structure

Berthing structures are to be designed such that they provide safe berthing of barges / vessels without damaging the barges / vessels as well as the structure. These structures should also cater to the requirements of the various equipments to be used for loading/ unloading of vessels. The requirements of the berth differ depending on the nature of cargo being handled at the berth. The size of the structure depends on the largest vessel likely to use the berth and the type of handling equipment to be used on the deck. The berth should be designed for all possible loads that are likely to act on the structure. The total number of berths required for the proposed terminal and their arrangement was fixed based on the nature of cargo, traffic, alignment of contours and predominant wind, water levels. The berth is planned for barges /vessels of 1000 DWT.

WAPCOS proposes to use 1000 DWT self propelled barge for transportation of the cargoes. The dimensions of the barge are 70 m length X 12 m beam and 1.8m loaded draft. Design of terminal has been computed in Chapter 6. Before arriving at the length of the terminal it is necessary to compute the number of barges required to handle the proposed traffic. After that numbers berths can be computed from which the length of the terminal will be determine. In order to compute numbers of barges required following assumptions has been made:

- Total cargo to be handled – 0.9 million tonnes per annum
- Barges of 1000 tonnes are assumed
- Speed at barges 10 km/hr
- Available days for transport in a year – 330 days
- Loading / unloading rate assumed – 100 TPH

The self propelled barge of 1000 tons has a length of 70 m. Hence one barges will need 70 m of berthing length and keeping a gap of 15m between the edges, the total length works out to 100m. Hence a terminal of 100m length is being planned. The width of the terminal will be 15m to accommodate rail mounted equipment as and when necessary. The electrical cabling, pipe line for water, oil products and fuel supply would be embedded in the berths so that the movement of mobile equipment is not affected. Adequate Fenders will have to be provided to absorb impact load of barges. Bollards of adequate capacity need to be provided for mooring the barges.

The terminal will be in the form of piled structure with bored cast in-situ piles. Details of pile diameter are given in Chapter-6.

Behind the jetty structure a dyke will have to be constructed to hold the backfill material. The terminal will be 1 m above high flood level of Tapi River. As the area of the terminal is low lying area the area behind the terminal has to be reclaimed with suitable material and some area will be required for stacking of material.

5.8 Terminal Costing

5.8.1 Capital Cost

The estimate of capital cost is made for the various items of civil, mechanical, electrical and utilities works cost estimate is presented in tables below.

Table 5.4 Terminal Cost Phase-1

Terminal Cost	**In Crores**
Dumas Tourist terminal ***(70m x 5m)***	3.30
Chowk Bazar Tourist Terminal ***(70m x 5m)***	3.30
Storage Area (Land acquisition, Including roads, warehouse, parking area etc)	24.50

Terminal Cost	In Crores
Total Cost(I)	31.10
3% Contingencies and 7% Supervision charges on Base cost	3.11
Total Terminal Cost	**34.21**

Table 5.5 Terminal Cost Phase-2

Terminal Cost	In Crores
*Ukai Cargo Terminal (**100m x 15m**)*	22.00
*KRIBHCO TERMINAL (**100m x 15m**)*	22.00
Storage Area (Including roads, warehouse, parking area etc)	49.00
Total Cost(I)	93.00
3% Contingencies and 7% Supervision charges on Base cost	9.30
Total Terminal Cost	**102.30**

5.8.2 O&M Cost

The annual operation and maintenance cost on different components of the project will be dependent on a number of variables such as the life of the component, repair and maintenance requirements, wages of crew of consumables, etc. Hence, accurate assessment of cost is not possible. Further even if all the variables are fixed such as the maintenance schedules for each structure and equipment is determined, crew strength is fixed, requirement of consumables quantified, etc., the estimation of O&M costs cannot be precise because of unpredictable breakdowns incurring considerable expenditure on repairs and replacement. The only practicable approach in this scenario is to fix the annual repair expenditure as a percentage of capital cost of project. This percentage is to be fixed on the basis of the past performance of similar structures and equipment functioning in the project or elsewhere under similar marine conditions.

Based on above criteria, the annual maintenance cost is estimated as a percentage and is presented in tables below.

Phase 1 – Rs. 0.34 Cr.
Phase 2- Rs. 19.88 Cr.

CHAPTER – 6

PRELIMINARY ENGINEERING DESIGNS

6.1 River Training

In order to make river navigable certain interventions along and across the river is required. The effect of the structure on the hydraulics of the river and the best ways to train the river such that the structure performs satisfactorily and also there is no significant damage to the riverine environment should be kept in mind while proposing any structure.

Detailed Methodology:

Step 1: Detailed study of river bathymetry especially dry patches/Dry Stretches in the river.

Step 2: Detailed study of all hindrances (Dams/Barrage/weir/Bridges) &Interventions needed along the river.

Step 3: Preliminary Designs of Proposed Structure

Step 1:

This is already covered in chapter 2; however, brief summary of dry patches/Dry stretch along River Tapi is mentioned in Table shown below:

Table 6.1: Summary of dry patches/Dry stretch

Sr.No.	Stretch Details	Length
D-1	Ch-7.0 to Ch 11	4 Km
D-2	Ch-14.0 to Ch 19	5 Km
D-3	Ch-29.0 to Ch 35	6 Km
D-4	Ch-50.0 to Ch 59	9 Km
D-5	Ch-81.0 to Ch 112	32 Km
D-6	Ch-136.0 to Ch 138	2 Km
D-7	Ch-172.0 to Ch 174	2 Km

Details are shown in **Fig. No. DP-01 to DP-04**

Step 2:

This is also covered in chapter 2 of this report; however, brief summary of hindrances details are shown below:

1) Details of Dams/ *Barrages, Weirs, Anicut*
2) *Details of Bridges*

Table 6.2 – Details of Dam, Barrages, Weirs, Anicut

S. No .	Structure Name	Chainage (Km)	Location	Length (m)	Width (m)	Height w.r.t. MSL	Proposed Intervention
1	Singnapor Weir -cum-Causeway	34.674	Singnapore	580	7.0	6.00	Navigational Lock
2	Kakrapar Weir	112.303	Kakrapar	633.5	3.05	15.50	Navigational Lock
3	UKAI DAM	137.311	Ukai	4927	6.5	68.58	-

Table 6.3 – Details of bridges

Sr. No.	Phase	Bridges to be demolished
1	Phase-1	-
2	Phase-2	1) Magdalla/ONGC Bridge (Ch 21.8) 2)Sardar Bridge (Ch 30.2) 3) Swami Vivekananda Bridge (Ch 31.1) 4) Nehru Bridge (Ch 31.6) 5) DabholiJahangirpura Bridge (Ch 36.6) 6) Amroli Bridge (Ch 44.3) 7) Railway Bridge (Ch 45.4) 8) KapodraUtran Bridge (Ch 47.1) 9) SavjibhaiKorat Bridge (Ch 50.0) 10) Service Road Bridge (Ch 59.2) 11) Kholvad Bridge-2 (Ch 59.3) 12) Kholvad Bridge-1 (Ch 59.3) 13) Bodhayan Flyover (Ch 77.3) 14) UmarsadiHaripura Bridge (Ch 92.9) 15) Mandvi Bridge (Ch 102.6)

Details are shown in **Fig. no. EC-1 to EC-4**

Phase-II is not recommended as it is not viable. However, calculations for phase-II is for reference only.

6.2 PRELIMINARY ENGINEERING OF BARRAGE(For reference only)

To maintain 2.0m water depth, 2. Nos of barrages at ch. 77 &ch. 95 have been proposed. Preliminary design of barrage is given below:

BARRAGE ON TAPI RIVER AT CHAINAGE AT km 77

PARAMETERS ADOPTED

Maximum design discharge = 22500 cumecs As per CWC gauge site at chainage 72km (Ghala site)

H.F.L = El 18.76

Pond level = El 17.0

Bed level of river = El 5.0

SALIENT FEATURES

Waterway between two abatement = 444 m

Divide wall = 2 no. of 3 m thick

Top of Bund = 18.76 + 2.50 = 21.26 m

Bridge = 7.5 m clear road width (As per M.O.T)

Navigation Lock 2 nos. = 18 m each

Under Sluices

No. of span = 5 nos.

Width of span = 20m

Thickness of divide wall = 3 m

Thickness of Abutment = 2 m at top & 3.5 m at base

5 nos. gates size = 20m x 12 m

Crest level = at El 5

Gate height = 12 m above crest

Cistern level = El 4

Floor length between

Weir

No. of span = 13 nos.

Width of span = 20m

Thickness of pier = 2 m

Thickness of Abutment = 2 m at top & 3.5 m at base

At base

13 nos. gates size = 20m x 8 m

Crest level = at El 9

Gate height = 8 m above crest

Cistern level = El 4

Floor length between

two C/walls	= 90 m	two C/walls	= 75 m
C/walls		**C/walls**	
U/s C/wall	= 15 m below bed	U/s C/wall	= 15 m below bed
D/s C/wall	= 20 m below bed	D/s C/wall	= 20 m below bed

Design of Barrage at chainage 77 km of TapiRiver

Design Discharge = 22500 cumecs as per CWC gauge site at chainage

HFL = 20.96 m

Q = 22500 cumecs

HFL at CH 77 km = 20.96 – 2.2 = 18.76

Pond level = River bed + 12 = 5 + 12= EL 17

Bed level = EL 5 m

Lacey's waterway = $4.83 \sqrt{22500}$

= 724.5 m As per BIS 6966 – 1989 Part I

Provide 13 nos.weir bays of 20 m each + 5 nos. under sluices of 20 m each + 2 nos. lock of 18 m

Pier width = 2 m

2 nos. divide wall = 3 m each

Total Waterway (Betweentwo abutments) = 13 x 20 + 5 x 20 + (2x18+2.5x2+3) + 17 x 2+ 2 x 3

= 260 + 100 + 44 + 34 + 6 = 444 m

Looseness factor provided = 444/724

= 0.61 O.K.

Provided Weir bays = 9 nos. of 18 m each

Under Sluices bays = 2 nos. of 18 m each

Where C = 1.84

H = HFL – Crest Level

= 18.76 – 9 = 9.76 m

Where n = end correction

Discharge through Weir Portion

It will act as sharp crested weir as head over the crest is 1.5 times of width of weir. The crest width of weir bays has been kept 2 m which is more than 1.5 times the width of crest. Hence acted as sharp crested weir.

Q_1 = 1.84 (L – 0.1 nH) $H^{3/2}$

= 1.84 (20 x 13 - .1 nH)$9.76^{3/2}$

= 1.84 (260 – 11.76) $9.76^{3/2}$

= 13700cumecs

Q_2 = Discharge passing through Under sluices bays crest has been kept at bed = 5.0 m

H = 18.76 – 5 = 13.76 m

Where C = 1.70 for broad crested weir

Q_2 = 1.70 (20 x 5 – 0.1 nH) $H^{3/2}$

= 1.70 (100 – 0.4 x 13.76) $13.76^{3/2}$

= 1.70 x 94.5 x $13.76^{3/2}$

= 1.70 x 94.5 x $13.76^{3/2}$

= 8193cumecs

Q_3 = Discharge passing through lock

= 1.84 (36 x $13.76^{3/2}$)

= 3380cumecs

Total Discharge passing through barrage = Q1 + Q2 + Q3 = 13700+8193+3380

	=	25278cumecs
	=	> 22500 cumecs
		Hence O.K.

SECTION THROUGH SHARP CRESTED WEIR

CISTERN

U/S HFL	=	18.76
D/S HFL	=	18.76 – 1 = 17.76
Q	=	13700 cumecs through weir bays
B_t	=	260 m
Q= $\frac{Q}{B_t} = \frac{1370}{260}$	=	52.69 cumecs/width
Assume retrogression on d/s	=	1 m
Diff. in water level between u/s & d/s	=	1 m
From Blanch curve between q and H_L		

Where

q	=	52.69			
H_L	=	1 m			
$\therefore Ef_2$	=	11.5	d_1	=	4.6

Cistern floor level required		=	d/s water level - Ef_2
	(i)	=	17.76 – 11.50
		=	6.26
	(ii)	=	1 m below the d/s bed (where bed = 5.0)
		=	5 – 1 = 4 m

By comparing (i) and (ii)

The cistern level has been kept at EL 4 m

$$Ef_1 = Ef_2 + H_L$$

= 11.5 + 1 = 12.50

From Blench curve

Value of depth d_2 w.r.t q	=	52.69 and	Ef_1	=	12.50
d_2	=	9.8			
Cistern length	=	$5 (d_2 – d_1)$			
	=	5 (9.8 – 4.6)			
	=	26 m			

Provided 30 m

Curtain Walls

Q	=	22500Cumecs		
River width	=	444 m		
q	=	Q/B	=	22500/444
	=	50.67cumecs/m		Where f = silt factor
M_r Grain size of particle in mm	=	.05 mm		
f	=	$1.76\sqrt{M_r}$		
	=	$1.76\sqrt{.05}$		
	=	0.3935		
Say	=	0.4		
R	=	$1.35 (q^2/f)^{1/3}$		
	=	$1.35 (50.67^2/0.4)^{1/3}$		
	=	1.35 x 18.58		
	=	25.09		

As per BIS Codes 6966 – 1989 Part I

Depth of u/s curtain wall	=	1.0 R = 25 m				
Depth of d/s curtain wall	=	1.25 R	=	1.25x25	=	31.25 m
Below level of u/s C/wall	=	HFL – 1 R				
	=	18.76 – 25				
	=	- 6.24				
Below bed	=	5 – (-6.24)				

	=	11.24 below bed
		Provided 15 m below bed
Bottom level of d/s C/wall	=	HFL – 1.25 R
	=	18.76 – 31.25 = -12.50
Below d/s bed	=	4 – (–12.50)
	=	16.50 m
	=	Provided 20 m

Check at Exit

H = u/s ponded level – d/s retrogressed level

17 – (5-1) = 13 m

d/s curtain wall depth = 20 m

d_{eff} = 20 – 2 = 18 m

$G_E = \dfrac{H}{\pi x \sqrt{\lambda} x d_{eff}}$

Where,

α = b/d

= 75/20

= 3.75

where b = Length between u/s and d/s c/walls = 75 m

λ = 1 + α/2

= 1 + 3.75/2

= 2.37

$\sqrt{\lambda}$ = 1.54

$G_E = \dfrac{13}{\lambda x 1.54 x 18}$

= 0.149 <1/6for such soils

< 0.167, Hence safe O.K.

SECTION THROUGH UNDER SLUICES BAYS

U/S HFL – D/S Bed dry

= 18.76 – 5 = 13.76

H = 13.76

As length of crest is sufficient as such it will act as broad crested wier.

Crest length = 2.59 H

= 2.59 x 13.76

= 35.64 m

Provided 45 m

Q = through under sluices bays

= 8193 cumecs

B_t = 100 m

$q = \frac{8193}{100}$ = 81.93 cumecs/m width

Due to retrogression diff. in water level between u/s & d/s = 1 m

From Blanch curve between q and H_L

Where

q = 81.93

H_L = 1 m

$\therefore Ef_2$ = 13.6 d_1 = 5m

Cistern floor level required = d/s water level - Ef_2

(i) = 17.76 – 13.6

= 4.16

(ii) = 1 m below the d/s bed(where bed = EL5)

= EL 5 – 1 = EL4 m

By comparing (i) and (ii)

The cistern level has been kept at EL 4 m

$Ef_1 = Ef_2 + H_L$

= 13.6 + 1 = 14.60

From Blench curve w.r.t. q = 81.93 and Ef_1 = 14.60

	d_2	=	10 m
Cistern length		=	5 ($d_2 - d_1$)
		=	5 (10 – 5)
		=	25 m

Kept the same cistern length as of weir bays = 30 m

Curtain Walls

R	=	already calculated under weir bays
	=	26.46
Depth of u/s curtain wall	=	1.0 R below HFL = 25 m
	=	18.76 – 25
	=	- 6.24
Below bed	=	5 – (-6.24)
	=	11.24 below bed
		Say 15 m below bed is provided
Bottom level of d/s C/wall	=	HFL – 1.25 R
	=	18.76 – 1.25 x 25
	=	18.76 – 31.25= -12.49
Below d/s bed	=	4 – (–12.49)
	=	16.49 m
	=	Provided 20 m below d/s bed

Check at Exit

H = u/s ponded level – d/s retrogressed level

17 – (5-1) = 13 m

d/s curtain wall depth = 20 m

d_{eff} = 20 – 2 = 18 m

$$G_E = \frac{H}{\pi x \sqrt{\lambda} x d_{eff}}$$

where floor length between u/s & d/s curtain walls = 92 m

α = b/d

	=	92/20
	=	4.6
λ	=	$1 + \alpha/2 = 2.8$
$\sqrt{\lambda}$	=	1.673
G_E	=	$\frac{13}{\lambda x 1.673 x 18}$
	=	0.14 <0.167 for such soils
		Hence safe O.K.

u/s& d/s Protection Works beyond C/walls

Beyond u/s c/walls, cement concrete blocks of 1600 x 1600 x 1000 mm are provided. A toe wall of 1 m deep provided and thereafter stone protection are being provided. Beyond d/s c/wall friction blocks of size 1600 x 1800x1000 mm are provided and 30 cm thick inverted filter is being provided. Between friction blocks, jharris comprising of bajri of 100 mm thick provided to release any upward pressure. Thereafter stones of 1.5 m thick has been provided.

DESIGN OF GUIDE BUND

Guide bunds are provided on both sides of the barrage to protect against flood and after that they are joined with the existing banks of the rivers.

HFL at this work site	=	18.76		
Free Board	=	2.50 m		
Top Level of Guide bund	=	18.76 = 1.50	=	21.26
Height of bund	=	Top of bund – bed of river		
	=	21.26 – 5.0		
	=	El 16.26		

Length of guide bund (As per BIS Code)

Waterway at barrage site	=	444 m (L)
Length of u/s guide bund	=	1.25 L
	=	1.25 x 444
	=	555 m

Length of d/s guide bund	=	0.25 L
	=	0.25 x 412
	=	111 m
	Provided 115 m	

Radius of curved head (u/s portion)

	=	0.45 L
	=	0.45 x 444
	=	200 m

The curved portion be kept between 120^{o} to 145^{o}

Say 130^{o} with a radius of 200 m

Section of Bund

Keep top width of Bund	=	6 m
Side slopes	=	2:1
Thickness of pitching T	=	0.06 $(Q)^{1/3}$
	=	0.06 $(22500)^{1/3}$
	=	0.06 x 28.28
	=	1.69 m
Say	=	1.7 m
Thickness of Apron	=	1.9 T
	=	1.9 x 1.7 = 3.25
	=	Say 3.25 m
Where Y	=	Depth of water above river bed
	=	18.76 – 5.0
	=	13.76 m

R	=	25 m
D	=	1.25 R-Y
	=	1.25 x 25 – 13.76
	=	31.25 – 13.76
	=	20 m
Length of Apron	=	1.5 D
	=	1.5 x 20
	=	15 m
		Say 30 m

<u>For Curvilliar Transition Portion of Guide Bund</u>

D	=	1.25 R-Y
	=	1.5 x 25 – 13.76
	=	37.5 – 13.76
	=	23.74 m Say 24 m
Hence length of Apron in curved portion	=	1.5 D
	=	1.5 x 24
	=	36 m
		Say 40 m

Pitching is provided on water side and grass turfing may be provided on other side of guide bund.

The length of apron at noses shall be increased 1.5 D

Where D	=	2.24 R-Y
	=	2.24 x 25 – 13.76

=   56 – 13.76

=   42.24

Provided 45 m

Bridge

A bridge of 7.50 m clear road width has been provided over the barrage with regulation platform of width 1.2 m

Slab thickness of 1.6 m thick and reinforcement has been provided as per MoT.

Road Level = Pond level + 1.5 m

= 17 + 1.6 = 18.6 m

Ramps are provided on both sides of bridge to join with the guide bunds at EL 21.26.

6.3 Navigation Lock(For reference only)

The functional requirements of a lock are mainly intended for navigation. The most important general functional requirement is that vessels have to be able to pass as rapidly and safely as is deemed socially (macro-economically) acceptable. Speed expressed as passing time is used to indicate the extra time required by a vessel participating as part of a fleet (with a particular number and composition) to progress from one side of the lock to the other, compared to the situation if the lock would not have been there. In this sense, the word lock is understood to mean a coherent whole of the lock approaches, lock heads and chamber(s) as well as the lay out and facilities provided in this. The passing time is determined by the time necessary for waiting, sailing in and out, mooring and unmooring and the operational time (closing and opening the gates and levelling out the chamber). This time largely depends on the amount of traffic (being the lock load or the relation between the intensity and capacity of the lock).Safe passage through the lock complex is determined by the degree of certainty in which navigation traffic can be dealt with (smoothly), without danger and/or damage to people, material and the environment and still guarantee quality of life in the direct vicinity.

The main parts of locks are mentioned below;

- The lock chamber;
- Lock approach structures;
- Filling/emptying systems;
- Lock gates;
- Mechanical and electrical equipment;

- Control systems,
- Instrumentation (including water level and flow monitoring equipment),
- Power supplies;
- Communications systems;
- Mooring equipment;
- Lighting and signaling equipment;
- Safety equipment;
- Stocks of spares;
- Maintenance equipment;

Lock Chamber

The necessary chamber dimensions mainly depend on:

• The dimensions of the largest vessel;
• The volume and pattern of navigation;
• Optimal chamber filling with several vessels;
• The marine, inland or recreational navigation purpose.

Methods for determining chamber dimensions of a capacity lock

It starts with an assumption of preliminary chamber dimensions and number of chambers.

For the provisionally chosen lock complex and a normative volume of navigation, one of the modelsused to determine the value of characteristic parameters to test the design at hand on:

- the average passing through time (particularly important to the captain because of costing,
- the permitted intensity;
- the necessary waiting space (-length),
- the locking time cost for navigation, per week (possibly converted to cost per annum).

Following are various method for determination of lock chamber dimesions.

- VAT model
- Simulation Model
- Rough review of lock capacity

In our case, Rough review of lock capacity method has been adopted for preliminary engineering.

Lock approach structures

The lock approach is the navigation area between the connecting waterway and the lock complex, where approaching vessels have the opportunity to decrease speed and moor to a guiding structure if necessary (mooring is usually not an option for large vessels; they keep their position, whether or not with tugboats). With this, sufficient view and overview should be ensured both by day and by night. The lock approach should therefore be free of obstacles and not be situated in a bend. In addition, transverse and longitudinal currents in the lock approach should be avoided as much as possible, in view of the reduced manoeuvrability of the vessel when reducing speed and stopping.

The lock approach is functionally divided into:

The line-up area

This area has to be equipped with proper mooring facilities and be situated as such that moored vessels are not an obstruction to departing vessels. This area is intended for vessels that will be locking through in the next locking process. From the mooring area, vessels should be able to enter the chamber quickly via the leading jetties. A mooring area is required per chamber and per side. The size of the mooring area corresponds with a completely filled chamber. A general guideline is a length of 1.2 or 1.3 times the chamber length.

The waiting area

This area is also equipped with mooring facilities. This area is only created at locks where the expected navigation intensity will be such that, on busy days, the mooring area will be too small for all the waiting vessels. This area is intended for vessels that will not be able to lock through at the next locking process after arrival. For a lock with one chamber, one waiting area per side is necessary or a communal area for a lock complex with several chambers.

Free area

Meant to provide vessels with the opportunity to decrease speed and start manoeuvres to moor in the line-up or waiting area. Furthermore, the free area provides the opportunity to, where necessary; adjust the profile of the waterway to the profile of the lock approach. For stopping and mooring, the following length should be available; an indication of inland navigation is approximately 2.5 times the normative vessel length.

Chamber and heads

The number of important parts of the primary function of the locking process take place in the chamber and the heads, namely

- The sailing in and tying up of one or several vessels,

- The untying and sailing out of one or several vessels,
- The closing and opening of gates and
- The levelling of the water level in the chamber.

Cables and mains

In general, we strive for an integration of crossing cables and mains (the small infrastructure) in the lock and/or lock approaches, as long as this does not result in unnecessary risks for the locking process. During construction, existing cables and mains will have to be moved temporarily if necessary or other facilities could be necessary in order to disrupt the performance as little as possible. This is executed under instructions of the authorities in charge ofsmall infrastructure. Often, these authorities will function as customers in relation to the moving or execute the moving under own management. To reduce costs, every effort will be made to consider the definite situation when planning the temporary diversions. In the definite situation, the crossing itself will generally be under the bottom of the lock or the lock approaches. Certain cables and mains of third parties could be housed in cable manholes and tunnels for lock operation, which can be made larger to allow for this. Between the cable manholes, extra lead through pipes can be added to the lock floor for these cables and mains. This is only possible if your operation is not exposed to additional risks or hindrance.

Cables and mains that cross a lock and/or lock approaches and the facilities that have to be made or provided for this, have to meet the following requirements:

- The cables should not yield unacceptable risk for the lock, lock operation and navigation.
- That which is unacceptable should be substantiated with a risk analysis.
- Gas mains are not included in a lock.
- Navigation must be unable to damage the cables and mains.
- Where visual inspection is impossible (and this will generally be the case) the condition of the cables and mains will have to be established in a different way, certainly in those cases where failure will have serious consequences.
- Cables and mains, with serious failure consequences, must immediately be disconnected or be free of electrical charge when necessary.
- Replacement, expansion or maintenance should take place without prolonged hinder to navigation.

Furthermore, attention has to be paid to possible transmission lines that cross the lock or the lock approaches.

Illumination, signalling and boarding

- For the average value of illumination intensity on horizontal surfaces of the lock is 10 lux.

- For the uniformity (E) of the illumination, a minimum value of Emin/Emax = 0.3 should be adhered to for both vertical and horizontal areas.
- Unsafe situations due to dazzling should be avoided. The correct combination of armature, lamp and positioning is of importance.
- The colour of the light is one of the factors in the recognition of boards and signalling. Both white and yellow light can be used. In the lamp choice of illumination, both high-pressure and low-pressure lamps as well as energy saving lamps qualify. In the application of low-pressure (monochromatic) sodium (vapour) light, colour recognition is impossible. If this is the case, separate illumination of traffic signs is recommended.

Safety facilities

Design and management of safety facilities of personnel will be executed in accordance with Health and Safety Regulations, construction regulations, labour regulations and safety regulations. A number of facilities are mentioned below.

Railings are attached to the top of gates. If the lock coping is more than 2.5 m above minimum locking level, fencing is placed behind the bollards. This fencing is always desirable where it concerns recreational navigation and where tourists are allowed on the lock coping.

Steel ladders should not be in regular use. Straight stairs, a spiral staircase or step ladders should be installed.

Basement chambers that could possibly flood (for instance those of operating mechanisms of mitre gates) have to be provided with an exit that can be opened from the inside. In addition, sufficient natural ventilation will be required as well as plunger pumps.

Design of Side Wall – Navigational lock			
Width of Beam	=	**1000**	mm
Depth of Beam	=	**500**	mm
Grade of concrete	=	**40**	N/m^2
Grade of steel	=	**500**	N/m^2
Density of concrete	=	**25**	kN/m^3
Cover	=	**50**	mm
Dia of bar	=	20	mm
Effective depth	=	500-50-(20/2)-20)	
	=	420	mm

Span of Beam (l1)	=	**5000**	mm
From STAAD result			
Maximum moment (Mu)		**625**	kNm
Maximum shear force (Vu)		**190**	kN
Check for Depth			
Mu	=	Mulim	
625	=	0.133 * fck * b * d * d	
d (required)	=	336.49	mm
d (Provided)	=	420	mm
336.49	<	420	mm
d(provided) is higher than d(req) So depth is sufficient			
Design of main Steel for Mid span Moment			
Ast (req) at mid span	=		
	=	3867.87	mm^2
Acc, IS-456-2000-Cl- 26.5.1.1,pn-46			
Ast(min)/bd	=	0.85*b*d/fy	
	=	714	mm^2
Provide the maximum of Ast(req) and Ast(min)			
Adopted Ast	=	3867.87	mm^2
Design of main Steel for Support Moment			
Ast (req) at mid span	=		
	=	3867.87	mm^2
Acc, IS-456-2000-Cl- 26.5.1.1,pn-46			
Ast(min)/bd	=	0.85*b*d/fy	
	=	714	mm^2
Provide the maximum of Ast(req) and Ast(min)			
Adopted Ast	=	3867.87	mm^2

Reinforcement			
Diameter (mm)	**Nos**		
20	13.00		
Design of shear Reinforcement			
Vu	=	190	kN
Nominal shear stress (t v)			
t v	=	Vu/bd	
	=	190*1000 / (1000*420)	
	=	0.46	N/mm^2
P_t	=	Pt at support	
	=	100 * 0.5 * 13 * 3.142/4 * 20 * 20/(1000 * 420	
	=	0.49	%
Shear strength of concrete (t c) From Table - 19-IS-456-2000			
t c	=	0.505	N/mm^2
Provide only nominal shear reinforcement			
Shear reinforcement (Asv)			
IS-456-2000-Cl- 40.4			
Provide vertical stirrups			
Vus	=	Vu - tcbd	
	=	190 - (0.505 * 500 * 1000/1000)	
	=	-62.500	kN
Vus	=	0.87 * fy * Asv * d / sv	
	Assume dia of stirrups =	**12**	
Legs of Stirrups		**4**	
Grade of Steel for Stirrups		**500**	N/m^2
-62.500	=	0.87*fy*Asv*d / sv	
Sv	=	-1322.42	mm

	12	**mm dia bar @**	**120**
Side Reinforcement			
(According to SP-34,Cl-8.2.4,pn-101 & IS-456-2000,Cl-26.5.1.3)			
exceeding 300 mm or web thickness/width whichever is less.			
Ast (side)	=	0.1 % * b * D	
	=	500	mm^2
Provide	**6**	Nos of	**16**
Ast(provided)	=	1206.37	mm^2
Design of Side Wall – Navigational lock			
Width of Beam	=	**1000**	mm
Depth of Beam	=	**500**	mm
Grade of concrete	=	**40**	N/m^2
Grade of steel	=	**500**	N/m^2
Density of concrete	=	**25**	kN/m^3
Cover	=	**50**	mm
Dia of bar	=	20	mm
Effective depth	=	500-50-(20/2) -20)	
	=	420	mm
Span of Beam (l1)	=	**5000**	mm
From STAAD result			
Maximum moment (Mu)		**625**	kNm
Maximum shear force (Vu)		**190**	kN

Check for Depth			
Mu	=	Mulim	
625	=	0.133 * fck * b * d * d	
d (required)	=	336.49	mm
d (Provided)	=	420	mm
336.49	<	420	mm
d(provided) is higher than d(req) So depth is sufficient			
Design of main Steel for Mid span Moment			
Ast (req) at mid span	=		
	=	3867.87	mm^2
Acc, IS-456-2000-Cl- 26.5.1.1,pn-46			
Ast(min)/bd	=	0.85*b*d/fy	
	=	714	mm^2
Provide the maximum of Ast(req) and Ast(min)			
Adopted Ast	=	3867.87	mm^2
Design of main Steel for Support Moment			
Ast (req) at mid span	=		
	=	3867.87	mm^2
Acc, IS-456-2000-Cl- 26.5.1.1,pn-46			
Ast(min)/bd	=	0.85*b*d/fy	
	=	714	mm^2
Provide the maximum of Ast(req) and Ast(min)			
Adopted Ast	=	3867.87	mm^2
Reinforcement			
Diameter (mm)	**Nos**		
20	13.00		

Design of shear Reinforcement			
Vu	=	190	kN
Nominal shear stress (t v)			
t v	=	Vu/bd	
	=	190*1000 / (1000*420)	
	=	0.46	N/mm^2
P_t	=	Pt at support	
	=	100 * 0.5 * 13 * 3.142/4 * 20 * 20/(1000 * 420	
	=	0.49	%
Shear strength of concrete (t c) From Table - 19-IS-456-2000			
t c	=	0.505	N/mm^2
Provide only nominal shear reinforcement			
Shear reinforcement (Asv)			
IS-456-2000-Cl- 40.4			
Provide vertical stirrups			
Vus	=	Vu - tcbd	
	=	190 - (0.505 * 500 * 1000/1000)	
	=	-62.500	kN
Vus	=	0.87 * fy * Asv * d / sv	
	Assume dia of stirrups =	**12**	
Legs of Stirrups		**4**	
Grade of Steel for Stirrups		**500**	N/m^2
-62.500	=	0.87*fy*Asv*d / sv	
Sv	=	-1322.42	mm
	12	**mm dia bar @**	**120**

Side Reinforcement			
(According to SP-34,Cl-8.2.4,pn-101 & IS-456-2000,Cl-26.5.1.3)			
exceeding 300 mm or web thickness/width which ever is less.			
Ast (side)	=	0.1 % * b * D	
	=	500	mm^2
Provide	**6**	Nos of	**16**
Ast(provided)	=	1206.37	mm^2

6.4 Navigation Aids

6.4.1 General Principles of the System

Within the IALA Buovage System there are 5 types of marks which may be used in combination. The mariner can easily distinguish between these marks by readily identifiable characteristics.

Lateral marks differ between Buoyage Regions A and B as described below, whereas the other 4 types of mark are common to both regions.

6.4.2 Lateral Marks

Following the sense of a conventional direction of buoyage, Lateral marks in Region A utilize red and green colours by day and night to denote the port and starboard sides of channels respectively. However Region B these colours are reversed with red to starboard and green to port.

A modified lateral mark may be used at the point where as channel divided to distinguish the preferred channel, that is to say the primary route or channel which is so designated by an authority.

6.4.3 Cardinal Marks

Cardinal marks indicate that the deepest water in the area lies to the named side of the marks. This convention is necessary even though for example, a North mark may have navigable water not only to the North but also East and West of it. The mariner will know he is safe to the North, but must consult his chart for further guidance.

Cardinal marks do not have a distinctive shape but are normally pillar or spar. They are always painted in yellow and black horizontal bands and their distinctive double cone top-marks are always black.

Cardinal marks also have a special system of flashing white lights. The rhythms are basically all “very quick” (VQ) or “ quick” (Q) flashing but broken into varying lengths of the flashing phase. “ Very quick flashing” is defined as a light flashing at a rate of either 120 or 100 flashes per minutes, “ quick flashing” is a light flashing at either 60 or 50 flahses per minutes.

The characters used for Cardinal marks will be seen to be as follows.

North: Continuous very quick flashing or quick flashing
East: Three “ very quick” or “ quick” flashes followed by darkness
South; Six "very quick" or "quick" flashes followed immediately by a long flash, then darkness
West: Nine "very quick" or "quick" flashes followed by darkness.

The concept of three, six, nine is easily remembered when one associates it with a clock face. The long flash, defined as a light appearance of not less than 2 seconds, is merely a device to ensure that three or nine "very quick" or "quick" flashes cannot be mistaken for six,

It will be observed that two other marks use white lights. Each has a distinctive light rhythm which cannot be confused with the very quick or quick flashing light of the Cardinal marks.

Isolated Danger Mark

The Isolated Danger mark is placed on a danger of small area which has navigable water all around it. Distinctive double black spherical top marks and Group flashing (2) white lights, serve to associate Isolated Danger marks with Cardinal marks.

Safe Water Marks

The Safe Water mark has navigable water all around it but does rot mark a danger. Safe Water marks can be used, for example, as mid-channel or landfall marks.

Safe water marks have an appearance quite different from danger marking buoys. They are spherical, or alternatively pillar or spar with a single red sphericaltopmarks. They are the only type of mark to have vertical stripes (red and white). Their lights, if any, are white using isphase, occulting, one long flash or morse“ A” rhythms.

Special Marks

Special marks are not primarily intended to assist navigation but are used to indicate a special are or feature whose nature may be apparent from reference to a chart or other nautical document.

Special marks are yellow. They may carry a yellow “X” topmark, and any light used is also yellow. To avoid the possibility of confusion between yellow and white in poor visibility, the yellow lights of special marks do not have any of the rhythms used for while lights.

Their shape will not conflict with that of navigational marks, this means, for example, that a special buoy located on the port hand side of a channel may be cylindrical, but will not be conical. Special marks may also be lettered or numbered to indicate their purpose.

New Dangers

It should be specially noted that a “new danger” which is one not yet shown in nautical documents, may be indicated be exactly duplicating the normal mark until the information is sufficiently promulgated. A “new danger” mark may carry a Racon coded Morse “D”.

Body	:	ABS Plastic sealed to IP68 Standard.
Lens	:	185 diamoulded UV stabilized Poly- carbonate lens
Color	:	Red, Green, Yellow, White
Range	:	2 to 3 NM at 0.74 ATF (Specify while ordering)
Light Control	:	Automatic on/off by Photo diode
Light Source	:	High Intensity light emitting diodes LEDS with 100, 000 hours of life
Divergence	:	360^0Horiz. X 15^0 Vertical (at 50%) of Peak Intensity

Character	:	Any one character from 256 IALA recommended character can achieved
Input Voltage	:	Nominal 12 VDC
Battery	:	Maintenance free lead-acid fitted with inside Base
Autonomy	:	200 to 300 Hours period
Solar Panel	:	Fitted on the Lantern Dome
Fixing	:	Four – 10 mm dia Hole on 200 PCD
Weight	:	3 Kg approx.

Marine Lantern @ 2km C/C is provided along the river tapi in has been provided. Designed aid is on the basis of light intensity, soil condition and wind direction and velocity

General assembly of proposed buoy is shown in Fig. 6.1 (A) & 6.1(B)

Fig. 6.1 (A) General assembly-partial

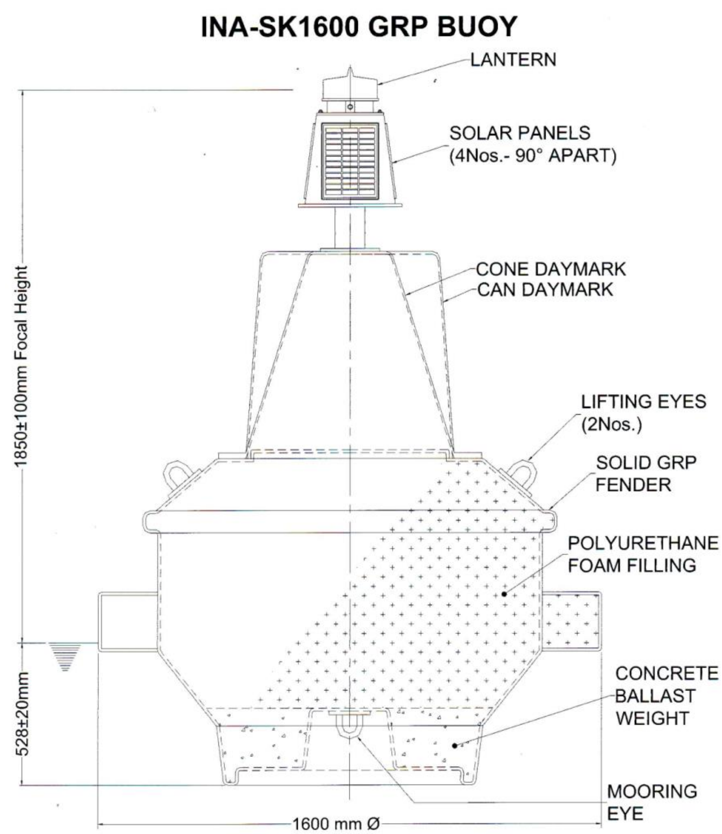
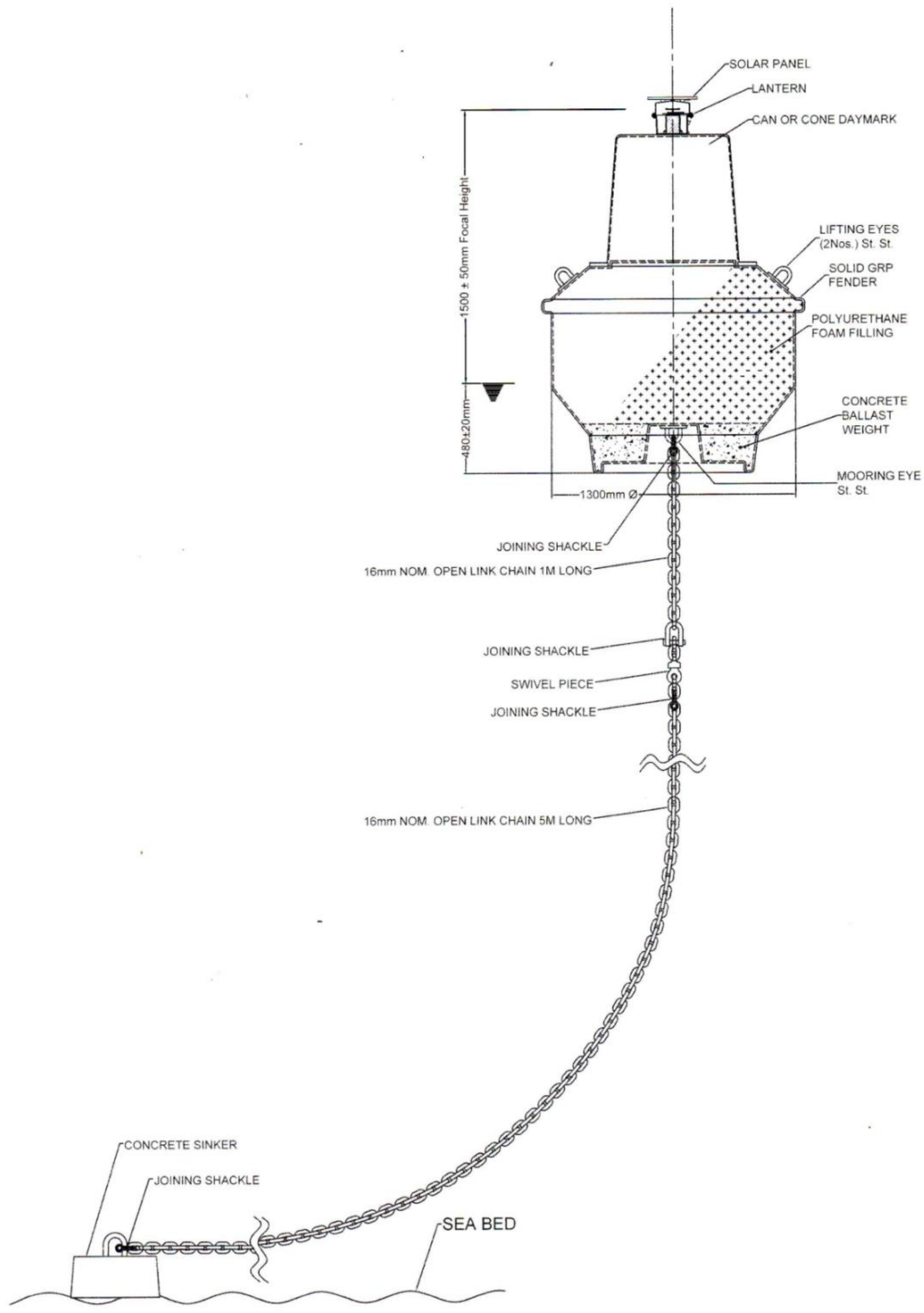


Fig. 6.1 (B) General assembly-Full



6.5 Cargo Terminals and River Ports

6.5.1 Details of Terminals

Total 4 nos. of terminal have been identified. However, terminals will be developed phase wise.

Sr. No	Phase	Terminal
1	Phase-1	Terminal 1 at Dumas,Terminal 2 at Old Fort Jetty.
2	Phase-2	Terminal 3 at KRIBHCO &Terminal 4 (Ukai)

Details of Type of jetty

Sr. No	Phase	Type of Jetty
1	Phase-1	Terminal 1- Floating Terminal 2- Floating
2	Phase-2	Terminal 3- Piled Jetty Terminal 4- Piled jetty

Salient Features of Floating Jetty:

Terminal 1 (Dumas Jetty):

Since permanent construction is not viableat Dumas beach due to huge tidal variation, floating Jetties are proposed under the project, for embarking & dis-embarking of passengers. To cater to the berthing requirements for easy embarkation/disembarkation to the taxi, a floating jetty of 70 m x 10 m is considered suitable. The floating jetty shall be used to facilitate embarking/disembarking of passengers between the terminal and water taxi. It will have sufficient space for accommodating passengers along with their luggage. The floating jetty will have appropriate arrangement to cater to the mooring requirements of the water taxi. The appearance of the jetty will be good and shall have superior finish as per international standards.

Floating jetties to be supplied shall meet the following broad technical specifications:

Sr.	Particulars	Details
A.	**JETTY**	
1.	Size	70m. x 10m.
2.	Max. loaded Draft	1.7 m.
3.	Minimum Free Board	0.5 m. for loading of 2 KM/m2on total deck area of 120 sq. m.
4.	Load Capacity	Deck designed for UDL of 3 KN/m2 or concentrated load of 4.5 KN over an area of 0.3m x 0.3m.
5.	Material for construction of module/block	Concrete
8.	Deck/Top Cover	Concrete
9.	Minimum Reserve Buoyancy	25% under design loading conditions
10.	Frames	Aluminum Alloy Grade – 6082 T5/T6 marine grade or equivalent
12.	Working Life	50 years or more
15.	Handrails	Fabricated out of StainlessSteel, 750 mm high. Reflective stickers to be provided on all the four sides.

Terminal 2 (Old Fort Jetty):

Permanent construction is not viable near **Old Fort Jetty**; floating Jetty is best possible option & proposed under the project, for embarking & dis-embarking of passengers. To cater to the berthing requirements for easy embarkation/disembarkation to the taxi, a floating jetty of 70 m x 10 m is considered suitable. The floating jetty shall be used to facilitate embarking/disembarking of passengers between the terminal and water taxi. It will have sufficient space for accommodating passengers along with their luggage. The floating jetty will have appropriate arrangement to cater to the mooring requirements of the water taxi. The appearance of the jetty will be good and shall have superior finish as per international standards.

Floating jetties to be supplied shall meet the following broad technical specifications:

Sr.	Particulars	Details
A.	**JETTY**	
1.	Size	70m. x 10m.
2.	Max. loaded Draft	1.7 m.
3.	Minimum Free Board	0.5 m. for loading of 2 KM/m2on total deck area of 120 sq. m.
4.	Load Capacity	Deck designed for UDL of 3 KN/m2 or concentrated load of 4.5 KN over an area of 0.3m x 0.3m.
5.	Material for construction of module/block	Concrete
8.	Deck/Top Cover	Concrete
9.	Minimum Reserve	25% under design loading conditions
10.	Frames	Aluminum Alloy Grade – 6082 T5/T6 marine grade or equivalent
12.	Working Life	50 years or more
15.	Handrails	Fabricated out of StainlessSteel, 750 mm high. Reflective stickers to be provided on all the four sides.

Mooring arrangements

Eight bollards, on the berthing side for water taxi will be fixed for the safe mooring of the water taxi.

Fenders

Protective fenders shall be provided on berthing side to prevent damage at the interface area.

Approach trestle/gangway

The gangway proposed is floating type with all the specifications, including material of construction, similar to Para - 2.1.

The broad dimensions are tabulated below: -

Length Over All	25.00 m
Breadth Over All	3.00 m
Draft not more than	1.2 m
Free board minimum	0.50 m for loading of 2kN/m2

Terminal 3 (KRIBHCO)

The proposed jetty is required to handle Self-propelled, carrying capacity 1000 DWT, Size (70m X 12m), Loaded draft 1.8m (Class-IV). The jetty is planned as a berthing structure proposed to be on piles, which provide least resistance to natural equilibrium and ease of extension/addition of facilities at a later date. The berthing structure is of length 100 m and width 15m.

Plan, elevation & cross-section of proposed jetty is shown in Fig**AD-1**

The deck level of jetty is w.r.t MSL. The thickness of the deck slab of jetty is 0.45 m. The slab at deck level is supported on Cross beams of 0.6m x 0.6 m in the lateral direction, secondary beams of 0.60 m x 0.60m in the longitudinal direction. The Cross beams rest on the pile caps / pile muffs which in turn support the longitudinal beams. The 600 mm diameter bored cast in situ piles with 6mm thick liner are fixed to the pile caps at the top and fixed into the ground at the bottom. The plan and cross section of jetty is shown as Fig. **AD-1**. The important design levels taken into consideration are discussed as follows:

Table 6.4 Design Parameters for Terminal 2 (KRIBHCO)

Top Level of Jetty (Deck slab)	+11.00 m
Top level of Piles	+9.6m

Diameter of piles (D)	0.6m
Unit wt. of RCC	25.0 KN/m^3
Unit wt. of sea water	10.025 KN/m^3
Unit wt. of Steel	78.50 KN/m^3
Founding Level of Piles	-25.00 m below bed Level

Terminal 4 (Ukai)

The proposed jetty is required to handle Self-propelled, carrying capacity 1000 DWT, Size (70m X 12m), loaded draft 1.8m (Class-IV). The jetty is planned as a berthing structure proposed to be on piles, which provide least resistance to natural equilibrium and ease of extension/addition of facilities at a later date. The berthing structure is of length 100 m and width 15m.

Table 6.5 Design Parameters for Terminal 4 (Ukai)

Top Level of Jetty (Deck slab)w.r. t MSL	+61.00 m
Top level of Piles	+59.60 m
Diameter of piles (D)	0.6 m
Unit wt. of RCC	25.0 KN/m^3
Unit wt. of sea water	10.025 KN/m^3
Unit wt. of Steel	78.50 KN/m^3
Founding Level of Piles	25.00 m below bed level

Design Codes and Standards

All works shall satisfy the requirement of the latest relevant codes and standards. Generally Indian Standards shall be followed. Wherever, the details for part of works are not defined adequately in Indian standards, the relevant acceptable International

Standards shall be adopted. The List of codes and standards covering the major part of the works to be followed are listed below:

Table 6.6 List of Codes and Standards

IS: 456	Code of practice for Plain and Reinforced Concrete
IS: 875	Code of practice for Design Loads for Buildings & Structures
IS: 1893	Criteria for Earthquake Resistant Design of Structures
IS: 4326	Earthquake resistant design and construction of Buildings – Code of practice
IS: 4651	Code of practice for Planning and Design of Ports and Harbours
IS: 9527	Code of practice for Design and Construction of Port and Harbour Structures
UFC4-152-01	US navy corps of engineer unified criteria Piers and Wharves
BS 6349-part 2	Code of practice for Marine structure quay, Wharves, jetties & Dolphins
IS: 800	Code of practice for General Construction in Steel
IS: 1786	Specification for High Strength Deformed Steel bars and wires for Concrete Reinforcement
IS: 13920	Ductile detailing of Reinforced Concrete Structures subjected to Seismic Forces - Code of Practice
IS: 2911	Code of practice for Design and Construction of Pile Foundations
IS: 1904	Code of practice for Design and Construction of Foundations in Soils : General Requirements
SP: 7	National Building Code of India
SP: 16	Design aids for Reinforced Concrete to IS: 456
SP: 34	Hand book on Concrete Reinforcement and Detailing

IRC : 21	Standard Specifications and Code of Practice for Road Bridges Section III
IRC : 6	Standard Specifications and Code of Practice for Road Bridges Section II

6.5.2 Design of Terminals (For reference only)

Structural System of Berthing Jetty

The proposed jetty is required to handle Self-propelled, carrying capacity 1000 DWT, Size (70m X 12m), loaded draft 1.8m (Class-IV). The jetty is planned as a berthing structure proposed to be on piles, which provide least resistance to natural equilibrium and ease of extension/addition of facilities at a later date. The berthing structure is of length 100 m and width 15m.

The deck level of jetty is w.r.t CD. The thickness of the deck slab of jetty is 0.45 m. The slab at deck level is supported on Cross beams of 1.0m x 1. 0 m in the lateral direction, secondary beams of 0.50 m x 0.65m in the longitudinal direction. The Cross beams rest on the pile caps / pile muffs which in turn support the longitudinal beams. The 500 mm diameter bored cast in situ piles with 6mm thick liner are fixed to the pile caps at the top and fixed into the ground at the bottom. The important design levels taken into consideration are discussed as follows:

6.5.3 Analysis of Jetty

STAAD Pro Modeling

The dimension of the jetty is 100m x 15m. The analysis of the structure has been performed in STAAD Pro 2007 as shown in **Fig. 6.2**. In the model the piles are assumed to be fixed at base. The pile length used in analysis is based on fixity length i.e15m. The cut off level of piles is +1.0m for inner pile.

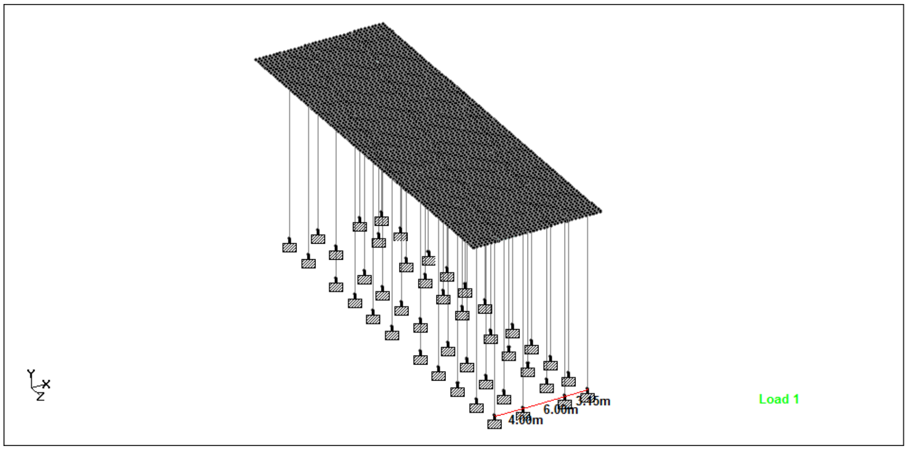


Fig. 6.2STAAD Panel of the Jetty

6.5.4 Design Loads and Load Combinations

The jetty, approach and bay have been designed considering the following loads:

A. Vertical Loads

a) Dead Load
b) Live Loads
   i) Uniform loading
   ii) Truck loading (IRC Class)

B. Horizontal Loads

c) Berthing load
d) Mooring load
e) Wind load
f) Current load
g) Seismic load

C. Combination of above

The loading has been considered taking into account the guidelines of IS 4651 (Part III): 1974, IRC 6:2000, IS 1893: 2002 (Part 1), IS 875 : 1987 (Part 1 and Part 3). UFC 4-152-01 2005.

(a) Dead Load

The dead load consists of the weight of the entire structure, including all the permanent attachments such as mooring hardware, light poles, utility booms, brows, platforms, vaults, sheds, and service utility lines. A realistic assessment of all present and future attachments has been made and included. Overestimation of dead loads generally will not adversely affect the cost of the structure. However, overestimation of dead loads would not be conservative for tension or uplift controlled design. Standard unit weights have been used to calculate dead loads. Dead load of the structure can be applied on STAAD MODEL.

Table 6.7 Dead Weight of Slab

Component	Depth of Slab (mm)	Unit Weight (KN/m^3)	Load (KN/m^2)
Jetty	450	25	11.25

Dead weight of Rails

(b) Live Loads

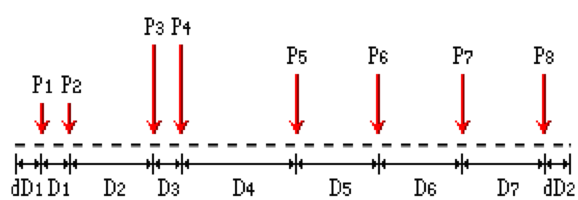
Uniform Live Loads

(i) 30 KN/m^2 (As per IS 4561: part-3,Page-5, Cl. 5.1.2)
(ii) 38KN/m^2 (As per UFC 4-152-01 2005, Page-54,Cl. 3-3.2, Table-3-2)

Critical Load is 38KN/m^2

Truck Loading

IRC Class A truck load has been applied as moving load. The load specification of IRC Class A train of vehicles (with impact factor) is given as under:



P_1 =27 KN	dD_1 = 0.5 m
P_2=27 KN	D_1 = 1.1 m
P_3= 114 KN	D_2 = 3.2 m
P_4= 114 KN	D_3 = 1.2 m
P_5=68 KN	D_4 = 4.3 m
P_6=68 KN	D_5 = 3.0 m
P_7 =68 KN	D_6 = 3.0 m
P_8 =68 KN	D_7 = 3.0 m

(c) Berthing Force

Berthing force is calculated for Self-propelled, carrying capacity 4000 DWT, Size (86m X 14m), Loaded draft 2.9m. According to UFC 4 15202, there are several factors that modify the actual energy to be absorbed by the fender system. The actual kinetic energy E absorbed by the fender system is calculated as per the following

E_{fender} = Energy to be absorbed by the fender system

$E_{fender} = M_D Vb^2 (C_m C_e C_s C_c) /2$

Where:

W_D	Displacement Tonnage (DT) of the vessel, (t)
V_b	Velocity of vessel in m/s, normal to the berth
C_m	Mass coefficient
C_e	Eccentricity coefficient
C_s	Softness coefficient
C_c	Configuratinal Coefficient

Type of Fender			=	**G2 Grade MCS 400 Cell Fender**	

Energy Absorption			=	**21.60**	kN*m
Reaction Force			=	**129**	kN

Details of above calculation is shown in **Annexure 6.1**

(d) Mooring Force

This force is taken according to IS-4561- 1974-Part-III,

(i) Mooring force due to wind

Mooring Force due to wind: $F_w = C_w A_w P$

C_w= Shape Factor

A_w= Windage Area in sqm = 1.175*Lp (D_m-D_L)

P = Wind Speed pressure in N/sqm = 0.6 V_z^2

Vz =V_b *k_1 * k_2* k_3 , where the k_1, k_2 and k_3 are probability factor and terrain height and structure size factor and Topography factor respectively. Values of coefficients are taken from IS-875-Part-III,

k_1 = 1

k_2 = 1

k_3 = 1

- The wind speed is considered as 50m/s for coastal Gujarat (IS - 875-III Part 3 1987, cl-5.4 & pg-9)
- Shape Factor C_w=1.5 is taken for calculation of Mooring force due to wind.

Calculation summery of mooring force is given below

A_w = 1.175*L_p (D_m-D_L)

= 167.49 m^2

P = 0.6 V_z^2 =0.6*(50*1*1*1)^2

= 1500 N/m^2

F_w = 37.7T

As per IS : 4651(Part III) – 1974 When the ships are berthed on both sides of a pier, the total windforce acting on the pier, should be increased by 50 percent to allow forwind against the second ship.

Accordingly, F_w= 1.5*38

= 60 t

(ii) Mooring force due to current

Mooring force due to current: $F_c = L_{pp} D_r P_c$

F_c = Mooring Force due to current in kg

L_{pp}= Length between the perpendiculars in m

D_r = Loaded draft of vessel in m

P_c = Pressure due to current in kg/sq.m

The current velocity is assumed as 0.6 m/s

F_c = $L_{pp} * D_r * P_c$

= 4.7 T

Assuming that the mooring force due to current and wind act simultaneously in the same direction.

Total Mooring Force (F_T) = $F_w + F_c$

= 64.7 t

Considering at least 4 nos. of bollards per vessel, mooring force at each pile,

F_T= 64.7/4 = 16.17 t Say 17 t

Details of above calculation is shown in **Annexure 6.2**

(e) **Wind Load**

The wind loads on the structure has been considered as per IS 875:Part3. The basic wind speed for Surat is 39 m /sec. Design Wind Speed can be obtained by the following formula:
Design Wind Speed $V_z = K_1*K_2*K_3*V_b$

Where,

K_1, Risk Coefficient as 1.00

K_2, Terrain (Category 2), Height (10m) and structure size factor (class C) as 1.00

K_3, Topography Factor as 1.0

Accordingly, the design wind pressure, $p_z = 0.6\ V_z^2$

p_z $= 0.6\ V_z^2 = 0.6*(50*1.00*1.00*1)^2$

$= 1500\ N/m^2$

(f) **Current Force**

The current force is given by $\gamma V^2/2g$

Where γ	=	Unit weight at water = 1.025 t/m^3
V	=	Current velocity = 0.6 m/sec.
F_C	=	$\gamma V^2/2g$
	=	1.025*0.6^2/(2*9.81)
	=	0.018t

(g) **Seismic Force**

The seismic force has been calculated as per IS-1893-2002. The design horizontal seismic coefficient A_h for a structure shall be determined by the following expression:

$$A_h = (Z/2)*(I/R)*(S_a/g)$$

Where,

Z = Zone factor given in Table 2, IS-1893-2002. Z at the site has been adopted as 0.16 corresponding to Zone III. Map showing the seismic zone from IS 1893-part – I, Gujarat falls in Zone – III.

I = Importance factor =1.5 has been used.

R = Response reduction factor has been taken as 3.0 for RCC Structures as per Table 7 of IS-1893-2002.

S_a/g = Average response acceleration coefficient has been taken as 1.4 as per Figure 2 of IS-1893(Part 1):2002 corresponding to T=0.91 seconds. The earthquake force has been applied in X as well main as Z directions.

(h) Load Combinations as per IS 4651 Part IV 2007

Method of Design: The Berth and its structural components have been designed as per Limit State Method. The partial safety factors for loads in limit state design method has been used. Accordingly, following load combinations have been considered as per IS : 4651-2007 (Draft copy)

Limit state of serviceability

1.0(DL+LL)

1.0(DL+LL+BF-S)

1.0(DL+LL+BF-(L)

1.0(DL+LL+MF-S)

1.0(DL+LL+MF-L)

1.0(DL+LL+SFX)

1.0(DL+LL+SF-X)

Limit state of collapsibility

1.2(DL+LL)+(CLX)

1.2(DL+LL)+(CL-X)

1.5(DL+LL+BF-S)+1.0CLX

1.5(DL+LL+BF-L)+1.0CLX

1.5(DL+LL+BF-S)+1.0CL-X

1.5(DL+LL+BF-L)+1.0CL-X

1.5(DL+LL+MF-S)+1.0CLX

1.5(DL+LL+MF-L)+1.0CLX

1.5(DL+LL+MF-S)+1.0CL-X

1.5(DL+LL+MF-L)+1.0CL-X

1.2(DL+LL)+1.0CLX

1.2(DL+LL)+1.0CL-X

1.2(DL+LL)+1.0CLX+1.5SFX

1.2(DL+LL)+1.0CL-X+1.5SFX

1.2(DL+LL)+1.0CLX+1.5SF-X

1.2(DL+LL)+1.0CL-X+1.5SF-X

1.2(DL+LL)+1.0CLX+1.5SFZ

1.2(DL+LL)+1.0CL-X+1.5SFZ

1.2(DL+LL)+1.0CLX+1.5SF-Z

1.2(DL+LL)+1.0CL-X+1.5SF-Z

1.2(DL+LL)+1.5SWLX+1.0CLX

1.2(DL+LL)+1.5SWLX+1.0CL-X

1.2(DL+LL)+1.5SWL-X+1.0CLX

1.2(DL+LL)+1.5SWL-X+1.0CL-X

1.2(DL+LL)+1.5SWLZ+1.0CLX

1.2(DL+LL)+1.5SWLZ+1.0CL-X

1.2(DL+LL)+1.5SWL-Z+1.0CLX

1.2(DL+LL)+1.5SWL-Z+1.0CL-X

DL – Dead Load

LL – Live Load

MF-S – Mooring Force Sea Side

MF-L – Mooring Force Lee Side

BF-S – Berthing Force Sea Side

BF-L – Berthing Force Lee Side

SF – Earthquake load
CL-Current Load
WL-Wind Load

6.5.5 Design of jetty

The governing STAAD Results for Longitudinal Beams, Cross Beams, and columns have been summarized as below:

6.5.6 Detailed Engineering

Table 6.8 Critical Forces in structural members of jetty

Beams	Design Moment (KNm)	Shear (KN)
	1224	1900

Piles	P (KN)	M_{ux}(KNm)	M_{uy} (KNm)
	920	1100	19

Slab	Design Moment (KNm)
	320

6.6 Construction schedule

PHASE-1

For Floating jetties (Terminal 1 & Terminal 2)

Sr.No.	Activity	Time in weeks from LoA
1	Submission of Detailed Engineering Drawing & Methodology for Installation	03 Weeks
2	Pre-dispatch third party inspection	04 Weeks
3	Supply of Primary units(Float)	09 Weeks
4	Onsite Inspection of supplied unit	15 Weeks
5	Installation of Gangway	17 Weeks
6	Installation of Jetty along with Accessories	19 Weeks
7	Testing, commissioning & trial	26 Weeks

For Fixed jetties (Terminal 3& Terminal 4)

Sr.No.	Activity	Time in weeks from LoA
1	Submission of Detailed Construction Drawing & Methodology	04 Weeks
2	Proof Checking of construction drawing	08 Weeks
3	Construction of dyke/Filling/Approach Trestle	20 Weeks
4	Construction of piles	20 Weeks
5	Installation of Precast Beam	30 Weeks
6	Installation of Precast Slab	35 Weeks
7	Laying of cast in-situ slab	43 Weeks
8	Installation of accessories	47 Weeks
9	Testing, commissioning& handing Over of site	55 Weeks

CHAPTER – 7

VESSEL DESIGN

7.1 General Review

River Tapi could be developed under Class III, Class IV, or Class VI waterways. The river is already being used extensively between Magdalla port of Gujarat Maritime Board and Hazira Anchorage by barges for transportation of cargo. The navigable length of the river could be extended further upstream for carrying bulk cargo. A major opportunity rests with cargo distribution at Ukai Thermal Power Plant. The plant acquires imported coal from Hazira, albeit ceased at present. In return, the fly ash produced at the power plant as a by-product could be transported back to Hazira, for one of the numerous cement plants in the district.

An optimum sized vessel has to be selected for carrying coal in Tapi. Ukai power plant would require periodic shipments of imported coal. The recent imports have been undertaken using Hazira Port on the mouth of river Tapi, followed by railway evacuation to power plant. The cost of operating vessel in Tapi should be lower compared to the total end-to-end logistics cost using alternate mode of transportation, viz. railways. The cost of transportation of any commodities using waterways is dependent upon the length of travel and volume of cargo. Large volume of cargo reduces per-tonne cost of transportation when moved using waterways. Availability of return cargo, in case of Terminal 4 at Ukai power plant, should further add to the viability of the operation. In the absence of return cargo, barges have to make return trips with just ballast. Such an operation induces cost overhead, as barges' operational cost still applies, but without maximizing its commercial viability by carrying cargo.
The section to follow gives development details for all the terminals along the earmarked stretch of River Tapi for waterway development. Two terminals are for cargo handling, and other two for tourism and passenger ferrying.

However, these 4 terminals could be acquired in phases based on the response to first phase.

Table 7-1 Phase-wise Development of Tapi

Phases	Terminals	Chainage (kms)	Type of Terminal	Phase Schedule
1	Terminal 1	-	Tourism	FY19-FY20
	Terminal 2	31.3	Tourism	
2	Terminal 3	18	Cargo	FY25-FY27
	Terminal 4	134	Cargo	

7.2 Terminal 1 and 2 (Phase 1)

There are two terminals proposed for developing tourism and river transportation of tourists from one location to another. The two locations identified for jetties to handle the proposed tourism activities will include following:

- ✓ *Passenger ferries travelling between Old Fort, Chowk Bazar and Dumas Beach*
- ✓ *Ferries undertaking small rides in the river*

Jetties planned for tourism would require small draft and provisions for berthing of light passenger crafts. Some of these vessels could be wooden boats, aluminium boats, steel, or fiber. Tourist vessels ferrying passengers between Terminal 1 and 2, or for luxury rides would have less than 1.5 m draft. These types of vessels would qualify in all classes of waterways classified by IWAI. The ferries would have sitting arrangement for passengers, along with sun deck for tourists to walk around and take a view of the surrounding. For reference purposes, such types of vessels are used in transporting passengers between Mumbai and Elephanta caves on a regular basis. These vessels can accommodate upward of 50 passengers. Multiple such vessels will be required to move passengers and tourists across and throughout the stretch to accommodate for the rise in traffic, as forecasted in tourism projections.

7.3 Terminal 3 (near KRIBHCO Jetty) – Phase 2

Technically, this terminal already exists, and is operated by KRIBHCHO for handling fertilizer by barges. The jetty is about 150 m long, presently used to import 0.5 million tonnes of Urea from Oman, annually. There exists scope for handling higher traffic at the jetty, by including other types of cargo as well. KRIBHCO has expressed its willingness to allow third-party clean cargo to be handled using the same jetty and on their premise. This will relieve IWAI from undertaking any infrastructure-related investment at this jetty. The potential contender for clean cargo is SBM, and Ruchi Soya is the only large producer that can find this arrangement viable.

At present, SBM from Indore gets exported using Bedi port in Gujarat. Since KRIBHCO is well connected by railways and is located closer to plant compared to Bedi, SBM can be exported using their jetty. Historically, Ruchi Soya has been using the River Tapi waterway to export SBM via Magdalla Port. Magdalla's preference for coal cargo acted as a hindrance, dissuading Ruchi Soya from continuing to use the port for exporting their clean cargo. Hence, this proposed shift will not be a sea change for the company. Additionally, Ruchi Soya should also benefit from logistics cost savings post switching to waterway from the current railway mode.

Ruchi Soya's plants in Indore, among other SBM producers from the state of Madhya Pradesh, fall in the secondary catchment area of River Tapi. Potential cargo from secondary catchment area may or may not translate into certain cargo for Terminal 3. Any in-depth assessment for such cargo, in relation to vessel designs and logistics cost analysis, will be inconsequential in view of this uncertainty. Still, in the event Ruchi Soya decides to use KRIBHCO jetty to export SBM, the best course of operation would be to charter hire barges from KRIBHCO itself. KRIBHCO's modest annual import requirements prevent it from completely utilizing its total fleet capacity round the year. When not in use by KRIBHCO, these barges can be used for handling Ruchi Soya's cargo.

7.4 Terminal 4 (Phase 2)

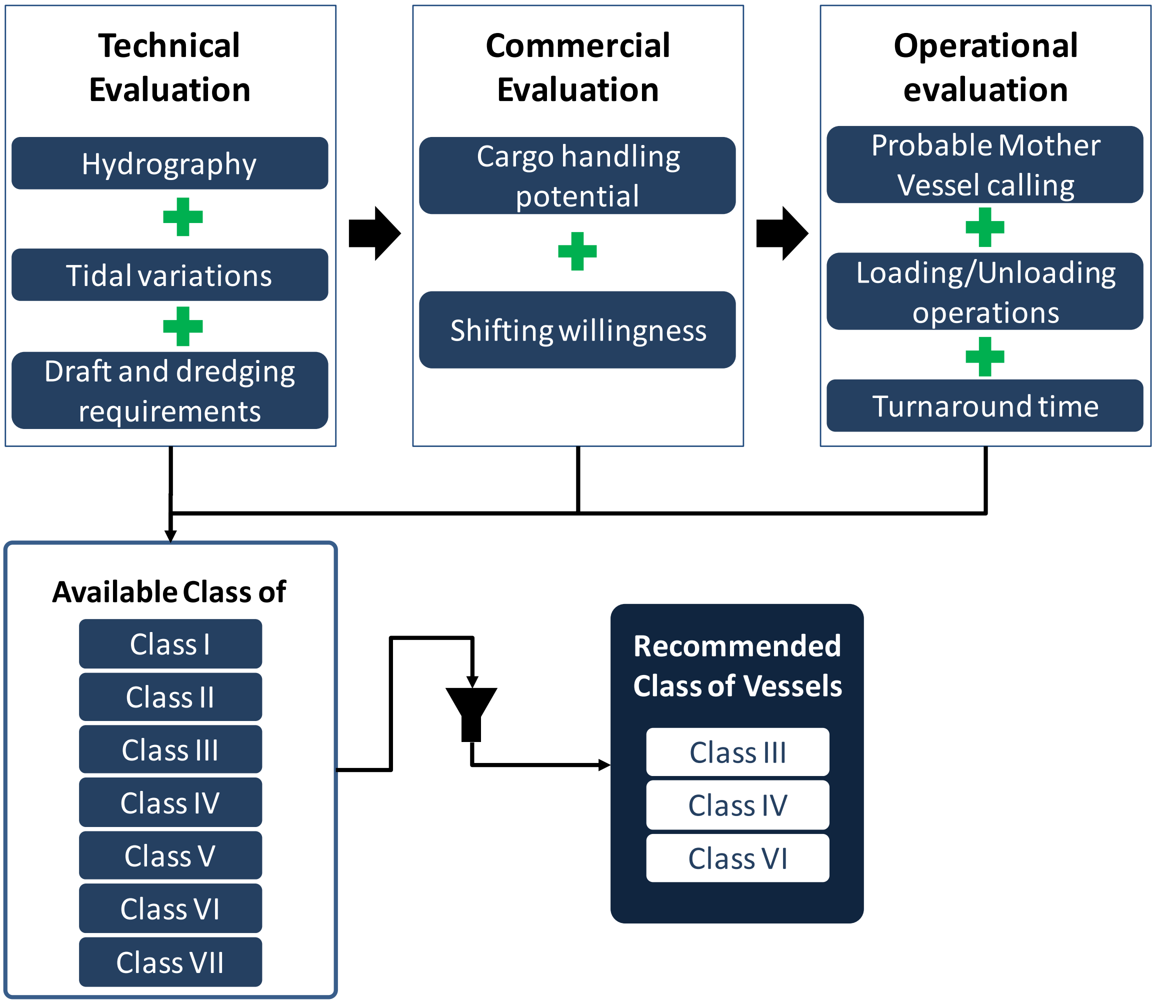
Terminal 4 will present opportunities for two-way cargo. Imported coal can be transported from Hazira via River Tapi using barges, and fly-ash from Ukai TPP could be the return cargo. Although coal import is facing a temporary stoppage at the plant, the operations are likely to resume soon.

The size, type, carrying capacity, and speed of the vessel to be deployed on River Tapi should result in a lower cost of operation. The cost of transporting coal on the waterway to Ukai TPP has to be lower compared to the existing cost of transporting coal via rail from Hazira port. One-to-one cost comparison has been undertaken for comparing all the activities including cargo handling, stacking, loading in to rakes, transportation and finally unloading at Ukai plant. This cost comparison has been undertaken only for coal. As an alternative to plying barge on just ballast, it's recommended that fly ash be transported instead. The cargo is in extensive demand among cement manufacturers across the country, and Ukai TPP produces this cargo in surplus. Also, since there is no current movement of fly ash along this route, using roadways or railways, end-to-end logistics comparison with the proposed waterway movement is not needed. Fly-ash related logistics will be utilized only in evaluating barge turnaround time on return trip.

7.4.1 Design Basis

The classification of vessels described by IWAI requires certain length and certain draft of vessel to be maintained for optimum use. Under this condition, there are other factors that will also influence the specific class of vessels that should be deployed on the River to handle traffic to and from Terminal 4. The following flowchart illustrates the decision-making involved in making the recommendation for the specific classes of vessels IWAI should invest in for Terminal 4:

Figure 7-1 Process for recommending vessel design



The technical evaluation acts as the ultimate framework, within which the vessel design selection has to be made. Primarily, hydrographic study, tidal study, draft available and required, together helps evaluate technical conditions that the vessel needs to meet in order to ply on River Tapi. Next, commercial evaluation involving projected traffic volume for Terminal 4, and willingness of the potential client (Ukai TPP) to shift to waterways further helps narrow down the type of vessels to be recommended. Traffic evaluation makes way for the probable operational conditions under which barges will be operating. This requires knowledge of mother vessels that will be calling at Hazira Port, followed by loading/unloading duration, which will further dictate the turnaround time for barges.

Prevailing maritime conditions on River Tapi, probable commercial demands that could be met via the proposed waterway, frequency of cargo movement, and total duration for the suggested operation are the overall understanding applied to determine the class of vessels. Vessel from class III, IV, and VIare the options available for IWAI to invest in to cater to the potential traffic at Terminal 4. Higher the class of vessels, larger the capacity, and lower the logistics cost will be.

7.4.2 Type of proposed Vessels

The following images depict typical Class IV and Class VI vessels that are used for river cargo transportation. These are for illustrative purposes only:

Figure 7-2 Class IV & Class VI vessels

Figure Error! No text of specified style in document.**-3Proposed Ferry - Passenger / Tourism**

7.4.3 Proposed vessel size and specifications

Vessels listed in Table 7-2 are the entire allowed fleet of river-class vessels that IWAI has classified. Among these, the highlighted ones are the vessels that are recommended to be deployed on River Tapi.

Table 7-2 Assumption for different class vessel design and logistics cost analysis

Class	Size (m)		Loaded Draft (m)	Capacity (DWT)	Charter Rates - Barge (Rs./Day)	Power (KW)	Consumption			Speed (Knots)
	L	B					Fuel		Ltr/Hr	
I	32	5	1.0	100	18,000	-	DO	1.0	50	6-7
II	45	8	1.2	300	30,000	337	DO	1.6	90	6-7
III	58	9	1.5	500	60,000	-	DO	2.0	110	6-7
IV	70	12	1.8	1,000	80,000	432	DO	2.4	122	6-7
V	70	12	1.8	1,000	80,000	432	DO	2.4	122	6-7
VI	86	14	2.5	2,000	110,000	597	DO	4.4	177	6-7
VII	86	14	2.9	4,000	130,000	-	DO	8.4	250	6-7

Source: IWAI

Class III, IV, and VI are all pliable on the river, primarily because the river has enough draft to accommodate all of these vessels. Even Class V vessels are a good contender, as their specifications are identical to Class IV vessels. Also, these are all self-propelled type vessels.

Detailed Specification of Passenger boat is mentioned in below table.

Table 7-3 Specification of Passenger boat

	Class I	Class II	Class III	Class IV	Class V	Class VI	Class VII
Passenger Ferry	India Bungy	AVE10	KAA 10	HD 3600 Passenger Boat	Damen Ferry 1806	Hydrofoil vessel Meteor	BLT 2003 Passenger Ferry
Length (m)	11	29.93	24	36	18	34.6	43
Beam (m)	3.84	6.05	8	6.2	5.62	9.5	8.9
Draft (m)	0.6	1.01	1.3	1.65	1.8	2.35	2.78
Passenger Capacity	20	150	130	200	130	116	500
Speed (Km/h)	12.95	18.5	22.2	18.5	18.5	65	31.45
Estimated Cost (INR)	31,38,720	4,51,19,100	2,25,18,00	2,28,86,500	2,35,29,00	4,25,15,000	4,10,12,000

7.4.4 Turnaround Time

Table 7-4 and Table 7-5 show the computed turnaround time required per barge for every class of vessels classified by IWAI. The entire waterway logistic analysis computed herein is based on the assumption that only day-time navigation will be allowed:

Table 7-4 Total turnaround time (One-way Ballast)

Description	Class						
	I	II	III	IV	V	VI	VII
Alongside time at Anchorage (Hours)	2	2	2	2	2	2	2
Loading time - Hours	1	1	1	2	2	3	5
Tide Margin	8	8	8	8	8	8	8
Sailing Time - Loaded (Hazira Anchorage to Ukai Plant) Hr	13	13	13	13	13	13	13
Discharge time @ Ukai Jetty - Hours	1	3	5	5	5	9	18
Sailing Time - Ballast (Ukai Plant to Hazira Anchorage) Hr	9	9	9	9	9	9	9
Total Time (Hrs.)	34	35	37	38	38	44	55

.

Table 7-5 Total turnaround time (No Ballast)

Description	Class						
	I	II	III	IV	V	VI	VII
Alongside time at Anchorage (Hours)	2	2	2	2	2	2	2
Loading time - Hours	1	1	1	2	2	3	5
Tide Margin	8	8	8	8	8	8	8
Sailing Time - Loaded (Hazira Anchorage to Ukai Plant) Hr	13	13	13	13	13	13	13
Discharge time @ The Ukai Jetty - Hours	1	3	5	5	5	9	18
Loading time - (Return Cargo) Hrs	1	3	5	5	5	9	18
Sailing Time - (Ukai Plant to Hazira Anchorage) Hr	13	13	13	13	13	13	13
Discharge time @ Hazira - Hours	1	1	1	2	2	3	5

Description	Class						
	I	II	III	IV	V	VI	VII
Total Time (Hrs.)	40	43	47	49	49	60	82

One of the basic assumptions here is that mother vessel calling on Hazira Anchorage will be of Panamax type, with an average parcel size of 68,000 DWT. Although other types of smaller-sized geared mother vessels like Supramax and Handymax can also call at the Port. However, optimum utilization-wise, Panamax will be the best fit for the suggested operation. These will be geared ships, meaning unloading of coal cargo on to the barges will be done by the cranes mounted on the mother vessel itself. This saves time that would otherwise involve loading and unloading operations at the Port.

Loading time is dictated by ship discharge rate and the carrying capacity of barges. The typical discharge rate for the mother vessel being considered is 800 tonnes per hour (TPH), while barge parcel size will vary based on the Class they fall under. Tide margin of 8 hours is arrived at from the tidal study. Sailing time of barges are limited by the loaded speed, which is 6 nautical-miles per hour (nmh). The speed has been kept constant for all class of vessels. The discharge rate at Ukai jetty is directed by the discharge rate of cargo, taken as 100 TPH. After unloading of coal, the barge will have to return to Hazira anchorage for the next round of coal transport. In the absence of return cargo, barges will sail to Hazira Anchorage with Ballast only. An unloaded barge will, hence, travel at 9 nmh speed.

In case of fly-ash as return cargo, all the logistics considerations and calculation will be retained. However, after unloading coal, barges will have to be loaded with fly-ash. Here, the discharge rate of the loading equipment at Ukai jetty at Terminal 4 is assumed to be the same as that of coal discharge rate. Hence, discharge time for coal and loading time for fly ash will be, nearly, the same. On its trip back to Hazira with return cargo, the barge's speed will be 6 nmh, as it's loaded with cargo. It's assumed that fly ash will be unloaded at the Port using the Port's unloading facility. This discharge rate is taken to be the same as that of the mother vessel, i.e. 800 TPH. Therefore, time taken to unload fly-ash from barge will be same as the discharge time taken for loading it with coal from the mother vessel. It's natural that total turnaround time in case of return cargo will be more than when barges return with just Ballast water. However, the former helps maximize commercial opportunities, allowing quicker recovery of the overall project cost.

7.4.5 Number of Vessel Required

- *Cargo Terminal 4*

The following table gives an estimate of the total barges IWAI may have to invest in. These requirements will differ based on the class of vessels that is ultimately chosen to move cargo on River Tapi.

Table 7-6 Number of barges/vessels required (One-way Ballast)

Description	Class - I	Class - II	Class - III	Class - IV	Class - V	Class - VI	Class - VII
DWT	100	300	500	1000	1000	2000	4000
Mother Vessel - Parcel Size	68,000	68,000	68,000	68,000	68,000	68,000	68,000
Barge - Parcel Size	90	270	450	900	900	1,800	3,600
Number of Days - Unloading	9	9	9	9	9	9	9
Turnaround of Barges - Day &Oneway Ballast	34	35	37	38	38	44	55
Cargo unloaded by Each Barge	548	1,560	2,474	4,818	4,818	8,421	13,449
Number of Barges	125	44	28	15	15	9	6

Table 7-7 Number of barges/vessels required (No Ballast)

Description	Class - I	Class - II	Class - III	Class - IV	Class - V	Class - VI	Class - VII
DWT	100	300	500	1000	1000	2000	4000
Mother Vessel - Parcel Size	68,000	68,000	68,000	68,000	68,000	68,000	68,000
Barge - Parcel Size	90	270	450	900	900	1,800	3,600
Number of Days - Unloading	9	9	9	9	9	9	9
Turnaround of Barges - Day & No Ballast	40	43	47	49	49	60	82
Cargo unloaded by Each Barge	463	1,272	1,957	3,753	3,753	6,128	8,965
Number of Barges	147	54	35	19	19	12	8

Similar to the turnaround time, requirements for total number of barges in case of return cargo will be more. Also, higher the class of vessels, lesser the number of barges IWAI will have to invest in. Hence, total number of barges required to unload cargo from one mother vessel will be between 8and 147, depending on the class of vessels that are ultimately deployed on River Tapi.

The following table shows the probable number of mother vessels that will call on Hazira, based on the projected traffic volume for coal for Ukai TPP:

Table 7-8 Annual number of Mother Vessels calling on Hazira (Phase 2)

Cargo	Fy 25	Fy 30	Fy 35	Fy 40	Fy 45
Coal	0.6	0.7	0.8	0.8	0.9
No. of Mother Vessels calling per year	10.0	11.0	12.0	13.0	14.0

Barges on River Tapi will be utilized for transporting coal for 90 days at the least or 126 days at the most. As approximately 10 number of mother vessels will come in Fy 25 with 9 number of unloading days for each vessel, therefore minimum number of operational days would be 90. Separate assessment with respect to fly ash movement is not needed, as the figures will be within the 90 – 126 operational days limits.

- ***Tourism Terminal 1 &2***

Detailed Estimation of number of passenger ferries to be deployed for accommodation of tourism traffic at Terminal 1 &2 are discussed. Class wise traffic count per trip is assessed.

Table 7-9 Estimation of number of Passenger Ferries

Financial Year	2021	2025	2030	2035	2040	2045
Traffic Per Day	256	349	513	648	788	959
Class 1 - India Bungy Passenger Boat						
Passenger Ferry Capacity Per Trip	20	20	20	20	20	20
No. of Ferries	2	2	2	2	3	3
No. of Trips	6	9	13	16	13	16
Class II - AVE 10						
Passenger Ferry Capacity Per Trip	150	150	150	150	150	150
No. of Ferries	1	1	1	1	1	2
No. of Trips	2	2	3	4	5	3
Class III - KAA 10						
Passenger Ferry Capacity Per Trip	130	130	130	130	130	130
No. of Ferries	1	1	1	1	1	2
No. of Trips	2	3	2	5	6	4
Class IV - HD 3600						
Passenger Ferry Capacity Per Trip	200	200	200	200	200	200
No. of Ferries	1	1	1	1	1	1
No. of Trips	1	2	3	3	4	5
Class V - Damen Ferry 1806						
Passenger Ferry Capacity Per Trip	130	130	130	130	130	130
No. of Ferries	1	1	1	1	1	2
No. of Trips	2	3	2	5	6	4
Class VI - Hydrofoil Vessel Meteor						
Passenger Ferry Capacity Per Trip	116	116	116	116	116	116
No. of Ferries	1	1	1	1	1	2
No. of Trips	2	3	2	6	7	4
Class VII - BLT 2003						
Passenger Ferry Capacity Per Trip	500	500	500	500	500	500
No. of Ferries	1	1	1	1	1	1
No. of Trips	1	1	1	1	2	3

7.5 Vessel Costing

As per estimates, River-class vessels of Class III to Class VI will cost IWAI anywhere between INR 4 crore to INR 7 crore for coal handling. If IWAI plans on buying these, then total investment will vary based on class type and annual requirement as dictated by traffic projections.

The estimated cost of passenger ferry for Terminal 1 & 2 is around 40 lakhs to 50 lakhs. This is just the indicative price for future reference. The price of passenger ferries is mostly linked to the luxuries associated with it. Two passenger vessels of same dimensions and carrying capacity may have a price variation of 2 times to 3 times depending upon the air-conditioning, interiors, etc. Hence, the above pricing is indicative for a moderately luxurious boat (Length- 13 m, Width- 3.8m and Draft- 1.2m) with all safety features installed on it.

7.5.1 Capital Cost

The following two tables (Table 7-10 and Table 7-11) give an estimate of capital investment and their breakup that IWAI will have to consider for developing all the terminals along River Tapi:

Table 7-10 Capital Cost estimates for development of Terminals 1 & 2

Description	INR Lakhs
Terminal 1 - Dumas Beach	
Protection - Breakwater	
Civil - Jetty	1,500
Terminal Facility - Ticketing, Waiting, etc.	2,000
Total Terminal 1	**3,500**
Terminal 2 - Old Fort, Surat	
Civil – Jetty	1,500
Terminal Facility - Ticketing, Waiting, etc.	2,000
Total Terminal 2	**3,500**
Total Capital Investment	**7,000**

Table 7-11 Capital Cost estimates for development of Terminal 4 at Ukai TPP

Description	INR Lakhs
Terminal 3 - KRIBHCO Jetty No Investment as Jetty Existing	
No Investment as Jetty Exists	
Terminal 4 - Ukai Power Plant	
Capital Investment - Locks	
Civil Infrastructure	5,000
Mechanical Infrastructure	2,000
Pump House	700
Electrical	300
Other Miscellaneous	300
Jetty Specification	150 x 15 square metre
Civil Infrastructure	3,375
Unloader	400
Hopper	200
Total Capital Investment	**12,275**

For Terminals 1 and 2, only the basic infrastructure for passengers/tourists to wait, embarks, and disembarks is needed. Terminal 1 at Dumas Beach will require an additional investment for breakwater, for protection against tidal variations, as the terminal will be exposed to sea currents. The only exception is the investment for Terminal 2. The allied infrastructure for Terminal 2 already exists, and thus, requires no investment from IWAI's side except the development of jetty at Terminal 2, Old Fort, Chowk Bazaar.

Terminal 4 at Ukai TPP will account for bulk of the investment. Due to its location, barges will have to cross Singanpore Weir-cum-Causeway, which would need a lock gate. In addition, a handful of personnel will have to be employed for managing and upkeep of the lock gate. Lastly, cargo-handling infrastructure at the Ukai jetty, along with bare necessary cargo-handling equipment will also require investment.

7.5.2 O&M Cost

In addition to the capital cost, which is a one-time investment, cost towards operation and maintenance (O&M) of the setup infrastructure will also feature in overall investment. The following table provides an estimate of the O&M cost for the cargo-handling facilities at Terminal 4, as well as the lock gate:

Table 7-12 O & M cost estimates for Terminal 4 at Ukai TPP and Lock gate

Description	Unit	INR Lakhs
Repair & Maintenance		
Civil Infrastructure		1%
Mechanical Infrastructure		5%
Civil Infrastructure		50
Mechanical Infrastructure		165
Total Cost for Repair & Maintenance		**215**
Lock operation Cost	Unit	INR Lakhs
Average Salary		5
Salary (20 personnel)	20	100
Electricity/Pump operation		250
Repair & Maintenance		500
Annual cost of operation		**850**
Total Annual Cost of Operation		**1,065**
Total Assumed Traffic (mnTonnes)	1	
Per Ton Cost		**106.5**

7.6 Summary and Recommendations

The following two tables summarize the overall logistic assessment of using River Tapi waterway, as against the current mode of railway:

Table 7-13 Logistics cost comparison between waterway and other routes (one-way Ballast)

INR/Tonne

Parameters	Class			Competing Ports & Routes		
	Class - III	Class - IV	Class - VI	GAPL	Kandla	HPPL
Mother Vessel - Unloading	392	392	392	88	358	358
Cargo Handling Charge	35	35	35	410	270	350
Lock Operation Cost	107	107	107	NA		
Freight Cost - Barge	527	334	291			
Charges for Jetty	60	60	60			
Storage @Ukai Plant	75	75	75			
Freight Cost - Rail	NA			964	899	206
Last Mile Connectivity	14	14	14	NA		
Total Cost	**1,208**	**1,016**	**973**	**1,462**	**1,527**	**914**

Table 7-14 Logistics cost comparison between waterway and competing (No Ballast)

INR/Tonne

Parameters	Class			Competiing Ports & Routes		
	III	IV	VI	GAPL	Kandla	HPPL
Mother Vessel - Unloading	392	392	392	88	358	358
Cargo Handling Charge	35	35	35	410	270	350
Lock Operation Cost	107	107	107	NA		
Freight Cost - Barge	356	227	158			
Charges for Jetty	60	60	60			
Storage @Ukai Plant	75	75	75			
Freight Cost - Rail	NA			964	899	206
Last Mile connectivity	14	14	14	NA		
Total Cost	**1,038**	**909**	**840**	**1,462**	**1,527**	**914**

Costs like GMB Charges, royalty towards IWAI, and cargo freight in case of return cargo have not been considered in computing logistics costs. It has been assumed that IWAI and the state maritime board will not charge the users for utilizing the navigation infrastructure and terminals. Application of cargo freight in case of return cargo will be different for waterway and different for the existing rail movement. In case of latter, it's not a standard practice for a rail freight to be loaded with return cargo and journey back to the point of origin after one-way dispatch. Instead, freight trains continue moving towards other cargo destinations. To maintain consistency in determining logistics cost, these variable cost components have been left out from the logistics cost comparison.

Last mile connectivity for waterway logistics assessment involves moving cargo from Terminal 4 jetty to the precise plant location. The distance between the proposed Terminal 4 and Ukai TPP is around 9 km. Here, an average truck freight rate of INR 1.5 per tonnes of cargo per km has been considered. Last-mile connectivity for competing routes involves one-time railway freight cost, discharging cargo at the exact plant location.

The following figures (Figure 7-3 & Figure 7-4) elaborate and extend upon the logistics cost comparisons depicted in the two tables above. These visuals give an idea about the total cost of ownership for Terminal 4, both in case of one-way ballast and no-ballast. The assessment has been carried out with respect to Class IV vessel. Logistics cost using railway from Hazira Port will be cheaper than moving the same on waterway. The logistics cost difference of INR 102/tonne of coal favours the rail movement. In this scenario, the government needs to subsidize the cost difference to encourage the traffic shift, and to promote IWT. However, in case of traffic diversion with return cargo, using IWT would result in a net saving of INR 5/tonne.

An important recommendation here is regarding the investment towards barges. As mentioned earlier, each barge will be put to utilization for 126 days at the most. For the remainder of the year, barges will lay idle, while also requiring regular maintenance, further adding to the operation cost. Therefore, a financially wiser approach would be to charter hire these barges, instead of resorting to the one-time investment of buying them.

Figure 7-3 Logistics cost comparison b/w Tapi River and Hazira Port (One-way Ballast) (INR)

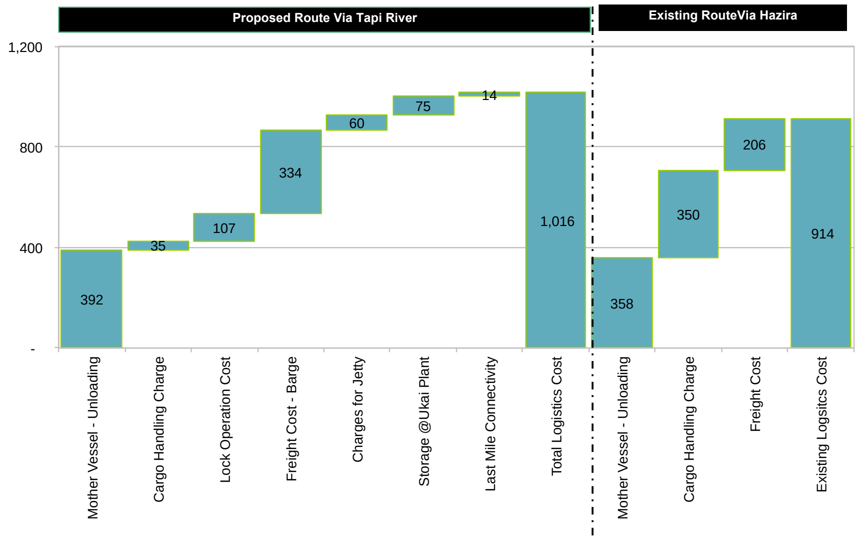
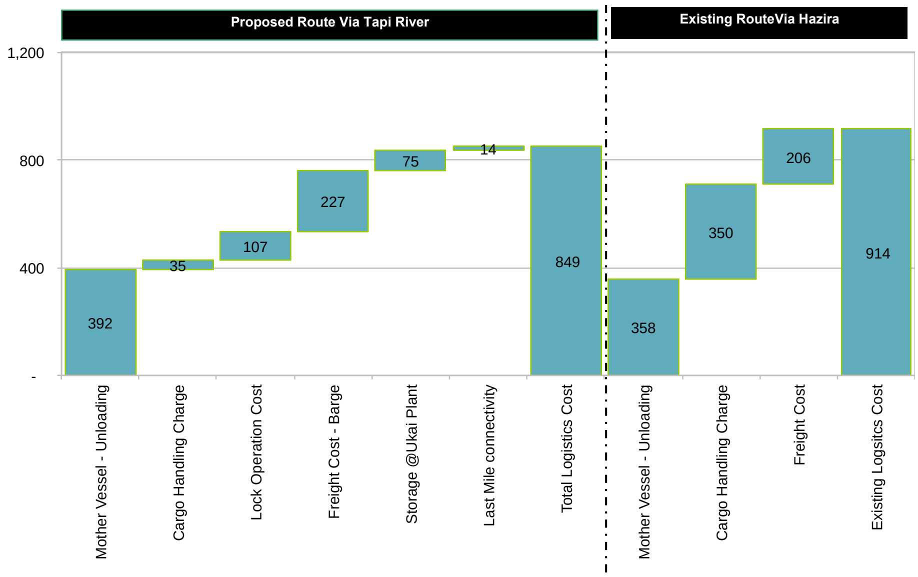


Figure 7-4 Logistics cost comparison b/w Tapi river and Hazira Port (No Ballast) (INR)



CHAPTER – 8

NAVIGATION & COMMUNICATION SYSTEM

8.1 General Requirement

Navigational system is considered as an important aid for any vessel movement in coastal and river channel. Navigational Safety in Port's Committee was formed in India known as NSPC to ensure navigational safety in waterways.

8.1.1 VHF/HF

VHF communication system is a part of VTS/VTMS system i.e. Vessel Traffic system or Vessel Traffic Management System. This navigational system is required when there is heavy traffic at port or terminals. Though there are international standards published by IMO, each Country and each state or province also follows its own standard. It helps to locate exact position for berthing of vessels and decide traffic lane for vessels accordingly. VHF also comes under Marine Communication Systems. VHF Radio also known as very high frequency radio used for communicating between shore & vessels or between two vessels. Depending upon area of operations of various ships activity of VHF system differs. As per nautical miles from shore of vessels, various types of VHF radio frequency system are used for communication. For Tapi river vessels could contact terminal Manager via VHF system and would be provided guidance for berthing or for anchorage etc. This system would also help in planning vessels arrival & departure schedule for terminal or port.

8.1.2 Differential Global Positioning System (DGPS)

DGPS is satellite-based system. Generally DGPS system has two reference stations, two integrity monitors, control computer, communication system, marine radio beacons and continuous power supply. All these equipment's are necessary for DGPS system to function. Vessel monitoring & controlling could be done from various DGPS stations or remotely from other control stations. Using DGPS corrections could be made in GPS receiver to increase the accuracy of navigation. It is the advance version of GPS system. AT present there are 23 DGPS stations installed on entire coastline of India. In Gujarat, DGPS stations are installed at Okha, Hazira, Porbandar and Gopnath.

8.1.3 RIS/AIS/Radar/VTMS

- River Information System (RIS)

First RIS system has been introduced in India on NW 1 in Fy-16. RIS is a combination of software & hardware equipment used for optimization of traffic & vessels movement in Inland waterways for navigation purposes. RIS is used for electronic data transfer between vessels & shore. Using RIS system many waterway transportation risks like vessels collisions, Vessel – bridge collisions could be avoided. TapiRiver also has many bridges on it. Vessels/barges that would use river could be benefitted by using RIS system and safely navigate in complete stretch of the river.

- Automatic Identification System (AIS)

AIS & RIS system together provide safe navigation for vessels. Both these systems are used simultaneously. Under AIS, vessels that would ply on whole river stretch are monitored. Remote stations/base stations site would be installed/developed for monitoring vessels and identify it. This would further strengthen safe navigation for vessels.

- Radar

Radar is basically used to locate other ships and nearby land area. In radar system there are X frequency & S frequency. X stands for secret & S for small range. Radar screen on ship display each and every object that are in the coverage of particular radar on ship. There is antenna on the top of radar, which continuously rotates, & flashes in order to find out any objects on the navigable path of the ships. It not only identifies objects but also shows its distance from ship. This also helps in avoiding accidents in the waterways. Radar system is also considered as user friendly and economical to install due to less consumption of power & electricity.

- Vessel Traffic Management System (VTMS)

Radar, VHF all are part of VTMS. Together it helps to plan ships arrival & departure, monitor anchorage activities, provide traffic guidance to ships and control traffic in the waterways. In case of emergency or rescue operations would be carried out successfully using VTMS system. Some of the vessels arriving at terminals on Tapi River would not be complying necessary norms for berthing purposes. In this case anchorage/pilotage or barges need to be used in order to access terminals on Tapi River. This could be done successfully using VTMS. Overall it helps to have complete control over management of vessels & terminal.

LIST OF EQUIPMENTS:

Sensor System

a. AIS Base Station
b. RADAR
c. VHF System
d. Meteo Sensor
e. Automatic Tank Gauge

Tracking

a. RIS Hardware (Servers & Computers)
b. RIS Software

Power Supply

a. UPS
b. DG Set

Civil Deliverables

a. Trestle Tower for installation RADAR
b. Building for installing RIS equipment / Porta cabin

RIS SYSTEM TAPI RIVER (NW-100)				
Sr. No.	**Equipment**	**Qty**	**Unit Price**	**Total**
1	AIS Base Station	1	3000000	3000000
2	RADAR	1	5000000	5000000
3	Meteo Sensor	1	700000	700000
4	ATG	1	900000	900000
5	VHF	1	500000	500000
6	DG Set 10 KVA	1	700000	700000
7	UPS	1	500000	500000
8	RIS Software	1	3500000	3500000
9	RIS Hardware	1	10000000	10000000
10	Installation Testing & Commissioning	1	2000000	2000000
11	Porta cabin	3	1200000	3600000
12	Trestle Tower	1	1000000	1000000
			Total	**31400000**
	Operation			-
1	Engineer 1 * Site 1 * Months 12 per year	12	35,000.00	420000
	Operator 3 * Site 1 * Months 12 per year	36	20,000.00	720000
	Security 3 * Site 1 * Months 12 per year	36	15,000.00	540000
2	Second Year			0
3	Third Year			0
4	Fourth Year			0
			Total	**1680000**

RIS SYSTEM TAPI RIVER (NW-100)				
Sr. No.	**Equipment**	**Qty**	**Unit Price**	**Total**
	CAMC for 4 Years			-
1	1st Year	1	3140000	3140000
2	2nd Year	1	3454000	3454000
3	3rd Year	1	3799400	3799400
				-
			Total	**10393400**
			Overall Cost	**43473400**

8.2 Existing System

At present there is no navigable or communication system developed on Tapi River.

8.3 Additional requirement

Once the terminals on Tapi River gets developed, all these basic safety norms need to be installed for safe navigation of vessels and to have complete control on traffic handled at terminal.

8.4 Costing

8.4.1 Capital Cost

Navigation & Communication Cost	**In Crores**
Marine Lantern/Buyos (10 nos.)	0.20
RIS	4.35
Total Cost(II)	4.55
3% Contingencies and 7% Supervision charges on Base cost	0.45
Total Navigation & Communication Cost	5.00

Table 8.1 Capital Cost for Navigation Aids (Phase-1)

Navigation & Communication Cost	**In Crores**
DGPS	1.00
VTMS	1.00
Marine Lantern/Buyos (48 nos.)	0.96
RIS	4.35
Total Cost(II)	7.31
3% Contingencies and 7% Supervision charges on Base cost	0.73
Total Navigation & Communication Cost	8.04

Table 8.2 Capital Cost for Navigation Aids (Phase-2)

8.4.2 O&M Cost

Table 8.3 Operation & Maintenance Cost (Phase 1)

II	**O & M Cost**	**In Crores**
(i)	Dredging @ 10%	0.94
(ii)	Civil works @ 1%	0.34
(iii)	Mechanical & Electrical Cost @ 5%	0.11
(iv)	**Ports Crafts/Nav. Aids @ 5%**	**0.25**
(v)	Fuel Cost	1.00
(vi)	Power Cost	2.00
(vii)	Manpower Cost	5.50
(viii)	Miscellaneous	0.50
	Total	**10.64**

Table 8.4 Operation & Maintenance Cost (Phase 2)

II	**O & M Cost**	**In Crores**
(i)	Dredging @ 10%	6.00
(ii)	Civil works @ 1%	19.88
(iii)	Mechanical & Electrical Cost @ 5%	1.221
(iv)	**Ports Crafts/Nav. Aids @ 5%**	**0.40**
(v)	Fuel Cost	2.00
(vi)	Power Cost	4.00
(vii)	Manpower Cost	2.74
(viii)	Miscellaneous	0.50
	Total II	**36.75**

CHAPTER 9
ENVIRONMENTAL AND SOCIAL ASPECTS

9.1 Objective of Environmental and Social Studies

Objective of Environmental and Social Studies is to acquire an awareness of the environment as a whole and its related problems. Participate in improvement and protection of environment and develop the ability to evaluate measures for the improvement and protection of environment.

9.1.1 Need of the Project

IWAI, Govt. of India intends to find the viability of Tapi river (NW-100) as a Inland navigational waterway. The development of national waterway will help in transportation of cargo and passengers which will help in decongestion of traffic on roads and railways. The transportation through waterway is cheaper and requires less fuel which ultimately reduces the carbon emission and is environment friendly, The development of waterway will contribute to the economy of the country.

This section discusses the global concept of the environmental problem arising as a result of the development of Inland waterway navigation project in Tapi river, construction of terminals and effects on environment due to movement of cargo. The section will cover the land usage pattern along the study area, Physiography of the area, Presence of any National Park, Wild life protected sanctuaries, Wetlands, flora and fauna, Protected sites, Archaeological survey of india declared sites present within 10km radius will be shown. It will also cover the Geology pattern, air quality and susceptibility to natural hazards of the study area.

Some of the environmental problems are air, land and water pollution, environmental health degradation, rehabilitation, wildlife migration etc. The continuous increase in concentration of air pollutants in the atmosphere has threatened the Green House and atmospheric ozone layer at global level. The carbon dioxide is mainly responsible for Green House effect. Navigation development projects are also of great concern for the environmental degradation. These ecological environmental changes may be reversible or irreversible, due to many interacting parameters. In general the combined effect of two parameters is greater than that of individual one. Consequently these impacts could have repercussions on others. The internationally accepted practice of studying environment impact involves its identification, prediction and evaluation.

Environmental Management Plan (EMP) based on the environmental baseline conditions, planned project activities and impacts assessed earlier, this section enumerates the set of measures to be adopted to minimize the adverse impacts.

To sum up, the objectives of environmental and social studies are to develop a world in which persons are aware of and concerned about environment and the problems associated with it, and committed to work individually as well as collectively towards solutions of current problems and prevention of future problems.

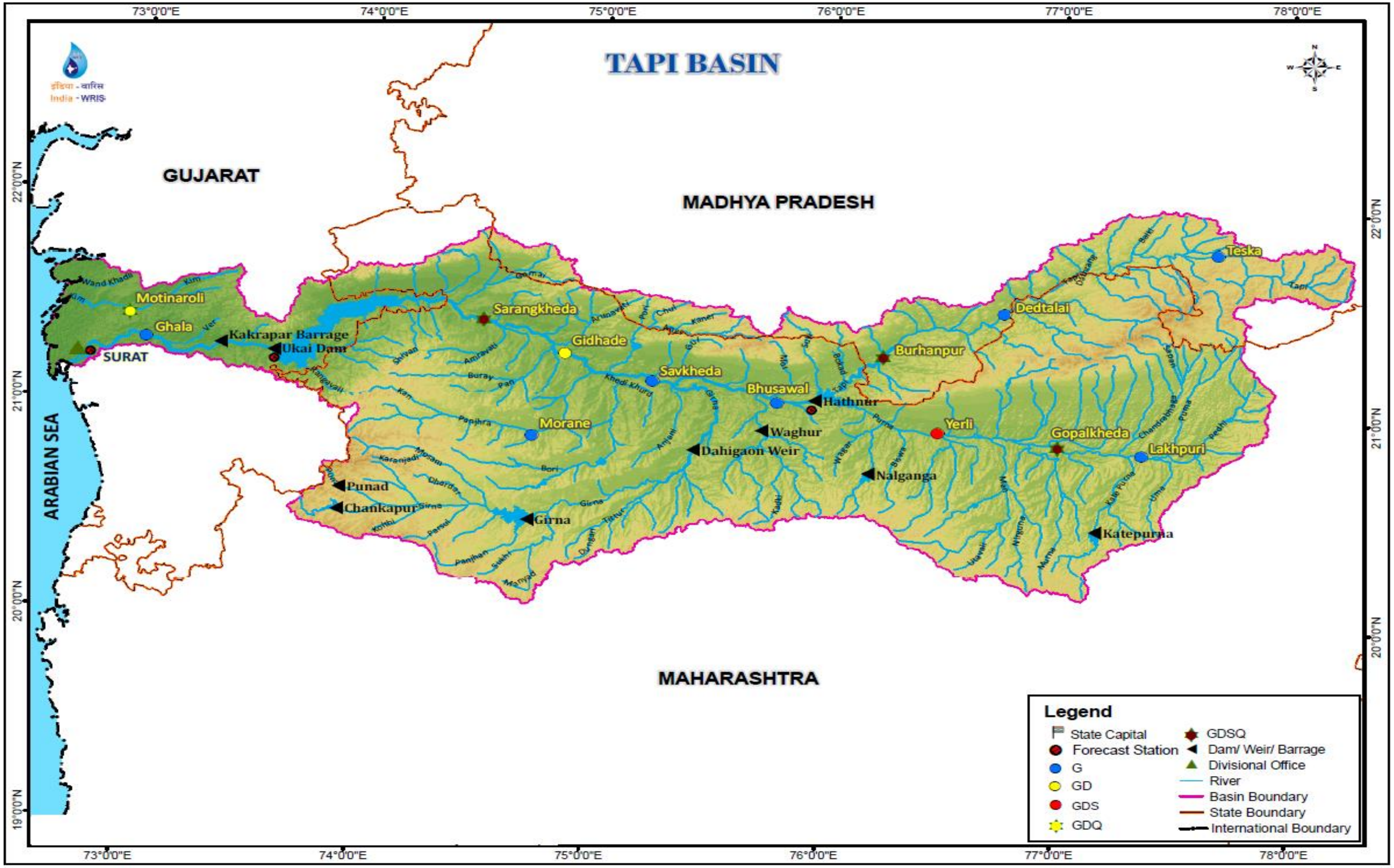
For collection of data related to environment setting in the project area the correspondence Letter to Additional Principal Conservator of Forests, Gandhinagar dated 6th April, 2017 by WAPCOS has been attached in page no.270-271.

9.2 Environmental Setting in the Project Area

The Tapi basin has two well-defined physical regions, viz. the hilly regions and the plains. The hilly regions cover the Satpura, the Satmala, the Mahadeo, the Ajanta andthe Gawilgarh hills and are well forested. The agricultural area of the basin is considered as the total of the land under crops and trees, current fallows, other fallows, agricultural wasteland and net area sown. The basin in Madhya Pradesh is mostly covered with Deccan trap lava flows. The other formations found in the basin are alluvium, lower Gondwana, Cuddapah system, Bijawar series, and granites gneiss. Most of the area of Tapi basin falling within Maharashtra state is full of cuts & valleys.

The map showing entire Tapi basin (Source: INDIA WRIS wiki) and Present study stretch is attached as Figure 9.1 & Figure 9.2 respectively.

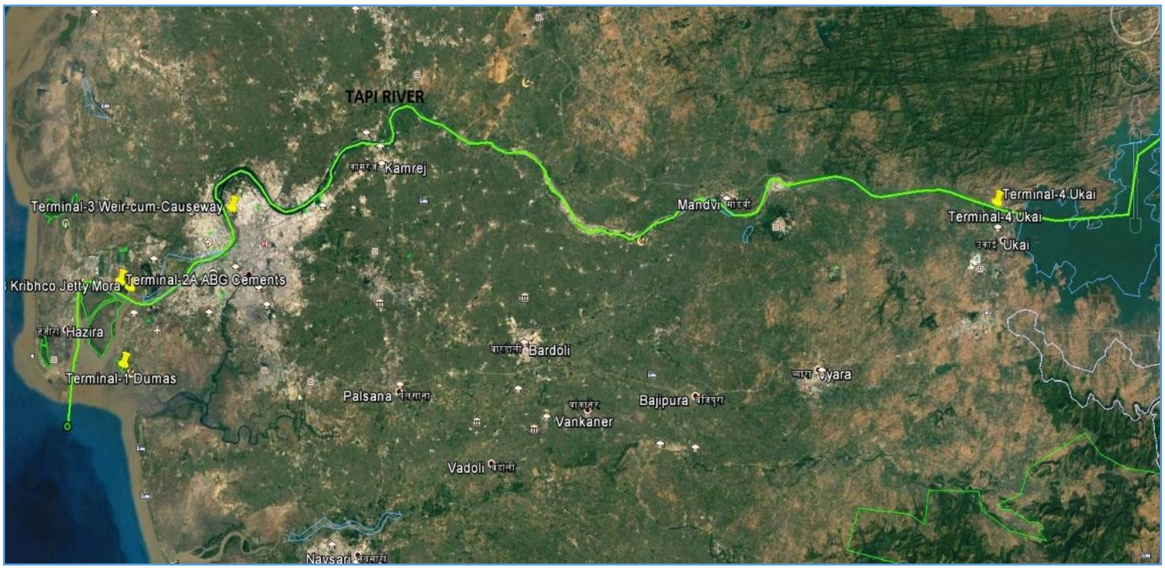
Fig:-9.1 Tapi Basin



The total length of the river from origin to outfall into the Arabian Sea is 724 km For the first 282km the river flows in Madhya Pradesh, out of which 54 km forms the Common boundary with Maharashtra State. It flows for 228 km in Maharashtra before entering Gujarat. Traversing the length of 214 km in Gujarat, the Tapi River joins Arabian Sea in the Gulf of Cambay after flowing past the Suratcity.However, only 174.58 km stretch is considered for the present study.

Region within 25 km on either side of the river falls under the primary catchment area. Districts of Surat and Tapi in Gujarat, and Nadurbar in Maharashtra fall under this primary catchment area. River Tapi falls in south Gujarat. Map showing the stretch of study is shown **Fig. 9.2**

Fig:-9.2 Map showing present stretch of study of River Tapi



Source:-Google Earth

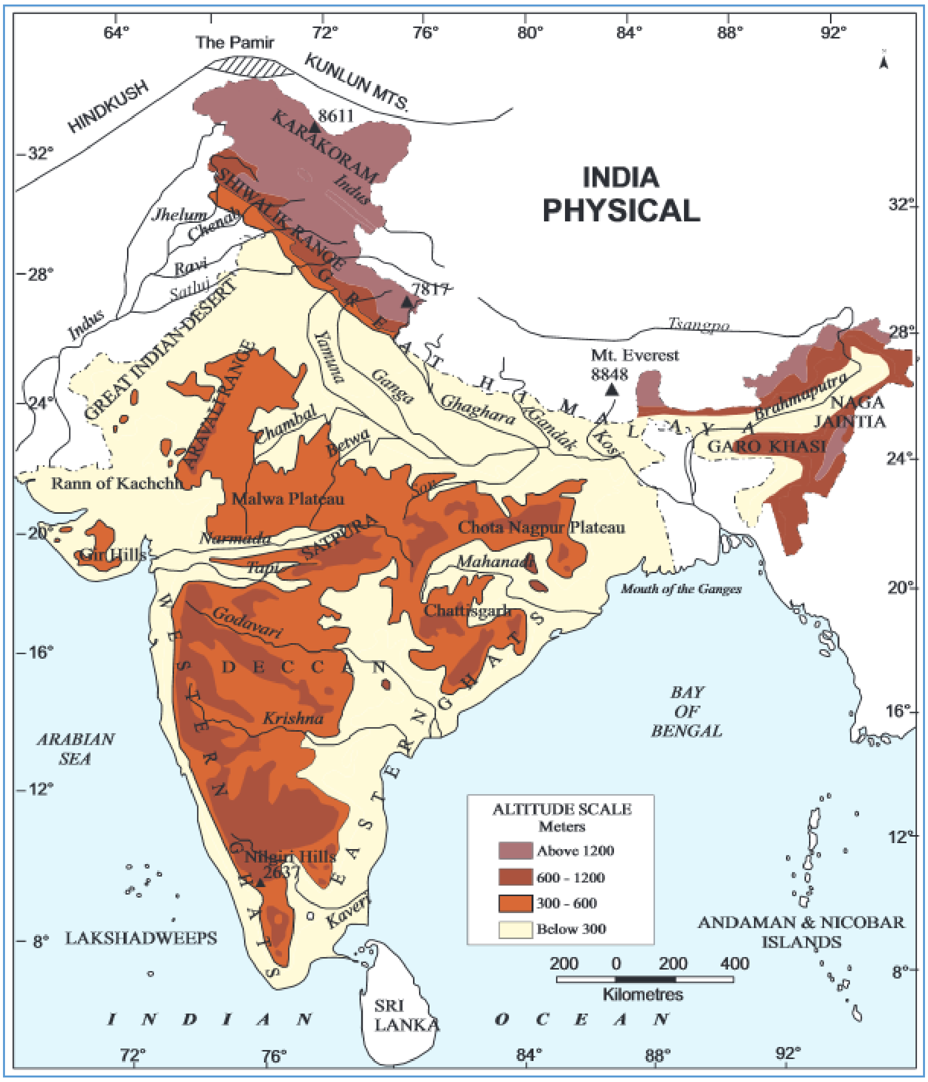
9.3 Physiographic

Physiography of India

The Tropic of Cancer passes through eight states in India – Gujarat, Rajasthan, Madhya Pradesh, Chhattisgarh, Jharkhand, West Bengal, Tripura and Mizoram.

Between the Western and Eastern longitudes there is a difference of 30 degrees which causes a difference of about two hours between the western-most and eastern most areas of the country. The Standard Meridian lies on 82°30′ East longitude, which falls in the middle of the country. It sets the Indian Standard Time (5 and half hour ahead of GMT). The Standard Meridian passes through Mirzapur near Allahabad in Uttar Pradesh.

Fig: 9.3- India Physical map



The coastal plains in India are situated parallel to the Arabian Sea and Bay of Bengal. On the basis of location and active geomorphic processes, it is divided into Western and eastern Coastal Plains.

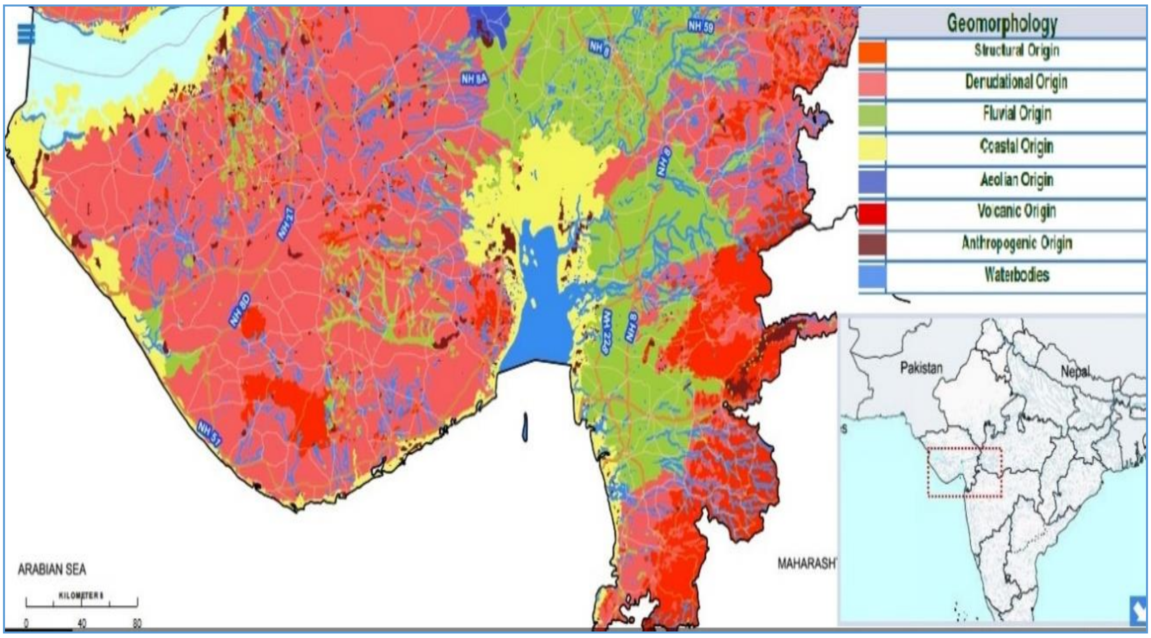
The Western Coastal Plain – Extends from Rann of Kachchh to Kanyakumari. It has four divisions:

Kachchh & Kathiawar coast in Gujarat, Konkan coast in Maharashtra, Goan coast in Karnataka Malabar coast in Kerala(has backwaters aka ‘kayal’ .The western coast is narrow in middle and gets broader in north and south. The rivers in Western Coast do not form DELTA.

9.4 Geology and Seismicity (From Primary / Secondary Sources)

The Geology and seismicity pattern of the region is discussed **Fig 9.4 & 9.5 respectively**

Fig:- 9.4 Geology pattern of Gujarat



As per figure shown above our project area is in Gujarat comprises of fluvial and structural origin.The area belongs to the southern part of the Cambay basin. It is mostly occupied by Quaternary sediments except for the south eastern and eastern parts where Deccan traps occur at higher elevations and north eastern parts where Tertiary sedimentaries are exposed. In the Surat district ferruginous sandstones of the Guj. series are underlain bynummulitic limestone, sub-num mulitic gypseous shales and supra-trappean lateritised sediments with pockets of bauxite. The stratigraphic sequence is shown in Table 9.1A as follows:

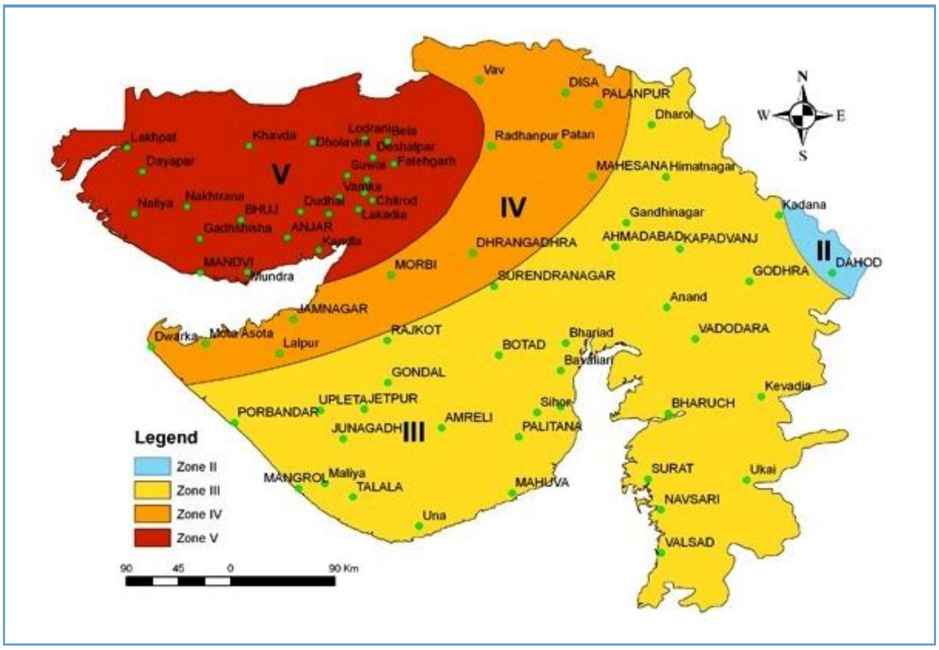
Table 9.1A Stratigraphic Sequence

T E R T Y A A R Y	Quaternary	Alluvial, estuarine and aeolian sediments.
	Miocene	Guj. Series - Ferruginous sandstone.
	Ecocene	Nummulitic Limestones.
	Palaocene	Sub-nummulitic Gypseous shales. Supratrappean sediments, partly lateritised with bauxite at places.
	Late Cretaceous to Eocene	Deccan -Traps.

The Cambay basin, which is well known to be bounded by step faults on the eastern and western margins, is also dissected into seven major crustal blocks in the N-S direction from Mehmudabad to Billimora. The various crustal blocks identified are, from the north: (i) Mehomadabad block (ii) Tarapur block (iii) Petlad Katana block (iv) Jambusar-Broach block,(v) Kosamba block, (vi Surat block and (vii) Navsari-Billimora block. These blocks are displaced, up or down, relative to the adjacent blocks due to movements along the faults bounding them. Most of the faults have been found to extend quite deep and to affect theMono boundary considerably, as is quite evident from the relief of the Moha found alongthe profile. Further, the seismic activity observed in the region, during historical as well asmodern times, suggests that these deep faults may even be currently active. The Jambusar-Broach block has a maximum crustal thickness of 38-40 Km with deepest granitic basementat 6.0 to 6.5 Km depth. Towards north and south of this graben, the Mono as well as thegranitic basement are found to be at Shallower depths. The Deccan traps, which from thebasement of the overlying Tertiary sediments very in thickness from 1.0 to 1.8 Km and riseto very shallow depths on the southern part of the profile. It is generally believed that the Tapi and Narmada rivers flow along parallel fissure zones trending NNE-SSW across theCambay graben. The above studies by Kaila at al op cit) have shown that deep faultsaresituated a few Kms (south and north from the present poraitions of Narmada and Tapi respectively.

Seismicity

Fig:- 9.5 Seismic Map of Gujarat



As per Map shown above it is clear that our project area lies in the Zone III of seismic zone

9.5 Climate

There are four distinct seasons in the catchment. They are (i) Cold weather, (ii) hot weather, (iii) south-west monsoon and (iv) post- monsoon. The cold weather season commences in December and continues till the end of February. December is the coldest month. The hot weather starts in March and continues up to the middle of

June. May is usually hottest month of the season. The south-West of monsoon sets in by the middle of June and withdraws by the first week of October. June to September is the period of heaviest rain In the post-monsoon season, a few thunder-storms occur, especially in October. Thereafter, the weather clears up and it is dry and pleasant throughout the valley. The temperature of the basin varies in a range of 50 to 480C. In the cold weather season mean minimum temperature varies between 11.1°C to 14.4°C. In May which is the hottest month of hot weather season. The mean max temperature ranges from 12°C to 40.11°C

9.6 Soils

The dominant soil-scapes, representing the region are gently to very gently sloping deep, loamy to clayey and nearly level to gently sloping deep black soils. The catchment of River Tapi under study covers consists of deep black soils and coastal alluvium. The soils in the catchment classified into Coarse shallow soils, Medium Black soil and Deep Black soil.They are clayey, slightly alkaline, and calcareous.Soil samples were collected at 18 different location along the stretch of present study which are mentioned Table 9.1

Table 9.1 Soil sample at different stretch

Sample No.	Chainage (km)	Soil Strata	Depth (m)
1	174.587	clay	2.00
2	167.065	clay	2.00
3	149.773	clay	3.00
4	142.212	clay	2.00
5	137.504	clay	4.00
6	132.343	Silty clay	7.22
7	122.452	sandy	10.62
8	112.617	sandy	4.45
9	101.266	sandy	0.50
10	92.976	sandy	0.80
11	81.570	sandy	0.50
12	70.088	sandy	5.83
13	59.391	sandy	7.89
14	44.279	Sandy, clay	4.92
15	34.717	Sandy, clay	4.72
16	23.712	Sandy, clay	5.02
17	12.180	Sandy, clay	7.20
18	5.722	Sandy, clay	13.68

Grain size analysis of the particle was also done and varies from .01mm to 0.1mm.

9.7. Land Use Pattern

Of the total area in Surat district, a vast portion or 65% comes under the net sown category area. This is followed by non –agriculture area and fallow lands, each at 14% and 10%.Forest area takes up less than 5% of total land in the Surat district. There are total 1,016 farmers in the district. Out of these, more than 43% of farmers have less than 1 hectare land each. The combined area held by 43% of farmers is only 11% of the total sown area. In contrast, over 66% of land is held by 29% of farmers who have an area of more than 2 hectares each.

Table 9.2 Land use pattern of the districts along the Tapi river stretch

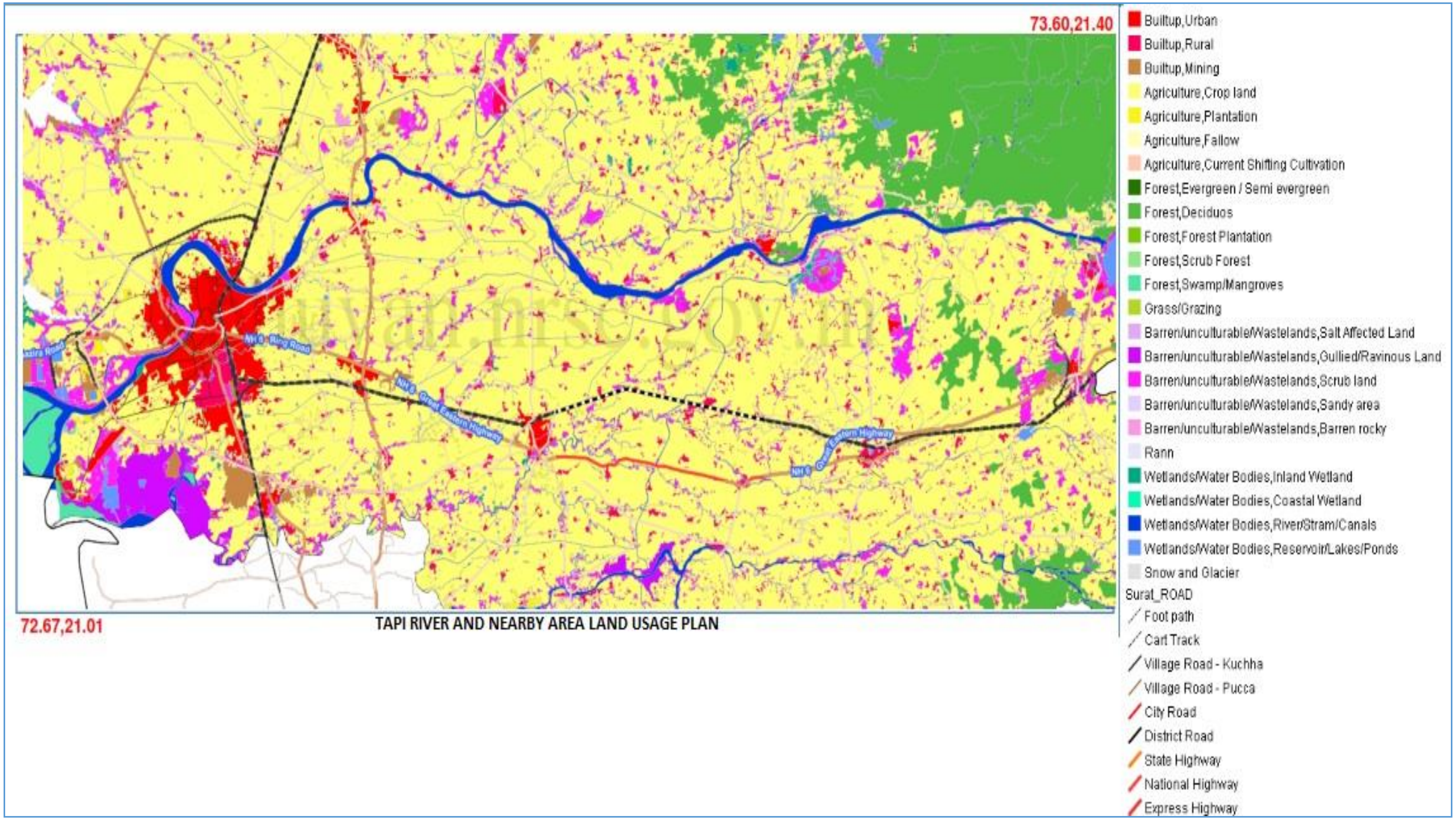
Area in Hectares

District	Forest	Non-Agriculture	Net Sown Area	Uncultivable barren land	Fallow Lands	Cultivable Waste	Others	Total Area
Surat	26	73	331	0	50.8	31	10	524
Tapi	74	48.5	164.1	46	0.5	3.4	9	345

In Tapi district, more than 48% of area is net sown area. This is followed by Forest area and non-agriculture area 21% and 14% each. The district also has 13% of barren land highest in percentage –wise amongst the districts along the Tapi River. Tapi district is known for dense forests with a major production of bamboos. There are total 73075 farmers in the district. Out of these, more than 40% of farmers have less than 1 hectare land each. The combined area held by 40% of farmers is only 8% of the total sown area.In contrast, over 71% of land is held by 32% (23,346) of farmers who have an area of more than 2 hectares each.

The satellite image of the present scope of the study is shown in figure 9.6

Figure 9.6 Satellite image of land use pattern



Source:- Bhuvan ,ISRO

Crops and Agriculture in the Region:

Agriculture:

Surat:

Rice and cereals dominate more than half of the net sown area. Sugarcane is another major crop having 30% of the net sown area in the district.

Table 9.3 Major crops for Surat District

District	Major Crops	Area in(000) Hectares	Production in ('000 tonnes)	% to total area sown
Surat	Paddy (*Oryza sativa)*	796	1805	24%
	Sorghum *(Sorghum vulgare)*	187	221	6%
	Wheat *(Triticum aestivum)*	60	122	2%
	Sugarcane *(Sacharum offinarum)*	989	7493	30%
	Cotton *(Gosypium arboreum)*	34	86	1%
	Cereals	1075	2258	32%

Tapi:

Paddy and cereals dominate more than half of the net sown area. Sugarcane is another major crop having 6% of the net sown area in the district.

Table 9.4 Major crops for Tapi District

District	Major Crops	Area in(000) Hectares	Production in ('000 tonnes)	% to total area sown
Tapi	Paddy*(Oryza sativa)*	380	798	23%
	Sorghum(*Sorghum vulgare*)	37.6	50.1	2%
	Sugarcane*(Sacharum offinarum)*	101	516	6%
	Groundnut *(Arachis hypogea)*	132	211	8%
	Cotton *(Gosypium arboreum)*	43	76	3%
	Cereals	630	1221	38%

9.8 Ambient Air Quality (From Primary / Secondary Sources)

Ambient air quality was collected from the Gujarat Pollution Control Board under the following programme for the Year 2014-15 average is presented below

1. **National Air Quality Monitoring Programme (NAMP)**

Under this project Ambient Air Quality monitoring is carried out at 38 stations in the state with the financial help of the Central Pollution Control Board, Delhi. The ambient air quality samples were collected as per the standard norms for ambient air quality monitoring prescribed by CPCB. Status of Ambient Air Quality monitoring NAMP Project. Tapi River is presented in Table 9.5 for Year 2014-15 average is presented below

The air quality data of city near to Tapi river is presented in **Table 9.5**

Table 9.5 Air quality data *[Yearly average 2014-15]*

S. No	City	LOCATION	PARAMETER											
			PM 10	PM 2.5	SO2	Nox	O3	NH3	CO	Pb	As	Ni	Benzene	Benzo- a-pyrene
		NATIONAL AMBIENT AIR STANDARDS	60	40	50	40	100	100	2	0.5	6	20	5	1
1	SURAT	SVR COLLEGE	84	29	13.8	38.4	10.7	10.3	1.35	0.09	<1.0	1.2	1.5	<0.5
2		BRC, UDHANA (DARSHAN PROCESSORS)	93	33	14.7	21.3	11.2	10.3	1.42	0.17	<1.0	1.7	1.7	<0.5
3		AIR INDIA BUILDING	90	32	13.8	20.6	11.1	9.9	1.38	0.11	<1.0	1.4	1.5	<0.5
4		CETP PALSANA	76	29	11.7	18.8	11.2	9.3	1.37	0.1	<1.0	1.6	1.7	<0.5
5		CHALTAN SUGAR	84	31	12.4	19.8	11.8	10.8	1.37	0.05	<1.0	1.5	1.8	<0.5
6		GIDC PANDESARA	87	31	12.6	20.4	12	11.5	1.35	0.08	<1.0	1.7	1.8	<0.5
7		SGPTA ASSOCIATION OFFICE	88	32	12.2	19.6	11.3	8.4	1.34	0.1	<1.0	1.6	1.8	<0.5
									All parameter are express in µg/m3					

Source:-Gujarat pollution control board

Form the table it is clear that the level of PM_{10} is higher from the permissible ambient air quality standards for the above mentioned city Surat, rest other parameters are within the NAAS limits

2. State Air Quality Monitoring Programme (SAMP):

Under this project Ambient Air Quality monitoring is carried out at 24 stations in the state. The ambient air quality samples were collected as per the standard norms for ambient air quality monitoring prescribed by CPCB.

Status of Ambient Air Quality monitoring SAMP Project. The air quality data of city near to Tapi river is presented in **Table 9.6** for Year **2014-15** average is presented below

Table 9.6 Air quality data [Yearly average 2014-15]

S. No	City	LOCATION	PARAMETER											
			PM 10	PM 2.5	SO2	Nox	O3	NH3	CO	Pb	As	Ni	Benzene	Benzo-a-pyrene
		NATIONAL AMBIENT AIR STANDARDS	60	40	50	40	100	100	2	0.5	6	20	5	1
1	SURAT	DELHI GATE POLICE CHOWKI	92	32	14	20.8	11	10.3	1.4	0.14	< 1	1.7	1.7	< 0.5
2		HI-CHOICE PROCESSERS, SACHIN	97	33	28.4	22.7	11.1	10.8	1.59	0.17	< 1	1.8	2	< 0.5
3		GARDEN SILK MILLS , KADODARA	89	31	13.9	20.9	10.9	9.3	1.32	0.14	< 1	1.9	1.9	< 0.5

All parameter are express in µg/m3

Source:-Gujarat pollution control board

Form the table it is clear that the level of PM_{10} is higher from the permissible ambient air quality standards for the above mentioned city Surat, rest other parameters are within the NAAS limits.

9.9 Noise Levels (From Primary / Secondary Sources)

Noise levels of the Surat district was collected from pollution control board of Gujarat shown **Table 9.7**

Table 9.7 Noise Levels

Noise Quality Data April 2015						
Sr. No.	Location	Zone	Limit as per CPCB Guidelines Leq, dB		Avg. of Observed value Leq, dB	
			DAY*	NIGHT**	DAY*	NIGHT**
1	Jhab,Mandvi	Industrial Zone	75	70	54.2	52.6
2	Uteva	Residential Zone	55	45	55.6	47.8
3	Jharpan	Residential Zone	55	45	53.4	52.1
4	Areth	Residential Zone	55	45	43.6	49.5

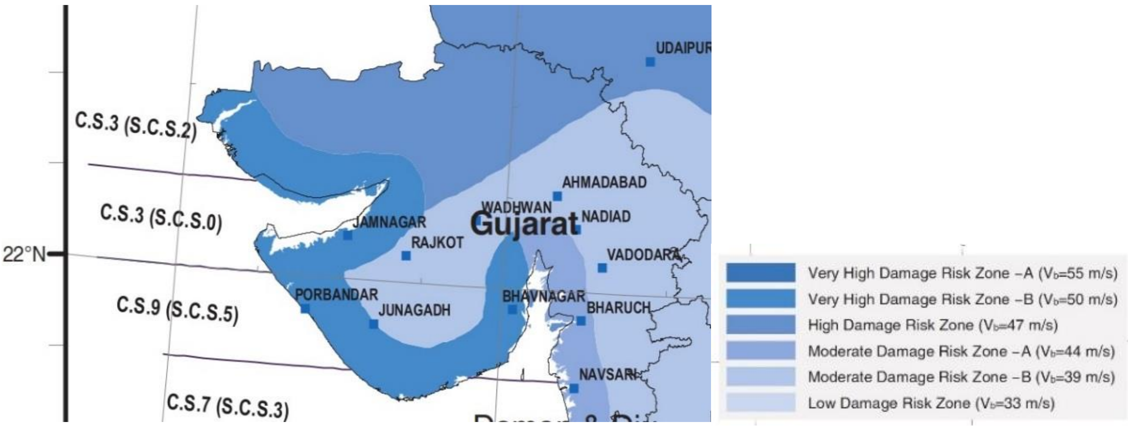
** Day time : Leq (6.00AM TO 10.00PM)*
*** Night time: Leq (10.00PM TO 6.00AM)*

Source:-Annual Report 2014-2015, Gujarat pollution control board

9.10 Susceptibility to Natural Hazards

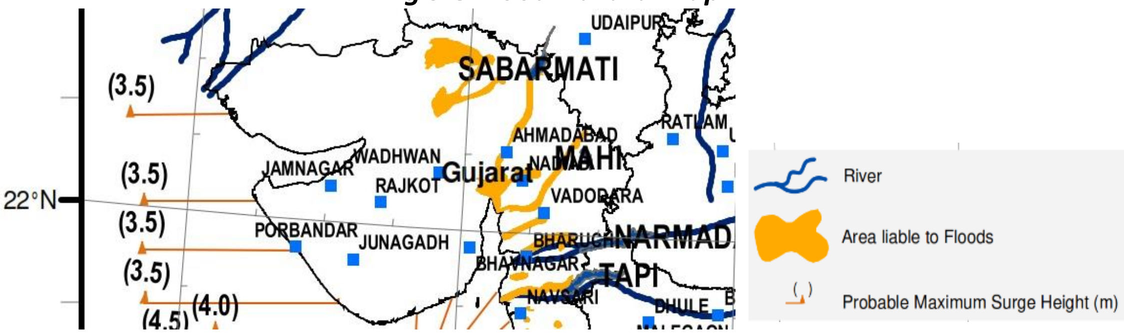
Susceptibility to Natural hazards like cyclone, flood and earthquake is shown **Fig 9.7** in the map.

Fig 9.7 Wind and cyclone hazard Map



It can be seen from the above map of wind and cyclone hazard that our project area is falling in low to moderate range of risk.

Fig 9.8 Flood Hazard Map



The above figure shows the areas liable to flood and probable maximum surge height. Earthquake prone areas has been already discussed in point 9.4 which shows our project area falls in seismic zone III. Hence the project area is not prone to natural hazards.

9.11 Estuary and Coastal Zone

An estuary is a partially enclosed body of water along the coast where freshwater from rivers and streams meets and mixes with salt water from the ocean. Estuaries and the lands surrounding them are places of transition from land to sea and freshwater to salt water. Although influenced by the tides, they are protected from the full force of ocean waves, winds, and storms by such land forms as barrier islands or peninsulas. Important coastal area falling in the stretch under study of Tapi river in Surat district.

Important Coastal and Marine Biodiversity Areas (ICMBAs)

India has taken several steps to achieve the National Biodiversity Target no 6 and Aichi Biodiversity Target no 11 which aim to conserve a substantial portion of the coastal and marine areas in the country and world respectively. Towards achieving these two targets, 106 coastal and marine sites have been identified and prioritized as Important Coastal and Marine Areas (ICMBAs) by the Wildlife Institute of India. Sixty-two ICMBAs have been identified along the west coast of India, and 44 have been identified along the east coast. Of these, 22 ICMBAs have been prioritized for immediate conservation actions and proposed to be upgraded as Protected Areas under categories such as Conservation or Communities Reserve to increase participation of the local communities in governance.

Important Coastal area in surat district is shown in **Table 9.8**

Table 9.8 Important Coastal area in Surat district

District	Identified Site	North	East	Area (Km^2)	Suggested category
Surat	Aliabet	21°38.294	72 ° 42.909	647	Cons./Comm. Reserve
Surat	Purna	20°56.254	72 ° 48.201	147	Cons./Comm. Reserve

Fig 9.9 Important coastal area Aliabet in Surat district

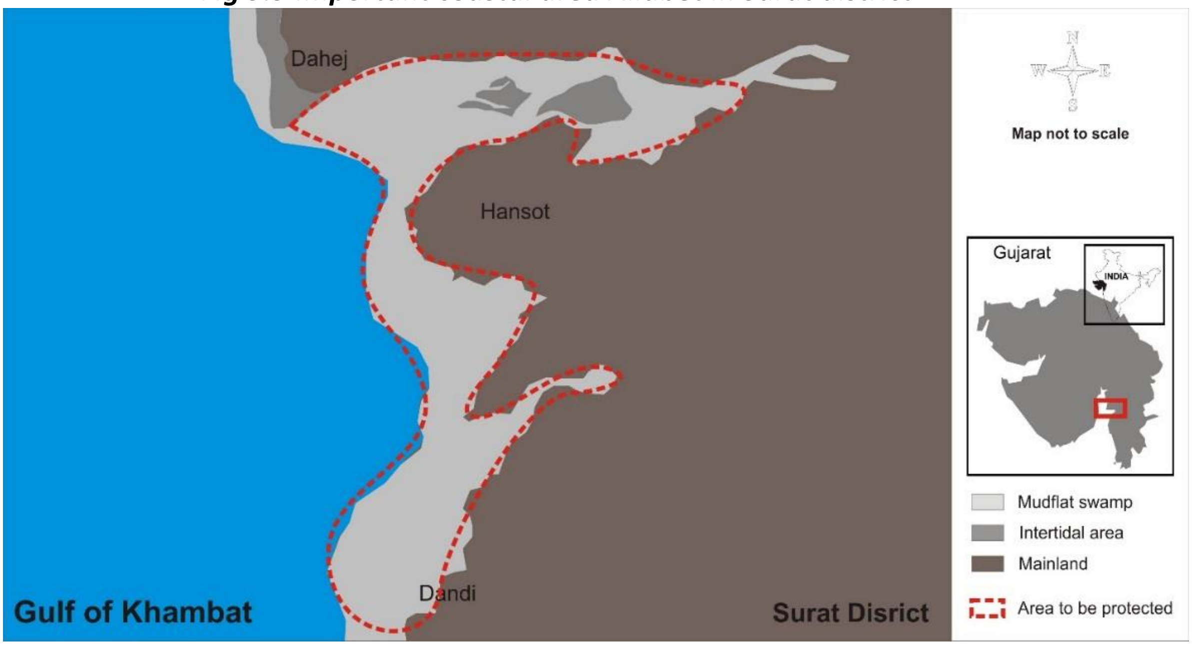
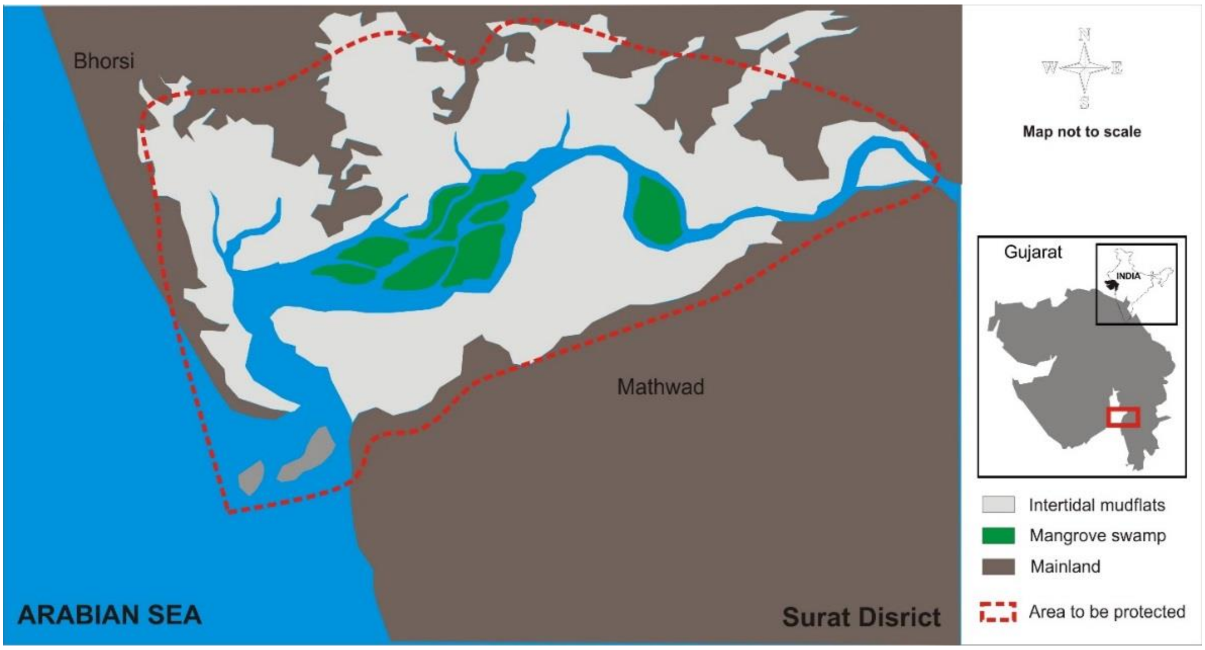
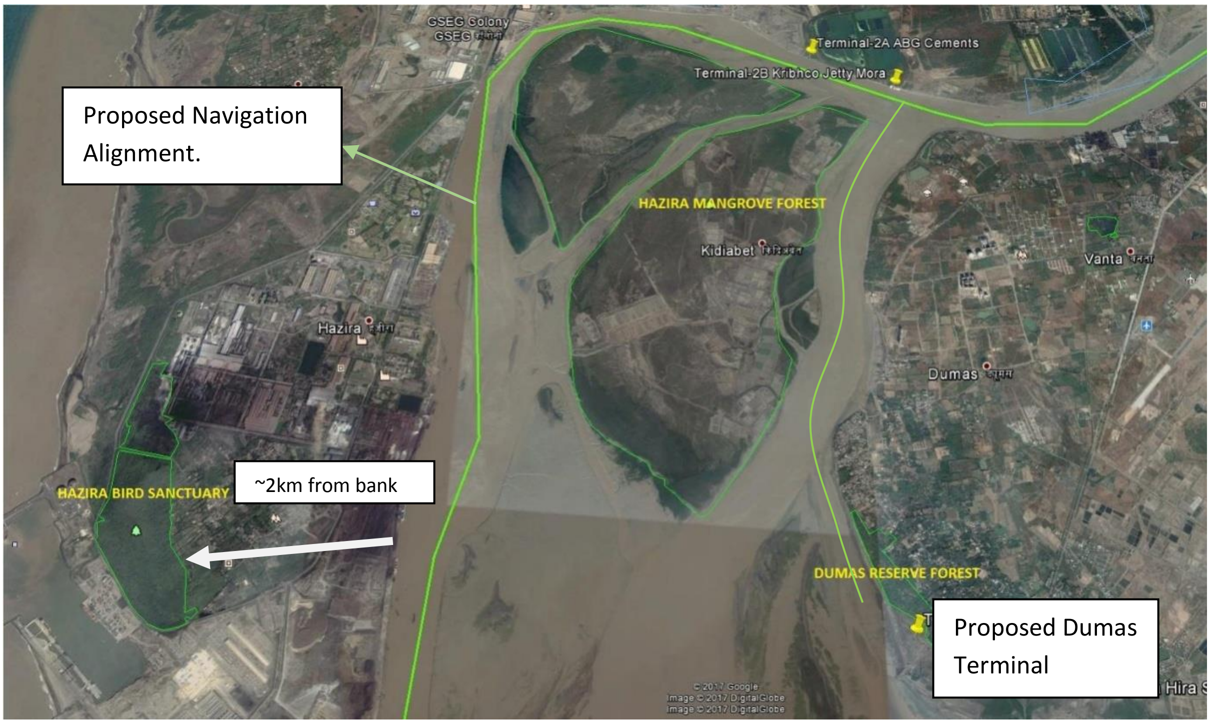


Fig 9.10 Important coastal area Purna in Surat district



The above mentioned important coastal areas are in the surat district, but they are more than 10km radius from the present stretch of study hence there is no ICMBA were found in the present study of stretch of River Tapi.

Fig 9.11 Estuary of River TAPI



From the figure 9.11A it is clear that the Hazira Bird sanctuary is at distance of more than 2km from the river bank, Proposed Dumas terminal which is for passengers only is near Dumas reserve forest. Raised island portion in between is Mangroves Reserve forest.

9.12 Archaeological and Heritage Locations

Archeological and Heritage Location was found along and nearby the present scope of study of Tapi river within 10km radius from river bank. Mainly 5 sites were found with 10km radius out of five one was found on the bank of river which are mentioned below.

(i) Ancient site ,kamrej, Surat ~ 100m from river bank shown in Fig. 9.12A
(ii) Tomb of Khwaja Safar Sulemani,Surat ~ 500m from river bank shown in Fig. 9.12B
(iii) Old dutch Armenian Tomb,Surat ~ 1km from river bank shown in Fig. 9.12C
(iv) Dargah Khawaja Dana Saheb's Rouza,Surat ~ 750m from river bank shown in Fig. 9.12D
(v) Old English Tomb,Surat ~ 1.3km from river bank shown in Fig. 9.12E

Fig 9.12A Ancient site ,Kamrej,Surat ~ 100m from river bank

Fig 9.12B Tomb of Khwaja Safar Sulemani,Surat ~ 500m from river bank

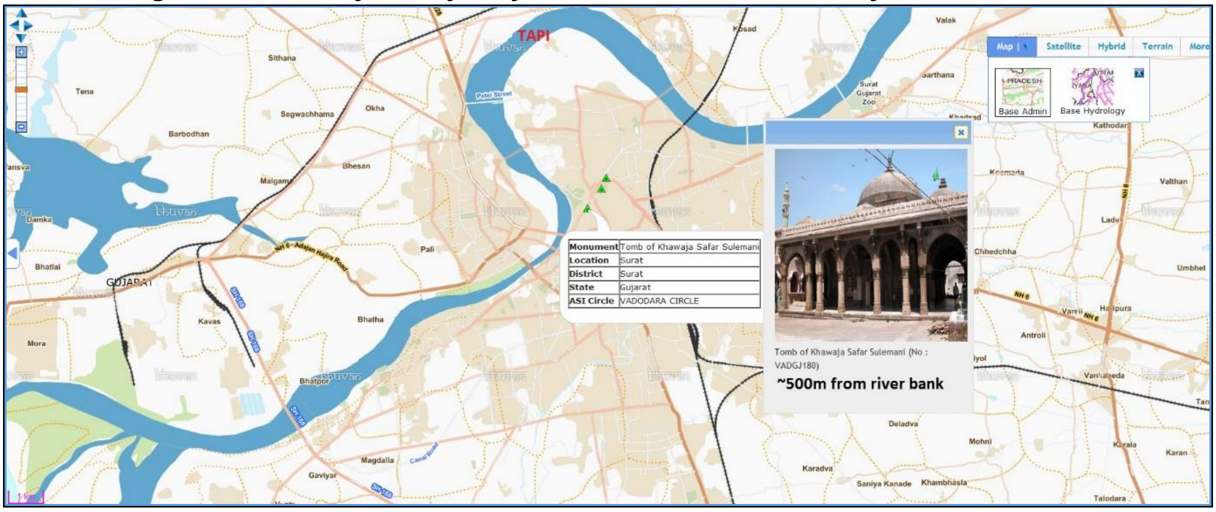


Fig 9.12C Old dutch Armenian Tomb,Surat ~ 1km from river bank

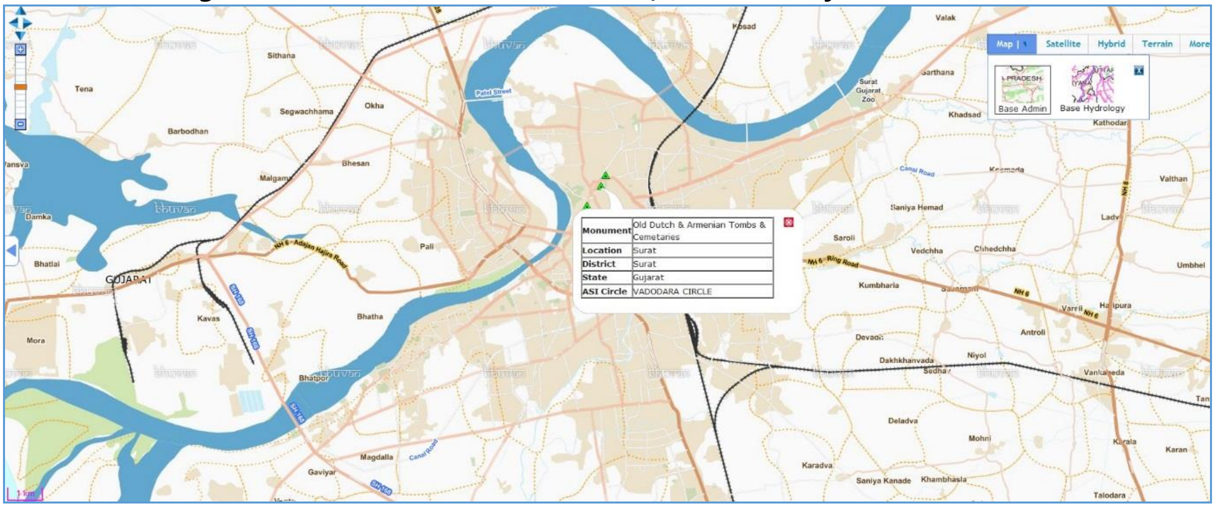


Fig 9.12D Dargah Khawaja Dana Saheb's Rouza,Surat ~ 750m from river bank

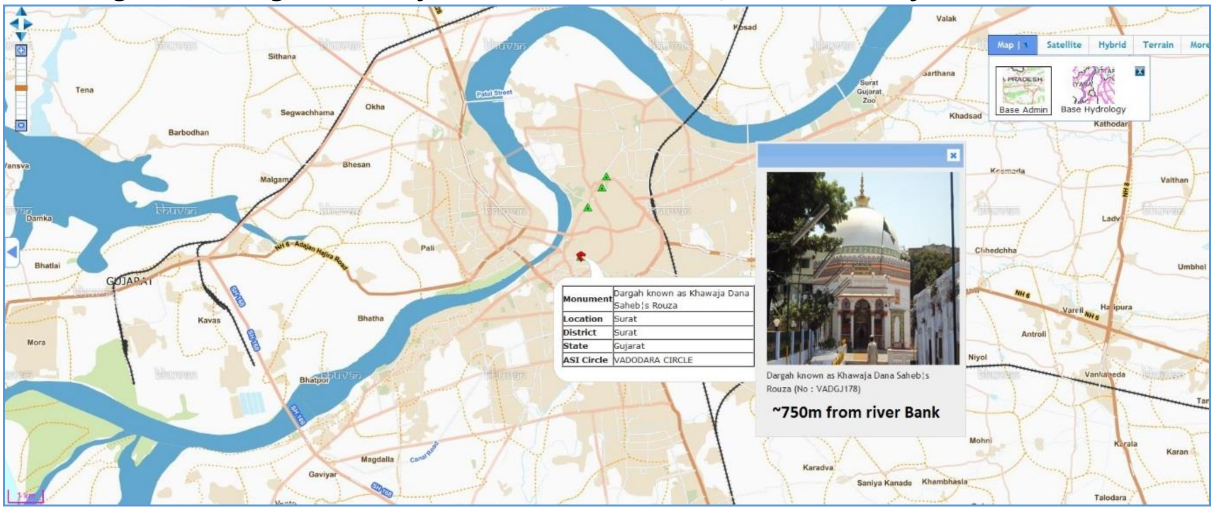
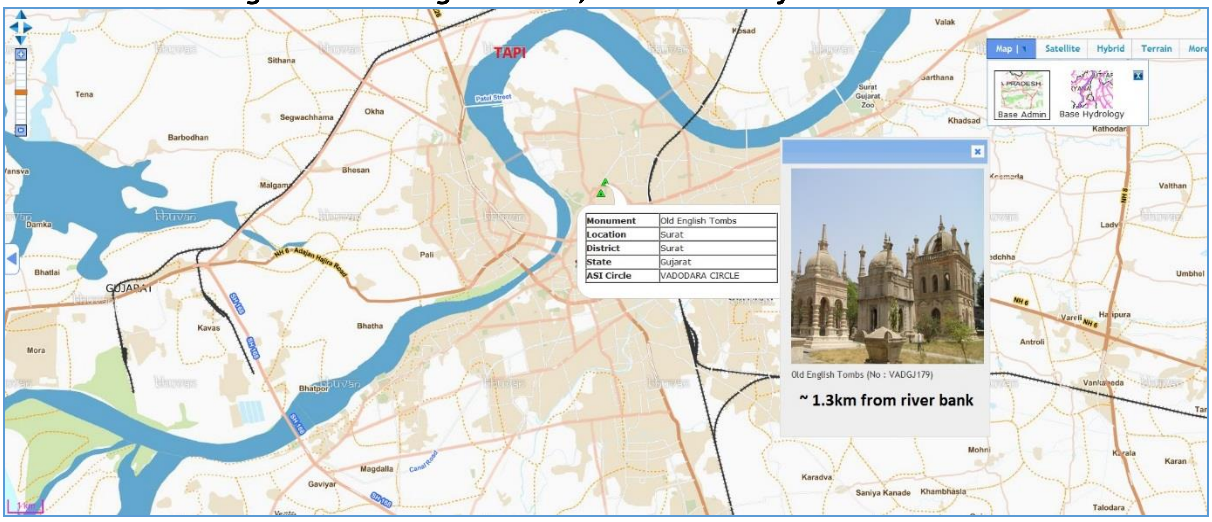


Fig 9.12E Old English Tomb,Surat ~ 1.3km from river bank



9.13 Flora and Fauna

9.13.1 Flora

Terrestrial flora are important features of the environment. They are organized into natural communities with mutual dependencies among their members and show various responses and sensitivities to anthropogenic influences. The changes in biotic community are studied in terms of their distribution, density and diversity. These changes through time can be utilized to assess the impacts of project on flora of the region, which are important components of biological environment. For this purpose, the baseline condition of the area needs to be studied.

Data of flora collected from various forest Government Departments is mentioned below.

Table 9.9 List of Existing Flora Found in the study area:

Sl. No	Name of Species	Name of the Family	Common Name
	Trees		
1.	*Acacia nilolica*	Mimosaceae	Babul
2.	*Acacia auriculiformis*	Mimosaceae	Earleaf acacia
3.	*Acacia leucophloea*	Mimosaceae	Kuteera-Gum
4.	*Achras sapota*	Sapotaceae	Chiku tree
5.	*Albizzia procera*	Mimosaceae	Brown Albizia
6.	*Anacardium occidental*	Anacardiaceae	Kaju
7.	*Anona reticulata*	Anonaceae	Custard apple
8.	*Artocarpus helerophyllus*	Artocarpaceae	Jackfruit
9.	*Azadirachta indica*	Meliaceae	Neem Tree
10.	*Bauhinia racemosa*	Caesalpiniaceae	Bidi Leaf Tree
11.	*Butea monosperma*	Caesalpiniaceae	Sacred Tree
12.	*Caesealpinia pulcherima*	Caesaipiniaceae	Peacock Flower
13.	*Cassia siamea*	Caesalpiniaceae	Siamese Senna
14.	*Casuarina equisetifolia*	Casuarinaceae	coast sheoak
15.	*Ceiba pentandra*	Bombaceae	Kapok Tree
16.	*Cocos nucifera*	Arecaceae	Coconut
17.	*Dalbergia sissoo*	Fabaceae	Indian rosewood
18.	*Delonix regia*	Caesalpiniaceae	Gulmohar
19.	*Dendrocalamus Hamilton*	Poaceae	Hamilton's bamboo
20.	*Eucalyptus sp.*	Myrtaceae	Tasmanian Blue Gum
21.	*Eugenia jambolana*	Myrtaceae	Jambolan
22.	*Ficus bengalensis*	Moraceae	Banyan
23.	*Ficus racemosa*	Moraceae	Cluster fig tree
24.	*Ficus religiosa*	Moraceae	Peepal tree
25.	*Lucaeana leucocephala*	Mimosaceae	River tamarind
26.	*Mangifera indica*	Anacardiaceae	Mango
27.	*Melia azadirachta*	Meliaceae	Chinaberry tree
28.	*Moringa tinctoria*	Moringaceae	Indian mulberry
29.	*Phoenix dactylifera*	Arecaceae	Date palm
30.	*Phoenix sy/vestris*	Arecaceae	Wild Date Palm

Sl. No	Name of Species	Name of the Family	Common Name
31.	*Pithocelobium dulce*	Mimosaceae	Madras thorn
32.	*Polyalthia longifolia*	Anonaceae	Ashoka
33.	*Pongamia pinnata*	Fabaceae	Pongam Tree.
34.	*Prosopis juliflora*	Mimosaceae	Algarroba
35.	*Sapindus emarginatus*	Sapindaceae	Notched Leaf Soapnut
36.	*Tabernemontana coronaria*	Apocynaceae	Crepe jasmine
37.	*Tamarindus indica*	Caesalpiniaceae	Tamarind tree
38.	*Tecoma stans*	Bignoniaceae	Tecoma stans
39.	*Tectona grandis*	Verbenaceae	Teak
40.	*Terminalia arjuna*	Combretaceae	Arjun Tree
41.	*Terminalia catappa*	Combretaceae	Indian-almond
42.	*Thevetia peruviana*	Apocyanaceae	yellow oleander
43.	*Zizyphus xylopyra*	Rhamnaceae	Jackal Jujube
	Shrubs		
44.	*Acanthus lilicifolius*	Acanthaceae	holly-leaved acanthus
45.	*Antigonon leptopus*	Nyctaginaceae	Mexican creeper
46.	*Caesea/pinia bonducella*	Caesalpiniaceae	Bonducella nut
47.	*Calotropis procera*	Asclepiadaceae	Mudar
48.	*Canavallia sp.*	Fabaceae	Jack-beans.
49.	*Canthium didymum*	Verbenaceae	Ceylon Boxwood
50.	*Carica papaya*	Caricaceae	Papaya
51.	*Cassia occidentalis*	Caesalpiniaceae	Coffee Senna
52.	*Ceriops roxburghiana*	Rhizophoraceae	Mangrove
53.	*Clerodendrum inermis*	Verbenaceae	Sankuppi
54.	*Datura stramonium*	Solanaceae	Moon flower
55.	*Ficus hispida*	Moraceae	Hairy fig
56.	*Hibiscus rosa-sinensis*	Rosaceae	China rose
57.	*Indigojera tinctoria*	Fabaceae	Neel
58.	*Ipomoea cornea*	Convolvulaceae	Besharam
59.	*Jatropha gossipifolia*	Euphorbiaceae	Bellyache bush
60.	*Lantana camara*	Verbenaceae	Raimuniya
61.	*Lantana indica*	Verbenaceae	Indian lantana
62.	*Murraya koenigii*	Rutaceae	Curry tree
63.	*Musa paradisica*	Musaceae	Banana
64.	*Nerium indicum*	Apocynaceae	Oleandar
65.	*Opuntia dilleni*	Cactaceae	Prickly pear
66.	*Ricinus communis*	Euphorbiaceae	Castor Bean Plant
67.	*Solanum hispidum*	Solanaceae	Turkey berry
68.	*Thespesialampas*	Malvaceae	Mallow
	Herbs		
69.	*Achyranthus aspera*	Amaranthaceae	chaff-flower
70.	*Aerva lanata*	Amaranthaceae	Mountain Knot Grass
71.	*Alocasia indica*	Areceae	Giant Taro
72.	*Amaranths spinosa*	Amaranthaceae	Spiny amaranth
73.	*Andropogon contortus*	Poaceae	Black Speargrass
74.	*Argemone mexicana*	Papaveraceae	Mexican Prickly Poppy
75.	*Asteracantha longifolia*	Acanthaceae	Kokilaksha
76.	*Asystasia spp*	Acanthaceae	Coromandel

Sl. No	Name of Species	Name of the Family	Common Name
77.	*Blumea membranacea*	Asteraceae	Boothamkolli
78.	*Boerhaavia diffusa*	Nyctaginaceae	Punarnava
79.	*Bryonopsis laciniosa*	Cucurbitaceae	Shivalingi Seed
80.	*Canna indica*	Cannaceae	Wild canna
8l.	*Celosia argentea*	Arnaranthaceae	Cockscomb Crested
82.	*Centella asiatica*	Centellaceae	Indian Pennywort
83.	*Chenopodium album*	Chenopodiaceae	Bathua
84.	*Cleome chaleidonli*	Cleomaceae	Asian spider flower
85.	*Cocculus hirsutus*	Menispennaceae	Broom Creeper
86.	*Crotalaria juncia*	Fabaceae	Sunn Hemp
87.	*Croton sparcijlorus*	Euphorbiaceae	Ban Tulsi
88.	*Cyanodon dactylon*	Poaceae	Bermuda Grass
89.	*Dinebra retrojlexa*	Poaceae	Viper Grass
90.	*Echorhnia sp.*		Echorhnia
9l.	*Eclipta alba*	Asteraceae	Bhringaraj
92.	*Eragrostis sp*	Poaceae	Canegrass
93.	*Hyptis suevelolens*	Lamiaceae	American Mint
94.	*Indigofera linifolia*	Fabaceae	Narrowleaf Indigo
95.	*Ipomoea aquatica*	Convolvulaceae	Water Morning Glory
96	*Ipomoea sinensis*	Convolvulaceae	Chinese Morning Glory
97.	*Mimosa pudica*	Mirnosaceae	Touch-me-not
98.	*Mirabilis jalapa*	Nyctaginaceae	Four o'clock flower
99.	*Momordica charantia*	Cucurbitaceae	Bitter Melon
100.	*Ocimum bacillicum*	Lamiaceae	Basil
101.	*Ocimum sanctum*	Larniaceae	Tulsi
102.	*Oldenlandia corymbosa*	Scrophulariaceae	Diamond Flower
103.	*Oldenlandia herbacea*	Scrophulariaceae	Slender Oldenlandia
104.	*Parthenium hysterophorus*	Asteraceae	Santa-Maria
105.	*Phyllanthus niruri*	Euphorbiaceae	Stonebreaker
106.	*Polygonum glabrum*	Polygonaceae	Knotweed
107.	*Rhynchosia minima*	Fabaceae	Burn-mouth-vine
108.	*Ruellia tuberosa*	Acanthaceae	Snapdragon root
109.	*Scirpus articulatus*	Cyperaceae	Deergrass
110.	*Scoparia dulcis*	Scrophulariaceae	Goatweed
111.	*Sida cordifolia*	Malvaceae	Flannel weed
112.	*Sida rhombifolia*	Malvaceae	Atibalā
113.	*Striga nudiflora*	Scrophulariaceae	Asiatic Witchweed
114.	*Suaeda nudiflora*	Chenopodiaceae	Muchole
115.	*Tagetes microphylla*	Asteraceae	Marigold
116.	*Tridax procumbens*	Asteraceae	Coatbuttons
117.	*Tephrosia purpurea*	Fabaceae	Wild Indigo
118.	*Typha angustata*	Typhaceae	Elephant Grass
119.	*Vigna radiata*	Fabaceae	Mung Bean
120.	*Vinca rosea*	Apocynacae	Sadabahar

Source: Forest Department, Surat District, Gujarat

9.13.2 Fauna

Fauna are important features of the environment. The changes in biotic community are studied in terms of their distribution, density and diversity. These changes through time can be utilized to assess the impacts of project on fauna of the region, which are important components of biological environment. For this purpose, the baseline condition of the area needs to be studied.

Birds like Bulbuls (*Pycnonotidae)*, Cormorants (*Phalacrocoracidae)*, Grey tits (*Parus afer)*, Herons (*Ardeidae*), Sandpipers *(Scolopacidae)*, Preys (*Accipitridae)*, Serpent eagles (*Spilornis cheela*),King fishers (*Alcedinidae*), Wood peekers (*Picidae)*, and Sun-birds (*Nectariniidae)* are found in the area. Migratory birds like Barheaded Geese (*Anser indicus)*, Brahminy Kite (*Haliastur indus)* come to feed and rest during winter month on the mud flats, sand bars and reclaimed lands in the study area. Some other important bird species recorded in the area are Peafowl (*Pavo cristatus)*, Koel (*Eudynamys)*,Black Drongo *(Dicrurus macrocercus*), Black Myna (*Acridotheres melanopterus)*, Indian Robin *(Saxicoloides fulicatus)*, Indian House Crow (*Corvus splendens)*, House sparrow (*Passer domesticus*) and Pigeon (*Columba livia domestica)*. Among the animals Five stripped palm squirrel (*Funambulus palmarum*), Common mangoose *(Herpestes edwardsi*), Indian hare (*Lepus nigricollis*), Jackal (*Canis aureus*), Jungle cat (*Felis chaus)*, Blue bull (*Boselaphus tragocamelus*), Common Indian monitor (*Varanus bengalensis*), Rat snake (*Pantherophis obsoletus*), ,Garden lizard (*Calotes versicolor*), Common cobra (*Naja naja)* are found in the area. Data of fauna collected from various forest Government Departments is mentioned below

Table 9.10 List of Existing Fauna Found in the study area:

Sl. No.	Scientific Name	Common Name	Family	Status in Wildlife Protection Act-1972
1.	*Panthera pardus*	Leopardor Panther	Felidae	Schedule I
2.	*Cervus unicolor*	Sambhar	Cervidae	Schedule III
3.	*Axis axis*	Spotted Deer	Cervidae	Schedule III
4.	*Sus scrofa*	Indian Wild Boar	Suidae	Schedule III
5.	*Lepus nigricollis*	Indian Hare	Leporidae	Schedule IV
6.	*Hyaena hyaena*	Hyaena	Hyaenidae	Schedule III
7.	*Canis aureus*	Jackal	Canidae	Schedule II
8.	*Hystrix indica*	Indian porcupine	Hystricidae	Schedule IV
9.	*Felis chaus*	Jungle Cat	Felidae	Schedule II
10.	*Canis lupus*	Indian Wolf	Canidae	Schedule I
11.	*Tetracerus*	Four Horned	Bovidae	Schedule I
12.	*Felis bengalensis*	Leopard Cat	Felidae	Schedule I
13.	*Bosela phus*	Blue Bull	Bovidae	Schedule-III
14.	*Vulpes bengalensis*	Indian Fox	Canidae	Schedule II
15.	*Macaca mulatta*	Rhesus Macaque	Cercopithecidae	Schedule II
16.	*Presbytis entellus*	Common Langur	Cercopithecidae	Schedule II

Sl. No.	Scientific Name	Common Name	Family	Status in Wildlife Protection Act-1972
17.	*Herpestes edwardsii*	Common Mongoose	Herpestidae	Schedule II
18.	*Indian pangolin scaly*	Manis crassicaudata	Manidae	Schedule I
19.	*Lutra lutra*	Otters	Mustelidae	Schedule II
20.	*Python molurus*	Pithon	Pythonidae	Schedule I
21.	*Vipera russelli*	Russelviper	Viperidae	-
22.	*Lycodon aulicus*	Dhaman	Colubridae	Schedule II
23.	*Varanus nebulosus*	Monitor lizzard	Varanidae	Schedule-II
24.	*Ptyas mucosus*	Common Rat Snake	Colubridae	Schedule II
25.	*Lissemys punctata*	Indian flap shell turtle	Trionychidae	Schedule I
26.	*Amphiesma stolata*	Buff stripdkeel back	Colubridae	Schedule IV
27.	*Atretium schistosum*	Olive Keelback waterSnake	Colubridae	Schedule II
28.	*Boiga forsteni*	Foresten's Cat Snake	Colubridae	Schedule IV
29.	*Boiga trigonata*	Common Cat Snake	Colubridae	Schedule IV
30.	*Elaphe Helena*	Common Trinket Snake	Colubridae	Schedule IV
31.	*Macropisthodon*	Green Keelback	Colubridae	Schedule IV
32.	*Xenochrophis*	Checkered Keel Back	Colubridae	Schedule II
33.	*Echis carinatus*	Saw Scaled Viper	Viperidae	Schedule IV

Source: Forest Department,Surat District, Gujarat

9.14 National Parks, Forests, Wildlife Sanctuaries and Reserves

A. Shoolpaneshwar Wildlife Sanctuary

The flora of the ecosystem represents semi-evergreen to moist deciduous forest. There are more than 575 species of flowering plants.

The sanctuary is a home for 32 species of mammals, several species of reptiles, 198 species of birds and countless insects.

Important Animals

Sloth bear, leopard, rhesus macaque, common mongoose, Indian civet cat, Indian porcupine, four-horned antelope, barking deer, chital, pangolin, flying squirrel, python, snakes, lizards, tortoise etc. The sanctuary has the rare distinction of having flying squirrels. It is reported to have tigers, leopard cat and wild dogs in the past. However, tigers have not been sighted here for more than two decades.

Important Birds

Crested serpent eagle, shikra, sparrow hawk, great-horned owl, gray hornbill, red and gray jungle fowls etc.

B. Purna Wild Life Sanctuary

About 700 identified plants species with dominance of grass and plants with broad leaves in high density and diversity are found in the sanctuary

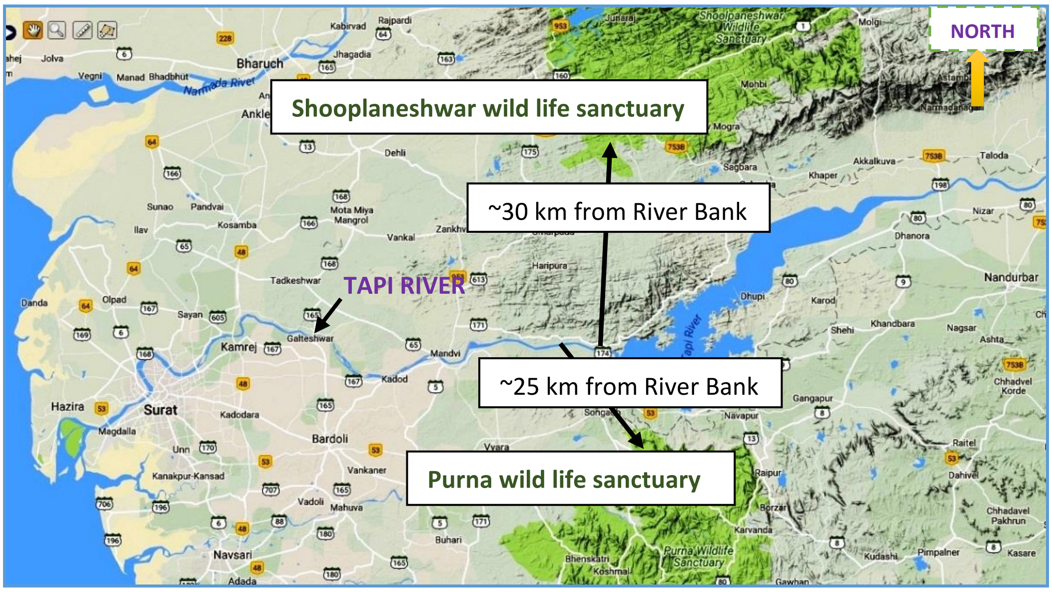
Important Animals : Leopard, rhesus macaque, bonnet macaque, common mongoose, Indian civat cat, Indian porcupine, four-horned antelope, barking deer, sambar, chital, hyena, jungle cat, flying squirrel, python, lizards etc.

Important Birds : Common grey hornbill, grey jungle fowls, barbets, woodpeckers, shrikes, cloropsis, bee-eaters, flycatchers and many raptors.

River in the present stretch of study which is in the region of Gujarat does not crosses any wild life sanctuary. However Purna wild life sanctuary is located in the south of Tapi River at a distance of 25-30 km from river boundary.

Shooplaneshwar wild life sanctuary is located in the North of Tapi River at a distance of 25-30 km from river boundary.

Fig 9.13 Map showing Purna and Shoolpaneshwar Wild life sanctuary



From the above figure 9.13 it is clear that Tapi river in the present stretch of study is at a distance of ~30km from Shooplaneshwar wild life sanctuary and ~25 Km from Purna wild life sanctuary respectively.

9.15 Socio-economic Profile

Demography

There are 21 districts according census (2011) in the basin, 5 Districts in Gujarat, 6 in Madhya Pradesh and 10 in Maharashtra. Some of the important districts covers by this basin are Surat, Bardoli, Nandrbar, Dhule, Jalgaon, Raver, Buldana, Akola, and Amaravati. Basin nearly covers 94.37% of Surat district, while 24% of area in Betul Madhya Pradesh area is covered by the basin Jalgaon district in Maharashtra 99% of the area is covered by the basin.

Our area of present study is for the Gujarat region only which consists mostly Surat and Tapi districts.

Industrial Profile of the Surat District:

Large industrial units such as Reliance Industries, Kribhko, Larsen &Tubro, ONGC, Essar, NTPC, Reliance Petrochemicals Ltd., Gas Authority of India Ltd., Shell India Ltd. Are contributing into industrial and economic growth of the district at present. There are nearly 500 texurising and 400 processing houses, 65,000 power looms and diamond units exist in the district. So, there is necessity of spare parts, machinery, and stores materials etc. on large scale for these industries. Hence, there is huge potentials for establishing new ancillary engineering and packaging industries on large scale to suffice the necessities of these industries.

Population Demographics:

The geographical spread of district is 4327 sq.km. District has a total population of 60.79 lakhs. A significant portion of district population lives in urban areas accounting for nearly 79.68 percent of the total population. Population spread in the district is significantly higher than the state average with a density of 1376 persons per sq.km. The district has registered an overall literacy rate of 86.65 percent. Nearly one third of the total workforce is dependent on secondary sector activities. Further, total work force participation rate is higher than the state average unlike most of the urban regions in India. Higher participation rates are attributed to significant women employment in textile units.

Industrial Profile of the Tapi District:

Vyara and Songadh in Tapi district are known for dense forests with a major production of bamboos the unit of Central Pulp Mills is located in Songadhtaluka. The industrialareas in Tapi district are Doswada, Nizer and Valod.

Population Demographics:

Nandurbar district has a total land area of 5,995 sq. km. and a population density of 276 people per sq. Km. Agriculture is the main occupation, employing 81.6 per cent of the labour force. Nandurbar district has a population of 16.46 lakh person. The district’s literacy rate is 63.04 per cent, which is significantly lower than the State average of 82.91 per cent, and the All-India average of 74 per cent. The district has a total workforce of about 7.7 lakh persons. Of this, 33.7 per cent are cultivators, 47.9 per cent are agricultural labourers, 1.7 per cent are workers in household industry and 16.7 percent are other workers.

9.16 Potential Environmental and Social Impacts of the Project

The impact of project on potential environment is not much as it will not produce any harmful wastes.

The project will provide the employment to the local villagers nearby to the terminal area and barrages during construction as well as in operational phase this will improve the social and economic conditions of the nearby commuters. Also by shifting of traffic from distant ports or terminals, mode of operation like from road to waterway to this terminals will reduce the overall carbon emission. Hence ultimately will bring a positive impact to the environment.

There is no wild life sanctuaries nearby 10km radius of the present scope of study of river stretch i.e 0-173 km.

9.16.1 Impacts due to construction activities

Pre-construction activities generally do not cause significant damage to environment. Preparatory activities like the use of existing access road, construction of storage sheds, etc. being spread over a large area, would have no further significant impact once the land is acquired and its existing use changes. Clearing, stripping and leveling of sites, construction of bunds for protection from flooding, earth filling and excavation for foundations, will lead to some disturbance to the habitat. The level of construction activities in the proposed project is not of such level and nature, to cause any significant adverse impact on this account.

a) Operation phase

Generation of garbage at Terminal area

The problem envisaged during operation phase could be the disposal of garbage. This could comprise floating materials, packaging, polythene or plastic materials, etc. accumulated from the fishing trawlers and boats. Garbage accumulated on the deck also needs to be suitably disposed. Therefore, a system needs to be developed, whereby undue quantity of garbage is not permitted to accumulate in the fishing harbour area and the same could be disposed off on the low lying areas in a scientific manner.

9.16.2 WATER ENVIRONMENT

a) Construction phase

Impacts due to effluents from labour camps

The average and peak labour strength likely to be deployed at the Terminal will be about 100 and 200 respectively. Most of the labour force will come from this village or from nearby village. The labour force engaged by the contractor could come from outside areas. A part of the labour population would stay in area. The balance labour population is likely to stay in labour camps close to the project site during construction phase. It is assumed that about 50% i.e. 100 labourers will stay at the site. Based on the above assumptions, total water requirement for the labour congregating in the area for constructing fishing harbour who will stay during the construction phase are estimated as below:

• Peak labour strength	:	200
• Labours likely to stay at construction site (50%)	:	100
• Married families (80% of 100)	:	80
• Single	:	20
Husband and wife both working (80% of 80)	:	64
• Families (64/2)	:	32
• Families where only husband is working (50% of 32)	:	16
• Family size (assumed)	:	5
• Total number	:	32x5+16x5+20=260 --(A)
• Add 5% for the persons who will be service provider like shops, repairing facilities, etc.	:	13
• 50% of service providers will have families	:	7
• Total number	:	7x6+6=48 --- (B)
Total population (A+B)	=	(A + B) = 260+48=308
Say 310 Water requirement	:	70 lpcd
Total water requirement	:	21.7 m^3/day

About 100 labour would stay at the construction site, only during working hours. The water requirement for such labour shall be 4.5 m^3/day @ 45 lpcd. Thus, total water requirement works out to (21.7 + 4.5) about 26 m^3/day. Water requirement for construction purpose has been estimated to be of the order of 50,000 lpd, apart from domestic water requirements. The source of water will be near by water supply authority and bore wells.

The sewage generated is normally taken as 80% of the total water requirement i.e. (0.8 x 26) 21 m^3/day. The domestic water normally contains high BOD, which needs proper treatment and disposal, otherwise, it can have an adverse impact on the DO levels of the receiving body. The disposal of sewage without treatment can cause problems of odour and water pollution. The typical composition of untreated sewage is given in Table-9.11

TABLE-9.11 Typical composition of untreated sewage

Parameters	Value
Total Solids, mg/l	720

Parameters	Value
Total Dissolved Solids, mg/l	500
Total Suspended Solids, mg/l	220
BOD mg/l	220
Oil and grease, mg/l	100
Alkalinity (as $CaCO_3$), mg/l	100
Total Phosphorus, mg/l	80
Total Nitrates, mg/l	40
Bicarbonates, mg/l	100
Carbonates, mg/l	10
Nitrates, mg/l	40
Phosphates, mg/l	40
Chlorides, mg/l	50
Sulphates, mg/l	30
Calcium, mg/l	40
Magnesium, mg/l	40
Potassium, mg/l	15
Sodium, mg/l	70

It is clear from Table-9.11 that BOD is the major pollutant, as far as sewage is concerned. Normally untreated sewage would find its way to natural drainage system which ultimately confluences into the sea. However, these natural drains are seasonal in nature and are likely to remain dry in the non-monsoon months. During this period, the flow of untreated sewage from the labour colonies in these drains can lead to development of anaerobic conditions, with associated water quality problems. However, in the present case it must be mentioned that the total quantity of sewage (21 m^3/day) generated as a result of congregation during construction phase is quite small and is not expected to cause any adverse impact on the marine water quality. However, it is proposed to treat the sewage from labour camps before disposal.

9.16.3 Impacts due to dredging

The dredging and other construction activities normally increase the turbidity levels in the water column. The total quantity of material to be dredged is to be disposed at nearby low lying areas or areas in the bank of rivers for strengthening or as suggested by the authorities. The dredged material would be dumped at designated disposal sites.

The change in water-column turbidity during dredging is a short-term impact. The increase in turbidity lasts as long as the material is being dredged. The turbidity level returns to the pre-project level sometime after the stoppage of the disposal of the dredged material. The time required for the turbidity level to return to its original turbidity level increases with the increase in clay content. The turbidity increase also depends on the type of dredging method adopted. Normally dredging in similar type of projects is done by a `Cutter Suction Dredger' (CSD). The method is preferred as it has minimal environmental impacts as far as increase in water turbidity is concerned. This is because of the fact that the dredged material is sucked before it gets an opportunity to spread. The sediments near the construction sites have high amount of fine portion. Due to the operation by CSD, the majority of clayey sediments would be sucked by the suction pipe. However, a small quantity of clay particles is likely to escape the cutter-suction head which may enter the water environment in the immediate vicinity of the dredging site. Since, the clay particles are in the range of 2 to 10μ, it would take about a week for these particles to settle down. The increase in turbidity level is likely to last for a period of 10 to 15 days, once the dredging activities are over.

The other impact of dredging on water quality is chemical in nature. Sediments take up various cations from water through the process of sorption.The cations and anions absorbed by sediments are weakly bonded and are generally released back to the water whenever there are slight changes in the physico-chemical characteristics of the environment. In the marine environment, due to prolonged residence time between water and sediments, cations and anions absorbed by the sediments are in equilibrium with the elemental concentration in water. When the sediments are removed, the concentration gradient between the liquid and the solid phase changes and there could be elemental transfer between the two phases. In the proposed project, it is suggested that dredging be done by a `Cutter Suction' dredger as it does not provide adequate time for the elemental transfer between the sediments and the water phase. Thus, no major change in marine water quality due to transfer of ions from sediments to water is anticipated. It can be concluded that apart from short-term increase in turbidity levels, no other significant effect on marine quality due to dredging is anticipated.

9.16.4 Impacts on Noise Environment

a) Construction phase

The major sources of noise during construction phase are due to operation of various construction equipment. The noise levels generated by various construction equipments are given in Table-9.12

Table-9.12 Average noise levels generated by the operation of various construction equipment

Equipment	Noise level [dB(A)]
Floating pontoon with mixer machine and crane	70
Winch machine	80
Transit mixer	75
Dumpers	75
Generators	85

Equipment	Noise level [dB(A)]
Batching plant	90
Air compressors	90
Pile drivers	115

Under the worst case scenario, considered for prediction of noise levels during construction phase, it has been assumed that all the equipments are operating at a common point. Likewise, to predict the worst case scenario, attenuation due to various factors too have not been considered for noise modeling.

Modeling studies were conducted to assess the increase in noise level due to operation of various construction equipment, and the results are given in Table-9.13

Table-9.13 Predicted noise levels due to the operation of construction equipment

Distance (m)	Ambient noise level (dB(A))	Increase in noise level due to construction activities (dB(A))	Noise level due to construction activities (dB(A))	Increase in ambient noise level due to construction activities (dB(A))
30	45	70	70	25
50	45	66	66	21
100	45	60	60	15
200	45	54	55	10
500	45	46	49	4
1000	45	36	46	1
1500	45	36	45.5	0.5
2000	45	34	45	-

It is clear from Table 9.13, that at a distance of 100 m and 200 m from the construction site, the increase in noise levels will be about 10 dB(A) and 15 dB(A) respectively. The nearest residential areas are at a distance of about 500 m from the proposed project site. Hence, there could be adverse impacts anticipated on noise levels in the proposed project area.

The other source of noise during construction phase will be due to movement of trucks, which will transport the construction material.

9.17 EMP and Mitigation of Environmental Effects

Based on the environmental baseline conditions, planned project activities and impacts assessed earlier, this section enumerates the set of measures to be adopted to minimize the adverse impacts.

Environmental Measures during Construction Phase

Provision of Community Kitchen, Sanitation and Drinking Water Facilities in Labour Camps

A community kitchen could be provided where workers have their meals. The fuel used in these community kitchens is LPG or diesel. The labour camps will be provided with adequate arrangement for disposal of solid waste, liquid waste, and ventilation, ample and clean supply of drinking water.

Provision for Free Fuel Distribution in Labour Camps

As a part of the contract, it is proposed to make it mandatory for the contractor to provide community kitchen facilities to its labour and supply of free fuel to avoid falling/cutting of trees in the project area for fuel wood purpose.

Sewage Treatment

One community toilet should be provided per 200 persons. The sewage from community toilets shall be treated in septic tanks. For each 500 persons, one septic tank would be provided. Using the above norms, adequate number of community toilets and septic tanks shall be constructed.

Solid Waste Management

About 200 labour and 20 technical staff is likely to congregate in the area during construction phase. The increase in population is expected to be of the order of 800. The average per capita solid waste generated is of the order of 210 gm/day/person. The solid waste likely to be generated from labour camps shall be of the order of 46.20 kg/day. Adequate facilities for collection, conveyance and disposal of solid waste shall be developed.

For solid waste collection, number of masonry storage vats should be constructed at appropriate locations in various labour camps. These vats should be emptied at regular intervals and the collected waste can then be transported to landfill site.

About 1 tonne per day of spoil shall be generated. The spoils shall be suitably disposed at low lying areas as a landfill site. The site shall be selected in consultation with the district administration. During construction phase, labour colonies are proposed to be located close to the project site.

For solid waste collection, number of masonry storage vats should be constructed at appropriate locations in various labour camps. These vats should be emptied at regular intervals and the collected waste can then be transported to landfill site.

One covered truck to collect the solid waste from common collection point and transfer it to the disposal site should be put to service. A suitable landfill site shall be selected in consultation with the local administration to store municipal waste.

Control of Air Pollution

During construction and operation phases, use of various construction equipment is the major source of noise. However, based on the modeling studies, the noise due to operation of various construction equipment is not likely to have any adverse impact on the habitations in nearby villages. However, efforts need to be made to reduce the noise generated by the various construction equipment. The various measures that could be implemented are as follows:

- Noise from air compressors could be reduced by fitting exhaust mufflers and intake mufflers.
- Chassis and engine structural vibration noise can be dealt by isolating the engine from the chassis and by covering various sections of the engines.
- Noise levels from the drillers can be reduced by fitting of exhaust mufflers and the provision of damping on the steel tool.
- Exposure of workers near the high noise levels areas can be minimized. This can be achieved by job rotation/automation, use of ear plugs, etc.

The effect of exposure of high noise levels on the workers operating the various construction equipment is likely to be harmful. It is known that continuous exposure to high noise levels above 90 dB (A) affects the hearing acuity of the workers/operators and hence, has to be avoided. To prevent the adverse impacts, the exposure to high noise levels should be restricted as per the exposure period suggested by Occupational Safety and Health Association (OSHA).

Greenbelt Development

It is proposed to develop greenbelt around the perimeter of Terminal/port area, colony etc. Sufficient budgetary provisions for its implementation shall be made.

Environmental Monitoring Programme

The Environmental Impact Assessment is basically an evaluation of future events. It is necessary to continue monitoring certain parameters identified as critical by relevant authorities under an Environmental Monitoring Programme. This would anticipate any environmental problem so as to take effective mitigation measures. An Environmental Monitoring Programme will be formulated for implementation during project construction and operation phases shown in table 9.14

Table 9.14 Environmental Monitoring Programme

Sl. No.	Environmental Attributes	Parameters	Monitoring Frequency	Unit	Agency Responsible for Action
1.	Ambient Air Quality	$PM_{2.5}$, PM_{10}, CO, SO_2, NO_2 *etc.*	24 Hourly sampling (Day & Night time) to be done at each location.	Per Sample with various parameters	Govt. of Gujarat or Designated Agency
2.	Water Quality monitoring	***Physical Properties:*** pH, Temp., DO, Conductivity, ***Chemical Properties:*** TSS, Alkalinity, Hardness, BOD, COD, NO_3, PO_4, Cl, SO_4, Na, K, Ca, Mg, Silica, Oil & grease, Phenolic compounds, Residual Sodium Carbonate. ***Bacteriological Properties:*** Total Coliform.	Surface and ground water to be monitored separately	Per Sample with various parameters	
3.	Noise Quality monitoring	Day & Time time monitoring to be done at each location	24 Hourly sampling (Day & Night time) to be done	Per Sample with various parameters	
4.	Soil	Bulk Density, Colour, Texture, Soil Type, pH, Electrical Conductivity, N, P, K *etc.*	Composite sample shall be prepared based on at least 3 replicates from each location.	Per Sample with various parameters	
5.	Aquatic Ecology	Trophic Status, Primary Productivity, Species diversity & densities of Phytoplankton, Zooplankton, Benthic Organism (Benthos, Macro-benthos), Fish and Macrophytes, Shanon Weiner Diversity Index.	One time study at this stage.	-	

9.18 Applicable Legal and Regulatory Framework

- *The National Waterway Act, 2016.*
- *The Environment (Protection) Act, 1986 with applicable Rules/Legislation.*
- *The EIA Notification, 14th Sep., 2006 and its latest amendments up to 2017.*
- *The Water (Prevention and Control of Pollution) Act and Rules, 1974 & 1975.*

- *The Air (Prevention and Control of Pollution) Act, Rules and Amendments, 1981, 1982, 1983 & 1987;*
- *The Municipal Solid Waste (Management and Handling) Rules, 2000.*
- *The Hazardous Waste (Management and Handling) Rules, 2008.*
- *The Forest (Conservation) Act, 1980 Forest Conservation Rules, 1981.*
- *The Wildlife (Protection) Act, 1972.*
- *The Wildlife (Protection) Amendment Act, 2006 and Bill, 2013.*
- *The Biodiversity Act, 2002.*
- *The Wildlife Conservation Strategy, 2002.*
- *The Disaster Management Act, 2005.*
- *The Wetlands Rules, 2010.*
- *The Ancient Monuments, Archaeological Sites and Remains Act, 2010*
- *CRZ Notification 2011*

9.19 Need for Environmental Clearance

Environmental clearance is required due to the construction of proposed structures like barrages on the river Tapi as proposed in 2nd phase. However in the 1st phase the environmental clearance is not required.

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

- Coastal Regulation Zone(CRZ) ,MoEF & CC
- Consent to Establish and operate from state pollution control board, Gujarat
- Gujarat Maritime Board(GMB)

CRZ clearance is required since the terminals are falling in the tidal zone and salinity of water. Consent to establish is required for the project execution and Consent to operate is required at operation stage of terminals. The necessary clearance for navigation needs to be taken from GMB.

9.21 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 to 1.5 year is adequate period for consultancy services (1 year for non-CRZ and 1.5 year for CRZ waterways) 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.

The estimated cost for conducting EIA-EMP & SIA studies along with obtaining all mandatory statutory clearances at pre-construction stage and timely and effective implementation of EMMP (EMP & EMoP) during construction and operation stages have been described in the following sections:

9.21.1 Estimated Cost at Pre-Construction Stage

As, the statutory fee shall be paid by the project authority for obtaining all mandatory statutory clearances. The estimated environmental and social budget for EIA & SIA studies have been summarized below:

Table – 9.15: Summarized estimated cost for Consultancy Services

S No.	Particulars of Estimated Budget	Amount	Remark (if any)
1.	Salary of 12 Professionals/Domain Experts on intermittent based input (as per QCI/NABET scheme)	50 Lakhs	Lump-sum cost on intermittent basis ranging 2-5 months
2.	Cost of one Time Baseline Data Generation at Pre-Construction Stage	4.13 Lakhs	To be done for one season (**Table – 9.16**).
3.	Public / Stakeholders Consultation Meeting	5 Lakhs	Lump-sum cost
4.	Reports / Document Printing	1 Lakhs	Lump-sum cost without break-up
5.	Travelling Cost for Site Visits (Bus, Taxi, Boat etc.)	3 Lakhs	Lump-sum cost
6.	Lodging & Boarding Cost	3 Lakhs	Lump-sum cost
7.	Cost for collection of metrological data and other information like Maps stationery etc.	1 lakhs	Lump-sum cost
	Grand Total (Rs)	**67.13 Lakhs**	

In words: (i) *Rs Sixty eight lakhs thirty one thousand only*

Note: No. of Key Experts: 12 as per QCI/NABET Scheme on intermittent basis. Which may increase or decrease by the project proponent as per actual scope of work.
(i) Above consultancy Fee is without GST
(ii) The breakup of Sl. No. 2 is given in Tables 9.16.

Table – 9.16: Estimated Sub-Cost for One Time Baseline Data Generation at Pre-Construction Stage

Sl. No.	Environmental Attributes	Parameters	Monitoring Frequency	Unit	No. of Tentative Locations	Unit Rate (Rs)	Amount (Rs)
1.	Ambient Air Quality	$PM_{2.5}$, PM_{10}, CO, SO_2, NO_2 *etc.*	24 Hourly sampling (Day & Night time) to be done at each location.	Per Sample with various parameters	7	15,000	135000
2.	Water Quality monitoring	***Physical Properties:*** pH, Temp., DO, Conductivity, ***Chemical Properties:*** TSS, Alkalinity, Hardness, BOD, COD, NO_3, PO_4, Cl, SO_4, Na, K, Ca, Mg, Silica, Oil & grease, Phenolic compounds, Residual Sodium Carbonate. ***Bacteriological Properties:*** Total Coliform.	Surface and ground water to be monitored separately	Per Sample with various parameters	7	10,000	90000
3.	Noise Quality monitoring	Day & Time time monitoring to be done at each location	24 Hourly sampling (Day & Night time) to be done	Per Sample with various parameters	7	6,000	54000
4.	Soil	Bulk Density, Colour, Texture, Soil Type, pH, Electrical Conductivity, N, P, K *etc.*	Composite sample shall be prepared based on at least 3 replicates from each location.	Per Sample with various parameters	7	8000	72000
5.	Aquatic Ecology	Trophic Status, Primary Productivity, Species diversity & densities of Phytoplankton, Zooplankton, Benthic Organism (Benthos, Macro-benthos), Fish and Macrophytes, Shanon Weiner Diversity Index.	One time study at this stage.	-	7	20,000	180000
	Sub-Total (Baseline Environmental Data Generation Cost)						**4,13,000**
	In Words: *Rs. Four Lakhs thirteen thousand only.*						

Note: Proposed length of NW-100 (River Tapi) is 174.58 Km / @ 25 Km/station = tentatively 7 Locations will be monitored

9.21.2 Estimated Cost for Construction Stage

The civil work contractor during construction stage shall depute a well experience environmental & safety Officer (ESO), who shall conduct Environmental Monitoring at Construction Stage as per stipulated conditions in the contractor documents. He/she shall also prepare environmental monitoring report to be submitted timely to the project proponent and statutory authorities as per project requirement.

Table-9.17: Estimate Environment Management during Construction

Sl. No.	Particulars of Estimated Budget	Cost (Rs. Lakhs)	Remark (if any)
1.	Environmental Monitoring Cost at Construction Stage once in a year	12.39	To be done one season for three years (**Table –9.18**)
2.	Solid Waste Management	5	Lump-sum cost
3.	Sanitary facilities at labour camps	5	Lump-sum cost
4.	Greenbelt Development nearby terminal Premises by Contractor	5	Lump-sum cost
5.	Purchase of noise meter	1	Lump-sum cost
6.	Water tanker with sprinkler	6	Lump-sum cost
7.	Disaster Management Plan	4	Lump-sum cost
	Total (Lakhs)	**38.39**	

Table – 9.18: Environmental Monitoring Cost for Construction Stage

Sl. No.	Environmental Attributes	Parameters	Monitoring Frequency	Unit	No. of Tentative Locations x Years	Unit Rate (Rs)	Amount (Rs)
1.	Ambient Air Quality	$PM_{2.5}$, PM_{10}, CO, SO_2, NO_2 *etc*.	24 Hourly sampling (Day & Night time) to be done at each location.	Per Sample with various parameters	7x3=21	15,000	315000
2.	Water Quality monitoring	***Physical Properties:*** pH, Temp., DO, Conductivity, ***Chemical Properties:*** TSS, Alkalinity, Hardness, BOD, COD, NO_3, PO_4, Cl, SO_4, Na, K, Ca, Mg, Silica, Oil & grease, Phenolic compounds, Residual Sodium Carbonate. ***Bacteriological Properties:*** Total Coliform.	Surface and ground water to be monitored separately	Per Sample with various parameters	7x3=21	10,000	210000
3.	Noise Quality monitoring	Day & Time time monitoring to be done at each location	24 Hourly sampling (Day & Night time) to be done	Per Sample with various parameters	7x3=21	6,000	126000
4.	Soil	Bulk Density, Colour, Texture, Soil Type, pH, Electrical Conductivity, N, P, K *etc.*	Composite sample shall be prepared based on at least 3 replicates from each location.	Per Sample with various parameters	7x3=21	8000	168000
5.	Aquatic Ecology	Trophic Status, Primary Productivity, Species diversity & densities of Phytoplankton, Zooplankton, Benthic Organism (Benthos, Macro-benthos), Fish and Macrophytes, Shanon Weiner Diversity Index.	One time study at this stage.	-	7x3=21	20,000	420000
	Sub-total (Environmental Monitoring cost during Construction)						**12,39,000**
	In Words: *Rs. Twelve lakhs thirty nine thousand only*						

9.21.3 Estimated Cost at Operation Stage

Like preconstruction stage, the environmental monitoring and supervision to be done by the project proponent.

Table-9.19: Estimate Environment Management during Operation

Sl. No.	Particulars of Estimated Budget	Cost (Rs. Lakhs)	Remark (if any)
1.	Environmental Monitoring Cost at Operational Stage once in a year.	4.13	To be done for one season as per Table-9.16 given above.
2.	Solid Waste Management	2.5	Lump-sum cost
3.	Maintenance of Greenbelt Development nearby terminal Premises by Contractor supervision	2.0	Lump-sum cost
	Total (Lakhs)	**8.63**	Per year

9.21.3 Summary of Estimated Environmental & Social Environmental Budget

This covers the consultancy fee at pre-construction stage along with implementation of EMMP (EMP & EMoP) during construction and operational stages of the project. The statutory fee along with the cost of private and government land acquisition shall be borne by the project proponent. This has been summarized in Table given below:

Table-9.20: Summary of Estimated Environmental & Social Costs for various Stages

Sl. No.	Project Stages	Cost (Rs.Lakhs)
1.	Pre-Construction Stage	67.13
2.	Construction Stage	38.39
3.	Operational Stage	8.63
Total Estimated Budget (Except Statutory Fee & Land Acquisition & R&R Costs)		**114.15**

Hence Total Cost say 114 Lakhs.

***** The basis of cost is on our previous experiences of the project but the actual cost will be based on the Approved TOR by MoEF & CC.

Note:-

- The EMP should be available at each project location along with availability of all safety PPEs to each worker and First-Aid facility should be easily approachable for all staff.The contractor should also provide separate toilet facility for male and female workers at site.
- Contractor will take prior all the necessary clearances for setting of labour colony near project sites.

Letter to Additional Principal Conservator of Forests, Gandhinagar

वाप्कोस लिमिटेड
WAPCOS LIMITED
(भारत सरकार का उपक्रम)
जल संसाधन, नदी विकास व गंगा संरक्षण मंत्रालय
(A Government of India Undertaking)
Ministry of Water Resources, River Development & Ganga Rejuvenation

ISO 9001 : 2008
- Consultancy Services
- Engineering, Procurement & Construction (EPC)

NO: WAP/P&H/GUJ/ENVR/APR/2017

Date: 06.04.2017

To,
The Additional Principal Chief Conservator of Forests,
D&M
Aranya Bhawan,Block B,3rd Floor,Sector-10/A,
Gandhinagar
Phone:-079 23254135
E-mail:gj050@ifs.nic.in

Sub: Requirement of Environment baseline data for Two Stage DPR of Proposed 04 Inland Waterways in the State of Gujarat & Maharashtra for official use.

Sir,

Ministry of Shipping (MoS), Govt. of India had directed IWAI to identify the viable waterways In India for their phased development; accordingly, 106 new waterways were identified and intimated to MoS. These rivers are in the process of being declared as National Waterway and a bill to this effect has already been passed in the lok Sabha during this winter season. Inland Waterways Authority of India (IWAI) a statutory body under the Ministry of Shipping, Govt. of India has been entrusted with the responsibility for conducting preparation of Detailed Project Report of the proposed waterway.

In order to assess the latest hydro-morphological condition of the rivers, IWAI has awarded the work of preparation of DPR s to M/s WAPCOS LIMITED is a "MINI RATNA-Category I" Public Sector Enterprise under the aegis of the Union Ministry of Water Resources, River Development & Ganga Rejuvenation for below mentioned river

Sl. No.	Name of the River / Canal	Name of the River / Canal Description of Inland Waterway
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 Baseline Data of 25km from both side of river bank.

76-C, Institutional Area, Sector - 18, Gurgaon - 122 015 (Haryana), INDIA
Tel. : +91-124-2399421 • Fax : +91-124-2397392
E-mail : ho@wapcos.co.in ; mail@wapcos.co.in • Website : http://www.wapcos.co.in
CIN : U74899DL1969GOI005070

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 Baseline Data of 25km from both side of river bank.
3.	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 Baseline Data of 25km from both side of river bank.

The following data is required for the Project

Terrestrial Ecology

- Description on forest type
- Checklist of floral species
- Forest map covering the study area
- Name and location of Reserve/Protected Forest, Mangrove etc

Wildlife

- Checklist of wild life including Mammals, Reptiles, butterfly, Avifauna etc Major threat to wild life.if any
- Map of migratory path of wild animals if any
- Name and location of National Park/Wildlife Sanctuary etc

It is therefore requested to kindly provide the below required

Thanking you and with best regards,

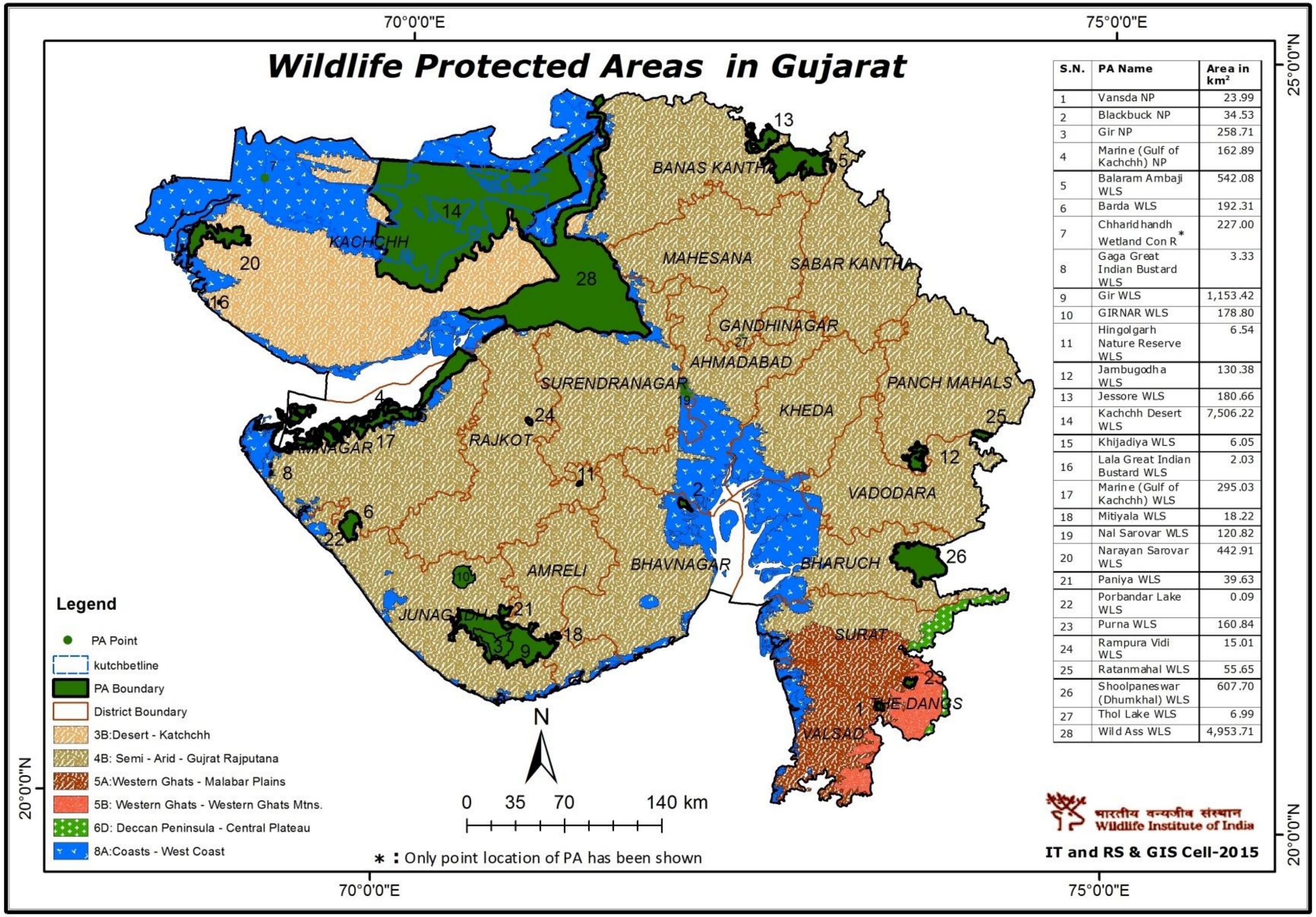
Yours truly,

Jatinder Kumar
Chief Engineer(Ports&Harbour)
WAPCOS Limited
Email:-Ports@wapcos.co.in

जतिन्द्र कुमार / JATINDER KUMAR
मुख्य अभियंता (प. एवं बं.) / Chief Engineer (P&H)
वाप्कोस लिमिटेड / WAPCOS LIMITED
(भारत सरकार का उपक्रम / A Govt. of India Undertaking)
76-सी, सैक्टर -18, गुड़गाँव-122015 (हरियाणा)
76-C, Sector - 18, Gurgaon -122015 (Haryana)

As per above letter regular follow ups were done with the department and our Team has collected the data from the concerned forest divisons.

Fig 9.14 : **Wildlife Protected Areas in Gujarat**



S.N.	PA Name	Area in km²
1	Vansda NP	23.99
2	Blackbuck NP	34.53
3	Gir NP	258.71
4	Marine (Gulf of Kachchh) NP	162.89
5	Balaram Ambaji WLS	542.08
6	Barda WLS	192.31
7	Chharidhandh Wetland Con R*	227.00
8	Gaga Great Indian Bustard WLS	3.33
9	Gir WLS	1,153.42
10	GIRNAR WLS	178.80
11	Hingolgarh Nature Reserve WLS	6.54
12	Jambugodha WLS	130.38
13	Jessore WLS	180.66
14	Kachchh Desert WLS	7,506.22
15	Khijadiya WLS	6.05
16	Lala Great Indian Bustard WLS	2.03
17	Marine (Gulf of Kachchh) WLS	295.03
18	Mitiyala WLS	18.22
19	Nal Sarovar WLS	120.82
20	Narayan Sarovar WLS	442.91
21	Paniya WLS	39.63
22	Porbandar Lake WLS	0.09
23	Purna WLS	160.84
24	Rampura Vidi WLS	15.01
25	Ratanmahal WLS	55.65
26	Shoolpaneswar (Dhumkhal) WLS	607.70
27	Thol Lake WLS	6.99
28	Wild Ass WLS	4,953.71

OFFICE ORDER FOR NON-REQUIREMENT OF ENVIRONMENT CLEARANCE FOR DREDGING IN RIVER

No. F.No.14-9/2016-IA-III
Government of India
Ministry of Environment, Forest and Climate Change
(Impact Assessment Division)

Indira Paryavaran Bhawan
Jor Bagh Road, Aliganj
New Delhi-110003

Dated: 21st December, 2017.

OFFICE MEMORANDUM

Subject: **Non-requirement of environment clearance for maintenance dredging in rivers for the purpose of navigation - regarding.**

This has reference to your Office Memorandum IWT-11011/89/2016-IWT-(Vol.II) dated 7th December 2017 on the above mentioned subject.

2. The minutes of the meeting held under chairmanship of Hon'ble Minister, Road Transport & Highways, Shipping and Water Resources, River Development & Ganga Rejuvenation held on 24.10.2017 concluded that as per the extant legal position, no prior EC is required for maintenance dredging for navigational channel for Inland Waterways.

3. In view of the above the Ministry of Shipping may like to go ahead with the decision taken during the meeting held under chairmanship of Hon'ble Minister, Road Transport & Highways, Shipping held on 24.10.2017 subject to the implementation of the environmental safety measures as enclosed as annexure.

4. This issues with the approval of the competent authority.

21/12/17

Sharath Kumar Pallerla
Director

To

The Secretary,
Ministry of Shipping,
Parivahan Bhavan, 1, Parliament Street,
New Delhi - 110 001

Page 1 of 3

ANNEXURE

Environmental safety measures to be implemented

i. 'Consent to Establish' and 'Consent to Operate' shall be obtained from State Pollution Control Board under the Air (Prevention and Control of Pollution) Act, 1981 and the Water (Prevention and Control of Pollution) Act, 1974.

ii. The project authority shall ensure that no rivers or tributaries are blocked due to any activities at the project site and free flow of water is maintained.

iii. Shoreline shall not be disturbed due to dumping. Periodical study on shore line changes shall be conducted and mitigation carried out, if necessary.

iv. Dredging shall not be carried out during the fish/turtle breeding seasons.

v. All vessels used in the river will be fitted with noise control and animal exclusion devices so that aquatic life is not unduly disturbed.

vi. Spillage of fuel / engine oil and lubricants from the construction site are a source of organic pollution which impacts aquatic life, particularly benthos. This shall be prevented by suitable precautions and also by providing necessary mechanisms to trap the spillage.

vii. Construction waste including debris shall be disposed safely in the designated areas and in no case shall be disposed in the aquatic environment.

viii. Vessels shall not discharge oil or oily water such as oily bilge water containing more than 15 ppm of oil.

ix. The project authority shall ensure that water traffic does not impact the aquatic wildlife sanctuaries that fall along the stretch of the river.

x. All vessels will also have to comply with 'zero discharge' standards to prevent solid or liquid waste from flowing into the river and affecting its biodiversity.

xi. The dredging shall be carried by integrated and systematic planning by selective grid method by allowing migratory movement of Benthic fauna.

xii. All required Noise and vibration control measures are to be adopted in Dredgers. Cutter section Dredgers should be avoided as much as possible which produces more noise and vibration. No Drilling and Blasting is to be carried out.

xiii. Pre geo-tectonic studies has to be completed and the strata to be dredged is predetermined with complete data pertaining to hardness, compressive and tensile strengths.

xiv. Dredger type and other strata loosening methods shall be preconceived.

xv. Staggered dredging shall be carried based on turbidity monitoring to minimise the impact of turbidity.

xvi. Threshold level of turbidity, which has a minimal effect on fauna, has to be predetermined and Dredging planned accordingly.

xvii. Further silt screens needs to be used for minimising the spread of Turbidity.

Page 2 of 3

xviii. Disposal places of Dredged sediments needs to be predetermined, along the shore by assessment of suitability, which will not affect the shoreline (erosion) and also causing impacts during monsoon and flooding.

xix. As much as possible, it shall not be disposed off in the river itself, and the site should be such that the dispersion is quicker by undertaking modelling studies.

xx. Ballast water control and management measures shall be implemented.

xxi. Waste and waste water reception facilities in Jetty shall be implemented.

xxii. The Risk and Disaster management plan has been prepared in consonance with the manual of terminals and harbours issued by the Ministry of Environment and Forests dated 5th May 2010.

xxiii. Standard Operating Procedures (SOP) and Emergency Response Plan (ERP) for onsite and offsite emergencies shall be prepared and implemented based on Hazard Identification and Risk Assessment to handle, process, store and transport of hazardous substances.

xxiv. Oil spill contingency plan shall be prepared and part of DMP to tackle emergencies. The equipment and recovery of oil from a spill shall be assessed. Guidelines given in MARPOL and Shipping Acts for oil spill management shall be followed.

xxv. No diversion of the natural course of the river shall be made without prior permission from the Ministry of Water resources.

xxvi. All the erosion control measures shall be taken at water front facilities.

xxvii. Necessary Air Pollution Control measures shall be taken during loading, unloading, handling, transport of the material at the berthing and water front facilities.

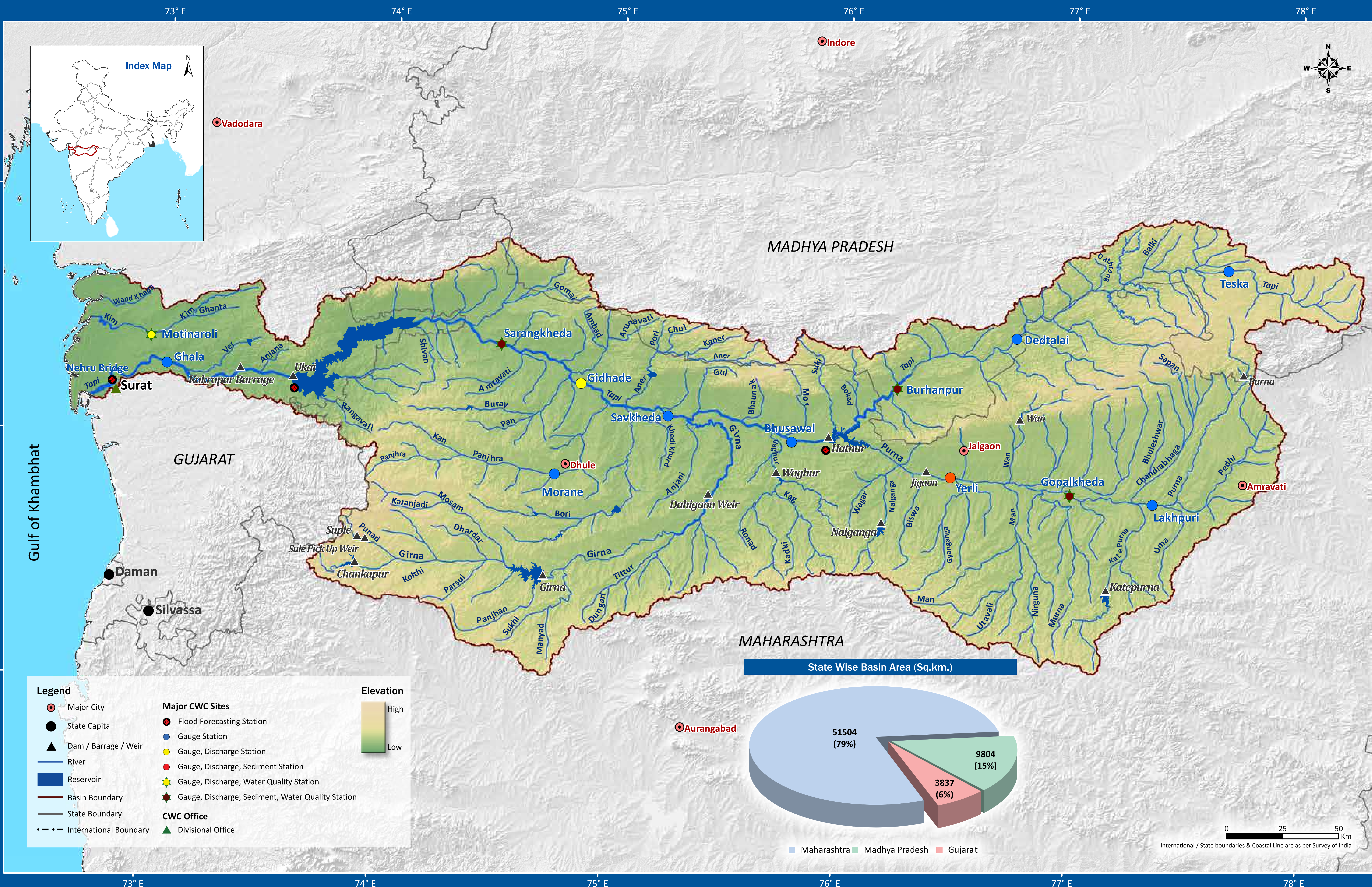
xxviii. The Vessels shall comply the emission norms prescribed from time to time.

xxix. All safety measures are to be implemented in coordination with the respective state government departments such as State Forest Department, Public Works Department, State Pollution Control Board etc.

21/12/17

Sharath Kumar Pallerla
Director

TAPI BASIN


73° E
74° E
75° E
76° E
77° E
78° E
22° N
21° N
20° N
Index Map
N
W
E
S
Indore
Vadodara
MADHYA PRADESH
GUJARAT
MAHARASHTRA
Gulf of Khambhat
Surat
Daman
Silvassa
Dhule
Jalgaon
Amravati
Aurangabad
Nehru Bridge
Ghala
Motinaroli
Kakrapar Barrage
Ukai
Sarangkheda
Gidhade
Savkheda
Bhusawal
Hatnur
Burhanpur
Dedtalai
Teska
Wan
Purna
Yerli
Jigaon
Gopalkheda
Lakhpuri
Katepurna
Nalganga
Waghur
Dahigaon Weir
Morane
Girna
Suple
Sule Pick Up Weir
Chankapur
Tapi
Kim
Kim Ghanta
Wand Khadi
Ver
Anjana
Rangavali
Amravati
Buray
Pan
Kan
Panjhra
Karanjadi
Mosam
Dharadar
Bori
Punad
Kolthi
Parsul
Panjhan
Sukhi
Manyad
Dungari
Tittur
Anjani
Ghedi Khurd
Shivan
Gomai
Ambad
Arunavati
Pori
Chul
Kaner
Aner
Gul
Bhaunak
Suki
Mor
Bokad
Vaghur
Kag
Ronad
Kadvi
Wagar
Biswa
Gyanganga
Man
Nirguna
Morna
Utavali
Kate Purna
Uma
Pedhi
Chandrabhaga
Bhuleshwar
Sapan
Balki
Dabhanya
Legend
Major City
State Capital
Dam / Barrage / Weir
River
Reservoir
Basin Boundary
State Boundary
International Boundary
Major CWC Sites
Flood Forecasting Station
Gauge Station
Gauge, Discharge Station
Gauge, Discharge, Sediment Station
Gauge, Discharge, Water Quality Station
Gauge, Discharge, Sediment, Water Quality Station
CWC Office
Divisional Office
Elevation
High
Low
State Wise Basin Area (Sq.km.)
51504
(79%)
9804
(15%)
3837
(6%)
Maharashtra
Madhya Pradesh
Gujarat
0
25
50
Km
International / State boundaries & Coastal Line are as per Survey of India

CHAPTER –10

INSTITUTIONAL REQUIREMENTS

10.1 Organizational Set up / Establishment

The Authority envisaged is Navigational waterway maintenance, transportation enterprise dealing with passenger and cargo handling, transit and transfer as well as being an administrative unit and an organ of Government which implements Government policies. This organization should integrate administrative functions with operation, maintenance and development function and run this enterprise on sound Business Management Principals. The set up should also have jurisdiction and control over all other Government, Public and Private Vessel Operators on the Tapi River (NW-100)

Other Government, Public and Private Parties can be allowed to carry on their present business as usual but under the administrative control on IWAI which frames rules and regulations for such operation.

The conceptual set up of such organization is given in chart 10.1. This envisages setting up of Inland Waterway Authority construction and maintenance division for Tapi River with its head quarters at Surat.

The Inland waterway authority will specifically control and will be responsible for following in Tapi River (NW-100).

- Developing and maintaining navigable waterway.
- Enforcement of rules and regulations of IWT Act.
- Channel Patrol.
- River route survey
- Issue of river notices, river, chart, river warnings
- Rescue and salvage operations on route.
- River training and maintenance works such as bandalling, bottom – paneling, dredging, bank protection etc. required to the extent of maintaining navigable waterway.
- Registration of vessels and issue of certificate of survey (compulsory for any sailing vessel)
- Issuing certificate of competency to masters, seamen, watch-keeping officers, engineers and to all the crew members of the sailing vessel.

- Policing the waterway through patrol and police boats. Checking, catching and prosecuting offenders, cancellation of registration certificates and taking other appropriate legal action.
- Providing pilotage to vessels wherever required.
- Levy and collection of vessel registration fee which will be related to capacity of vessels and river route it travels. (Normally this levy will be related to river route development and maintenance expenditure).
- Operation and maintenance of terminals run by IWAI and collection of berthing, handling and storage charges.
- Operation and levy of pilotage charges on river route.
- Operation and maintenance of various vessels, equipments and other facilities owned by IWAI.
- Maintaining liaison with Gujarat Maritime Board, Kandla Port Trust and Inland Waterway Authorities to ensure smooth passage of vessels and loading / unloading of cargo.
- Purchasing new equipment/ floating craft as and when required.
- Planning and developing new terminals in Gujarat depending on traffic and additions to existing terminals, fleet and other facilities.
- Liaison with various concerned organization to ensure efficient functioning.
- Business development and expansion of facilities.
- Financial / administrative/ technical control of operations with a view to raise efficiency, reduce cost and accomplish better handling.

The specific tasks of some key personnel are detailed below:

1) Repairs Division

Dy. Director (Repairs) heads this division. The main function of this division is to maintain the floating crafts owned by IWAI in working order. Minor repairs are carried out by the Departmental personnel and vessels will be sent to different repair yards if in need of major repair or overhauling. Adequate stocks of spares are kept in ready stock by timely ordering and procurement of same. Fuel and lubricants required for operation will be arranged by the division. Replacement or additional vessels if required will be arranged by division.

2) Waterway Maintenance Division

For effective maintenance waterway the river stretch will be under the joint administrative control of Deputy Director and Senior Hydrographic Surveyor. The major task of this group is to maintain the waterway navigable. The following tasks are entrusted to Deputy Director and Senior Hydrographic Surveyor.

Dy. Director: Deputy Director will be incharge of dredging works, patrol tasks, security of waterway, pilotage and salvage duty.

This department will perform specifically following tasks:

- Patrolling the navigational waterway and gathering information on status of waterway and transmitting this information to barge operators on the route.
- Finding and marking best channel for navigation and clearing these channels of obstructions.
- Checking on observation of rules and regulations of waterways and bring to book the offenders.
- Go to rescue of boats in distress.
- Maintenance of river training work such as bank protective works, bandalling works, bottom paneling works etc. (normally major works are contracted out).
- Maintain required minimum depth in the waterway by dredging the shallow patches wherever required.
- Pilot the cargo boats in difficult reaches.
- Legal enforcement of rules and regulations by catching offenders and legally prosecuting them.
- Operating and maintain communication equipments.

Senior hydrographic surveyor: The task will include checking the water levels, changes in channels, checking position of marking systems and buoys, collection of morphological data, regular cross section soundings and bank levels, discharge measurements etc. This department would make available to barge operators on daily basis following information in the form of river notice and over radio contact.

- Water level at fixed gauge stations.
- Available depth for particular river section in their command and the location of shallowest place/ stretch.

- General information on changes in channels and marking system.
- Execution of river works, dredger location etc. Route mapping shall be carried out on regular basis once in two to three weeks and charts issued to barge operators immediately. Their tasks include maintaining the system of channel marking, buoys and beacons.

3) Terminals

Each terminal will be under the control of Terminal Manager. Terminal Manager will be responsible for operation and maintenance of the terminal. Their tasks include:

- Operations and maintenance of all mechanical handling equipment.
- Berthing and deberthing of cargo and passenger vessels.
- Loading and unloading of cargo vessels.
- Storage and dispatch of cargo
- Collection of berthing, handling, handling and storage charges.
- Operation and maintenance of all utilities in the terminal area.
- Terminal security and communication.

10.2 Man Power Requirement

Man power requirement for Development of waterway in Tapi River includes for terminal operations and departmental requirement. Departmental regional office will be set up at Surat. Every terminal will require institutional setup for proper functioning of terminal operations. Terminal manager will be the head at terminal responsible for overall terminal operations.

S.No.	Staff detail	No. of Personnel Required **Phase-1**	No. of Personnel Required **Phase-2**
1	**TERMINAL MANAGER**	2	1
2	**ADM OFFICER**	2	1
3	**OPERATION MANAGER**	2	1
4	**MAINTENANCE MANAGER**	2	1
5	**SURVEYOR**	2	1
	Mechanical	4	2
	Civil	4	2
	Electrical	4	2
3	**Office Staff**		
	Clerical Staff	4	2
4	**Security Staff**	6	3
	Total	**32**	**16**

However, it is to be noted that River Tapi (NW-100) has been allocated to Deendayal Port trust (DPT) for development. In present case scenario, officer at level of assistant director and junior account officer at Head Office may be required to monitor various developments & monitoring of fund utilization.

10.3 Training Requirement / Capacity Building

Capacity Building is the process by which the Organization assesses and assists in sustainable development and improvement of the performance. Capacity Building involves more than training. It should be a strategy that involves a long time vision towards the enhanced production, modernization, and development of human resources leading to overall organizational objectives. In order to improve the efficiency of the navigation education & training in the field of inland navigation should be provided to the man power required.

Training Module

Dredging Technical Training
Safety training courses
Dredging management
Terminal Management & Operation Courses

10.4 Infrastructure

10.4.1 Immovable

Immovable infrastructure established includes Administrative building, Security office, Electrical substation, parking area etc.

10.4.2 Movable

Movable cranes, vehicles and survey boats will be required at terminals.

10.5 Cost Implications

Cost implication for establishing institutional requirement will include salaries of employees deployed at terminals, navigational lock and regional offices in general. Institutional setup required for operation and maintenance of waterway, locks and terminals. Capacity building through education and training to the staff and employees will also have cost implications. Average annual salary of top management is taken as Rs1600000 (PB-4+ Rs. 8700). Average annual salary of officers and staff at Dy. Director, Terminal Mangers offices is taken as 70000 (PB-3+ Rs. 5400).

Item	Quantity	Rate	Amount
Salaries(Top Management)	8	1600000	12800000
Middle Management	14	700000	9800000
Clerical Staff	4	400000	1600000
Unskilled	6	120000	720000
Misc	Lump sum		29904000
Total(Annual)			**54824000**

CHAPTER – 11

PROJECT COSTING

11.1 General and Financial Assumptions

The technical aspects of development of National Waterways for handling of the projected traffic are dealt with in the previous chapters. In the present chapter project cost estimates has been done. In order to arrive at capital cost for the proposal it is necessary to ascertain, for budgetary purposes, unit rates of materials used for construction, dredging etc. Accordingly, efforts were made to obtain the above information from the relevant sources.

Modification in existing cross structures has to be done for providing clear passage of vessels. Most of the bridges are not having vertical clearance in that case deck elevation of bridges may be raised by strengthening of piers and foundations. Bridges not having horizontal clearance may be modified as Cable Bridge. Bridges which are more than fifty years of age may be dismantled and reconstructed. New bridges should be constructed keeping in mind the guidelines for navigation of vessel in rivers. Navigational locks have been proposed at weir and barrages. Two barrages are also proposed at CH 77Km and CH 95 Km.

11.2 Basis of Costing

An estimate of the capital cost of various facilities is made. The cost arrived at are based on the budgetary quotes and the in house data base available on cost estimates. The rates for various site ms of work have been prepared on the basis of current rates for various items of work prevailing in the region.

The items and costs have been arrived at broadly on the following:

- Rates taken from current works of similar nature
- Updated rates of work of similar nature completed in the recent past.
- Consultant's in house data bank of cost estimates and budgetary quotations.

Gujarat Maritime Board Schedule of Rate, 2013-14 has been followed and escalated by 5% per annum to arrive at for year 2018 to arrive at the cost of the project.

11.3 Development Cost

Phase-1

Development cost of waterway in Tapi River is given as below:

Fairway Development Cost	In Crores
Navigation Locks	-
Demolition & Reconstruction of bridges	-
Dredging (0.31 Mm3)	9.36
Navigation & Communication Cost	5.00
Total Fairway Development Cost	**14.36**

*Excl. Contingency, Supervision Charges & IDC

Phase-2

Development cost of waterway in Tapi River is given as below:

Fairway Development Cost	In Crores
Navigation Locks	180.00
Construction of barrages	700.00
Demolition & Reconstruction of bridges	834.48
Dredging (2.0 Mm3)	60.00
Navigation & Communication Cost	8.04
Total Fairway Development Cost	**1782.52**

*Excl. Contingency, Supervision Charges & IDC

11.4 Capital Expenditure

The estimate of capital cost is made for the various items of civil, mechanical, electrical and utilities works for the development of terminals in the waterway stretch, cost estimate is presented in Table11-1.

The capital cost worked out is excluding land cost for construction of terminals & navigational locks.

Table11.1 Capital Cost Estimate Phase-1

A	Capital Cost	In Crores
	(I) Civil Cost	
(A)	Fairway Development Cost	
	Navigation Locks	0.00
	Bank Protection	0.00
	Demolition & Reconstruction of bridges	0.00
	Total	0.00
	3% Contingencies and 7% Supervision charges on Base cost	0.00
	Total Fairway Development Cost	**0.00**
(B)	Terminal Cost	
	*Dumas Tourist terminal **(70m x 5m)***	3.30
	*Chowk Bazar Tourist Terminal **(70m x 5m)***	3.30
	Storage Area(Land acquisition, Including roads, warehouse, parking area etc)	24.50
	Total Cost(I)	31.10
	3% Contingencies and 7% Supervision charges on Base cost	3.11
	Total Civil Cost	**34.21**
(C)	**(II) Navigation & Communication Cost**	
	Marine Lantern/Buyos (10 nos.)	0.20
	RIS	4.35
	Total Cost(II)	4.55
	3% Contingencies and 7% Supervision charges on Base cost	0.45
	Total Navigation & Communication Cost	5.00
(IV)	**(III) Handling Equipment & Utilities**	
	Mechanical & electrical	2.0
	3% Contingencies and 7% Supervision charges on Base cost	0.20
	Total Handling Equipment & Utilities Cost	**2.20**
(V)	Other cost including financing cost and interest during construction (10% of (I)	3.42
	Total Cost ((I)+(II)+(III)	**44.83**
	(IV) Dredging	
(A)	Dredging **(0.31 Mm3)**	**9.36**
	Total Cost	
	Total Capital Cost	**54.19**

Table11.2 Capital Cost Estimate Phase-2

A	Capital Cost	In Crores
	(I) Civil Cost	
(I)	Fairway Development Cost	
	Navigation Locks	180.00
	Construction of Barrages ***(2 Nos)***	700.00
	Demolition & Reconstruction of bridges ***(16-Bridges)***	834.48
	Total	1714.48
	3% Contingencies and 7% Supervision charges on Base cost	171.45
	Total Fairway Development Cost	**1885.93**
(II)	Terminal Cost	
	*Ukai Cargo Terminal (****100m x 15m)***	22.00
	*KRIBHCO TERMINAL****(100m x 15m)***	22.00
	Storage Area(Including roads, warehouse, parking area etc)	49.00
	Total Cost(I)	93.00
	3% Contingencies and 7% Supervision charges on Base cost	9.30
	Total Civil Cost	**102.30**
	(III) Navigation & Communication Cost	
(A)	DGPS	1.00
(B)	VTMS	1.00
(C)	Marine Lantern/Buyos (48 nos.)	0.96
(D)	RIS	4.35
	Total Cost(II)	7.31
	3% Contingencies and 7% Supervision charges on Base cost	0.73
	Total Navigation & Communication Cost	8.04
(IV)	**(III) Handling Equipment & Utilities**	
	Mechanical & electrical	22.2
	3% Contingencies and 7% Supervision charges on Base cost	2.22
	Total Handling Equipment & Utilities Cost	**24.42**
(V)	Other cost including financing cost and interest during construction (10% of (I)	10.23
	Total Cost ((I)+(II)+(III)	**2030.92**
	(IV) Dredging	
(A)	Dredging **(2.0 Mm3)**	**60.00**
	Total Capital Cost	**2090.92**

Detailed BOQ for the capital cost estimate is given in Annexure-11.

11.5 Operation and Maintenance Expenditure

The annual operation and maintenance cost on different components of the project will be dependent on a number of variables such as the life of the component, repair and maintenance requirements, wages of crew of consumables, etc. Hence, accurate assessment of cost is not possible. Further even if all the variables are fixed such as the maintenance schedules for each structure and equipment is determined, crew strength is fixed, requirement of consumables quantified, etc., the estimation of O&M costs cannot be precise because of unpredictable breakdowns incurring considerable expenditure on repairs and replacement. The only practicable approach in this scenario is to fix the annual repair expenditure as a percentage of capital cost of project. This percentage is to be fixed on the basis of the past performance of similar structures and equipment functioning in the project or elsewhere under similar marine conditions.

Based on above criteria, the annual maintenance cost is estimated as a percentage and is presented in tables below.

Table 11.3 Operation & Maintenance Cost (Phase 1)

II	O & M Cost	In Crores
(i)	Dredging @ 10%	0.94
(ii)	Civil works @ 1%	0.34
(iii)	Mechanical & Electrical Cost @ 5%	0.11
(iv)	Ports Crafts/Nav. Aids @ 5%	0.25
(v)	Fuel Cost	1.00
(vi)	Power Cost	2.00
(vii)	Manpower Cost	5.50
(viii)	Miscellaneous	0.50
	Total	**10.64**

Table 11.4 Operation & Maintenance Cost (Phase 2)

II	O & M Cost	In Crores
(i)	Dredging @ 10%	6.00
(ii)	Civil works @ 1%	19.88
(iii)	Mechanical & Electrical Cost @ 5%	1.221
(iv)	Ports Crafts/Nav. Aids @ 5%	0.40
(v)	Fuel Cost	2.00

II	O & M Cost	In Crores
(vi)	Power Cost	4.00
(vii)	Manpower Cost	2.74
(viii)	Miscellaneous	0.5
	Total II	**36.75**

CHAPTER – 12
IMPLEMENTATION SCHEDULE

12.1 Time Frame

Time scheduling is the assigning of start dates and completion dates to the various activities that take place in project implementation. The important points to be noted to schedule the time are:

- The earliest time that an activity can start
- The latest time that an activity may be completed without delaying the project completion
- The leeway or float or degree of freedom available in scheduling an activity
- The resultant critical path

Before scheduling time of a project with different activities of work, following facts have been considered.

- Determination the parts or implementation phases of the project and the sequence in which the associated activities shall be carried out
- Then estimate the amount of time required for each activity
- List the activities that can be carried out at the same time and identify those to be carried out sequentially

Detailed time schedule is shown in **Annexure-12.1**.

12.2 Phasing:

Phasing of activities have been done keeping importance of the event in project completion. However, ultimate aim was stick to early completion of project.

Phase-1

Activity 1: Land Acquisition

Activity 2: Development of Recreational Activities

Activity 3: Construction of Jetty

Activity 4: Development of Waterway (Dredging & Navigational facilities)

Progress Flow Chart

A progress flow chart of all the above activities have been presented in **Annexure. 12.2**. The PERT chart was prepared after calculating total time of each activity including setting-up time/curing time and other related activities. The setting / curing time for concrete has been taken as 6 days. Monsoon time of 90 days & other delay of 120 days has already considered for total time calculation. The slow rate of work during monsoon has also been considered in the PERT chart.

12.3 Suggested Implementation Mechanism

If the availability of funds with IWAI to implement e-governance initiatives is limited, IWAI can go for PPP models to implement these projects. PPP initiatives not only save the costs but also inject the much needed private sector efficiency in the government sector domain. While there is a need to create PPP deals, these need to be structured to ensure a win – win for all the stakeholders.

In the new regime, standard norms are prescribed for determining the investment and operational efficiency of the project. Target revenue is then calculated as the sum of operating cost, depreciation and an allowable return on capital employed. Target revenue is then categorized into revenue from various services based on estimated demand for each service. These ceiling tariffs are indexed to WPI and escalated year on year, there by removing the effects of varying demand on tariffs (as used to happen in the previous regime during tariff revisions).

Contractual Framework of PPP projects

- All intentions need to be set out in a contract
- Concession Agreement - bundle of rights & obligations and consequences in case of non-fulfilment
- Usually the only tangible security available
- Contracting parties : Government Agency – Concessioning Authority and Private Party – Concessionaire
- Other parties – state government, Lenders, Suppliers of services
- A concession is a license – rights enjoyed for obligations performed

Issues

- Striking a balance between differing concerns & objectives of parties
- Legislative Back up
- Rights and obligations of parties
- Identification and allocation of risks
- Penalties and rewards which would ensure performance

In present case, DBFOT model is the best model for implementation of the project. But as there is no shortage of funds, IWAI can directly implement the project.

Design Phase

The Independent Engineer shall review the Designs and Drawings submitted by the Concessionaire and provide its comments/observations and suggestions on the same within 21 (twenty one) Days from the date of the receipt of such Designs and Drawings.

In the event that the Independent Engineer has observed that the Designs and Drawings are not in conformity with the Project Requirements, the Concessionaire shall promptly and without any undue delay revise and resubmit the Designs and Drawings or satisfy the Independent Engineer with regards its compliance.

If the Independent Engineer does not make any observation/comments with respect to the Designs and Drawings submitted to it by the Concessionaire within 21 (twenty one) Days of the submission, it shall be deemed that the Independent Engineer has no suggestions to make with respect to the Designs and Drawings and the Concessionaire shall be entitled to proceed with the Project accordingly.

The Concessionaire shall not be entitled to any extension of time for completing construction or any other relief on account of delay caused due to providing any clarification or in resubmitting the Designs and Drawings. Provided however the Concessioning Authority at its sole discretion may suitably extend the Construction Phase or provide other relief to compensate for any such delay not attributable to the Concessionaire.

Notwithstanding the review by the Independent Engineer, the Concessionaire shall be solely responsible for any defect and/or deficiency in the Designs and Drawings relating to the Project or any part thereof and accordingly the Concessionaire shall at all times remain responsible for its obligations under this Agreement.

Any review of the Designs and Drawings conducted by the Concessioning Authority is solely for the Concessioning Authority's own information and that by conducting such review, the Concessioning Authority does not accept any responsibility for the same.

The Concessionaire shall in no way represent to any Person that, as a result of any review by the Independent Engineer, the Concessioning Authority has accepted responsibility for the engineering or soundness of any work relating to the Project/ the

Project Facilities and Services or part thereof carried out by the Concessionaire and the Concessionaire shall, in accordance with the provisions of this Agreement, be solely responsible for the technical feasibility, operational capability and reliability of the Project/ the Project Facilities and Services or any part thereof.

12.3.1 Construction Phase

The Concessionaire shall promptly commence and complete the works, including installation of equipment in accordance with the Project Schedule and shall also obtain from the Independent Engineer a certificate as to completion of construction of Project Facilities and Services

During the Construction Phase, the Concessionaire shall:

- Arrange for, in a timely manner all necessary financial and other resources required for construction and installation of the Project Facilities and Services.
- Engage professionally competent Persons for project management and construction and ensure that all works are carried out in compliance with the Construction Standards;

- Give written notice to the Concessioning Authority within 7 (seven) Days of any material modification or change to any of the Financing Documents and/or any Equity Documents and shall simultaneously therewith also furnish copies of such modified/ amended documents to the Concessioning Authority. Provided no such modification/amendment will be made if it in any manner whatsoever has the effect of imposing an additional financial obligation or increasing the financial obligation of the Concessioning Authority in addition to that contemplated under the Financing Documents provided on Financial Close, without the prior written consent of the Concessioning Authority. For avoidance of doubt any such modifications/amendments made without the prior written consent of the Concessioning Authority will not be enforceable against the Concessioning Authority;
- Obtain Applicable Permits, comply with Applicable Laws and Applicable Permits and give priority to safety in its construction and planning activities in order to protect life, health, property and environment;
- Provide to the representative(s) of the Concessioning Authority, at reasonable times and upon prior intimation, access to the Project Site to review progress in construction and to ascertain compliance with any of the requirements of this Agreement. Provided that non-inspection by the Concessioning Authority of any works shall not, in relation to such works,
- Amount to any consent or approval by the Concessioning Authority nor shall the same be deemed to be waiver of any of the rights of the Concessioning Authority under this

Agreement; and (ii) release or discharge the Concessionaire from its obligations or liabilities under this Agreement in respect of such work;

- Provide monthly reports on the progress of Construction Works or such other relevant information as may be required by the Independent Engineer;
- Promptly carry out at its cost such further works as may be necessary to remove any defects or deficiencies observed by the Independent Engineer and ensure timely completion of construction of the Project / the Project Facilities and Services in all respects in accordance with the provisions of this Agreement; and
- to ensure safe and timely construction and completion of the Project/Project Facilities and Services, the Concessionaire may, at its cost, interrupt and divert/create barriers on the flow of water or on the road or port traffic, adjacent to the Project Site if such interruption and diversion is imperative for the efficient progress of Construction Works and conforms to Good Industry Practice; provided that such interruption and diversion shall be undertaken by the Concessionaire only with the prior written approval of the Independent Engineer which approval shall not be unreasonably withheld. For the avoidance of doubt, it is agreed that the Concessionaire shall at all times be responsible for ensuring safe operation of Construction Works and shall remove the interruption or diversion within the period specified by the Independent Engineer.

12.3.2 Operations & Maintenance

The Concessionaire shall manage, operate, maintain and repair the Project Facilities and Services, entirely at its cost, charges, expenses and risk in accordance with the provisions of this Agreement. The Concessionaire's obligations shall include but shall not be limited to the following:

(i) Berth and Terminal Operations:

The Concessionaire shall:

- Promptly commence operations upon the Project Facilities and Services being declared by the Concessioning Authority as ready for operations;
- Make efforts to maximise cargo handled so as to achieve optimal utilization of the Project Facilities and Services;
- Ensure compliance of the Project Facilities and Services at least with the Project Requirements;
- Ensure compliance of the Project Facilities and Services at least with the Performance Standards;
- Ensure that the Project Facilities and Services shall adhere to the Operations and Maintenance Standards and Safety Standards and there is safe, smooth and uninterrupted flow of traffic normal operating conditions;

- Minimise disruption to traffic in the event of accidents or other incidents affecting the safety and use of the Project Facilities and Services by providing a rapid and effective response and maintaining liaison with emergency services of the Concessioning Authority or other agencies;
- Make available all necessary financial, technical, technological, managerial and other resources for operation, maintenance, repair and replacement of the Project Facilities and Services in a timely manner;
- Except for the priority and preferential berthing that may be authorized in terms of guidelines issued by the Government from time to time, manage and operate the Project Facilities and Services on a first come - first serve, common-user basis, open to any and all shipping lines, importers, exporters, shippers, consignees and receivers, and refrain from indulging in any unfair or discriminatory practice against any user or potential user thereof;
- Ensure maintenance of proper and accurate record/data/accounts relating to operations of the Project Facilities and Services and the revenue earned therefrom;
- Obtain, maintain and comply with Applicable Permits and comply with the Applicable Laws including those relating but not limited to dock side safety, health, environment and labour;
- Subject to the provisions of this Agreement, perform, undertake or provide, in connection with the Project, all services which the Concessioning Authority is authorized to perform, undertake or provide under the provisions of the MPT Act; and

- Prevent, with the assistance of concerned law enforcement agencies, any encroachment or unauthorized use of the Project Facilities and Services.

12.3.4 Repairs, Maintenance and Replacement

The Concessionaire at it's own cost promptly and diligently maintain, replace or restore any of the project facilities or part thereof which may be lost, damaged, destroyed or worn out.

While carrying out the repairing, maintaining and replacing the project facilities, the Concessionaire acknowledges and accepts that it is holding and maintaining the concession or assets, project facilities in trust for eventual transfer to the Concessioning Authority on termination of the agreement and therefore, will not do any act as a result of which the value of Port Assets and Project Facilities and Services is diminished.

The Concessionaire shall, at all times during the Concession Period, at its own risk, cost, charges and expenses, performance and pay for maintenance repairs, renewals and replacement of various type of assets and equipment in the concessionaire premises and /or the project or any parts thereof, whether due to use and operations or due to deterioration of materials and /or parts, so that on the expiry or termination of Concession, the same shall except normal wear and tear be in good working condition as it were at the time of commencement of the Concession.

While carrying out the repair, maintenance and replacement of the project facilities, the Concessionaire shall carry out the work in accordance with the manufacturer's recommendations and the relevant latest Indian Standards or in its absence ISO/OISD Standards. In the event that the concessionaire, by necessity or otherwise need to follow any other country standard and it shall be equal or superior to the standard specified above.

The repairs and maintenance shall generally conform to the following specifications.

E.1 Maintenance Standards

ISO 4308-1-2003	Maintenance of lifting appliances
ISO 4309-2004	Cranes wire rope care, maintenance and discard
IS 13367: Part 1 : 1992	Safe use of cranes – Code of Practice Part 1 General
BS 7121-2-2003	Code of Practice for safe use of cranes, inspection, testing & examination
BS 7121-4-1997	Code of Practice for safe use of cranes (Lorry Loaders)
BS 7121-5-2006	Code of Practice for safe use of cranes (Tower Cranes)

12.3.5 Safety Standards

The Concessionaire shall ensure compliance with the safety standards set out under Applicable Law/international conventions, as relevant, from time to time including those required under the following :

- Dock Workers (Safety, Health and Welfare) Act, 1986 & Regulations framed thereunder of 1990.
- The Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989.
- The Petroleum Act, 1934 along with the Petroleum Rules, 2002.

- OISD – Guidelines – 156 (Oil Industry Safety Directorate): Fire Protection Facilities for Port Oil Terminals.
- The Explosives Act, 1884 along with The Explosive Substance Act, 1983 & The Explosive Rules, 1983
- Guidelines by Fire Advisor, CCE & DG FASLI, Government of India
- National Fire Codes (National Fire Protection Association – USA)
- Drill Manual for the Fire Services of India.
- International Safety Guide for Oil Tankers & Terminals.
- ISPS (International Ship & Port Facility Security) Code (2003 Edition)
- MARPOL CONVENTION
- International Maritime Dangerous Goods Code

Chapter – 13

ECONOMIC AND FINANCIAL ANALYSIS

Cost-benefit analysis

Cost-benefit analysis (CBA), sometimes called benefit-cost analysis (BCA), is an economic decision-making approach, used particularly in government and business. CBA is used in the assessment of whether a proposed project, programme or policy is worth doing, or to choose between several alternative ones. It involves comparing the total expected costs of each option against the total expected benefits, to see whether the benefits outweigh the costs, and by how much.

In CBA, benefits and costs are expressed in money terms, and are adjusted for the time value of money, so that all flows of benefits and flows of project costs over time (which tend to occur at different points in time) are expressed on a common basis in terms of their "present value." This is often done by converting the future expected streams of costs and benefits into a present value amount using a suitable discount rate.

13.1 Revenue

A major source of revenue will arise from Tourism. Traffic projection is given in the table below.

Table 13.1: Traffic projection-Boat ride

Terminal Traffic (Boat ride)	Fy 21	Fy 25	Fy 30	Fy 35	Fy 40	Fy 45
Weekend	1.1	1.4	2.1	2.7	3.2	3.9
Weekdays	0.8	1.0	1.5	1.9	2.3	2.8
Annual Traffic	94	127	187	236	288	350

Table 13.2: Traffic projection Recreational Traffic

Recreational Tourism Traffic	Fy 21	Fy 25	Fy 30	Fy 35	Fy 40	Fy 45
Weekends	7.0	9.5	14.0	17.7	21.5	26.2
Weekdays	5.0	6.8	10.0	12.6	15.4	18.7
Annual Recreational traffic	624	849	1247	1576	1917	2333

Table 13.3: Tariff

Rate	INR
Terminal Traffic (Boat ride)	100
Recreational Tourism Traffic	120

Table 13.4 Revenue from Boat ride & Recreational Tourism Traffic

Boat ride (Dumas Jetty- Old Fort Jetty) & Recreational facilities						
	FY 21	FY 25	FY 30	FY 35	FY 40	FY 45
Tourism Revenue	818	1113	1635	2066	2514	3058
Grand Total	**1487**	**1812**	**2357**	**2921**	**3555**	**4427**

In Lakhs

13.2 Possible ancillary revenue

As far as now, there is no possible ancillary revenue.

13.3 Financial Analysis / FIRR

For projects involving heavy investment, it becomes very important to analyze the benefits of owner i.e. IWAI/ Govt. & users, i.e. Barge/ ship operators who would use the IWT facility as compared to other modes of transport. FIRR shall be evaluated for IWAI/ Government and Users (barge / Ship operators).

FIRR for IWAI / Govt.

The financial analysis shall be carried out to drive possible levy charges per tonne kilometer of cargo transported through IWT that IWAI / Govt may levy to recover the costs of project from users. For calculations, economic cost along with cargo projection shall be considered for various scenarios.

FIRR for Barge/Ship operators

The development of waterway that include heavy investments is completely defined and meaningful if the user or Barge operator is getting minimum financial benefits as compared to other modes and is therefore attracted to invest money and time. The total cost to be invested by the barge operator may be classified as Capital cost and Operation and maintenance cost (O & M cost)

Capital/Initial cost depends upon the infrastructure proposed and depicts the future planning. A high initial cost may act as burden on the operator and therefore phase-wise development of all infrastructure and allied facilities shall be proposed.

The running profits are usually governs by less operating cost and operational viability. Operating viability depends upon various factors as:

- Vehicle costs,
- Fuel costs
- Crew costs / Administrative expenses
- Repair and Maintenance costs
- Loading Unloading costs
- Cost of insurance
- Manpower cost

Phase: 1

Considering life of project to be 30 years, the ***FIRR analysis*** is shown in table 13.4:

Table 13.5 FIRR Analysis

FIRR	11.76%
Cap. Cost (+) 10%	10.40%
Cap. Cost (-) 10%	12.05%
ANNUAL O &M COST (+) 10%	10.21%
ANNUAL O &M COST (-) 10%	13.22%
REVENUE (+) 10%	13.97%
REVENUE (-) 10%	9.26%

13.4 Risk Factors

Pre-operative task risks	
External linkages	Refers to the risk that adequate and timely connectivity to the project site is not available, which may impact the

	commencement of construction and overall pace of development of the project.
Financing risks	Refers to the risk that sufficient finance will not be available for the project at reasonable cost (eg, because of changes in market conditions or credit availability) resulting in delays in the financial closure for a project.
Planning risks	Refers to the risk that the pre-development studies (technical, legal, financial and others) conducted are inadequate or not robust enough resulting in possible deviations from the outcomes that were planned or expected in the PPP project development.
Construction phase risks	
Design risk	Refers to the risk that the proposed design will be unable to meet the performance and service requirements in the output specification. It can result in additional costs for modification and redesign.
Construction risk	Refers to the risk that the construction of the assets required for the project will not be completed on time, on budget or to specification. It may lead to additional raw materials and labour costs, additional financing costs, increase in the cost of maintaining existing infrastructure or providing a temporary alternative solution due to a delay in the provision of the service.
Approvals risk	Refers to the risk that delays in approvals to be obtained during the construction phase will result in a delay in the construction of the assets as per the construction schedule. Such delays in obtaining approvals may lead to cost overruns
Operation phase risks	
Operations and maintenance risk	Refers to the risks associated with the need for increased maintenance of assets or machinery over the term of the project in order to meet performance requirements. In a brownfield PPP, where the private partner takes over operation of existing assets, O&M risk is very sensitive to

	the starting condition of the assets. In this case the private operator's O&M risk is related to the risk of poor or incomplete information about the quality of the assets that it will take over.
Volume risk	Refers to the risk that demand for water or sanitation services will vary from the initial forecast, such that the total revenue derived from the project over the project life will vary from initial expectations.
Payment risk	Refers to the risk that charges for services are not collected in full or are not set at a level that allows recovery of costs. Who bears the payment risk depends on whether the charges for services are paid directly by users, or are paid by the municipality. If charges are paid by the municipality (via taxes) the public sector bears this risk.
Financial risk	Refers to the risk that the concessionaire introduces too much financial stress on a project by using an inappropriate financial structure for the privately financed components of the project. It can result in additional funding costs for increased margins or unexpected refinancing costs.
Performance risk	This is a risk that the quality of services delivered will not meet the performance standards agreed in the Concession Agreement. The Concession Agreement should stipulate penalties or compensation terms in this case.
Environmental risk	Refers to the risk of environmental damage in excess of what is planned for in the environmental impact mitigation plan. For example, ground water pollution from sewerage release.
Handover risks	
Handover risk / Terminal value risk	Refers to the risk that the concessionaire will default in the handover of the asset at the end of the project life, or that it will fail to meet the minimum quality standard or value of the asset that needs to be handed back to the public entity. This risk (and terminal value risk) generally relates to concession and BOT type PPPs. However, it may also be

	relevant to performance based management contracts in which the private partner is responsible for investing in meters.
Other risks	
Change in law	Refers to the risk that the current legal / regulatory regime will change, having a material adverse impact on the project.
Force Majeure	Refers to the risk that events beyond the control of either entity may occur, resulting in a material adverse impact on either party's ability to perform its obligations under the PPP contract. These events are sometimes also called "Acts of God", to indicate that they are beyond the control of either contracted party.
Concessionaire risk	Refers to the risk that the concessionaire will prove to be inappropriate or unsuitable for delivery of the project, for example due to failure of their company.
Sponsor risk	Refers to the risk that the Sponsor will prove to be an unsuitable partner for the project, for example due to poor project management or a failure to fully recognise the agreed terms of the Concession Agreement.
Concessionaire event of default	Refers to the risk that the concessionaire will not fulfil its contractual obligations and that the public Sponsor will be unable to either enforce those obligations against the concessionaire, or recover some form of compensation or remedy from the concessionaire for any loss sustained by it as a result of the breach.
Government event of default	Refers to the risk that the public Sponsor will not fulfil its contractual obligations and that the concessionaire will be Unable to either enforce those obligations against the Sponsor, or recover some form of compensation or remedy from the Sponsor for any loss sustained by it as a result of the breach.

13.5 Necessity of Govt. support (VGF/PPP)

The guide lines were notified by the ministry of finance, department of economic affairs for financial support to infrastructure project that are to be undertaken through Public Private Partnerships (PPP).

Proposal is to be made under this scheme shall be considered for providing Viability Gap Funding (GAF), one time or deferred with the objective of making a PPP project commercially viable.

The proposal shall relate to a public private partnership (PPP) project which is based on a contract or concession agreement between a Government or statutory entity (Inland Waterways Authority of India) on the one side and a private sector company on the other side, for delivering an infrastructure service on payment of user charges.

This scheme will apply only if the contract/concession is awarded in favour of a private company in which 51% or more of the subscribed and paid up equity is owned and controlled by a private entity.

A private sector company shall be eligible for VGF only if it is selected on the basis of open competitive bidding and is responsible for financing, construction, maintenance and operation of the project during concession period.

The project should provide a service against payment of a predetermined tariff or user charge.

The proposal for seeking clearance of the Empowered Institution shall be sent (in six copies, both in hard and soft form) to the PPP cell of the Department of Economic Affairs in the prescribed format. The proposal should include copies of all project agreements (such as concession agreement, state support agreement etc.) and the project report.

Once cleared by Empowered Institution, the project is eligible for financial support.

Financial bids shall be invited by the concerned ministry, state Government or statutory entity, as the case may be, for the award of the project within four months of the approval of the Empowered Institution. This period may be extended by the Department of Economic Affairs.

The private sector company shall be selected through a transparent and open competitive bidding process. The criterion for bidding shall be the amount of VGF required by a private sector company where all other parameters are comparable.

13.6 SWOT Analysis

Strength	**Weakness**
• Various proposals by state government like river front development, barrage, and renovation of Surat Castle etc. • Beaches near river mouth. • Various recreational facilities near Singanpore Weir. • Well-developed approach road • More environment friendly mode of transport, reduces carbon footprint and decongestion of existing road and rail traffic.	• No navigational locks on existing Weir / Dam • Bridges without sufficient horizontal & vertical clearance • Lack of awareness among people regarding IWT.

Opportunities	Threats
• Possibility of Tourism, recreational and local ferry services as number of tourist places and villages exist along river bank. • Lack of tourist facilities in and around River Tapi. • Socio-Economic development of nearby project areas.	• Natural calamities • Social problems are observed during reconnaissance survey

Chapter – 14
Conclusions & Recommendations

14.1 Conclusions & Recommendations :

WAPCOS has studied four terminal locations in two phases at various sites on the basis of traffic potential, water availability and land availability. The details of these terminals are given in table 14.1 below:

Table 14.1: Phase-wise details of terminals

Phase	Terminal	Location	Type	Land details
Phase-1	Terminal 1	Dumas Jetty	Tourism	Forest land
	Terminal 2	Old Fort Jetty	Tourism	Govt. land
Phase-2	Terminal 3	KRIBHCO Jetty	Cargo	Govt. land
	Terminal 4	Ukai Jetty	Cargo	Govt. land

Phase wise dredging is given below in Table 14.2.

Table 14.2: Phase-wise details of length, dredging quantity, proposed class and bridges

Phase	Length of waterway	Dredging Quantity	Proposed Class	Bridges to be demolished
Phase-1	19 km	0.31 Mm^3	-	No Bridge
Phase-2	134 km	2.00 Mm^3	Class-IV	15

Phase-1 is viable technically. However, Phase-II is not viable from technical, economical & financial point of view.

Also, **Phase-1 can be executed only after complete renovation of Old Fort (Near Chowk Bazaar) and other facilities** proposed by State Government like water front development& recreational facilities.

Reasons behind non viability of Phase-II:

1) Based on recent survey carried out by WAPCOS, total 15 bridges have to dismantle as modification of these bridges is not possible. The cost of the construction for new bridges will be very high.

2) In phase-1 computed dredging quantity is 0.31 Mm^3. Two barrages have been proposed in Phase-II at Ch. 95 & Ch.77 resp. Computed dredging quantity in Phase-2 is 2.0 Mm^3

3) There is no intermittent traffic from Old Fort to Ukai Dam. Hence, only possibility of cargo movement is for Ukai thermal power plant due to which Phase-2 is not feasible from financial & technical point view.

4) Two nos. of navigational lock will be required one at Singanpore & other at Kakrapar weir, which will incur extra cost & practically not possible to provide locks at these two locations.

5) There is very well developed and well-connected road network around the River Tapi throughout its whole stretch.

This report can be updated at a later stage when required, by considering the fresh cargo analysis, change in requirement of the Government or change in policy either of the state or government of India.

Following studies should be carried out prior to any development for broad view of implications:

i. Conduct a comprehensive geomorphic study and review and analyses sedimentation processes. The sedimentation study shall be aimed at developing an improved understanding of the significant sedimentation processes within the entire river basin. The major emphasis of this work shall be on analyzing major channel morphology and the sedimentation phenomenon during the last 10 year period. the sedimentation study shall include:

   a. Document the variations in sediment transport (size and quantity);

   b. Identify and quantify all major sources of sediments (bed and banks, tributaries) and

   c. Identify degrading, aggrading, and stable reaches, and

   d. Establish the range of flows transporting the major of sediments.

ii. Correlate the results of the sedimentation study with historical changes in the basin (channel improvements, land use, barrage and reservoir construction, etc.) enabling the development of a firm understanding of past and present sedimentation processes. This information shall be used to

   (a) Qualitatively analyses the effects of anticipated project features. This information shall be used to determine what may or may not work when designing navigation improvements.

(b) Determination of those reaches that are stable in depth and width and thus provide the basis for all subsequent preliminary design works.

(c) Analysis of the bend-ways to determine the siltation and erosion process in the same and the minimum radius required for navigation of the reference vessels.

iii. Undertake various types of model studies to verify and / or enhance all design parameters. As a minimum this shall include a numerical model to produce detailed pictures of flow in the river system under current and future flow conditions and also the required flow/ discharge to maintain LAD throughout the year with or without interventions like (barrages) in River.

15.1 Environmental and Social Screening Template

Annexure-VIII

TAPI RIVER

Screening Question	Yes	No	Details/Remarks
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	-	No	
b) Wildlife/ Bird Sanctuary	Yes	-	Hazira bird sanctuary near estuary. Shoolpaneshwar and Purna Wildlife Sanctuary is located at 25-30km from the river bank near Ukai Dam.
c) Tiger or Elephant Reserve	-	No	
d) Biosphere Reserve	-	No	
e) Reserved/Protected Forest	Yes		Terminal 1 Dumas
f) Wetland	Yes		
g) Important Bird Areas	Yes		Hazira bird sanctuary near estuary.
h) Mangroves Areas	Yes		Estuary at the confluence point of river with sea.
i) Estuary with Mangroves	Yes		Estuary at the confluence point of river with sea.
j) Areas used by protected, important or sensitive species of fauna for breeding, nesting, foraging, resting, overwintering, migration	-	No	
k) World heritage sites		No	
l. Archeological monuments/ sites (under ASI's Central / State list)	Yes		5 sites within 10km. I. Ancient site ,kamrej,Surat ~ 100m

			from river bank II. Tomb of Khwaja Safar Sulemani,Surat ~ 500m from river bank III. Old dutch Armenian Tomb,Surat ~ 1km from river bank IV. Dargah Khawaja Dana Saheb'sRouza,Surat ~ 750m from river bank V. Old English Tomb,Surat ~ 1.3km from river bank
2. Is the project located in whole or part in/near any Critically Polluted Areas identified by CPCB?	-	No	
3. Is, there any defense installations near the project site?	-	No	
4. Whether there is any Government Order/ Policy relevant / relating to the site?	-	No	
5. Is the project involved clearance of existing land, vegetation, and buildings?	Yes		Forest Land, Terminal 1near Dumas
6. Is the project involved dredging?	Yes	-	
7. Is the project area susceptible to natural hazard (*earthquakes, subsidence, erosion, flooding, cyclone or extreme or adverse climatic conditions*)	-	No	
8. Is the project located in whole or part within the Coastal Regulation Zone?	Yes	-	Tidal variation upto Chainage 35 Km (Part)
9. Is the project involved any demolition of the existing structure?	Yes		Bridges falling in the stretch
10. Is the project activity require the acquisition of private land?	-	No	
11. Is the proposed project activity result in loss of direct livelihood/employment?	-	No	
12. Is the proposed project activity affect	-	No	

schedule tribe/ caste communities?			

Sl.No.	Result of Screening Exercise	(Yes/No)
1.	Environment Impact Assessment is Required	Yes
2.	CRZ Clearance is Required	Yes
3.	Environmental Clearance is Required	No
4.	Forest Clearance is required	Yes
5.	Wildlife Clearance is required	No
6.	NOC from SPCB is required	Yes
7.	Social Impact Assessment is Required	Yes
8.	Abbreviated RAP is required	Yes
9.	Full RAP is required	
10.	Any other clearance is required	Gujarat Maritime board

15.2 Traffic Template

15.2 Traffic Template

15.2.1 Catchment Baseline

- Local economic geography - Tapi river origin – Chandora Dam. At an elevation of about 752 m, and flows for about 724 km before falling into the Arabian Sea. The river is bound on the three sides by the hill ranges.
- Catchment area - Districts of Surat and Tapi in Gujarat, and Nandurbar in Maharashtra
- Population – As per census 2011, total population residing in Surat district is 1,02,59,161, in Tapi district 6,50,538, in Nandurbar district 14,52,541
- Economic activities – Gujarat is one of the most developed states of India, in terms of economic growth. Agriculture, mining, fishing, live stock are contributing to primary sector. Tertiary sector contribution to economy come first then secondary and then primary.
- Major industries - Ukai TPP, Reliance, Essar, L & T, ONGC, KRIBHCO, NTPC
- Connectivity
  - ✓ Major roads - NH 53, SH 06 crosses river near mouth. . Gujarat has 3,245 km of National Highway and 19,761 km of State Highways. The district roads connect all talukas and major towns.
  - ✓ Major railway – The rail coverage in Tapi is less compared to other districts, but it is sufficient. The railway network in Nandurbar is good in the southern region
- Specific Developments
  - ✓ Bridge over Tapi river between Ved, Surat to Variav, Surat.

- Catchment area Map

Terminals	Location	Lat. / Long.	Chainage (Km)
Terminal 1	Dumas	21° 5'26.86"N / 72°42'13.15"E	-
Terminal 2	Surat Old Fort, Chowk Bazar	21°11'44.04"N/ 72°48'59.72"E	31.3
Terminal 3	KHRIBHCO Jetty	21° 8'48.17"N / 72°42'38.26"E	18
Terminal 4	Ukai	21°15'26.80"N / 73°34'7.03"E	134

15.2.2 Navigation Baseline

- Existing Waterway Usage
  - ✓ Cargo gets handled at the mouth of the river. There are Six jetties on the mouth namely HPPL, Essar,L&T, Reliance, Kribhco and Ambuja. These jetties handle cement tankers, OMIFCO vessels, Bulk carrier of 1 lakh DWT. Etc.
  - ✓ Floating restaurant and boating activity takes place in Tapi River for tourism purpose.
  - ✓ Kakrapar Dam and Ukai Dam on Tapi in navigable stretch and Hatnur Dam is out of the study stretch

15.2.3 Market Baseline

- Potential Market
  - ✓ Bulk & Semi bulk commodities – Coal, Fly ash
  - ✓ General/ Other Cargo –SBM

Commodity	Source	Reasoning
Coal	Imported Coal from Hazira	Only domestic coal is considered in FSR. Domestic coal is obtained from Chhattisgarh mines, which doesn't fall in the proposed River Tapi stretch. Ukai TPS uses 15% - 20% Indonesian coal as the imported variety. It can be transported from Hazira to Ukai via waterways.
Fly Ash	Ukai TPS	It is obtained from Ash Handling plant at Ukai TPS. It can be transported to various cement plants in Surat via waterways.
SBM	Ruchi Soya	Magdalla has a history of handling SBM, now discontinued. This volume can be moved on River Tapi by handling it at an alternative facility alongside KRIBHCO jetty.

15.2.4 Forecasting Years

- IWT Share
  - o Ruchi Soya, or any other Soya refiners from Madhya Pradesh, are currently either using road or rail, especially latter. For forecast, it was assumed that the base volume will be the maximum volume achieved by Magdalla while it was handling SBM for Ruchi Soya. In addition, an uncertain share, albeit small one, from rail transportation would also be moved via the waterway.
  - o Assuming a standard maximum import share of 30% of the total coal requirement, IWT will be moving this whole share. However, this growth will happen in gradual successions spread across projected years between FY18 and FY45.

- A modest 15% (all unutilized) share of existing fly ash volume from Ukai TPP has been earmarked for IWT movement. Gradually, IWT will also account for 75% share of the fly ash volume the plant is able to utilize at the moment, and distribute it locally using different modes. In totality, a total share of nearly 80% can be moved using the waterway by FY45.

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-18	Fy 28	Fy 29	Fy 30	Fy 35	Fy 40	Fy 45
Proposed Terminal 3 Opportunity for IWAI															
1	SBM	General/Other	Ruchi Soya	Terminal 3	Export market (via Kandla, Bedi, etc.)	n/a	21° 8'46.11"N / 72°42'40.74"E	mn T	0	0.1	0.1	0.2	0.3	0.4	0.8
								Total	**0**	**0.1**	**0.1**	**0.2**	**0.3**	**0.4**	**0.8**
Proposed Terminal 4 Opportunity for IWAI															
1	Coal	Bulk	Hazira Port	n/a	Ukai TPP	Terminal 4	21°15'26.80"N / 73°34'7.03"E	mn T	0.7	0.6	0.7	0.7	0.8	0.8	0.9
2	Fly Ash		Ukai TPP	Terminal 4	Cement plants (Surat, Saurashtra)	n/a			0.5	0.3	0.3	0.3	0.3	0.3	0.4
								Total	**1.2**	**0.9**	**0.9**	**1.0**	**1.1**	**1.2**	**1.3**

15.2.5 Presentation of Forecast

Sr. No	Name of Cargo	Type of Cargo	Origin	Final Destination	Unit p.a	Fy-18	Fy 28	Fy 29	Fy 30	Fy 35	Fy 40	Fy 45
Existing Jetty (Fully developed, Capacity attained hence difficult to handle any other traffic, therefore arises need for new terminal)												
Proposed Terminal 3 Opportunity for IWAI												
1	SBM	General/Other	Ruchi Soya, (2B)	Export market (via Kandla, Bedi, etc.)	mn T - km	0	3	3	3	6	10	18
	Total					**0**	**3**	**3**	**3**	**6**	**10**	**18**
Proposed Terminal 4 Opportunity for IWAI												
1	Coal	Bulk	Hazira Port	Ukai TPP	mn T - km	88	82	85	87	95	104	113
2	Fly Ash		Ukai TPP	Cement plants (Surat, Saurashtra)		63	32	33	33	38	43	50
	Total					**151**	**113**	**118**	**120**	**133**	**147**	**164**

15.2.6 Market Success Factors

15.2.6.1 Fairway availability

- Fairway development up to Ukai TPP (134.6 km chainage) will have to be developed by IWAI to maintain navigable conditions.
- Coal import for Ukai will be a regular movement, followed by occasional fly ash traffic as return cargo.
    - Chainage for movement of SBM from other terminals will fall into this 134.6-km chainage.
    - Clinker movement is uncertain and speculative at best in the current scenario.
    - River Tapi could be utilized for SBM for one or two shipments of SBM every month for the better part of the forecast period.

Reliable waterway transportation with adequate depth and other navigable conditions is imperative for Ukai TPP to operate. Hence, it behoves IWAI to ensure smooth flow of cargo across the 134.6 km chainage.

.

15.2.6.2 Vessel types

Following table shows recommended class of vessels and their specifications that could be deployed on River Tapi.

Terminals	Type - Capacity	Annual Barge Capacity	Fleet capacity (No. of Barges)					Loading Point	Discharge Point
		mn Tonnes	FY28	FY30	FY35	FY40	FY45		
Terminal 4 (No ballast)	Class III - 500 DWT	2.69	28	28	28	28	28	Hazira Anchorage	Terminal 4
	Class IV - 1,000 DWT	2.81	15	15	15	15	15		
	Class VI - 2,000 DWT	2.94	9	9	9	9	9		
Terminal 4 (One way ballast)	Class III - 500 DWT	2.66	35	35	35	35	35	Hazira Anchorage	Terminal 4
	Class IV - 1,000 DWT	2.77	19	19	19	19	19		
	Class VI - 2,000 DWT	2.85	12	12	12	12	12		

The total number of vessels required per vessel type varies based on traffic projections estimated for above terminals. No-ballast computation in case of Terminal 4 has been considered because of the availability of return cargo (fly ash) at the Terminal.

The number of barges would have to be deployed considering 9 days unloading schedule of cargo from mother vessel. The 9 days unloading schedule of mother vessel leads to 28 barges in class-III category, 15 barges in class - IV category and 9 barges in Class VI category. The total annual capacity of transporting coal from anchorage to Terminal 4 would be 2.69 mn tonnes, 2.81 mn tonnes and 2.94 mn tonnes respectively in each of the selected class. The maximum cargo traffic potential in the stretch for terminal 4 is 0.9 mn tonnes in Fy-45. This is less than the total annual coal transportation capacity of barges. Hence, the number of barges deployed in the region would remain same.

.

15.2.7 Complementary investment

IWAI is only required to develop fairway, construct the terminals, and install the necessary handling facilities at these terminals. Specific to connectivity, there's road connecting Terminal 4 to Ukai TPP. Similarly, KRIBHCO is already using the jetty for cargo movement, meaning there's road connectivity between the plant and the jetty. This same route could be utilized by Ruchi Soya for last mile-connectivity. There's also a rail siding near the jetty, for Ruchi Soya to unload SBM arriving from Madhya Pradesh.

15.2.8 Forecasting Methodology

For cargo currently moved on road and rail, the volume and logistics cost between the designated O-D was ascertained. Analysis revealed cargo potential, and justification to attract some share of the existing cargo movement.

Similar line of approach was applied for new companies that could utilize the proposed waterway. Probable volume and conditions for committing to the proposed waterway was determined by interviewing these companies.

Coal -Ukai TPP hasn't announced any expansion plans for the near future. Hence, traffic projection assumes the current coal requirement of 4.5 mn T constant for the entire projected period. Most power plants adhere to the advised blend ratio of 30:70 in favour of domestic coal. For this purpose, the traffic projections assumes import share increasing at regular intervals, peaking at 20% in FY45. The plant's import share will be 10% for the first 10 years since FY28. This share is then assumed to increase to 20% by Fy 45.

Fly Ash-A modest volume of 0.2 mn T of the unutilized share is assumed for projection purposes. It's estimated that the company will ship this volume to cement plants in and around Surat using River Tapi. It's also assumed that the plant would gradually shift to waterway to distribute the share of fly ash it currently is able to utilize and distribute locally by other modes.

SBM-Projection for SBM is based on the assumption that SBM exports will be resumed by companies that once utilized Magdalla. It's also assumed that a small share of cargo, currently dispatched to Kandla Port on rail, might come to this terminal. By FY45, it's assumed that Terminal 3 will handle 0.8 mn T of SBM.

15.3 Project Costing Template

15.3.1 Capital Cost (Phase 1)

A	Capital Cost	In Crores
	(I) Civil Cost	
(A)	Fairway Development Cost	
	Navigation Locks	0.00
	Bank Protection	0.00
	Demolition & Reconstruction of bridges	0.00
	Total	0.00
	3% Contingencies and 7% Supervision charges on Base cost	0.00
	Total Fairway Development Cost	**0.00**
(B)	Terminal Cost	
	Dumas Tourist terminal ***(70m x 5m)***	3.30
	Chowk Bazar Tourist Terminal ***(70m x 5m)***	3.30
	Storage Area(Land acquisition, Including roads, warehouse, parking area etc)	24.50
	Total Cost(I)	31.10
	3% Contingencies and 7% Supervision charges on Base cost	3.11
	Total Civil Cost	**34.21**
(C)	**(II) Navigation & Communication Cost**	
	Marine Lantern/Buyos (10 nos.)	0.20
	RIS	4.35
	Total Cost(II)	4.55
	3% Contingencies and 7% Supervision charges on Base cost	0.45
	Total Navigation & Communication Cost	5.00
(IV)	**(III) Handling Equipment & Utilities**	
	Mechanical & electrical	2.0
	3% Contingencies and 7% Supervision charges on Base cost	0.20
	Total Handling Equipment & Utilities Cost	**2.20**
(V)	Other cost including financing cost and interest during construction (10% of (I)	3.42
	Total Cost ((I)+(II)+(III)	**44.83**
	(IV) Dredging	
(A)	Dredging **(0.31 Mm3)**	**9.36**
	Total Cost	
	Total Capital Cost	**54.19**

15.3.2 Capital Cost (Phase 2)

A	Capital Cost	In Crores
	(I) Civil Cost	
(I)	Fairway Development Cost	
	Navigation Locks	180.00
	Construction of Barrages ***(2 Nos)***	700.00
	Demolition & Reconstruction of bridges ***(16-Bridges)***	834.48
	Total	1714.48
	3% Contingencies and 7% Supervision charges on Base cost	171.45
	Total Fairway Development Cost	**1885.93**
(II)	Terminal Cost	
	*Ukai Cargo Terminal (**100m x 15m)***	22.00
	*KRIBHCO TERMINAL**(100m x 15m)***	22.00
	Storage Area(Including roads, warehouse, parking area etc)	49.00
	Total Cost(I)	93.00
	3% Contingencies and 7% Supervision charges on Base cost	9.30
	Total Civil Cost	**102.30**
	(III) Navigation & Communication Cost	
(A)	DGPS	1.00
(B)	VTMS	1.00
(C)	Marine Lantern/Buyos (48 nos.)	0.96
(D)	RIS	4.35
	Total Cost(II)	7.31
	3% Contingencies and 7% Supervision charges on Base cost	0.73
	Total Navigation & Communication Cost	8.04
(IV)	**(III) Handling Equipment & Utilities**	
	Mechanical & electrical	22.2
	3% Contingencies and 7% Supervision charges on Base cost	2.22
	Total Handling Equipment & Utilities Cost	**24.42**
(V)	Other cost including financing cost and interest during construction (10% of (I)	10.23
	Total Cost ((I)+(II)+(III)	**2030.92**
	(IV) Dredging	
(A)	Dredging **(2.0 Mm3)**	**60.00**
	Total Capital Cost	**2090.92**

15.3.3 Operation & Maintenance Cost (Phase 1)

II	O & M Cost	In Crores
(i)	Dredging @ 10%	0.94
(ii)	Civil works @ 1%	0.34
(iii)	Mechanical & Electrical Cost @ 5%	0.11
(iv)	Ports Crafts/Nav. Aids @ 5%	0.25
(v)	Fuel Cost	1.00
(vi)	Power Cost	2.00
(vii)	Manpower Cost	5.50
(viii)	Miscellaneous	0.50
	Total	**10.64**

15.3.4 Operation & Maintenance Cost (Phase 2)

II	O & M Cost	In Crores
(i)	Dredging @ 10%	6.00
(ii)	Civil works @ 1%	19.88
(iii)	Mechanical & Electrical Cost @ 5%	1.221
(iv)	Ports Crafts/Nav. Aids @ 5%	0.40
(v)	Fuel Cost	2.00
(vi)	Power Cost	4.00
(vii)	Manpower Cost	2.74
(viii)	Miscellaneous	0.5
	Total II	**36.75**

15.3.5 Recurrent Cost

Mechanical & Electrical cost will be recurrent cost. Details of recurrent cost is mentioned below:

Phase 1

item	Cost in crores
Mechanical & electrical	2.00
3% Contingencies and 7% Supervision charges on Base cost	0.20
Total Handling Equipment & Utilities Cost	**2.2**

Phase 2

item	Cost in crores
Mechanical & electrical	22.2
3% Contingencies and 7% Supervision charges on Base cost	2.22
Total Handling Equipment & Utilities Cost	**24.42**

15.3.4 Cost Verification

Gujarat Maritime Board Schedule of Rate, 2013-14 has been followed and escalated by 5% per annum to arrive at for year 2018 to arrive at the cost of the project. For dredging (2015-16) rates has been considered as substantial change has not been observed.

In annexures of chapter 11, reference of rates has been provided in to reach realistic overall cost.

15.4 Financial Evaluation Template

Template 15.4.1: FIRR, Revenue and Sensitivity Analysis

Year	Year	Capital cost	Annual O & M Cost	Total Cost	Total Revenue	Net Cash Flow	SENSITIVITY ANALYSIS					
							Cap. Cost (+) 10%	Cap. Cost (-) 10%	ANNUAL O &M COST (+) 10%	ANNUAL O &M COST (-) 10%	REVENUE (+) 10%	REVENUE (-) 10%
	1	2	3	4 = (2+3)	5	6= (5-2)	10	11	12	13	14	15
1	2019	38	0	38	0.00	-38	-42	-34	-38	-38	-38	-38
2	2020	16	0	16	0.00	-16	-18	-15	-16	-16	-16	-16
3	2021		10.4	10.4	14.87	4	0	0	4	4	4	4
4	2022		10.7	10.7	14.87	4	4	4	3	5	6	3
5	2023		11.0	11.0	14.87	4	4	4	3	5	5	2
6	2024		11.4	11.4	14.87	4	4	4	2	5	5	2
7	2025		11.7	11.7	18.12	6	6	6	5	8	8	5
8	2026		12.1	12.1	18.12	6	6	6	5	7	8	4
9	2027		12.4	12.4	18.12	6	6	6	4	7	8	4
10	2028		12.8	12.8	18.12	5	5	5	4	7	7	4
11	2029		13.2	13.2	18.12	5	5	5	4	6	7	3
12	2030	2	13.6	15.8	23.57	8	8	8	6	9	10	5
13	2031		14.0	14.0	23.57	10	10	10	8	11	12	7
14	2032		14.4	14.4	23.57	9	9	9	8	11	12	7
15	2033		14.8	14.8	23.57	9	9	9	7	10	11	6
16	2034		15.3	15.3	23.57	8	8	8	7	10	11	6
17	2035		15.7	15.7	29.21	13	13	13	12	15	16	11
18	2036		16.2	16.2	29.21	13	13	13	11	15	16	10
19	2037		16.7	16.7	29.21	13	13	13	11	14	15	10

Year	Year	Capital cost	Annual O & M Cost	Total Cost	Total Revenue	Net Cash Flow	SENSITIVITY ANALYSIS					
							Cap. Cost (+) 10%	Cap. Cost (-) 10%	ANNUAL O &M COST (+) 10%	ANNUAL O &M COST (-) 10%	REVENUE (+) 10%	REVENUE (-) 10%
20	2038		17.2	17.2	29.21	12	12	12	10	14	15	9
21	2039		17.7	17.7	29.21	12	12	12	10	13	14	9
22	2040	2	18.2	20.4	35.55	15	15	15	13	17	19	12
23	2041		18.8	18.8	35.55	17	17	17	15	19	20	13
24	2042		19.3	19.3	35.55	16	16	16	14	18	20	13
25	2043		19.9	19.9	35.55	16	16	16	14	18	19	12
26	2044		20.5	20.5	35.55	15	15	15	13	17	19	11
27	2045		21.1	21.1	44.27	23	23	23	21	25	28	19
28	2046		21.8	21.8	44.27	22	22	22	20	25	27	18
29	2047		22.4	22.4	44.27	22	22	22	20	24	26	17
30	2048		23.1	23.1	44.27	21	21	21	19	23	26	17
	Total	**59**	**446**	**505**								
IRR(%)						**11.76%**	**10.40%**	**12.05%**	**10.21%**	**13.22%**	**13.97%**	**9.26%**
NPV@ discount factor 9% in Cr.						**Rs. 19.01**	**Rs. 10.71**	**Rs. 20.41**	**Rs. 8.10**	**Rs. 29.92**	**Rs. 36.32**	**Rs. 1.69**

ANNEXURE 6.1 Berthing Force

Design Vessel	Displacement Tonnage	L_{OA} (m)	L_{PP} (m)	Beam (m)	Draft (m)
Class-VII	**4000**	**86**	**86**	**14**	**2.9**

1) Kinetic Energy, E imparted to Fendering System

$E = M_D V_b^2 (C_m C_e C_s C_c)/2$

W_D	Displacement Tonnage (DT) of the vessel, (t)
V_b	Velocity of vessel in m/s, normal to the berth
C_m	Mass coefficient
C_e	Eccentricity coefficient
C_s	Softness coefficient
C_c	Configuratinal Coefficient

a) Displacement Tonnage, W_D (Tonnes) 4000 t

b) Approach Velocity (m/s) 0.20 m/s

Choose Site Condition - Berthing Condition from the following menu:

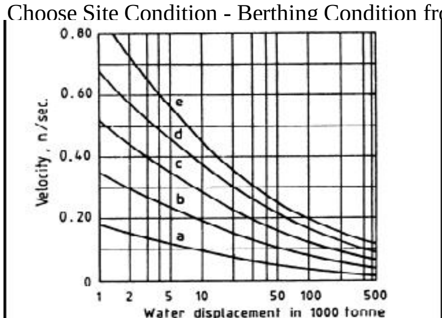


Figure 1 — Design berthing velocity as function of navigation conditions and size of vessel (Brolsma et al, 1977)

a) Good berthing, sheltered.
b) Difficult berthing, sheltered.
c) Easy berthing, exposed.
d) Good berthing, exposed.
e) Navigation conditions difficult, exposed.

c) Mass Coefficient Cm = 1.41

=

Unit Weight of sea water (g_w) = 1.0026 t/m^3

Cm = 1+ 2D/B =

d) Eccentricity Coefficient Ce = **0.60**

e) Softness Coefficient Cs = **1.00**

Kinetic energy, E = = (4000*(0.2^2)*1.41428571428571*0.6*1/(2*9.81)

= 6.92 **t-m**

Factor of safety = 1.4

Kinetic Energy, E imparted to a fendering system = **9.688** **t-m**

= **96.88** **kN*m**

According to this Kinetic energy following fender has been assumed

G2 grade of MCS 2000

Type of Fender	=	**MCS 400 Cell Fender**	
Energy Absorption	=	**21.60**	kN*m
Reaction Force	=	**129**	kN

Annexure 6.2 Analysis Of Mooring Force Due To Wind And Current

Class-VII Vessel

Design Vessel	Displacement Tonnage	L_{OA} (m)	L_{PP} (m)	Beam (m)	Draft (m) D_R
Vikrant	4,000	86.0	86.0	14.0	2.9

1) Mooring Force due to Wind:

Mooring Force due to wind: $F_w = C_w A_w P$

C_w	=	Shape Factor
	=	1.5
L_{pp}	=	Length between the perpendiculars in m
	=	86.0
D_R	=	Loaded draft in m
	=	2.9
D_M	=	Moulded depth in m
	=	3.9
	=	3.9 m
D_L/D_M	=	58%
	=	3.9 * 0.575
	=	2.2425
A_w	=	Windage area in sq. m
	=	$1.175\ L_p\ (D_M - D_L)$
	=	1.175 * 86 * (3.9 - 2.2425)
	=	167.49 m^2
V z	=	Design normal wind speed in m/s
	=	50.0
P_w	=	$0.06\ V^2$
	=	0.06 * (50 ^ 2)
	=	150

Mooring Force due to wind: **F_w (kg)** **=** 37,685.33

F_w (T) = **37.7**

F_w (kN) = **376.85**

2) Mooring Force due to Current:

Pressure due to current: $P_c = g_w V^2 / 2g$

where,

P_c =	Pressure due to current in kg/sq.m	=	18.8
g_w =	Unit weight of water in kg/cu.m	=	1025
V =	Current velocity in m/s	=	0.60
g =	Acceleration due to gravity in m/s^2	=	9.81

Mooring force due to current: $F_c = L_{pp} D_r P_c$

where,

F_c =	Mooring Force due to current in kg		
L_{pp} =	Length between the perpendiculars in m	=	86.0
D_R =	Loaded draft of vessel in m	=	2.9
Pc =	Pressure due to current in kg/sq.m (as explained abo	=	18.8

Mooring Force due to current:	**F_c (kg)**	4690.55
	F_c (T)	**4.7**

Assuming that the mooring force due to current and wind act simultaneously in the same direction, Total Mooring Force (T)	**42.4**

The total force can be assumed to be equally distributed to three bollards if the ship is moored to eight bollards

Force on each Bollard	(T)	**14.13**

Highest of the two above calculated mooring forces for coal and container vessel is 135.5 T per bollard. Hence 150 T Bollard Pull is adopted.

MARINETEK INDIA

To,
Reshu Verma
WABCOS
Gurgaon

03 November 2017

Dear Ms Verma,

Our ref: Floating Tourist Jetty

Further to our recent discussion we take pleasure in submitting this proposal for a state-of-the-art floating tourist jetty at an undisclosed location as per your request. To facilitate our calculations we have assumed the site to be in a tidal creek with a silt riverbed located within 200 kms of Bombay. We have also assumed the site to have an existing concrete quay wall or other form of bankseat to secure the shore end of the gangway.

1. Introduction to Marinetek

The Marinetek Group is one of the world's largest designers, manufacturers, and installers of floating jetty systems. We have undertaken more than 2,000 top reference projects in 40 countries. Please see details on the Group website www.marinetekgroup.com

We enclose our Marinetek India brochure.

For your project the pontoons will be manufactured in at our production facility near Bombay and transported to your location by road.

2. Description of the Floating Jetty

We propose to supply our Premier all-concrete pontoons for your project; please see enclosed data sheet.

We propose a Type 1 jetty comprising 3No. pontoons, as shown on the enclosed drawings at Fig. 1.

The freeboard of the pontoon will be approx 0.5m. This freeboard is the international standard, and it has proved ideal for the embarkation and disembarkation of passengers. This is well illustrated in Fig. 2.

The jetty will be positioned approximately as shown on the Google Earth image enclosed as Fig. 3. However, we can adjust the location as you may require.

We will fit 150mm D-rubber fender along the berthing face of the pontoon. This fender will be secured to stainless steel cast-in sockets.

We will fit 6No. 5t capacity stainless steel twin-post mooring bollards along the 24m long berthing face, and 3No. to the rear berthing face, and 2No. on the gangway landing pontoon.

We have not at this stage quoted for guardrails or any MEP (mechanical, electrical and plumbing) on the jetty but this can be arranged, if you wish.

We have allowed for a solar-powered, double fixed-red navigation light on the jetty. This would be in accordance with IALA Regulations.

3. Advantages of Marinetek Floating Jetties

Marinetek floating jetties offer many very positive features, including:

a) They are genuinely unsinkable by virtue of their core of closed-cell foam. Unlike with steel or plastic pontoons, there are no compartments that may leak and cause them to sink.

b) The concrete deck of the pontoon is highly anti-slip, even in the pouring rain.

c) The pontoon has a design life of 50 years in normal use, with essentially zero maintenance. Unlike with a steel pontoon there is no need to regularly chip and paint, or to have a dry-docking every couple of years (as often required by insurers). And unlike with plastic pontoons, the sun's UV rays have no effect.

d) The heavy mass of the Type 1 floating jetty (about 47 tons) means that it will barely move under the weight of passengers or from waves in the river. This lack of movement ensures that passengers and tourists are safe and feel happy.

4. Gangway

The floating jetty will be accessed by a gangway fabricated of marine-grade aluminium. This aluminium is corrosion-free which means it is maintenance free. It will be designed for a live-loading of 4KPa, in accordance with international standards. The deck will be of fibre-reinforced plastic (FRP) panels with an anti-slip gritted surface.

Subject to a further site inspection and confirmation of the precise location for the jetty, we have allowed for a gangway of 10m length and 1.5m width.

Certain accessories and enhancements are available for a small additional cost. For example:

- Handrails with integral LED down-lighting.
- Painting of the gangway in your corporate colours.
- Display panels along both sides of the gangway.

5. Moorings

For your project, we propose to secure the floating jetty in position with mooring chains. This means that there will be no "construction" in the river or on the riverbed and therefore (to the best of our knowledge and understanding) there will be no conflict with the CRZ Law and no need to seek clearance from the environmental authorities.

Please note that the moorings should be checked once every two years by an engineering diver. We also recommend that sacrificial anodes on the chain be renewed as and when required.

6. Client Supply Items

Our price is based on you being responsible for the following:

- A bathymetric survey adequate for the mooring design.
- All permissions needed to install and operate the pontoon system.
- Providing free and clear access to the site for our trucks and mobile crane.

7. Price & Terms of Payment

Our lump-sum contract price will be **INR 98,00,000/-** (Rupees Ninety Eight Lacs), plus relevant taxes.

For the avoidance of doubt this price includes:

- Manufacturing and transporting the pontoons.
- Fabricating and transporting the gangway.
- Procuring and transporting the moorings.
- Laying the moorings, launching the pontoons, and connecting-up.
- Installing the gangway.

This jetty will be manufactured exclusively for your project, and therefore our terms of payment shall be:

a) An advance payment of 40% of the above lump-sum price.

b) An interim payment of 30% when the 3No. pontoons have been completed but before they are dispatched from our yard.

c) An interim payment of 20% when the gangway has been completed but before it is dispatched from our yard.

d) The balance within 14 days of the jetty and gangway installation having been completed.

For each, (a) to (d) above, the amounts shall have relevant taxes added.

8. Terms & Conditions

This offer is subject to the following.

a) Ownership of the floating jetty shall remain vested in Marinetek until all payments have been made to us. Until such time as we have received the final payment, the jetty may not be used unless with our prior permission given in writing.

b) All Intellectual Property Rights relating to the pontoon shall remain the exclusive property of Marinetek. You acknowledge the distinctiveness, validity, originality, value, goodwill and sole ownership by Marinetek of these Intellectual Property Rights.

c) Any dispute arising out of or relating to the performance, validity, or termination of the contract that arises from this offer and the commercial consequences thereof, shall be finally settled by arbitration in accordance with the Arbitration Rules of the Mumbai Chamber of Commerce then in effect, and the provisions of the Arbitration and Conciliation Act 1996 shall apply. The arbitration shall take place in Mumbai and the proceedings shall be conducted, and the award shall be rendered in the English language. There shall be one arbitrator. The arbitration award shall be final and binding on both Parties and not subject to any appeal.

d) The price in this offer is valid for 60 days unless previously withdrawn.

I trust that this offer will meet with your approval. Please do not hesitate to contact me for any further information, or to let me know if I have misunderstood any of your requirements.

Yours faithfully,

By email - no signature

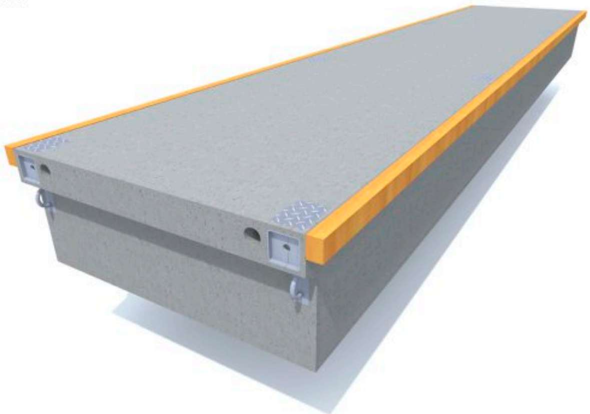
Gautama Dutta
Managing Director

Enc. Marinetek India brochure

PREMIER M2712PE M2716PE M2720PE M3312PE M3316PE M3320PE

Premier Pontoons 2700, 3300

Based on the world famous Marinetek breakwaters, the completely new **Premier Pontoon** range represents the latest technology in concrete pontoon construction. All units can be provided with integral top entry service channels. As with all Marinetek concrete systems these are of exceptionally strong construction with continuous floatation providing a high loading capacity with higher freeboard for large boat marinas. Premier pontoons can be moored by piles, chain or Seaflex.



TECHNICAL DATA

Concrete strength: 45 N/mm^2 steel reinforced plastic fibre concrete. Exposure class according to European EN 206-1 standard

Core: Expanded polystyrene, density 15 kg/m^3

Reinforcement: Partly or fully hot dip galvanised or stainless steel

Optional accessories: Wooden deck, fixing rails, cable ducts, service channels (240x120 mm) and fenders (timber or wood plastic composite)

FLOATS	M2712PE	M2716PE	M2720PE	M3312PE	M3316PE	M3320PE
Length (m)	12,20	16,05	19,90	12,20	16,05	19,90
Width with fenders (m)	2,7	2,7	2,7	3,3	3,3	3,3
Concrete width (m)	2,4	2,4	2,4	3,0	3,0	3,0
Weight (t)	12,5	16,5	20,6	15,6	20,7	25,7
Height (m)	1,0	1,0	1,0	1,0	1,0	1,0
Net capacity (kN/m^2)	5,6	5,6	5,6	5,6	5,6	5,6
Freeboard (m)	0,56	0,56	0,56	0,56	0,56	0,56
Strenght of joint (kN)	2x322	2x322	2x322	2x322	2x322	2x322
Joint gap (mm)	35	35	35	35	35	35

Exact unit weight and freeboard are subjects to detailed specification of the unit, equipment and mooring methods. Shown numbers are for standard and unloaded units.

Marinetek operates a policy of continuous development and reserves the right to change specifications without notice.

Modification date: 14.11.2014

ISO 14001 DNV CERTIFIED ORGANISATION

ISO 9001 DNV CERTIFIED ORGANISATION

FI

MARINETEK GROUP OY

Vattuniemenkatu 3
FI-00210 Helsinki
www.marinetek.net

TEL. +358 (0)9 682 4100
FAX +358 (0)9 682 41030
EMAIL info@marinetek.net

MARINETEK

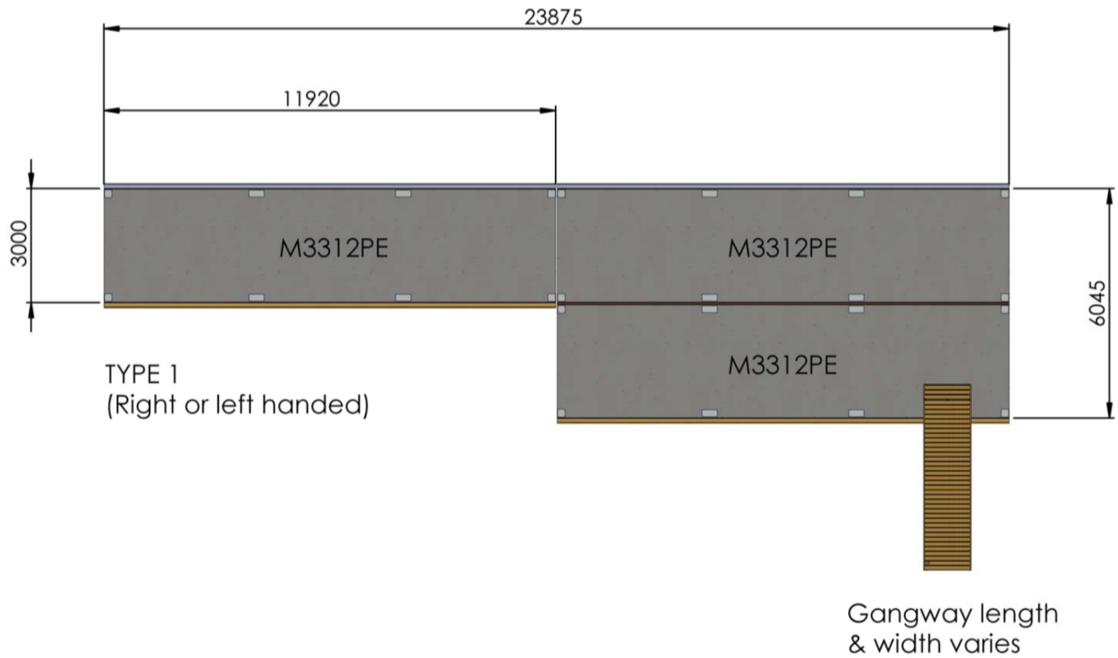

23875
11920
3000
M3312PE
M3312PE
M3312PE
6045
TYPE 1
(Right or left handed)
Gangway length
& width varies

Fig. 1

Fig. 2

Fig. 2

Schematic Layout of Type 1 Floating Jetty

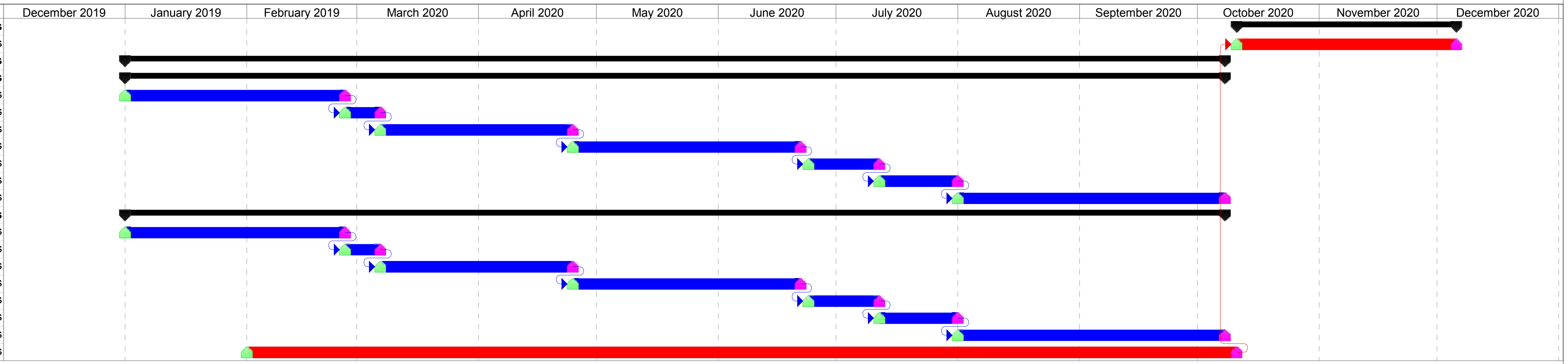
MARINETEK INDIA

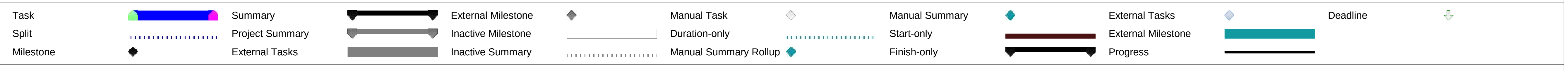
Fig. 3

Annexure. 12.1: Time Schedule

Time Frame-Tapi River (Phase-1)

ID	Task Name	Duration
1	**6.3 Navigation Aids**	**40 days**
2	Marine Lantern	40 days
3	**6.4 Terminals**	**200 days**
4	**Terminal 1: Dumas**	**200 days**
5	Submission of Detailed Engineering Drawing & Metl	40 days
6	Pre-dispatch third party inspection	7 days
7	Supply of Primary units(Float)	35 days
8	Onsite Inspection of supplied unit	42 days
9	Installation of Gangway	14 days
10	Installation of Jetty along with Accessories	14 days
11	Testing, commissioning & trial	48 days
12	**Terminal 2: Old Fort Jetty**	**200 days**
13	Submission of Detailed Engineering Drawing & Metl	40 days
14	Pre-dispatch third party inspection	7 days
15	Supply of Primary units(Float)	35 days
16	Onsite Inspection of supplied unit	42 days
17	Installation of Gangway	14 days
18	Installation of Jetty along with Accessories	14 days
19	Testing, commissioning & trial	48 days
20	Dredging	180 days





Chapter – 11

PROJECT COSTING

ANNEXURES

Annexure 11.1 Cost estimate for dredging

Phase: 1

Dredging					
Sr No	**Description**	**Quantity**	**Unit**	**Rate**	**Amount**
1.00	Dredging by dredger in creek / channel / infront of wharf / Jetty etc. in rocky strata including disposal of materials on shore for a lead up to 1000 m and all lift (Including tidal condition).	311,990.38	M^3	300.00	93,597,114.00
	TOTAL AMOUNT =				**93597114**

Phase: 2

Dredging					
Sr No	**Description**	**Quantity**	**Unit**	**Rate**	**Amount**
1.00	Dredging by dredger in creek / channel / infront of wharf / Jetty etc. in rocky strata including disposal of materials on shore for a lead up to 1000 m and all lift (Including tidal condition).	2,000,000.00	M^3	300.00	600,000,000.00
	TOTAL AMOUNT =				**600000000**

Annexure 11.2 Cost estimate for Jetty

Sr No	Reference	Description	Qty	Unit	Rate	Amount
1	Ch. 1 Para 1.2 - 6	Mobilisation of plants and equipment to site for installation of bored cast-in-situ pile(600mm dia) Dembolisation of plant and equipment after piling	1.00	Job	0.05	10613230.47
2	GMB SOR Sr. No. 27014 Page No. 196	Providing , fabricating and delivering to the site 6 mm thick M .S. plate liners of specified diameter for bore piles , including cost of material , welding, labour and transportation etc. complete	619.92	Tonne	103493.79	64157737.80
3	GMB SOR Sr. No. 27015 Page No. 196	Driving of steel liners for cast in situ bore piles upto specified depth including pitching of liners using GPS, welding, jointing etc. using pile driving rig and other mechanical equipments , cutting down extra length not required etc .complete	3508.80	m	976.05	3424769.57
4	GMB SOR Sr. No. 27018 Page No. 197	Boring in all sorts of soil including boulders but other than rock using hydraulic piling rig with supporting equipment and removal of excavated earth with all lifts and lead upto 1000m including shifting of piling rig from one bore location to another etc . Complete - 600 mm dia piles.	3508.80	RM	2454.11	8610971.06

Sr No	Reference	Description	Qty	Unit	Rate	Amount
5	GMB SOR Sr. No. 5018 Page No. 37	Supplying, bending, hooking and binding thermomechanically treated (TMT) corrosion resistant Fe-415 grade bar reinforcement including placing in position etc. complete upto floor two level.	962208.00	Kg	98.57	94840031.52
6	GMB SOR Sr. No. 8010 Page No. 64	Conducting standard penetration test at requiredintervals	33.00	No.	243.10	8022.34
7	DSR Code No.. 7247 Page No. 201	Pile load test on single vertical pile (initial load test on test pile or routine load test on working pile) in accordance with IS:2911 (part-IV) or load testing on wells as directed.	2.00	per test	48984.90	97969.80
8	GMB SOR Sr. No. 27027 Page No.198	Providing and laying design mix cement concrete M40 grade using minimum cement 478 kg/cum and graded crushed stone aggregates 20 mm nominal maximum size , for RCC bored cast -in- situ piles excluding the cost of reinforcement but including lowering of reinforcement while concreting and using tremie pipe all as perdrawing and technical specifications.	3969.00	Cum	8371.19	33225259.24

Sr No	Reference	Description	Qty	Unit	Rate	Amount
9	GMB SOR Sr. No. 27034 Page No.200	Providing and laying cast -in-situ design mix cement concrete M -40 grade using minimum cement 435 kg/cum and graded crushed stone aggregates 20 mm nominal maximum size for RCC slab, wearing coat etc . of RCC jetty or such other structure using vibrator , including nominal side formwork but excluding the cost of bottom formwork and reinforcement as per drawing and technical specifications. - Pile Caps	23.80	Cum	9289.51	221090.26
10	GMB SOR Sr. No. 27040 Page No.201	Providing and laying cast -in-situ design mix cement concrete M -40 grade using minimum cement 435 kg/cum and graded crushed stone aggregates 20 mm nominal maximum size for RCC slab, wearing coat etc . of RCC jetty or such other structure using vibrator , including nominal side formwork but excluding the cost of bottom formwork and reinforcement as per drawing and technical specifications.- Deck Slab	525.00	Cum	7880.13	4137066.68

Sr No	Reference	Description	Qty	Unit	Rate	Amount
11	GMB SOR Sr. No. 27040 Page No.201	Providing and laying cast -in-situ design mixcement concrete M -40 grade using minimumcement 435 kg/cum and graded crushed stoneaggregates 20 mm nominal maximum size forRCC slab, wearing coat etc . of RCC jetty or suchother structure using vibrator , including nominalside formwork but excluding the cost of bottomformwork and reinforcement as per drawing andtechnical specifications.-Beams	236.00	Cum	7880.13	1859709.98
12	GMB SOR Sr. No. 27040 Page No.201	Providing and laying cast -in-situ design mix cement concrete M -40 grade using minimum cement 435 kg/cum and graded crushed stone aggregates 20 mm nominal maximum size for RCC slab, wearing coat etc . of RCC jetty or such other structure using vibrator , including nominal side formwork but excluding the cost of bottom formwork and reinforcement as per drawing and technical specifications. - Wearing Coat	150.00	Cum	7880.13	1182019.05
13	GMB SOR Sr. No. 27055 Page No.204	Supplying and Fixing CI Bollards all as per design/type as shown in the drawing excluding the cost of bolts, nuts, washers etc. complete including two coats of paint over one coat of red lead paint.	14.00	q	12954.26	181359.61

Sr No	Reference	Description	Qty	Unit	Rate	Amount
14	GMB SOR Sr. No. 27079 Page No.209	Manufacture and Supply of "CELL" type fenders of size 400 H, weighing approximately 75 kgs at site and installing the same on dock wall at all levels upto low water as shown in the drawing oras directed including cost of all materials , SS (non magnetic) anchor bolts of size 22 mm, transportation, testing of materials , drilling of hole , anchoring fixtures using mechanical /chemical anchors as per design etc.complete.	7.00	nos	45514.63	318602.42
		Total (Ex. Mob Demob)				212264609.33
					Total Cost	**222877839.80**

Annexure 11.3 Cost estimate for Navigational Lock

NAVIGATIONAL LOCKS						
Sr No	**Reference**	**Description**	**Qty**	**Unit**	**Rate (Rs.)**	**Amount (in Rs)**
1	GMB SOR Sr. No.250140 Page No.174	Clearing the land by uprooting rank vegetation, grass, bushes, shrubs, saplings and trees girth upto 300mm, and disposal upto 1 km. including all labour,tools & plants etc complete.	20000	Sqm	5.56	111132
2 i	GMB SOR Sr. No. 40040 Page No. 27	Excavation for foundation upto 1.5m depth including sorting out and stacking of useful materials and disposing of the excavated stuff upto 50 metre lead. (D) Soft rock not requiring blasting (up to 1.5 M depth)	31500	Cum	217.87	6862748.29
ii	GMB SOR Sr. No. 40090 Page No.27	(1.5 to 3.0 M depth)	31500	Cum	236.39	7446191.29
iii	GMB SOR Sr. No. 40140 Page No. 28	(3.0 to 5 M depth)	42000	Cum	301.21	12650989.05
3		Consolidation grouting				
a)		Consolidation grouting of foundation area by drilling holes at the rate of 1 hole per 3 sq.m area, minimum depth 5 m area and	8000	m	700	5600000

NAVIGATIONAL LOCKS						
Sr No	Reference	Description	Qty	Unit	Rate (Rs.)	Amount (in Rs)
		grouting with cement slurry				
b)		Grouting	12000	Bags	500	6000000
4		M-30 concrete in Pier and Side walls	28900	Cum	6880	198832000
5	GMB SOR Sr. No. 26058 Page No. 187	Cement Concrete M20 grade of specified thickness in pavement using OPC grade 43 minimum @ 325 kg/cum and graded stone aggregates 25 mm nominal maximum size laid to required slope and camber in panels as required using mechanical mixer including admixture (super plasticizer) @ 0.4 % by weight of cement,formwork, vibrating, finishing, curing etc complete.	8370	Cum	5337.58	44675522.42
6	GMB SOR Sr. No. 5001 5.3.2 Page No. 35	Providing and Laying CC 1:3:6 (1 cement :3 coarse sand : 6 hand broken stone aggregate 40mm nominal size) and curing complete excluding cost of form work in. (A) Foundation and plinth	1800	Cum	3950.40	7110711.56

NAVIGATIONAL LOCKS						
Sr No	**Reference**	**Description**	**Qty**	**Unit**	**Rate (Rs.)**	**Amount (in Rs)**
7		Providing water stop @ 25m c/c	420	m	500	210000
8	GMB SOR Sr. No. 27054 Page No. 204	Bitumastic filler for joints	420	m	520.93	218791.13
9	GMB SOR Sr. No. Sr. No 5017 5.4.11 page 37	Reinforcement steel in R.C.C	1985.1	tonne	66794.96	132594680.1
10	GMB SOR Sr. No. 27054 Page No. 204	Providing and Laying filter media of specified thickness with granular material /stone crushed aggregates satisfying the requirements laid downin clause 2504.2.2 of MORT&H specifications with smaller size towards the soil and bigger size towards the wall and provided over the entire surface behind whaft wall , abutment, wing wall or return wall , including watering and compacting complete as per drawing and technical specifications	5625	Cum	1841.09	10356113.25
11		Providing swing bridge (2 Nos. x 15m clear span)	36	m	L.S	50
12		Fender	15	Nos	2000	30000

NAVIGATIONAL LOCKS						
Sr No	**Reference**	**Description**	**Qty**	**Unit**	**Rate (Rs.)**	**Amount (in Rs)**
13		Security Room (4 Nos) 3m x 3m each	20	Sqm	4000	80000
14		Lock operating room (2 nos) with operating panel 3m x 7m each	42	Sqm	4000	168000
15		Power Room (2 Nos) for battery with acid resistance tiles 3m x 4m each	24	Sqm	5000	120000
16		Stand by Generator Room (2 Nos) 5m x 3m each	30	Sqm	4000	120000
17		Store Room (2 Nos) 8m x 5m each	80	Sqm	4000	320000
19		Bollard	5	Nos	20000	100000
20		Mast	4	Nos	20000	80000
21		Fencing	250	m	200	50000
22		Lock Lighting Arrangement	L.S			1000000
23		Instrumentation	L.S			1500000
		Sub-total (1 to 23)				**446694910.7**
24		Dewatering at 2% of above cost				8933898.21
Total (Lakhs)						**4456.29**

Annexure 11.4 Cost estimate for Barrage

Sl. No	Reference	Description	Quantity	Unit	Rate (Rs.)	Amount (Rs.)
CIVIL WORKS						
1	GMB SOR Sr. No.4004, Page No.27	Excavation for foundation upto 1.5m depth including sorting out and stacking of useful materials and disposing of the excavated stuff upto 50 metre lead. (D) Soft rock not requiring blasting	55611	Cum	303.097982	16855581.88
2	GMB SOR Sr. No.4009, Page No.27	Excavation for foundation for depth from 1.5 m to 3.0 m including sorting out and stacking of useful materials and disposing of the excavated stuff upto 50m lead. (D) Soft rock not requiring blasting	55611	Cum	328.866142	18288575.02
3	GMB SOR Sr. No.4014, Page No.28	Excavation for foundation for depth from 3.0 m to 5.0 m including sorting out and stacking of useful materials and disposing of the excavated stuff upto 50 m lead. (D) Soft rock not requiring blasting	74148	Cum	419.054702	31072068.04
4	GMB SOR Sr. No.4019, Page No.29	Extra for additional depth more than 5.0m for excavation for foundation including sorting out and stacking of useful material disposing of the excavated stuff upto 50m lead. (D) Soft rock not requiring blasting	37074	Cum	444.822862	16491362.79
Total						82707587.73

Sl. No	Reference	Description	Quantity	Unit	Rate (Rs.)	Amount (Rs.)
5	GMB SOR Sr. No.26001, Page No.177	Earthwork for embankment including breaking clods dressing with all lead and lift and including watering rolling and consolidation of subgrade in layers at O.M.C. to required dry density including filling the depressions which occur during the process using power roller 8 T to 10 T. (A) From borrow pits within land width	386961.984	Cum	147.200614	56961041.64
6	GMB SOR Sr. No.26063, Page No.188	Providing land laying dry stone pitching on slopes using stones weighing not less than 40 kg. and stone spalls minimum 25 mm size to fill up voids between the stones, including preparing the surface etc. as per drawing and clause no. 2504 of MORT & H specification etc. complete (Filter layer below the stone pitching if any to be paid for separately).	213478.0	Cum	2235.82711	477300078.7
7	GMB SOR Sr. No.5031 5.8.1, Page No.38	Providing and Laying design mix concrete M25 using minimum cement 345 kg/cum, crushed stone aggregates 20 mm nominal maximum size and curing complete excluding the cost of form	5160	Cum	7321.37846	37778312.85

Sl. No	Reference	Description	Quantity	Unit	Rate (Rs.)	Amount (Rs.)
		work and reinforcement for reinforced concrete work in (A) Piers, Abutments, divide walls and wing walls				
7	GMB SOR Sr. No.5017, Page No.37	Providing HYSD bar reinforcement for RCC work including bending, binding and placing in position complete upto floor two level	811.152	tonne	92926.427	75377457.11
8	GMB SOR Sr. No.5031 5.8.1, Page No.38	Providing and Laying design mix concrete M25 using minimum cement 345 kg/cum, crushed stone aggregates 20 mm nominal maximum size and curing complete excluding the cost of form work and reinforcement for reinforced concrete work in (A) Foundations, footings, base of columns and mass concrete	204750.125	Cum	7321.37846	1499053155
8	GMB SOR Sr. No.5031 5.8.1, Page No.38	Providing and Laying design mix concrete M25 using minimum cement 345 kg/cum, crushed stone aggregates 20 mm nominal maximum size and curing complete excluding the cost of form work and reinforcement for reinforced concrete work in (A) Curtain walls on u/s and d/s of the work.	38850	Cum	7321.37846	284435553.2

Sl. No	Reference	Description	Quantity	Unit	Rate (Rs.)	Amount (Rs.)
Total						2,430,905,598.29
TOTAL						**2,513,613,186.02**
MECHANICAL WORKS						
		Gates			**Rates**	
1	1.4 Input rates Statement - 2 : Basic rates for materials	13 No. of Weirbays Gates(20m X 6m)	122.616	tonne	200000.00	24523200
2		5 No. of Undersluices Gates(20m X 10m)	78.6	tonne	200000.00	15720000
3		2 No. of Lock Gates(18m X 10m)	28.296	tonne	200000.00	5659200
4		Fabrication, installation, mouldingetc	20	per gate	6000000.00	120000000
Total						165902400
	Bridge RCC works					
1	GMB SOR Sr. No.5031, Page No.38	RCC works (M25) for slab thickness of 1.6m and clear roadwidth 7.5m	5967.36	Cum	7321.37846	43689300.97
2	GMB SOR Sr. No.5031, Page No.38	RCC works (M25) for Regulation plateform 1.2 m wide with 0.5 m thick slab	266.4	Cum	7321.37846	1950415.222
3	GMB SOR Sr. No.5017, Page No.37	Providing HYSD bar reinforcement for RCC work including bending, binding and placing in position complete upto floor two level	979.947072	Cum	92926.427	91062980.05
		Ramps of lenghth 50m on left & right bank of the bridge	600	Cum	6655.7986	3993479.16
3	GMB SOR Sr. No.5017, Page No.37	Railing, Hoist and regulation arrengements for gates & gearings		Lump sum		20000000
			Total			**160696175.4**
	Protection works					

Sl. No	Reference	Description	Quantity	Unit	Rate (Rs.)	Amount (Rs.)
1		Loose stones on both sides of weirbays, under sluiceways beyond curtain walls	40000	Cum	1600	64000000
2		Bajri between friction blocks	400	Cum	800	320000
3		Loose Gravel below blocks	1600	Cum	1600	2560000
4		Filter under friction blocks of barrage bays & undersluices ways	4000	Cum	1520	6080000
5	GMB SOR Sr.No.26058, Page No.187	50 No of Cement Concre Blocks (M20)	250	Cum	7426	1856435
Total						74816435
						2,915,028,196.30
Unforeseen works			20% of Total			583,005,639.26
					Total	3,498,033,835.55
						Say 350 Crore
***Above Estimated cost does not include the cost of land**						

Annexure 11.5 Cost estimate for Mechanical Equipment

Phase-1

Mechanical / Handling Equipments						
Sr. No.	**Reference**	**Description**	**Quantity**	**Unit**	**Rate**	**Amount(Rs in Lakhs)**
	Electrical					200.00
		4000 KVA Transformers- 11 KV/3.3 KV				60
		500 KVA Transformers- 3.3 KV/415 V				40
		Switch Gear				20
		Motor Control Gear				20
		HT Electric Cable				10
		Illumination High Mast Towers				30
		Conventional Fittings, LT cables				10
		Misc.				10
Sub Total Mechanical / Handling Equipments (In Lakhs)						**200.00**

Phase-2

Mechanical / Handling Equipments					
Sr. No.	**Description**	**Quantity**	**Unit**	**Rate**	**Amount(Rs in Lakhs)**
1	Mobile Harbour crane - 100 TPH	4	Nos.	40,000,000.00	1600.00
2	Crane Attachments	4	LS	10,000,000.00	400.00
3	Forklift - 10 Ton	2	Nos.	1,000,000.00	20.00
4	**Electrical**				200
	4000 KVA Transformers- 11 KV/3.3 KV				60
	500 KVA Transformers- 3.3 KV/415 V				40
	Switch Gear				20
	Motor Control Gear				20
	HT Electric Cable				10
	Illumination High Mast Towers				30
	Conventional Fittings, LT cables				10
	Misc.				10
Sub Total Mechanical / Handling Equipments (In Lakhs)					**2220.00**

Annexure 11.6 Cost estimate for Bridges

Sr. No.	Structure Name and for road / rail	Chainage (km)	Location	Length (m)	Width (m)	Present Cost	Demolition	Reconstruction	Total
1	MagadalaHazira Bridge/ ONGC Bridge	21.845	Magadalla	900	16		0.864	86.4	87.264
2	Bridge U/C	27.124	Adajan Gam	-	-		0		0
3	Sardar Bridge	30.254	Adajan	700	22.4		0.9408	94.08	95.0208
4	Swami Vivekanand Bridge (Makkaipool)	31.103	Adajan	620	19.5		0.7254	72.54	73.2654
5	Nehru Bridge	31.562	Adajan	550	18		0.594	59.4	59.994
6	Fulwari Bridge U/C	32.771	AdajanPatiya	-	-		0		0
7	DabholiJahangirpura Bridge	36.587	Dabholi Village	1000	21		1.26	126	127.26
8	Amroli Bridge	44.332	Katargam (Near Hanuman Temple)	655.2	20		0.78624	78.624	79.41024
9	Railway Bridge	45.373	Utran Railway Station	570	12		0.4104	41.04	41.4504
10	Kapodra-Utran Bridge	47.061	Utran	600	20	98.3	0.72	72	72.72
11	Savjibhaikorat Bridge	50.01	Sarthana Nature Park	544.6	21.5		0.702534	70.2534	70.955934
12	Service Road Bridge (Tapi River)	59.238	Kamrej	320	5		0.096	9.6	9.696
13	Kholvad Bridge (Tapi River)-1	59.27	Kamrej	470	10		0.282	28.2	28.482
14	Kholvad Bridge (Tapi River)-2	59.299	Kamrej	470	12		0.3384	33.84	34.1784
15	Bodhan Flyover (SH-165)	77.259	BodhanVilage Near Galteshwar Temple	580	8		0.2784	27.84	28.1184

Sr. No.	Structure Name and for road / rail	Chainage (km)	Location	Length (m)	Width (m)	Present Cost	Demolition	Reconstruction	Total
16	UmarsadiHaripura Bridge	92.891	Kadot	560	7		0.2352	23.52	23.7552
17	Mandvi Bridge (SH-5)	102.63	Mandvi	600	6		0.216	21.6	2.9088
18	Mandvi Bridge	104.388	Mandvi	-	-		0		0
								Total	**834.48**

Annexure 11.7 Cost estimate for Utilities

Utilities					
Sr. No.	**Description**	**Quantity**	**Unit**	**Rate**	**Amount (Rs. in Lakhs)**
1	Land Acquisition	1.5	ha	-	1800
2	Building	1.00	LS	20,000,000.00	200
3	Water Supply, Pipelines & OHT	1.00	LS	15,000,000.00	150
4	Fire Figthing	1.00	LS	5,000,000.00	50
5	Communcations	1.00	LS	5,000,000.00	50
6	STP / ETP	1.00	LS	20,000,000.00	200
				Sub Total Utilities (In Lakhs)	**2,450.00**

Annexure 11.8 Cost estimate for RIS

RIS SYSTEM TAPI RIVER (NW-100)				
Sr. No.	**Equipment**	**Qty**	**Unit Price**	**Total**
1	AIS Base Station	1	3000000	3000000
2	RADAR	1	5000000	5000000
3	Meteo Sensor	1	700000	700000
4	ATG	1	900000	900000
5	VHF	1	500000	500000
6	DG Set 10 KVA	1	700000	700000
7	UPS	1	500000	500000
8	RIS Software	1	3500000	3500000
9	RIS Hardware	1	10000000	10000000
10	Installation Testing & Commissioning	1	2000000	2000000
11	Porta cabin	3	1200000	3600000
12	Trestle Tower	1	1000000	1000000
			Total	**31400000**
	Operation			-
1	Engineer 1 * Site 1 * Months 12 per year	12	35,000.00	420000
	Operator 3 * Site 1 * Months 12 per year	36	20,000.00	720000
	Security 3 * Site 1 * Months 12 per year	36	15,000.00	540000
2	Second Year			0
3	Third Year			0
4	Fourth Year			0
			Total	**1680000**

RIS SYSTEM TAPI RIVER (NW-100)				
Sr. No.	**Equipment**	**Qty**	**Unit Price**	**Total**
	CAMC for 4 Years			-
1	1st Year	1	3140000	3140000
2	2nd Year	1	3454000	3454000
3	3rd Year	1	3799400	3799400
				-
			Total	**10393400**
			Overall Cost	**43473400**

Chapter – 13

ECONOMIC AND FINANCIAL ANALYSIS

ANNEXURE

Annexure 13.1 FIRR Analysis (Phase 1)

FIRR	11.76%
Cap. Cost (+) 10%	10.40%
Cap. Cost (-) 10%	12.05%
ANNUAL O &M COST (+) 10%	10.21%
ANNUAL O &M COST (-) 10%	13.22%
REVENUE (+) 10%	13.97%
REVENUE (-) 10%	9.26%

સુપ્રિટેન્ડન્ટ ઓફ સ્ટેમ્પસ, ગાંધીનગર, ગુજરાત રાજય.

CORPORATION / AUTHORITY

ASR - 2011 Final

તા.૧૮/૦૪/૨૦૧૧ ના સરકારશ્રીના મહેસુલ વિભાગના ઠરાવ અન્વયે અમલ માં આવેલ જંત્રી

જીલ્લો : SURAT

તાલુકા :SURAT CITY

વિસ્તાર નામ : **SULTANABAD**

TPS-79

(ભાવ પ્રતિ ચો.મી.)

વેલ્યુઝોન	ખુલ્લા પ્લોટનો ભાવ	જમીન + બાંધકામનો ભાવ			ખુલ્લા પ્લોટનો ભાવ (ઔદ્યોગિક)	ખેતીની જમીનનો ભાવ	
		રહેણાંક ફ્લેટ/ એપાર્ટમેન્ટ	ઓફિસ	દુકાન		પીયત	બીન પીયત
૧	૨	૩	૪	૫	૬	૭	૮
54/1	**9000**						**4900**

FP. No **TPS-79**

1/(220/PAIKI 1), 2/A(224 /Paiki1), 2/C(224 /Paiki2), 2/B(224 /Paiki2), 3/(225), 4/A(226 /Paiki1), 4/B(226 /Paiki2), 6/(228), 8/A(232/Paiki1), 8/B(232/Paiki1), 9/(232/Paiki2), 10/(232/Paiki 3), 18/(251), 19/(252), 20/A(253), 20/B(255), 20/C(255), 21/B(256), 21/A(256), 22/(257), 23/(258), 24/(259), 25/A(260), 25/B(260), 26/A(261 /PaiKi1), 26/B(261 /Paiki3), 27/(262), 28/(265/P/1), 29/(300), 30/(301), 31/(302), 32/(303), 33/(304), 34/(305), 35/(306), 36/(307), 37/(308), 40/(311), 41/(312), 42/(313), 43/(314), 44/(315), 47/(318), 48/(319), 49/(320), 50/(321), 150/(502), -/7(227/p+228/p+229), and all other plots included in the zone boundary.

54/10	**6500**						**2250**

FP. No **TPS-79**

159/(10), 190/A(71 /B/Paik 2, 190/G(71 /B/Paik 8, 190/K, 190/L, 194/(75), 195/(76/p1,76/p2), 196/A(77), 196/B(77), 197/A(78), 197/B(78), 198/(79), 199/(80 /Paiki1), 200/(80 /Paiki 2), 201/(81 /Paiki 1), 202/(81 /Paiki 2), 203/(82 /Paiki 1), 204/(82 /Paiki 2), 205/(83), 206/(84), and all other plots included in the zone boundary.

54/11	**6500**						**2400**

FP. No **TPS-79**

160/B(11 /Paiki 2), 160/A(11 /Paiki 1), 162/A(13 /PaiKi1), 162/B(13 /PaiKi 2), 163/B(14 /PaiKi 1), 163/A(14 /PaiKi 1), 163/C(14 /PaiKi 1), 164/B(14 /PaiKi 2), 164/A(14 /PaiKi 2), 165/(15 /PaiKi 1), 190/H(71 /B/ Paik , and all other plots included in the zone boundary.

54/2	**9000**						**5400**

FP. No **TPS-79**

38/(309), 51/(322), 52/(323), 53/(324 /Paiki1), 54/(325), 56/(327), 57/(328), 58/(329), 84/(362), 85/(363), 86/(364), 87/(365), 88/(366), 89/(367), 90/B(368), 90/A(368), 91/(369), 92/(370), 93/(371), 94/(372), 95/(373), 96/(374), 97/(375), 98/(376), 99/(377), 100/(378), 102/(384), 103/(385), 104/(338866), 105/(387), 106/A(390), 106/B(390), 107/(391), 108/(392), 110/A(395 /Paiki1), 110/B(395 /Paiki2), 110/C(395 /Paiki2), 112/(402,403/P), 113/(418/P), 117/(447), 118/C(448), 122/C(458), 132/(472), -/109(394+411+412), -/111(399+400+401), -/116(446/P 1+2/3), -/101(379+380+381+382+383), -/114(446/P 1+2/1,393), -/115(446/P 1+2/2), -/82(360+361,360/P 1+361), and all other plots included in the zone boundary.

સુપ્રિટેન્ડન્ટ ઓફ સ્ટેમ્પસ, ગાંધીનગર, ગુજરાત રાજ્ય.

CORPORATION / AUTHORITY

ASR - 2011 Final

તા.૧૮/૦૪/૨૦૧૧ ના સરકારશ્રીના મહેસુલ વિભાગના ઠરાવ અન્વયે અમલ માં આવેલ જંત્રી

જીલ્લો : SURAT

તાલુકા :SURAT CITY

વિસ્તાર નામ : **SULTANABAD**

TPS-79

(ભાવ પ્રતિ ચો.મી.)

<table>
<tr><th rowspan="2">વેલ્યુઝોન</th><th rowspan="2">ખુલ્લા પ્લોટનો ભાવ</th><th colspan="3">જમીન + બાંધકામનો ભાવ</th><th rowspan="2">ખુલ્લા પ્લોટનો ભાવ (ઔદ્યોગિક)</th><th colspan="2">ખેતીની જમીનનો ભાવ</th></tr>
<tr><th>રહેણાંક ફ્લેટ/ એપાર્ટમેન્ટ</th><th>ઓફિસ</th><th>દુકાન</th><th>પીયત</th><th>બીન પીયત</th></tr>
<tr><td>૧</td><td>૨</td><td>૩</td><td>૪</td><td>૫</td><td>૬</td><td>૭</td><td>૮</td></tr>
<tr><td>54/3</td><td>8500</td><td></td><td></td><td></td><td></td><td></td><td>4400</td></tr>
<tr><td colspan="8">FP. No TPS-79
5/A(227), 5/B(227), 15/A(248), 16/(249 /Paikii1), -/17(250p/18+19/15), and all other plots included in the zone boundary.</td></tr>
<tr><td>54/4</td><td>9000</td><td></td><td></td><td></td><td></td><td></td><td>4900</td></tr>
<tr><td colspan="8">FP. No TPS-79
13/A(246 /Paiki1), 13/B(246/Paiki 2), 14/A/1(247), 14/A/2(247), 14/B, 14/B(247), 15/B(248), 39/(310), 46/(317), 54/(325), 55/(326), 59/(330 /Paiki1), 60/A(330 /Paiki2), 60/B(330 /Paiki2), 61/(331), 62/(332), 63/(333), 64/(334), 65/(335), 66/(336), 68/(339), 69/(340), 71/(342), 72/(346/p/1), 73/(347), 74/(348), 75/(349/P), 76/(349/p1), 78/(354), 79/(355), 80/A(358), 80/B(358), 81/(359), -/11/A(236 to 244/p1), -/12(245 /Paiki1+2), -/11/B(236 to 244/p1), -/67(337+338 /Paiki 1), and all other plots included in the zone boundary.</td></tr>
<tr><td>54/5</td><td>9150</td><td></td><td></td><td></td><td></td><td></td><td>4800</td></tr>
<tr><td colspan="8">FP. No TPS-79
70/(341), 77/(352), 118/A(448), 119/(449 /Paiki 1), 120/(455), 121/(456), 122/A(457), 122/B(458), 123/(459), 124/(460), 125/(461), 126/(462), 127/(463,464,465), 128/A(466), 133/A(473), 137/A(475 /Paiki1), 137/B(475 /Paiki2), 138/(476), 140/A(480), 140/B(480), 141/B(481), 142/(482), 143/A(483), 143/B(483), 144/(485), 145/(486 /Paiki 1), 146/(487 /Paiki 1), 148, 149/A(493), 149/B(493), 183/(28), 187/B(31), 189/(71 /A/ Paiki , 191/(72, 56/p7, 56, 192/(73), -/147(488 /P 1+2/2/1), and all other plots included in the zone boundary.</td></tr>
<tr><td>54/6</td><td>8750</td><td></td><td></td><td></td><td></td><td></td><td>4150</td></tr>
<tr><td colspan="8">FP. No TPS-79
134/(474/P1), 135/(474/P/2), 139/(477), and all other plots included in the zone boundary.</td></tr>
<tr><td>54/7</td><td>8000</td><td></td><td></td><td></td><td></td><td></td><td>3900</td></tr>
<tr><td colspan="8">FP. No TPS-79
86/1, 166/(16/PAIKI 1), 167/(16/PAIKI 2), 169/(17/PAIKI 1), 170/(17/PAIKI 2), 171/(17/PAIKI 3), 172/(17/Paiki 5), 173/(18), 174/(21 /Paiki1), 175/(21 /Paikii2), 176/(22 /Paiki1), 177/(22 /Paiki2), 178/(3 /Paiki 1), 179/(24), 180/(25 /Paiki 1), 181/A(26 /Paiki 1), 181/B, 182/(27 /Paiki1), 183/(28), 184/A(29 /Paiki1), 184/B(29 /Paiki1), 185/(29 /Paiki 2), 186/A(30), 188/(61/p/1), 188/C, and all other plots</td></tr>
</table>

વેલ્યુઝોન	ખુલ્લા પ્લોટનો ભાવ	જમીન + બાંધકામનો ભાવ			ખુલ્લા પ્લોટનો ભાવ (ઔદ્યોગિક)	ખેતીની જમીનનો ભાવ	
		રહેણાંક ફલેટ/ એપાર્ટમેન્ટ	ઓફિસ	દુકાન		પીયત	બીન પીયત
૧	૨	૩	૪	૫	૬	૭	૮
included in the zone boundary.							
54/8	**7500**						**3900**
FP. No **TPS-79** 128/B, 129/A(467/Paiki 11, 130, 131/(471), 152/(2 /Paiki1), 153/(3), 154/(4), 157/C, 158/(9), 161/(12), 168/(16/p4/1), 187/A(31), 190/B(71 /B/ Paiki, 190/C(71 /B/ Paiki, 190/F(71 /B/ Paik , 190/J, 207/A(85), 207/B(85), 207/C(85), 251, -/129/B(467+468+469/P1+2/1), and all other plots included in the zone boundary.							
54/9	**6500**						**2900**
FP. No **TPS-79** 155/(5), 156/(6), 157/A(8/P), 157/B(8/P), 190/A(71 /B/PaikI , 190/D(71 /B/PaikI , 190/E(71 /B/PaikI , 195/(76/p1,76/p2), and all other plots included in the zone boundary.							

વેલ્યુઝોન	ખુલ્લા પ્લોટનો ભાવ	જમીન + બાંધકામનો ભાવ			ખુલ્લા પ્લોટનો ભાવ (ઔદ્યોગિક)	ખેતીની જમીનનો ભાવ	
		રહેણાંક ફલેટ/ એપાર્ટમેન્ટ	ઓફિસ	દુકાન		પીયત	બીન પીયત
૧	૨	૩	૪	૫	૬	૭	૮
54/12	**7250**						**3450**

FP. No **TPS-80**

124/(104), 131/(109), 132/(110), 133/(111), 134/(112/P/1), 135/(113), 150/(137), 152/(139), 157/(144), 158/(145), 159/(146), 160/(147), 161/(148), 162/(149), 163/(150), 164/B(151), 164/A(151), 165/(152), 167/(155/P/1), -/166(153+154), and all other plots included in the zone boundary.

54/13	**9500**			**16500**			**3800**

FP. No **TPS-80**

118/(98/P/1), 119/A(99), 119/(99), 120/(100), 121/(101/P), 122/(102, 118/120), 123/(103), 125/(105/P/1/3), 126/(106/P/1/2), 127/(107/P/1), 128/(107/P), 129/(107/P7), 130/(108), 168/(156/P), 169/(157/P), 170/A(158/P), 170/B(158/P), 172/(159/p/2/1), 173/(159/P/2/2), 174/(159/P/2/3), 175/(159/P/2/4), 177/(161/p), 178/A(161/p), 179/(162/p1), 181/(162/p), 212/(199), 216/(204), 217/(205), 218/(206), 219/B(207/p), 220/(208/p), 221/(208/P1), 222/(209), 223/(210/p), 282/(497), 284/(499/p2), 285/(500), -/182(162/p2+203/p), -/283(498 + 499/p1), -/116/A(96 to 124/P3), -/225(212+213+214), and all other plots included in the zone boundary.

54/14	**9000**			**15000**			**3900**

FP. No **TPS-80**

171/9, 171/C(159/P/1/3), 171/E(159/P/1/5), 171/F(159/P/1/6), 171/H(159/P/1/7), 171/I(159/P/1/7), 171/M(159/P/1/7), 171/N(159/P/1/7), 171/O(159/P/1/7), 171/A(159/P/1/1), 171/B(159/P/1/2), 171/D(159/P/1/4), 171/G(159/P/1/7), 171/J(159/P/1/7), 171/K(159/P/1/7), 171/L(159/P/1/7), 176/(160/P), 189/A(170), 189/B(170), 190/(171/p1), 191/(172), 255/A(273), 255/B(273), 256/(274/p1), 257/(275), 258/(276), 261/(280), 263/A(283/p1/2/3), 263/C, 263/B(283/p1/2/2), 269/A(294), -/188(168+169), -/260(278+279), -/262/A(281+282), -/262/B(281+282), and all other plots included in the zone boundary.

54/15	**9000**						**3900**

FP. No **TPS-80**

180/(162/p1/3), 183/(163), 184/(164), 185/(165), 186/(166), 187/B(167), 187/A(167), 192/(173/p1), 193/A(174), 194/A(175), 194/B(175), 195/(179), 214/(201), 215/(202), 215/B, 251/D(267), 252/A(270), 252/B(270), 253/A(271/p1/1), 253/B(271/p2/1/2), 253/C(271/p2/1/3), 254/(272), 264/B(284), 264/A(284), 266/(292/p1), 267/(292/p2), 268/(293), 269/B(294), and all other plots included in the zone boundary.

સુપ્રિટેન્ડન્ટ ઓફ સ્ટેમ્પસ, ગાંધીનગર, ગુજરાત રાજ્ય.

CORPORATION / AUTHORITY

ASR - 2011 Final

તા.૧૮/૦૪/૨૦૧૧ ના સરકારશ્રીના મહેસુલ વિભાગના ઠરાવ અન્વયે અમલ માં આવેલ જંત્રી

જીલ્લો : SURAT તાલુકા :SURAT CITY

વિસ્તાર નામ : **SULTANABAD** **TPS-80** (ભાવ પ્રતિ ચો.મી.)

વેલ્યુઝોન	ખુલ્લા પ્લોટનો ભાવ	જમીન + બાંધકામનો ભાવ			ખુલ્લા પ્લોટનો ભાવ (ઔદ્યોગિક)	ખેતીની જમીનનો ભાવ	
		રહેણાંક ફ્લેટ/ એપાર્ટમેન્ટ	ઓફિસ	દુકાન		પીયત	બીન પીયત
૧	૨	૩	૪	૫	૬	૭	૮
54/16	**7500**						**3150**
FP. No **TPS-80** 246/(254), 247/(263), 248/A(264/p1), 248/B(264/p1), 249/(264/p2), 250/(265/p1), 251/F(267), 251/A(267), 270/(295), 271/(296/p1), 275/(491/p1/2), and all other plots included in the zone boundary.							
54/17	**9250**						**3900**
FP. No **TPS-80** 151/E, 199/(185/p1/p1), 200/B(185/p1/p2), 200/A(185/p1/p1), 201/B(185/p3/p1), 201/A(185/p3/p1), 202/(186), 236/A(222/p1), 236/B(222/p1), 238/(223/p1), 251/C(267), -/197/B(181+182+183), -/197/C(181+182+183), -/197/E(181+182+183), -/197/D(181+182+183), and all other plots included in the zone boundary.							
54/18	**8000**						**3400**
FP. No **TPS-80** 203/(190/p1), 204/(190/p2), 205/A(191), 205/B(191), 206/(192), 207/(193), 209/A(196), 209/B(196), 210/(197/p1/1), 213/(200), 221/(208/P1), 224/(211), 237/(222/p2), 239/(223/p2), 296, 297/A, 298, -/208(194+195/p1), and all other plots included in the zone boundary.							
54/19	**11500**						**5200**
FP. No **TPS-80** 75/B(69/1), 92/(78/P/1/2), 93/(78/P1/1), 94/(78/P1/4), 96/(78/P/2/5), 108/(86/P/1), 112/(90), 113/(93/P/1), 114/(94/P/1), 115/(95/P/1), 224/(211), 226/(215/P/1/1), 228/(217/p1/1), 229/(217/p1/2), 240/(230), 241/A(231/p1), 241/B(231/p1), 241/C, 242/(231/p2), 243/(233), -/111/A(89/P/1+2+3/7), -/232(218+219/p1+2/3), -/95(78/P1+2/3), -/98/B(80/P/1/1+80/P/2/1), -/111/B(89/P/1+2+3/1), -/227(216+221/1), -/230(218+219/p1+2/1), -/231(218+219/p1+2/2), -/233(218+219/p1+2/4), -/234(218+219/p1+2/11), and all other plots included in the zone boundary.							
54/20	**8500**						**4300**
FP. No **TPS-80** 117/(96/124/P/1), 136/(114), 137/(115), 138/(116), 139/(117), 140/(125/P), 148/(135), 149/(136), 151/(138), 153/(140), 154/(141), 155/(142), 156/(143), -/116/B(96 to 124/P3/1), -/141(125+126/p1), and all other plots included in the zone boundary.							

વેલ્યુઝોન	ખુલ્લા પ્લોટનો ભાવ	જમીન + બાંધકામનો ભાવ			ખુલ્લા પ્લોટનો ભાવ (ઔદ્યોગિક)	ખેતીની જમીનનો ભાવ	
		રહેણાંક ફ્લેટ/ એપાર્ટમેન્ટ	ઓફિસ	દુકાન		પીયત	બીન પીયત
૧	૨	૩	૪	૫	૬	૭	૮
54/21	**9500**						**5050**

FP. No **TPS-80**

31/(28/P9), 38/B(34), 46/(42), 47/(43/P/1), 59/(55), 60/(56), 61/(57), 62/(28), 63/(59/P/1), 64/(59/P/2), 65/(59/P/3), 66/(59/P/4), 67/(60), 69/(64/P/1), 78/(70), 79/(71/P/1), 80/(72), 81/(73/P/1/1), 82/(73/P/1/2), 83/(73/P/2/2), 84/(74), 85/(75/P/1), 86/(75/P/2), 87/(75/P/3), 88/(76/P/1), 89/(76/P/2), 90/(77/P/1), 91/(77/P/2), 97/(79), 98/A(80/P/1/2), 99/(81), 100/(82/P/1/2), 105/(83/P/1/P/1), 106/C, 107/(85), 109/(87), 142/(128), 143/(129), 144/(130), 145/(131), 146/(133/P/2), 147/(133/P/1), -/101(82/P/2+82/P/2/2/1), -/102/B(82/P/1+82/P/2/1), -/106/A(84+132/P/1/P), -/106/B(84+132/P/1/P), -/106/D/3(84+132/P/8+9), -/73(68/B/1+68/A/2), -/102/A(82/P/1+82/P/2/1), -/103(82/P/1+82/P/2/1), -/104(82/P/1+82/P/2/2), -/106/D/1(84+132/P/1+2+3), -/106/D/2(84+132/P/4+5+6), -/68(61+62+63/P/1), and all other plots included in the zone boundary.

54/22	**9500**	**14000**					**5050**

FP. No **TPS-80**

1/(1), 2/A(2), 2/B(2), 4/A(5), 4/B(5), 5/(6), 6, 6/(7/P/ 1), 23/(23), 24/(24), 26/(26/P/1), 29/(28/P/1), 30/(28/P/1/6), 33/(29), 34/(30), 35/(31), 36/(32), 37/(33), 38/A(34), 39/(35), 40/(36), 41/(37), 42/(38), 43/(39), 44/(40), 45/(41), 48/(44), 49/(45), 50/(46), 51/(47), 52/(48), 53/(49), 54/(50), 55/(51), 57/(53), 58/(54), and all other plots included in the zone boundary.

54/23	**11500**						**6050**

FP. No **TPS-80**

13/(13/P/1), 14/(13/P/2), 15/(15), 16/(16), 17/(17), 28/B(27/P/2), 28/A(27/P/1), 32/(28/p/10), 70/(66/P/1), 71/(67/P/1/1), 72/(67/P/2/2), 74/(69/P), 75/A(69/1), 76/(69/P/2/2), 77/(69/P/2/3), 245/(254), 273/(489), 274/(490/p1), -/27(26+27/p/1), and all other plots included in the zone boundary.

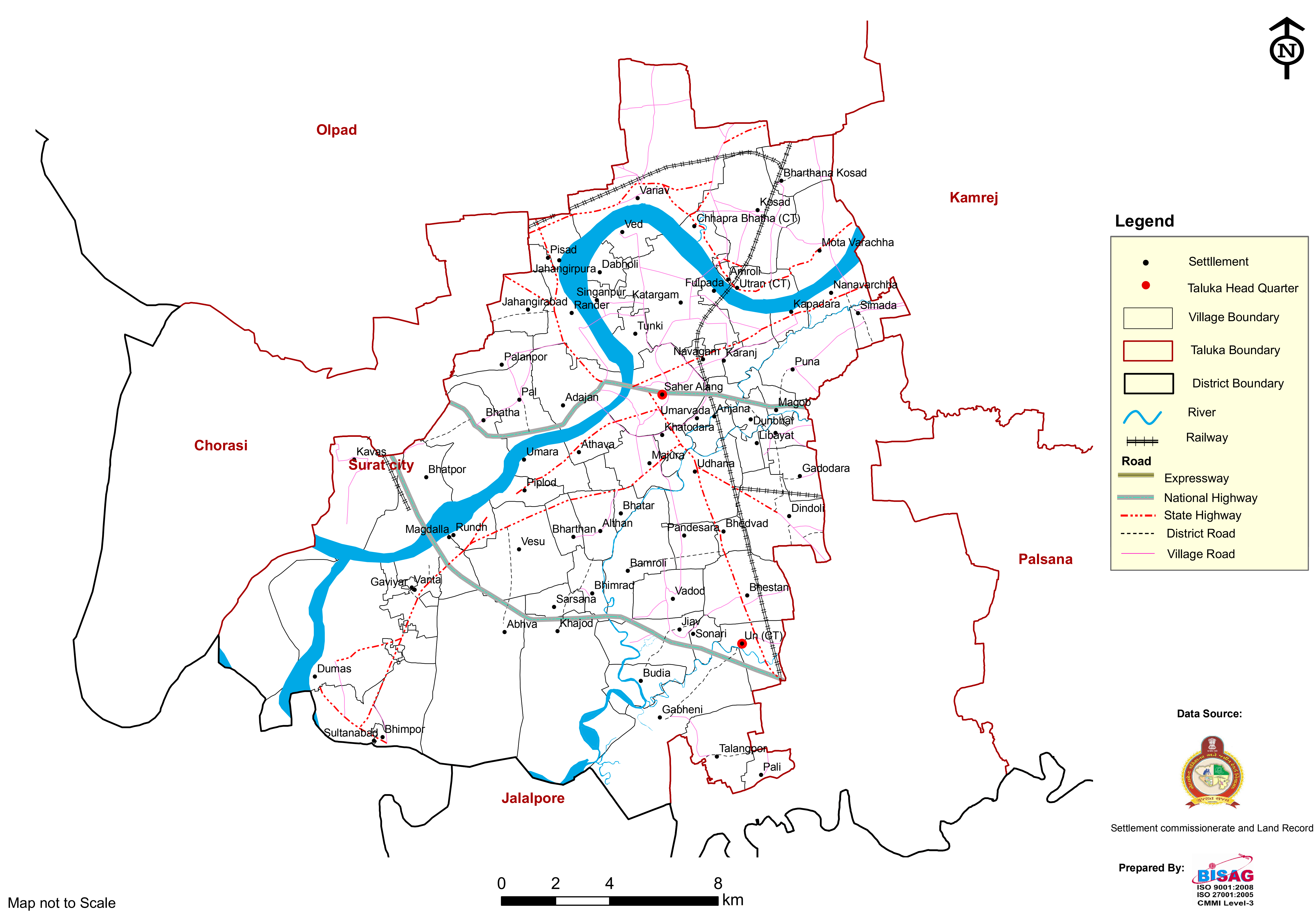
54/24	**9750**						**5050**

FP. No **TPS-80**

3/(4), 7/(8), 8/A(9/P/ 1), 8/B(9/P/ 2), 9/(9/P1/a), 10/(10), 11/(11), 12/(12), 18/(18/p/1), 19/(19), 20/(20), 21/(21), 22/(22), 25/(25/P/1), 193/B(174), 275/(491/p1/2), 276/(491/p1/1), 277/(492), 278, 280/A(496/p1), 280/B(496/p1), 281/(496/p3), -/278/A(494+496/p2/1), -/278/B(494+496/p2/2), and all other plots included in the zone boundary.

District : Surat **Taluka : Surat city**

For official use only



Dear Ms Verma,

Further to our discussion and trailing mails, please find below our **Budgetary quote of Terex Gottwald Mobile Harbour Crane (4 rope)**

Proj no. 16713
CIF East Coast, India
Budgetary Price for: 1 x Model: GHMK 2305 B

FOB North Sea Port: EURO 944779.91
**including freight costs*

Included Options (per crane):

- ✓ Tropical package – Temperature Zone 3
- ✓ Second Stairway
- ✓ Emergency Descending Device

Excluded Options (not offered):

- ✓ Grabs
- ✓ Assembly equipment
- ✓ Test weights

Attached alongwith is the brochure and technical details for your reference. Please note that G HMK 2305 B is fitted with an additional axle.
The updated files for the same will be submitted to you within due course.

We request you to go through the details and reconfirm your technical suitability.

Kind Regards,
Nikhil Misal

Terex Port Solutions
T: 91 2135 61 4578
M: 91 96733 31806

G HMK 2304 Mobile Harbour Crane

Table of Contents

1.0 Main Dimensions

Length of chassis without stabiliser pads	approx.	14.7 m
Width of chassis without stabiliser pads *	approx.	8.1 m
Size of stabiliser pads *		1.2 m x 1.8 m
Propping base (length, width)		11.5 m x 11.0 m
Tail radius		6.1 m
Height of boom pivot point	approx.	9.8 m
Crane operator viewing height	approx.	16.1 m
Boom length		40.0 m
Maximum radius		40.0 m
Minimum radius		11.0 m
Hoisting height on hook above quay *	11 m to 15 m radius	40.0 m
	40 m radius	14.0 m
Hoisting height on hook below quay		12.0 m

2.0 Weights

Counterweight		63.0 t
Total weight of operational crane***	approx.	240.0 t

3.0 Main Drive

Type of drive system	Diesel – electric

3.1 Diesel Engine *

Manufacturer	MAN
Model	D 2868 LE122
Engine type	Diesel
Cooling	Water
Nominal output	570 kW at 1800 rpm
Number of cylinders	8
Fuel consumption (at full load)	max. 213 g/kWh

3.2 Fuel Tank

Volume of main fuel tank in chassis	approx.	5400 l
Possible operating time without refueling (depending on operating mode and intensity)		up to 200 h

3.3 Fuel Saving Potential

Savings possible using optional hybrid drive and ultracaps	to 23 %[1]

[1]Achieved under specific deployment conditions and based on experience gained from operating a Terex® Gottwald Generation 5 crane over a period of more than one year.

4.0 Hoist

Number of rope drums		1
Number of ropes		2
Hoisting speeds:		
	without load	85.0 m/min
	10.0 t	67.0 m/min
	45.0 t	38.0 m/min
	63.0 t	30.0 m/min
	80.0 t	25.0 m/min

5.0 Slewing Gear

Number of slewing gear drive units		1
Slewing speeds:		
	to 47.0 t	to 1.4 rpm
	to 80.0 t	to 0.6 rpm
Maximum peripheral speeds at boom head:		
	to 47.0 t	to 180 m/min
	to 80.0 t	to 80 m/min

6.0 Luffing Gear

Average luffing speeds:	to 47.0 t	60 m/min
	to 80.0 t	27 m/min

7.0 Travel Gear

Travel speed	up to	80.0 m/min
Total number of axles		4
Number of steered axles		4
Number of driven axles		2
Number of wheels		16
Tyre size		14.00-24
Climbing ability		6.0 %
Vertical axle compensation		+250 mm / -250 mm
Minimum inner curve radius	approx.	5.5 m
Minimum outer curve radius	approx.	13.5 m
Maximum crab steering angle	approx.	25°

8.0 Ambient Conditions

Permissible wind speeds:

Crane in operation	to	20 m/s
Crane in travel operation	to	20 m/s
Crane out of service	to	46 m/s

At wind speeds above 46 m/s, the boom head should be lowered and secured.

Permissible ambient temperatures: **	minimum	-20° C
	maximum	+45°C

9.0 Stability Requirement (Percentage of Tipping Load)

Normal-load operation / heavy-load operation	≤ 75 %
Motor grab operation	≤ 50 %

10.0 Classification of Crane and Mechanisms

Classification in accordance with: FEM 1.001, 3rd edition, 1998

10.1 Crane Classification

Container operation (single lift)		A6
Motor grab operation	32.0 t	A7
Normal-load operation	47.0 t	A6
Heavy-load operation	63.0 t	A5
	80.0 t	A4

10.2 Classification of Mechanisms

Hoist:		
Container operation (single lift)		M6
Motor grab operation	32.0 t	M7
Normal-load operation	47.0 t	M6
Heavy-load operation	63.0 t	M3
	80.0 t	M3
Slewing gear:		
Container operation (single lift)		M7
Motor grab operation	32.0 t	M7
Normal-load operation	47.0 t	M7
Heavy-load operation	80.0 t	M7
Luffing gear:		
Container operation (single lift)		M7
Motor grab operation	32.0 t	M7
Normal-load operation	47.0 t	M7
Heavy-load operation	80.0 t	M7
Travel gear:		M4

11.0 Lighting

Boom head *	Metal vapour lamp	1 x 2000 W
Bottom of boom *	Metal vapour lamp	1 x 2000 W
Front of tower *	Metal vapour lamp	2 x 400 W
Rear of tower *	Metal vapour lamp	1 x 400 W
Boom head obstacle beacon **		1
Tower head obstacle beacon **		1

12.0 Surface Treatment

Surface treatment of the steel structure:		EN ISO 12944
Surface preparation:		Sa 2.5 (ISO 8501-1)
Edge protection:	Two-component epoxy resin with micaceous iron ore	
Primer coat:	Two-component epoxy resin	≥ 60 µm
Intermediate coat:	Two-component epoxy resin	≥ 60 µm
Top coat:	Two-component acrylic-polyurethane	≥ 50 µm
Total coating thickness:		≥ 170 µm

Key:

* Data for basic equipment. Alternative special equipment available
** Data for special equipment
***Depending on the configuration selected

Subject to technical modification without prior notice.

9.6 - DREDGING

✓

Sr. No.	Item Code	Name of Item	Unit	2015-16
1	DRED0001	Labour for drilling holes in Nilgiri Vertical /Horizonal piles and fitting of MS assorted size bolts and nuts with labour and material in all respect	Per Hole	191
2	DRED0002	Labour for shifting of HDPE or Steel pipe up to 500 mm dia. (Min. 10 mtrs distance). It includes shifting, lowering and shifting 500 mm dia steel OR HDPE pipes with all materials etc. within harbour area. **0- 6 mtrs length**	per mtr distance	58
3	DRED0003	Labour for shifting of HDPE or Steel pipe up to 500 mm dia. (Min. 10 mtrs distance). It includes shifting, lowering and shifting 500 mm dia steel OR HDPE pipes with all materials etc. within harbour area. **0- 12mtrs length**	Mtr	81
4	DRED0004	Labour for shifting of HDPE or Steel pipe up to 500 mm dia. (Min. 10 mtrs distance). It includes shifting, lowering and shifting 500 mm dia steel OR HDPE pipes with all materials etc. within harbour area. **0- 18 mtrs length**	Mtr	115
5	DRED0005	Marinating floating steel or HDPE pipe as well under water pipelines, ball and socket pontoons etc. including anchoring, positioning as per needs complete in all respect without any breakage leakage.	Mtr	23
6	DRED0006	Labour charges for handling, pitching and driving Nilgiri piles includeing cutting down extra un-driven length if not required in soft strata.	Mtr	69
7	DRED0007	Labour charges for handling, pitching and driving Nilgiri piles including cutting down extra un-driven length if not required in soft strata. **3.00 to 6.00 m**	Mtr	92
8	DRED0008	Labour charges for handling, pitching and driving timber including cutting down extra un-driven length if not required in hard strata. **0.00 to 3.00 m**	Mtr	92
9	DRED0009	Labour charges for handling, pitching and driving timber including cutting down extra un-driven length if not required but in hard strata **3.00 to 6.00 m**	Mtr	115

Sr. No.	Item Code	Name of Item	Unit	2015-16
10	DRED0010	Labour charges for handling pitching and driving timber piles in foundation of the structure including cutting down extra un-driven length if not required in tidal zone viz. in jetties, dolphins, wharves etc. **0.00 to 3.00 m**	Mtr	104
11	DRED0011	Labour charges for handling pitching and driving timber piles in foundation of the structure including cutting down extra un-driven length if not required in tidal zone viz. in jetties, dolphins, wharves etc. **3.00 to 6.00 m**	Mtr	138
12	DRED0012	Opening, cleaning, servicing, rousing of anchor spud guide pulley and fitting back with necessary trials. Labour charges only.	No	863
13	DRED0013	Opening, cleaning, servicing, overhauling of main derrick of Dredger and also replacing worn out parts excluding cost of materials but including satisfactory trials and consumables.	No	17538
14	DRED0014	Opening, cleaning, servicing, overhauling of hydraulic operated suction valve of dredge pump of Dredger by replacing worn-out parts with satisfactory trials and consumables. Labour job only.	No	19435
15	DRED0015	Removal and replacement of sunk fit CS coupling of output shaft for reduction gearbox of dredge pump of Dredger (a) Removal of sunk fit CS coupling. (b) Replacement of bearing and oil seal. (c) Checking trueness of shaft. (d) Checking trueness of CS coupling and machining the same as per requirement. (e) Refitting of the coupling on the shaft assembly of gearbox. (f) Alignment of gearbox. (g) Complete test and trials to be given to the satisfaction of EIC	No	37398
16	DRED0016	Checking and doing alignment of dredge pump shaft with gearbox output shaft in Dredger with standard permissible limits. Chokes and foundation bolts will be provided by department while other materials and equipments will be arranged by the contractor.	Job	36455

Sr. No.	Item Code	Name of Item	Unit	2015-16
17	DRED0017	Hopper door water tightness checking/rectification labour charges only	No	22793
18	DRED0018	Hopper door damaged sealing renewal labour charges.	Each	10833
19	DRED0019	straightening of eyes of hopper door.	Each	5635
20	DRED0020	Labour for opening, cleaning, servicing, overhauling of main derrick of dredger and also replacing workout parts excluding cost of materials but including satisfactory trials.	Each	14490
21	DRED0021	Dismantling & erecting of grab bucket after MS plate its pin and pulley bushes complete in all respect with satisfactory trials. **up to 1 cu.m. capacity**	each	6555
22	DRED0022	Dismantling & erecting of grab bucket after MS plate its pin and pulley bushes complete in all respect with satisfactory trials. **between 1.1-2.0 cu.m. capacity**	each	9085
23	DRED0023	Dismantling & erecting of grab bucket after MS plate its pin and pulley bushes complete in all respect with satisfactory trials. **Between 2.1-3.0 cu.m.**	each	10810

10.7 - DREDGING COMPONENTS

Sr. No	Component Code	Name of Components	Group Code	Unit	Unit Rate in Rs
1	DREDG00001	Dredging with Cutter Suction incl. mob-demob	DR1	Cu.M.	228
2	DREDG00002	Dredging with Trailer-suction incl. mob-demob	DR1	Cu.M.	248
3	DREDG00003	Dredging with Grab incl. mob-demob	DR1	Cu.M.	155
4	DREDG00004	Dredged material delivery by pump- pipe upto 100 m. distance	DR2	Cu.M.	10
5	DREDG00005	Dredged material delivery by pump- pipe upto 300 m. distance	DR2	Cu.M.	17
6	DREDG00006	Dredged material delivery by pump- pipe upto 1000 m. distance	DR2	Cu.M.	29
7	DREDG00007	Dredged material delivery by pipe upto 2000 m. distance	DR2	Cu.M.	41
8	DREDG00008	Dredged material delivery by barge upto 500 m. distance	DR2	Cu.M.	92
9	DREDG00009	Dredged material delivery by barge upto 2000 m. distance	DR2	Cu.M.	115
10	DREDG00010	Dredged material delivery by barge upto 5 nautical mile distance	DR2	Cu.M.	132
11	DREDG00011	Dredged material delivery by barge above 5 n. m. distance	DR2	Cu.M.	155
12	DREDG00012	Dredged material delivery by barge above 10 n. m. distance	DR2	Cu.M.	-
13	DREDG00013	Dredged material dumping by trucks upto 1000 m. distance	DR2	Cu.M.	46
14	DREDG00014	Dredged material dumping by trucks between 1000m. to 5000 m. distance	DR2	Cu.M.	69
15	DREDG00015	Dredged material dumping by trucks beyond 5000 m. distance	DR2	Cu.M.	92

Sr. No.	Component Code	Name of Component	Group Code	Unit	Unit Rate in Rs
16	DREDG00016	Dredger Toyo Pump Mob- Demob to site upto 10 Km. distance	DR3	per unit	57500
17	DREDG00017	Dredger backhoe Mob- Demob to site upto 10 Km. distance	DR3	per unit	57500
18	DREDG00018	Dredger cutter-suction Mob- Demob to site upto 10 Km. distance incl. assembly	DR3	per unit	1,72,500
19	DREDG00019	Dredger cutter-suction Mob- Demob to site upto 100 Km. distance excl.assembly	DR3	per Km	403
20	DREDG00020	Dredger cutter-suction Mob- Demob to site above 100 Km. distance excl. assembly	DR3	per Km	345
21	DREDG00021	Dredger cutter/trailing-suction Mob-Demob by sea to site upto 100 n.m. distance	DR3	per unit	2,87,500
22	DREDG00022	Dredger cutter/trailing-suction Mob-Demob by sea to site above 100 n.m. distance	DR3	per n.m.	863
23	DREDG00023	Mob-Demob of Dredger- Grab/Toyo pump/Backhoe for jobs upto 100,000 cu.m.	DR3	per cu.m.	21
24	DREDG00024	Mob-Demob of Dredger- Grab/Toyo pump/Backhoe above 100,000 cu.m.	DR3	per cu.m.	12
25	DREDG00025	Mob-Demob of Dredger-Cutter/Trailing Suction for jobs upto 500,000 cu.m.	DR3	per cu.m.	41
26	DREDG00026	Mob-Demob of Dredger-Cutter/Trailing Suction for jobs above 5 upto 1,000,000 cu.m.	DR3	per cu.m.	21
27	DREDG00027	Mob-Demob of Dredger-Cutter/Trailing Suction for jobs above 1,000,000 cu.m.	DR3	per cu.m.	12

Rate + 15% Add

mitul1974@gmail.com

Sr. No.	Component Code	Name of Components	Group Code	Unit of Measurement	Unit Rate in Rs.
DREDGING					
1	DREDG00001	Dredging with Cutter Suction incl. mob-demob	DR1	Cu.M.	198
2	DREDG00002	Dredging with Trailer-suction incl. mob-demob	DR1	Cu.M.	216
3	DREDG00003	Dredging with Grab incl. mob-demob	DR1	Cu.M.	135
4	DREDG00004	Dredged material delivery by pump- pipe upto 100 m. distance	DR2	Cu.M.	9
5	DREDG00005	Dredged material delivery by pump- pipe upto 300 m. distance	DR2	Cu.M.	15
6	DREDG00006	Dredged material delivery by pump- pipe upto 1000 m. distance	DR2	Cu.M.	25
7	DREDG00007	Dredged material delivery by pipe upto 2000 m. distance	DR2	Cu.M.	36
8	DREDG00008	Dredged material delivery by barge upto 500 m. distance	DR2	Cu.M.	80
9	DREDG00009	Dredged material delivery by barge upto 2000 m. distance	DR2	Cu.M.	100
10	DREDG00010	Dredged material delivery by barge upto 5 nautical mile distance	DR2	Cu.M.	115
11	DREDG00011	Dredged material delivery by barge above 5 n. m. distance	DR2	Cu.M.	135
12	DREDG00012	Dredged material delivery by barge above 10 n. m. distance	DR2	Cu.M.	
13	DREDG00013	Dredged material delivery by trucks upto 1000 m. distance	DR2	Cu.M.	40
14	DREDG00014	Dredged material delivery by trucks upto 5000 m. distance	DR2	Cu.M.	60
15	DREDG00015	Dredged material delivery by trucks upto 10000 m. distanc	DR2	Cu.M.	80

GMB 13-14

Sr. No.	Component Code	Name of Components	Group Code	Unit of Measurement	Unit Rate in Rs.
		DREDGING			
16	DREDG00016	Dredger Toyo Pump mob-bemob to site upto 10 Km. distance	DR3	per unit	50000
17	DREDG00017	Dredger backhoe mob-bemob to site upto 10 Km. distance	DR3	per unit	50000
18	DREDG00018	Dredger cutter-suction mob- bemob to site upto 10 Km. distance incl. assembly	DR3	per unit	1,50,000
19	DREDG00019	Dredger cutter-suction mob- bemob to site upto 100 Km. distance excl.assembly	DR3	per Km	350
20	DREDG00020	Dredger cutter-suction mob- bemob to site above 100 Km. distance excl. assembly	DR3	per Km	300
21	DREDG00021	Dredger cutter/trailing-suction mob- bemob by sea to site upto 100 n.m. distance	DR3	per unit	2,50,000
22	DREDG00022	Dredger cutter/trailing-suction mob- bemob by sea to site above 100 n.m. distance	DR3	per n.m.	750
23	DREDG00023	Mob-demob of Dredger-Grab/Toyo pump/Backhoe for jobs upto 100,000 cu.m.	DR3	per cu.m.	18
24	DREDG00024	Mob-demob of Dredger-Grab/Toyo pump/Backhoe above 100,000 cu.m.	DR3	per cu.m.	10
25	DREDG00025	Mob-demob of Dredger-Cutter/Trailing Suction for jobs upto 500,000 cu.m.	DR3	per cu.m.	36
26	DREDG00026	Mob-demob of Dredger-Cutter/Trailing Suction for jobs above 5 upto 1,000,000 cu.m.	DR3	per cu.m.	18
27	DREDG00027	Mob-demob of Dredger-Cutter/Trailing Suction for jobs above 1,000,000 cu.m.	DR3	per cu.m.	10

List of all Team Members (In-House & Empanelled Key Experts)

Sl. No.	Name of the Key Expert	Proposed Position
1.	Sh. D. N. Deshmukh	Team Leader
2.	Sh. Prakash Krishnaji Khare	Port Planning and Infrastructure Specialist
3.	Dr. Santosh K. Sati	GIS/Remote Sensing Expert
4.	Sh. R. N. Bansal	Floodplain Specialist
5.	Sh. Bidyadhyar Thakur	Hydrographic Expert
6.	Sh. Prasanta Kumar Kundu	Soil Engineer/Foundation Engineer
7.	Capt. Gary Vaz	Traffic Surveyor
8.	Sh. M Ganesan	Transport Economist

Contact Authority:

Shri Jatinder Kumar
General Manager (PH & IW)
WAPCOS Limited
76-C, Sector-18,
Institutional Area,
Gurgaon - 122 015 (Haryana)

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.

जतिन्द्र कुमार /JATINDER KUMAR
मुख्य (सिविल) / Chief (Civil)
वाप्कोस लिमिटेड / WAPCOS LIMITED
(भारत सरकार का उपक्रम/A Govt. of India Undertaking)
76–सी, सैक्टर–18, गुड़गाँव–122015 (हरियाणा)
76-C, Sector-18, Gurgaon-122015 (Haryana)

75/522

K. Srivastava
जलीय मुख्य / Hydrographic Chief
भा.अ.ज.प्रा./ I.W.A.I.
(पोत परिवहन मंत्रालय,भारत सरकार)
(Ministry of Shipping Govt. of India)
ए 13, सेक्टर, नौएडा 201301(उ.प्र.)
A-13, Sector-1, NOIDA-201301

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.

जतिन्द्र कुमार /JATINDER KUMAR
मुख्य (सिविल) / Chief (Civil)
वाप्कोस लिमिटेड /WAPCOS LIMITED
(भारत सरकार का उपक्रम/A Govt. of India Undertaking)
76–सी, सैक्टर–18, गुड़गाँव–122015 (हरियाणा)
76-C, Sector-18, Gurgaon-122015 (Haryana)

कमां प्रशा... कु. श्रीवास्तव
Cdr. P. K. Srivastava
जलीय मुख्य / Hydrographic Chief
भा.अ.ज.प्रा./ I.W.A.I.
(पोत परिवहन मंत्रालय,भारत सरकार)
(Ministry of Shipping Govt. of India)

77/522

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

जतिन्द्र कुमार /JATINDER KUMAR
मुख्य (सिविल) / Chief (Civil)
वाप्कोस लिमिटेड /WAPCOS LIMITED
(भारत सरकार का उपक्रम/A Govt. of India Undertaking)
76–सी, सैक्टर–18, गुड़गाँव–122015 (हरियाणा)
76-C, Sector-18, Gurgaon-122015 (Haryana)

कमां प्रशान्त कु. श्रीवास्तव
Cdr. P. K. Srivastava
जलीय मुख्य / Hydrographic Chief
भा.अ.ज.प्रा./ I.W.A.I.
(पोत परिवहन मंत्रालय,भारत सरकार)
(Ministry of Shipping Govt. of India)

78/522

Hydrographic survey may b as per the International Standards including the following for finding the poter l Inland Waterways for inland navigation:-

(i) The detailed hydrog s to be carried out in WGS'84 datum.

(ii) The horizontal co 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-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

जतिन्द्र कुमार /JATINDER KUMAR
मुख्य (सिविल)/Chief (Civil)
वाप्कोस लिमिटेड/WAPCOS LIMITED
(भारत सरकार का उपक्रम/A Govt. of India Undertaking)
76-सी, सैक्टर-18, गुड़गाँव-122015 (हरियाणा)
76-C, Sector-18, Gurgaon-122015 (Haryana)

Cdr. P. K. S
जलीय मुख्य / Hydro Chief
भा.अ.ज.प्रा. / I.W.A.I.
(पोत परिवहन मंत्रालय, भारत सरकार)
Ministry of Shipping Govt. of India)
13, सेक्टर, नौएडा 201301(उ.प्र.)
NOIDA-201301 (U.P.)

79/522

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-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.

जतिन्द्र कुमार /JATINDER KUMAR
मुख्य (सिविल) / Chief (Civil)
वाप्कोस लिमिटेड / WAPCOS LIMITED
(भारत सरकार का उपक्रम/A Govt. of India Undertaking)
76–सी, सैक्टर–18, गुड़गाँव–122015 (हरियाणा)
76-C, Sector-18, Gurgaon-122015 (Haryana)

कमां प्रशान्त कु. श्रीवास्तव
Cdr. P. K. Srivastava
जलीय मुख्य / Hydrographic Chief
भा.अ.ज.प्रा. / I.W.A.I.
(पोत परिवहन मंत्रालय, भारत सरकार)
(Ministry of Shipping Govt. of India)

80/522

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.

कमांडर प्रशान्त कु. श्रीवास्तव
Cdr. P. K. Srivastava
जलीय मुख्य / Hydrographic Chief
भा.अ.ज.प्रा./ I.W.A.I.
(पोत परिवहन मंत्रालय,भारत सरकार)
(Ministry of Shipping Govt. of India)
ए 13, सेक्टर, नौएडा 201301(उ.प्र.)
A-13, Sector-1, NOIDA-201301 (U.P.)

जतिन्द्र कुमार /JATINDER KUMAR
मुख्य (सिविल) / Chief (Civil)
वाप्कोस लिमिटेड / WAPCOS LIMITED
(भारत सरकार का उपक्रम/A Govt. of India Undertaking)
76–सी, सैक्टर–18, गुड़गाँव–122015 (हरियाणा)
76-C, Sector-18, Gurgaon-122015 (Haryana)

81/522

rmanent structures located within this corridor are also required to be indicated on e report & charts.

l prominent shore features (locks, bridges, aqueducts, survey pillars if available etc) ..d 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. (

जतिन्द्र कुमार /JATINDER KUMAR
मुख्य (सिविल) / Chief (Civil)
वाप्कोस लिमिटेड / WAPCOS LIMITED
(भारत सरकार का उपक्रम/A Govt. of India Undertaking)
76–सी, सैक्टर–18, गुड़गाँव–122015 (हरियाणा)
76-C, Sector-18, Gurgaon-122015 (Haryana)

कमां प्रशान्त कु. श्रीवास्तव
Cdr. P. K. Srivastava
जलीय मुख्य / Hydrographic Chief
भा.अ.ज.प्रा./ I.W.A.I.
(पोत परिवहन मंत्रालय,भारत सरकार)
(Ministry of Shipping Govt. of India)
ए 13, सेक्टर, नौएडा 201301(उ.प्र.)

92/322

vailable) are also to be included in the report. Brief write up based on visual observation, photographs and information from State Irrigation Deptt. and local urces.

e chart shall also be suitably updated with prominent land features from the Topo-ets/site. Available Survey of India (SOI) Topographic sheet will be shared with cessful Consultant on receipt of Undertaking. Satellite imageries are not available IWAI for the designated area. Route map and survey plan will be provided by I to the successful Consultant.

aw 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.

जातेन्द्र कुमार /JATINDER KUMAR
मुख्य (सिविल) / Chief (Civil)
वाप्कोस लिमिटेड / WAPCOS LIMITED
भारत सरकार का उपक्रम/A Govt. of India Undertaking)
76–सी, सैक्टर–18, गुड़गाँव–122015 (हरियाणा)
76-C, Sector-18, Gurgaon-122015 (Haryana)

Cdr. P. K. Srivastava
जलीय मुख्य / Hydrographic Chief
भा.अ.ज.प्रा./ I.W.A.I.
(पोत परिवहन मंत्रालय, भारत सरकार)
(Ministry of Shipping Govt. of India)

जातेन्द्र कुमार /JATINDER KUMAR
WAPCOS LIMITED

83/522

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 a...

जतिन्द्र कुमार /JATINDER KUMAR
मुख्य (सिविल) / Chief (Civil)
वाप्कोस लिमिटेड / WAPCOS LIMITED
(भारत सरकार का उपक्रम/A Govt. of India Undertaking)
76–सी, सैक्टर–18, गुड़गाँव–122015 (हरियाणा)
76-C, Sector-18, Gurgaon-122015 (Haryana)

कमांडर प्रशान्त कु. श्रीवास्तव
Cdr. P. K. Srivastava
जलीय मुख्य / Hydrographic Chief
भा.अ.ज.प्रा./ I.W.A.I.
(पोत परिवहन मंत्रालय,भारत सरकार)
(Ministry of Shipping Govt. of India)
ए 13, सेक्टर-1, नौएडा 201301(उ.प्र.)
A-13, Sector-1, NOIDA-201301 (U.P.)

84/522

	Sl. No	Activity	Cluster-8 Time in weeks**
Stage-I	a)	Mobilization of the Team and submission of Inception Report (2 copies)	15
	b)	Submission of Draft Feasibility Report (3 copies)	18
	c)	Comments from IWAI	20
	d)	Presentation and Submission of Final Pre-feasibility Report (3 copies)	22
Stage-II	a)	Acceptance of Stage-I report and go ahead for Stage-II by IWAI	24
	b)	Submission of Hydrographic Survey Charts and report (3 copies)	38
	c)	Submission of Draft Detailed Project Report (3 copies)	46
	d)	Receipt of comments of IWAI on Draft DPR.	48
	e)	Submission of Final Detailed Project Report (10 copies) after incorporating final comments of IWAI.	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 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:**

जतिन्द्र कुमार /JATINDER KUMAR
मुख्य (सिविल) / Chief (Civil)
वाप्कोस लिमिटेड / WAPCOS LIMITED
(भारत सरकार का उपक्रम/A Govt. of India Undertaking)

प्रशान्त कु. श्रीवास्तव
Srivastava
जलीय मुख्य / Hydrographic Chief
भा.अ.ज.प्रा./ I.W.A.I.
(पोत परिवहन मंत्रालय, भारत सरकार)
(Ministry of Shipping Govt of India)
ए 13, सेक्टर, नौएडा 201301
A 13, Sector-1, NOIDA-201301 (U.P.)

जतिन्द्र कुमार /JATINDER KUMAR
WAPCOS LIMITED

85/522

Sl. No	Key Professionals	Qualification Criteria
		• 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 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.

जतिन्द्र कुमार /JATINDER KUMAR
मुख्य (सिविल) / Chief (Civil)
वाप्कोस लिमिटेड /WAPCOS LIMITED
भारत सरकार का उपक्रम/A Govt. of India Undertaking)
76-सी, सैक्टर–18, गुड़गाँव–122015 (हरियाणा)
76-C, Sector-18, Gurgaon-122015 (Haryana)

कमां प्रशान्त कु. श्रीवास्तव
Cdr. P.K. Srivastava
जलीय मुख्य / Hydrographic Chief
भा.अ.ज.प्रा./ I.W.A.I.
(पोत परिवहन मंत्रालय,भारत सरकार)
(Ministry of Shipping Govt. of India)
ए 13, सेक्टर, नौएडा 201301(उ.प्र.)
A-13, Sector-1, NOIDA-201301 (U.P.)

86/522

Sl. No	Key Professionals	Qualification Criteria
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.

NOTE1:-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:- 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 accessed by prospective bidder.

जातेन्द्र कुमार /JATINDER KUMAR
मुख्य (सिविल) / Chief (Civil)
वाप्कोस लिमिटेड /WAPCOS LIMITED

कमा. प्रदीप कु. श्रीवास्तव
Cdr. P. K. Srivastava
जलीय मुख्य / Hydrographic Chief
भा.अ.ज.प्रा./ I.W.A.I
(पोत परिवहन मंत्रालय,भारत सरकार)
of Shipping Govt. of India

जतिन्द्र कुमार /JATINDER KUMAR
मुख्य (सिविल) / Chief (Civil)
वाप्कोस लिमिटेड /WAPCOS LIMITED