TRACTEBEL

ENGIE

CONSULTANCY SERVICES FOR PREPARATION OF TWO STAGE DPR OF CLUSTER VI OF PROPOSED 53 NATIONAL WATERWAYS

FEASIBILITY REPORT-UDAYAVARA RIVER (16KM) - (NW-105)
Project No. P.009050
Document No. P.009050-W-10204-D11
Final Report

Karnataka and Kerala | INDIA

Inland Waterways Authority of India (IWAI) - Government of India Ministry of Shipping - Head Office

29 September 2016

Report

Rev.02

RESTRICTED

CATEGORY-II WATERWAYS: STAGE-I REPORTS

SALIENT FEATURES AT A GLANCE

<table>
<tr><th>Sl.No</th><th>Particulars</th><th>Details</th></tr>
<tr><td>1.</td><td>Name of Consultant</td><td>Tractebel Engineering Pvt. Ltd.</td></tr>
<tr><td>2.</td><td>Cluster Number & State(s)</td><td>Cluster-VI & Karnataka</td></tr>
<tr><td>3.</td><td>Waterway stretch, NW#</td><td>Udayavara River (16 km), NW-105</td></tr>
<tr><td>4.</td><td><u>Navigability status</u></td><td></td></tr>
<tr><td>a)</td><td>Tidal & non tidal portions (from…….to, length, average tidal variation)</td><td>Fully Tidal (Chainage 0.0km to Chainage 15.19 km, average tidal variation of 0.9m)
Tidal Variation is 1.68m/0.03m</td></tr>
<tr><td>b)</td><td>LAD status (w.r.t.CD)
i) Survey period (10th Feb., 2016)
ii) < 1.0 m (km)
iii) 1.0 m to 1.5 m (km)
iv) 1.5 m to 2.0 (km)
v) >2.0 m (km)</td><td>
<table>
<tr><th>0-5 (km)</th><th>5-10 (km)</th><th>10-15.19 (km)</th><th>Total (km)</th></tr>
<tr><td>1.91</td><td>3.52</td><td>0.32</td><td>5.75</td></tr>
<tr><td>0.78</td><td>1.01</td><td>1.66</td><td>3.45</td></tr>
<tr><td>0.75</td><td>0.26</td><td>1.25</td><td>2.26</td></tr>
<tr><td>1.56</td><td>0.21</td><td>1.96</td><td>3.73</td></tr>
</table>
</td></tr>
<tr><td>c)</td><td>Cross Structures
i) Dams, weirs, barrage etc. (total number; with navigation locks or not)
ii) Bridges, Power cables etc. (total number; range of horizontal and vertical clearances)</td><td>Cross Structures
i) Nil
ii) 4 no. of Bridges, HC: 20 m , VC: 2.0 m to 3.5 m
1 no. HT line, HC: 25 m , VC: 10.5 m
3 no. Electric Line, HC: 25 m to 30 m , VC: 3 m to 10.5 m
1 no. Cable, HC : 30.0 m, HC: 30.0m
Out of 4 bridges, one bridge is under construction (Ch 1.5km).
Apart from above, fifth bridge is located at the end (Ch 15.19 km, HC: 20 m, VC: 4.0m).
(VC are above MHWS / HFL)</td></tr>
<tr><td>d)</td><td>Avg. discharge & no. of days</td><td>Since the entire stretch is tidal, discharge of the river is not relevant for navigability.</td></tr>
<tr><td>e)</td><td>Slope (1 in……)</td><td>1 in 5333</td></tr>
<tr><td>5.</td><td><u>Traffic Potential</u></td><td></td></tr>
<tr><td>a)</td><td>Present IWT operations, ferry services, tourism, cargo, if any</td><td>Ferry Services between Malpe- Padukar is operational.</td></tr>
<tr><td>b)</td><td>Important industries within 50 km</td><td>Manipal Media & Network Pvt. Ltd, Suzlon Wind International Ltd, SE Blades Ltd (Formerly S.E Composite Ltd.), Tebma Shipyards Limited, Udupi Power Corporation Limited.
For More details refer Annexure 4.1</td></tr>
<tr><td>c)</td><td>Distance of Rail & Road from Industry</td><td>Both Rail & Road network is available within 5.0km of distance from the nearest industrial area.</td></tr>
<tr><td>6.</td><td>Consultant’s recommendation for going ahead with Stage-II (DPR preparation)</td><td>Recommended for development as Class-II waterway for Ch 0.00 km to 16.00km.
MHWS –1.68m, HTL—1.68m, LTL—0.03m, Average Tidal Variation—0.90m, Port Name—New Mangalore Port.</td></tr>
</table>

Date: 29-09-2016

Consultant signature

CONSULTANCY SERVICES FOR PREPARATION OF TWO STAGE DETAILED PROJECT REPORT OF PROPOSED 53 NATIONAL WATERWAYS

UDAYAVARA RIVER

(NW-105)

CLUSTER - VI

KARNATAKA AND KERALA, INDIA

			Arun Kumar	Shaloo Puri	
02	29.09.2016	For Acceptance	Arun Kumar	Shaloo Puri	Mithilesh Kumar
Rev.	Date	Description	Prepared By	Checked By	Approved By

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LIST OF ABBREVIATIONS

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

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EXECUTIVE SUMMARY

A. Introduction

The available water resource in the globe can be used and utilized in various ways whereas Inland Water Transport (IWT) is one among them. The water bodies can be utilized for IWT also. India has been bestowed with vast water bodies consisting of rivers, canals, backwaters, creeks and lakes and having the potential for development of efficient waterways transport network. However, when compared to the development of IWT in certain countries, the same is to be geared up in our country. IWT mode remains underdeveloped and its share in overall internal cargo transport remains abysmally low. IWT sector presently has a meager modal share of 0.1% in India compared to 42% in European Union, 8.7% in China and over 8% in USA. This is a great economic opportunity loss to the country.

Based on various earlier studies on IWT, subsequent to the recommendations of National Transportation Policy Committee (NTPC 1980) and in order to give more thrust to the Inland water transport mode duly keeping in view the major benefits of this mode viz., Cheaper operational cost on comparison / Higher fuel efficiency / Eco friendly nature of the mode, the IWT development system is under consideration in our country. The potential through IWT mode can be used as an alternate and supplementary mode of transportation in certain favorable conditions.

India has about 14,500 km of navigable waterways which comprise of rivers, canals, backwaters, creeks, etc., out of which about 5200 km of the river and 4000 km of canals can be used by mechanized crafts. About 55 million tonnes of cargo is being moved annually by Inland Water Transport (IWT). Its operations are currently restricted to a few stretches in the Ganga-Bhagirathi-Hooghly Rivers, the Brahmaputra, the Barak River, the rivers in Goa, the backwaters in Kerala, inland waters in Mumbai and the deltaic regions of the Godavari - Krishna Rivers.

Inland Waterways Authorities of India (IWAI), a statutory body under Ministry of Shipping, Government of India intends to explore the navigational potential of newly declared national waterways across the country for year round commercial navigation.

National Waterways Act, 2016 has come into force 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 and for matters connected therewith or incidental thereto. There are now a total of one hundred and eleven national waterways altogether across the country which includes five existing national waterway besides 106 newly declared waterways as national waterway through National Waterways Act, 2016. The objective is to promote

integrated development of waterways throughout the country so as to have a considerable and maximum mode shift to IWT which can reduce the density in rail/road apart from the environmental benefits of IWT mode.

It has been planned to study in two stages comprising of feasibility study in stage-I followed by preparation of DPR in stage-II and recommending thereafter the possibility of composite and integrated development of proposed newly declared national waterway to achieve navigation and to develop water transport facilities. This report presents study detail of stage-I of national waterway of Udayavara River in the state of Karnataka. Udayavara River has been designated as national waterway-105 with its description in the gazette notification as, Udayavara 16 km length of the river from Arabian Sea Mouth at Malpe Lat 13°20'57.24"N, Lon 74°41'28.22"E to Bridge near Manipura Lat 13°17'32.70"N, Lon 74°46'25.56"E.

Sl No.	Introductory Consideration	Description of the River
1	Name of the river / canal	Udayavara River (NW-105)
2	State/ District through which river passes	The Udayavara River mostly passes through Udipi District of Karnataka State.
3	Length of the river / canal	The length of the Udayavara main stream in the catchment from the origin to the outfall in the Arabian Sea is about 53km. Out of the total length of 53 km of river, 16 km length of the river from Arabian Sea Mouth at Malpe Lat 13°20'57.24"N, Lon 74°41'28.22"E to Bridge near Manipura Lat 13°17'32.70"N, Lon 74°46'25.56"E has been declared as new national waterway and proposed to undertake the two stage DPR. The index map of Udayavara River showing proposed waterway stretch, topographic features and road networks are shown in **Figure 1.1 & Figure 1.2**.
4	Catchment Area	The total catchment area of Udayavara River basin is about 492sqkm

B. Methodology Adopted

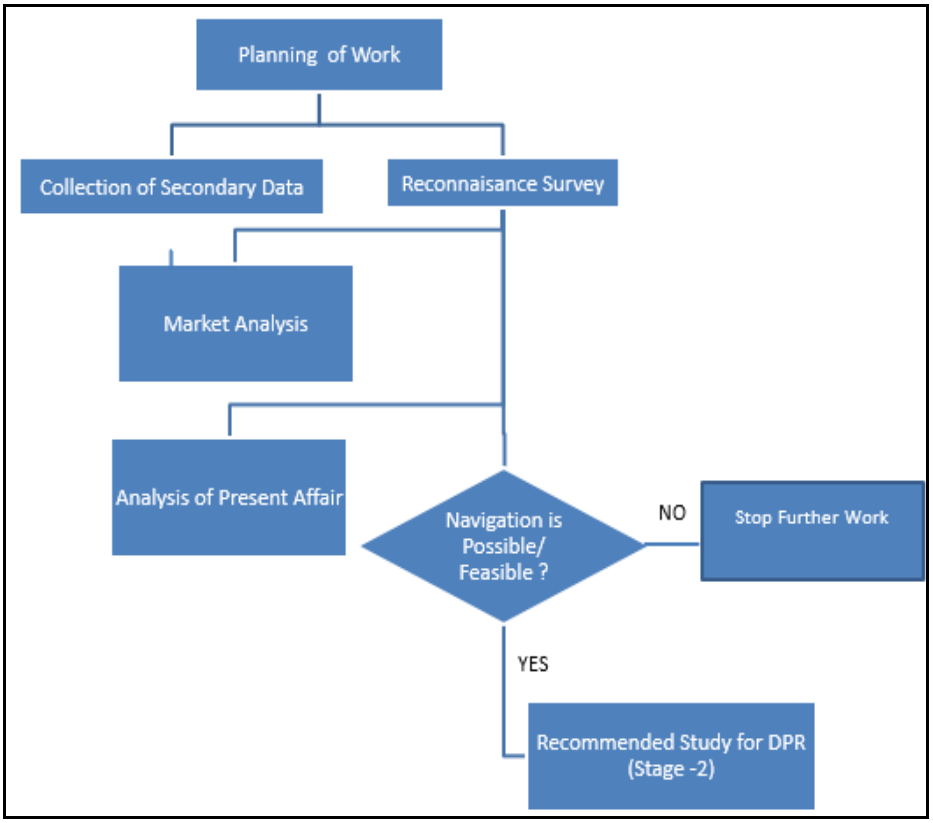
The feasibility of the navigation in the considered waterway has been examined from the following three perspectives:

A. The physical system: - It includes the study of hydrographic characteristics of the channel/stability of channel/water depth/width of river/ LAD/ port/ infrastructure/ cross over structure/ sediment analysis/ physical constraints/ hindrances etc.

B. The current functions: - It covers the current utilization of the river – existing navigation/ ferry services/ jetties/ cross over structures/ irrigation facilities/ dam/ barrage/ canals/ fishery/mining etc.

C. The market potential:- This aspect covers ferry services, existing cargo movement, existing rail & road network, population served, local produces, industrial establishment, future potential, transfer of cargo movement to inland waterways transport system etc.

Work Execution for stage-I study has been depicted through following diagram.



Execution Diagram of Stage I

C. Collection of Data and Analysis

Reconnaissance survey has been conducted through expert agency for collection of primary data and various secondary data have also been collected from different sources e.g. benchmark, G & D data & chart datum from IWAI, Govt. of India / MSME, Govt. of India/ Cargo Movement Data for the Year 2014 and 2015 provided by IWAI, Govt. of India/ Directorate of Ports & IWT, Karnataka / Directorate of Industries, Karnataka / New Mangalore Port office / Old Mangalore Port office / WRD, Govt. of Karnataka / Malpe Port office / IOCL, Govt. of India undertaking / respective district authorities of State Govt. of Karnataka and information available in the public domain through web.

A review of the existing data available with the State Agencies and Central Water Commission for the proposed Inland Waterways has been done for determining the nature, extent, adequacy, validity of the available data and identifying the data gaps.

D. Observations and Inferences

Following conclusions have been derived for establishing the navigability of the proposed waterway;

1. The river length as given by IWAI is 16.0km, whereas the total surveyed length along the river to capture the thalweg is only 15.19km. The initial 570m could not be surveyed and the distance surveyed to the end of the stretch is only 15.19km. The deepest channel route has been reckoned as 15.19km. All inferences derived for identifying the navigable length had been derived with reference to deepest channel length (15.19km).
2. The river is tidal affected for full length under study and relevant chart datum has been used. 25% of the surveyed length has water depth more than 2 m i.e. for about 3.73km, however not continuous.
3. Feasibility study suggests that the river is generally navigable without any obstruction, however after due modification to the Power cable lines / Bridges. Also after attending the dredging and smoothening of bends.
4. The lengths of the waterway, where a depth more than 2.0m, 1.5m and 1.0m with reference to the Chart Datum have been compiled in the main report. The brief of this is given in **Table 3.6** and being reproduced below:

Chainage (Km)	Draft Available		Length of River (Km)			
	Max. (m)	Min. (m)	>2m	1.5-2.0m	1-1.5m	<1m
-0.57-0.0	Could not be approached by the survey boat due to the rough weather condition. However, sufficient water depth is available for navigation in this stretch					
0.0-5	5.71	-0.17	1.56	0.75	0.78	1.91
5-10	4.77	-0.17	0.21	0.26	1.01	3.52
10-15.19	3.12	0.1	1.96	1.25	1.66	0.32
Total			**3.73**	**2.26**	**3.45**	**5.75**

5. Five Power cables are crossing the study stretch, which are to be modified for safe navigation according to the required standards.
6. Three Bridges are crossing the study stretch, which are to be modified for safe navigation to meet the required standards. Further, the clearance requirements are to be appraised to the concerned bridge authorities to maintain the standards for the bridge under construction.

The above description & classification of the waterway has been presented schematically based on the survey observation and duly keeping in view the river classification criteria in **Table 3.15** as reproduced below:

Criteria	Classification																		
Length of waterway from start (km)	1	2	2	3	4	5	6	6	7	8	9	10	10	11	12	13	14	14	15	16
Chainage length in %	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
Depth availble	C-II																			
Raod Bridge Vert. Clearance	All Class															Needs Modification				
Raod Bridge Hor. Clearance	All Class															Needs Modification				
HT Line Vert. Clearance	All Class															Needs Raising of HT Base				
Bend Radius	C-I																			
Index	All Class		Class-V		Class-IV		Class-III		Class-II		Class-I									

E. Cargo Feasibility

Based on preliminary assessment a possibility of moving cargo through Udayavara River is very limited.

Potential of Passenger movement exists and in the catchment area and is expected to be 4-5 lakhs and Ferry points and Fleet and dredging will be required.

Tourism potential also exists in the River.

These are very preliminary observations and will be studied in detail at DPR stage.

F. SWOT Analysis

SWOT analysis has been carried out for deriving meaningful information specifying the objective of the study for development of the waterway for year round commercial navigation and identifying the internal & external factors that are favorable and unfavorable in the development of the waterway.

Strength

1. 27% of the 16km (15.19km + 0.57km) has waterway having more than 2m water depth available for navigation.
2. More than 2.0m is available for a length of 4.3km (3.73kms + 0.57kms) in the proposed waterway, however not continuous. Shoals have been observed, which may have to be attended by Dredging.
3. The maximum tidal fluctuation of 1.68m has been observed and this will strengthen the safe mobility of vessels in the waterway, using the diurnal tidal window.
4. Approximately 7 lacs of population is residing in the Udupi Taluka.
5. Malpe Port is connected to the Udayavara River.
6. M/s Tebma Ship Yard is on the banks of Udayavara River.
7. Director, IWT, Karnataka State study assessed 8 Ferry Routes (11 Ferry points) to cater to the passenger mobility through IWT to an extent of 4.9 lacs in next 10 years.
8. Fishing activity is on in the study stretch of Udayavara River.
9. Good Road and Rail connectivity exists in the vicinity of the study stretch.

Weakness

1. Presently, there is no IWT movement.

Opportunity

1. 27% of the 16km is having more than 2m water depth available for navigation, which can be used advantageously for the mobility of hinterland cargo.
2. 2.0m water depth is available for about 4.3kms, which can be used advantageously for the mobility of hinterland cargo, since the balance stretch can be managed by Dredging activity.
3. The maximum tidal fluctuation of 1.68m, as observed, can be an opportunity for the safe mobility of vessels in the waterway.
4. The interconnectivity to Malpe Port may establish through IWT traffic.
5. Ro – Ro operation, if established, decongestion of Udupi Town may be a possibility.
6. The hinterland population will get direct or indirect benefit with the development of IWT in this river.
7. The existing fishing activity (through the Malpe Port) will get support with the development of this River.
8. The planning by local Government on 8 Ferry Routes (11 Ferry points) to cater to the passenger mobility through IWT to an extent of 4.9 lacs in next 10 years on the Udayavara River, Passenger mobility will flourish, if the Waterway is developed.
9. The presence of M/s Tebma Ship Yard on the banks of Udayavara River may attract good mobility of Repair Infrastructure.
10. The present Rail and Road connectivity though competing with IWT may also be an opportunity for creating an efficient intermodal hub for IWT.
11. Policies are to be firmed up for development of IWT in this stretch.

Threat

1. The Panvel Edappally Highway in the study area may create competing mode of transport.
2. NH 17, SH 66 and SH 67 in the vicinity may be a competing mode, if not effectively used for intermodal connectivity.
3. The Udayavara River banks covered by marginal mangrove trees in certain places may involve some socio-environmental issues and may require statutory approvals and clearances to construct the jetties/ terminals/ ports/ intermodal connectivity.

G. Development Cost (Tentative)

The reconnaissance survey data with regard to physical constraints may have cost implications for making the river stretch navigable to the required standards. Henceforth the development of the proposed national water way involves physical interference in the form of dredging, construction of terminals at the identified locations, modification of HT Lines at crossing locations to provide a minimum vertical clearance of 20.1m (with respect to 220 kVA) or the case may be combined with some unforeseen expenses. Moderate dredging effort has been envisaged with an average dredging of 1.0m required in 11.5m of the length of proposed waterway reckoned with reference to ascertained data. The cost of dredging has been considered @ INR 230 per cum. The cost of a small terminal has been estimated @ INR 10.0 crore each. The cost of modification of

one transmission tower has been estimated to be INR 20.00 lacs each and the stringing cost across the pair of towers shall be INR 4.0 lacs per pair of towers. The total estimated cost for modification to the Five power cables shall be INR 5 x 44.0 lacs = INR 220 lacs. Three nos. of Bridges may have to be modified with reconstruction at an estimated cost of INR 1.5 crores each amounting to INR 4.5 crores. The cost of navigational aids for day/night navigation has been considered as INR 150 lacs. 10% of the amount for dredging, terminal construction and night navigation has been envisaged as unforeseen. The tentative total cost of development to make the river navigable round the year to achieve safe navigation for the required classification of vessel mobility has been estimated to INR 31.70 crore. (Table 5.1 is reproduced below)

Sl. No.	Name of Waterway	Length of Waterway	Dredging Required (w. r. to 2m draft & 40.0m width)	Dredging Cost @ INR 230/ cum	Terminal Proposed	Terminal Cost @ INR 10 Cr each	Cost of Modification of Transmission line	Night Navigation	Total cost including 10% unforeseen
		(km)	(km)	INR in Cr.)	(Nos)	(INR in Cr.)	(INR in Cr.)	(INR in Cr.)	(INR in Cr.)
1	Udayavara River	16.00	11.5	10.60	1	10.00	6.70	1.50	31.70

H. Classification of Waterway

The Ministry of Shipping, Road Transport and Highways (Inland Waterways Authority of India) has classified the Inland waterways into seven categories for rivers and canals for safe plying of self propelled vessels up to 2000 DWT and tug-barge formation in push tug + four barge units of carrying capacity up to 8000 DWT (Ref: IWAI, Gazette Notification dated 26th January 2007).

As per the above Classification of Inland Waterways, the entire waterway of Udayavara River (NW-105) of 16km length has been classified based on the available minimum water depth, bottom width, minimum vertical and horizontal clearances of cross over structures and bend radius in the river. The classification of Udayavara River is described below. (Table 5.2 is reproduced below).

Chainage (km)	Minimum Depth (m)	Bottom Width (m)	Minimum Vertical Clearance (m)	Minimum Horizontal Clearance (m)	Bend Radius (m)	Classification of Waterway (Proposed)
0.0 – 16.0	- 0.17	150	2.0 (Bridge) 3.0 (Power Cable)	20 (Bridge) 25 (Power Cable)	180	**Class – II**

The entire study stretch of the waterway is amenable for development as **Class II** waterway as explained above. However, considerable Dredging is required. Smoothening of the bends may be essential.

The above stretch of the waterway, hence, can be considered under Class II, which is navigable without any hindrance and shall be used for plying self-propelled vessel of carrying capacity up to 300 DWT (approximate size 45m overall length, 8m moulded breadth and 1.2m loaded draft) or one tug and two barges combination of 600 DWT (approximate size 110m overall length, 8m breadth and 1.2m loaded draft).

I. Recommendation

The national waterway-105 of Udayavara River has been identified having potential for development as waterway of Class II for the entire study stretch of 16km, as described above. This stretch of the river is, therefore, recommended for stage-II study for preparation of Detailed Project Report (DPR) to establish the viability for implementation as a project.

Accordingly, the national waterway NW-105 of Udayavara River is proposed for development as **Class II** waterway in the stretch of the waterway as depicted below:

River Stretch	0.00km 16.00km
Classification	**Class-II**
Horizontal clearance (m)	40
Vertical clearnce (m)	5
Minimum Depth (m)	1.4
Bottom Width (m)	40
Self Propelled Vessel	
Dead Weight Tonnage	300
Vessel size (m)	45 x 8 x 1.2
Tug + Barge	
Dead Weight Tonnage	600
Vessel size (m)	110 x 8 x 1.2

Note:

1. All vertical clearances of cross over structures have been reckoned with MHWS of 1.68m above MSL and details are described in Para 3.3.5.
2. The depths have been reckoned in the full stretch with reference to the chart datum of 0.95m (below mean sea level).
3. MHWS –1.68m, HTL—1.68m, LTL—0.03m, Average Tidal Variation—0.90m, Port Name—New Mangalore Port.

CHAPTER 1: INTRODUCTION

1.1 Introduction to Inland Waterways

The Inland Waterways Authority of India (IWAI) came into existence on 27th October 1986 for development and regulation of inland waterways for shipping and navigation. Inland Waterways Authority of India (IWAI) is the statutory authority in charge of the waterways in India. The Authority primarily undertakes projects for development and maintenance of IWT infrastructure on national waterways through grant received from Ministry of Shipping. The head office of the Authority is at Noida, UP. It does the function of building the necessary infrastructure in these waterways, surveying the economic feasibility of new projects and also administration. The Authority also has its regional offices at Patna, Kolkata, Guwahati and Kochi and sub-offices at Allahabad, Varanasi, Bhagalpur, Farakka, Swaroopganj, Hemnagar, Dibrugarh (Assam), Dhubri, Kollam, Vijayawada (Andhra Pradesh) and Bhubaneshwar (Odisha).

India has about 14,500 km of navigable waterways which comprise rivers, canals, backwaters, creeks, etc., out of which about 5200 km of the river and 4000 km of canals can be used by mechanized crafts. About 55 million tonnes of cargo is being moved annually by Inland Water Transport (IWT), a fuel - efficient and environment - friendly mode. Freight transportation by waterways is highly underutilized in India compared to other large countries and geographic areas like the United States, China and the European Union. Its operations are currently restricted to a few stretches in the Ganga-Bhagirathi-Hooghly Rivers, the Brahmaputra, the Barak River, the rivers in Goa, the backwaters in Kerala, inland waters in Mumbai and the deltaic regions of the Godavari - Krishna Rivers.

Besides these organized operations by mechanized vessels, country boats of various capacities also operate in various rivers and canals and substantial quantum of cargo and passengers are transported in this unorganized sector as well. The total cargo moved (in tonne kilometers) by the inland waterway was just 0.1% of the total inland traffic in India. There now are one hundred and eleven national waterway across the country which includes five existing national waterway besides 106 waterway which have been declared recently as national waterways through a central legislation.

1) National Waterway 1

The Ganga - Bhagirathi - Hooghly river system between Haldia (Sagar) & Allahabad.

Estd.	= October 1986.
Length	= 1620 km
Fixed terminals	= G R Jetty 2, Kolkata, Pakur, Farakka, Gaighatt (Patna) & Allahabad.
Floating terminals	= Kolkata, Diamond Harbour, Katwa, Bahrampur, Jangipur, Bhagalpur, Semaria, Doriganj, Ballia, Ghazipur, Varanasi, Chunar, Allahabad.
Cargo Movement	= 3 million tonnes Approx.

2) National Waterway 2

Sadiya — Dhubri stretch of Brahmaputra river.

Estd = September 1988.

Length = 891 km

Fixed terminals = Pandu

Floating terminals = Dhubri, Jogighopa, Tezpur, Silghat, Jamgurhi, Bogibil, Dibrugarh, Saikhowa and Sadiya

Cargo Movement = 2.0 million tonnes Approx.

3) National Waterway 3

Kottapuram-Kollam stretch of the West Coast Canal, Champakara Canal and Udyogmandal Canal.

Estd = February 1993

Length = 205 km

Fixed terminals = Kottapuram, Aluva, Bolgatty, Willingdon Island, Maradu (Kochi), Cherthala (Vaikom), Thannermukkom, Alappuzha, Thrikkunnapuzha, Kayamkulam (Ayiramthengu), Chavara and Kollam.

Cargo Movement = 1.0 million tonnes Approx.

4) National Waterway 4

Kakinada–Pondicherry stretch of canals and the Kaluvelly Tank, Bhadrachalam – Rajahmundry stretch of River Godavari and Wazirabad – Vijayawada stretch of River Krishna.

Estd = November 2008

Length = 1095 km

Tentative Cargo Potential = 2.0 million tonnes Approx which can go up to 4.0 million tonnes in next 15 years or so.

5) National Waterway 5

Talcher–Dhamra stretch of the Brahmani River, the Geonkhali - Charbatia stretch of the East Coast Canal, the Charbatia–Dhamra stretch of Matai river and the Mangalgadi - Paradip stretch of the Mahanadi River Delta.

Established = November 2008

Length = 623 km

Tentative Cargo Potential = Coal from Talcher to Dhamra and Paradip ports is the most important potential cargo for this waterway. Immediately after the development of the waterway, it is estimated in the DPR that about 11.0 million tonnes of cargo can be transported per year which can go up to 23.0 million tonnes in next 15 years or so.

6) 106 Newly Declared National Waterways

For newly declared national waterways, IWAI is carrying out feasibility studies /DPR preparation through a number of consultants.

1.2 Project Background of the Present Study

IWAI, Ministry of Shipping, 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 study in two stages comprising of feasibility study followed by preparation of DPR and recommending thereafter the possibility of composite and integrated development of proposed waterways to achieve navigation and to develop water transport facilities across India.

106 more waterways across the country have been declared as new national waterways through a bill passed in the Parliament in March 2016 with contention that the measure is aimed at providing a cheaper mode of transport and reducing traffic burden on the roads. These 106 new national waterways will be in addition to the five existing National Waterways. The proposed legislation is aimed at integrated development of inland waterways throughout the country since the waterways is "lagging behind" road and rail sectors. Promotion of waterways is a priority as it is a cheaper mode of transportation, being economical compared to roads and railways, and at the same time it is environment friendly too.

Feasibility study shall examine the viability of navigational routes and therefore potential to develop waterway transport facility is to be established. This shall be followed by preparation of Detailed Project Report (DPR) for those feasible waterways, which would include detailed hydrographic surveys and investigation, traffic survey, proposed location for terminals and cost assessment etc. Tractebel Engineering had been awarded two of the clusters i.e. Cluster-6 & Cluster-7 consisting of the rivers/canals/creeks for two stage studies, screen the rivers with respect to navigational feasibility and subsequently prepare a Detailed Project Report for the development of Inland Waterways. This report deals with the study of **Cluster-6** which consists of rivers/creeks of Karnataka and Kerala (length-487 km) and described in **Table 1.1** as shown below:-

Table 1.1: List of Rivers/Canals in the State of Karnataka and Kerala under Cluster-6 (Length-487.0 km)

Sl. No.	Name of Rivers/ Canals	National Water Way (NW)	Length (km)	State
1.	West Coast Canal	3	160	Kerala
2.	Alappuzha- Changanassery Canal	8	28	Kerala
3.	Alappuzha- Kottayam – Athirampuzha Canal	9	38	Kerala
4.	Kottayam-Vaikom Canal	59	28	Kerala
5.	Gurupur River	43	10	Karnataka
6.	Kabini River	51	23	Karnataka
7.	Kali River	52	54	Karnataka

Sl. No.	Name of Rivers/ Canals	National Water Way (NW)	Length (km)	State
8.	Netravathi	74	78	Karnataka
9.	Panchagangavali (Panchagangoli) River	76	23	Karnataka
10.	Sharavati River	90	29	Karnataka
11.	**Udayavara River**	**105**	**16**	**Karnataka**
	Total		**487**	

The layout plan of the all eleven rivers/canals covered in **Cluster-6**, showing the location and Index Map of Udayavara River is shown in **Figure 1.1 & Figure 1.2** respectively.

Figure 1.1: Location Map of the proposed Waterway of Cluster-6 in Karnataka and Kerala

Figure 1.2: Index Map of Udayavara River

1.3 Objective of the Study

IWAI, Ministry of Shipping, Government of India intends to explore the potential of additional waterways across the country for commercial navigation.

The objective of the study shall necessarily include:

1. To Explore the Potential of Year Round Commercial Navigation on the Proposed National Waterways by Conducting Feasibility Studies.
2. Recommending thereafter the possibility of Composite and Integrated development of proposed waterways under **Cluster-6** consisting of Canals/ Rivers to achieve navigation and to develop water transport facilities on these waterways.

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, viability etc.

1.4 Scope of the Assignment

The complete scope of assignment shall include the study in 2 stages:

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.
2. **Stage-II** would consist of the detailed hydrographic survey, topographic survey, detailed traffic survey including the divertible traffic, selection of terminal locations and preparation of detailed project report including the returns /viability analysis for implementation as a project.

This report covers the activities of Stage-I only for feasibility of the **Udayavara River** for navigation, which may have the potential for year round navigation or at least for a few months in a year.

Stage-1 consists of the following activities:

A. Reconnaissance Survey

B. Collection and review of available data

C. Feasibility Report

1.5 Methodology Adopted

The Stage I Feasibility Study of the Inland Waterway stretches is based on three approaches:

The physical system

The current functions

The market potential

1.5.1 Physical System

The potential for inland navigation strongly depends on the physical environment. Success of navigation will depend on:

- the stability of the channel: frequent variations of channel positions requires river conservancy measures;
- the regime: in most cases good navigation conditions are required most of the time for fluvial navigation to develop as a competitive transport mode, if such conditions are not met other – more reliable - modes of transportation will be used, making it difficult to get a return on the investments required for navigation (ships, maintenance, port infrastructure):
    - The regime which defines the variability of water depth, draught and water level (position of port infrastructure, vertical clearance at bridges).
    - Sediment supply: certain stretches are characterized by high sediment supply; developing such sections would require high maintenance efforts to keep the channels at depth; it must be economically and technically feasible to maintain a balance between dredging and sediment supply; therefore, the decision to construct of barrages to increase the water depth, must be taken with care, as these may act as sediment traps.
- Hydrographic characteristics of the channel: depth and width of the channel. The fairway design shall conform to channel geometry. The discharge should guarantee sufficient water depth alternatively, weirs, canals could be constructed to allow required water depth for safe navigation.

From a quick scan of satellite images it becomes clear that the morphological and hydrological conditions of the different rivers vary strongly, even within the same river. Satellite images provide a complete, accessible and qualitative data source for a first appraisal of potential.

Morphological features can be easily derived from satellite images. The morphological analysis of satellite images, therefore, has been used as a basis for a first, but reliable appraisal of the physical potential of the river (for navigation). Such analysis is, therefore, proposed as one of the methods in stage 1.

It should be pointed out, however, that the period in which the satellite images have been taken may strongly effect the appearance: otherwise dry sections may well be flooded in monsoon season. A careful evaluation shall be contemplated. Also, information obtained from water managers such as CWC, and local authorities will be a useful complement to evaluate navigability.

1.5.2 Current Functions

Current functions of the river have also been taken into consideration:

- navigation, present in certain areas – it's relevant to know why, how it's organized:
    - transportation of people (including the tourism potential) and goods

- structures aligned to rivers
- crossing infrastructure
  - bridges: vertical clearance, may even be absent for navigation
  - weirs, barrages: water supply, regulation, hydro-power
  - ferry terminals: variations in water levels and terminal infrastructure
- fishery
- mining, occurs along certain rivers, and depends on (the often) shallow channels for processing
- Presence of forest and wild life sanctuaries on the banks will be advantage to IWT
- Irrigation/ water supply, the available water may be shared between different functions, barrages exist to tap water for supply – as Indian agriculture is important for the GDP and the employment of most of the population, equilibrium must be found between available water resources and additional uses such as use for navigation.

1.5.3 Market Potential

Historically, economic demand is a driving force behind waterway development. In several cases waterways were constructed and developed for specific industries. Also navigation was developed using existing irrigation or water supply canals. Further, the accessibility also was another driving force, when alternative mode of development was difficult/ uneconomical.

In an emerging economy such as India the presence of waterways probably will also stimulate further economic development. While train and railroad networks connect cities and industrial areas independently of the hydrographic network, now it must be analyzed where the hydrographic network can establish alternative and new links between cities. In navigable portions such links would be logical.

Environmental concerns as viz. the emissions, consequences on air pollution and climate change, and social and economic pressure of congestion, led to a boost of inland navigation projects in all around the world. Such development can also be expected in India, as the development of waterways may be economically and socially more beneficial than the construction of the road and rail networks, not necessarily as a substitute, but to be developed in parallel, in a multi-modal transportation system.

The current scope for Stage I is executed as per following framework shown in **Figure 1.3**.

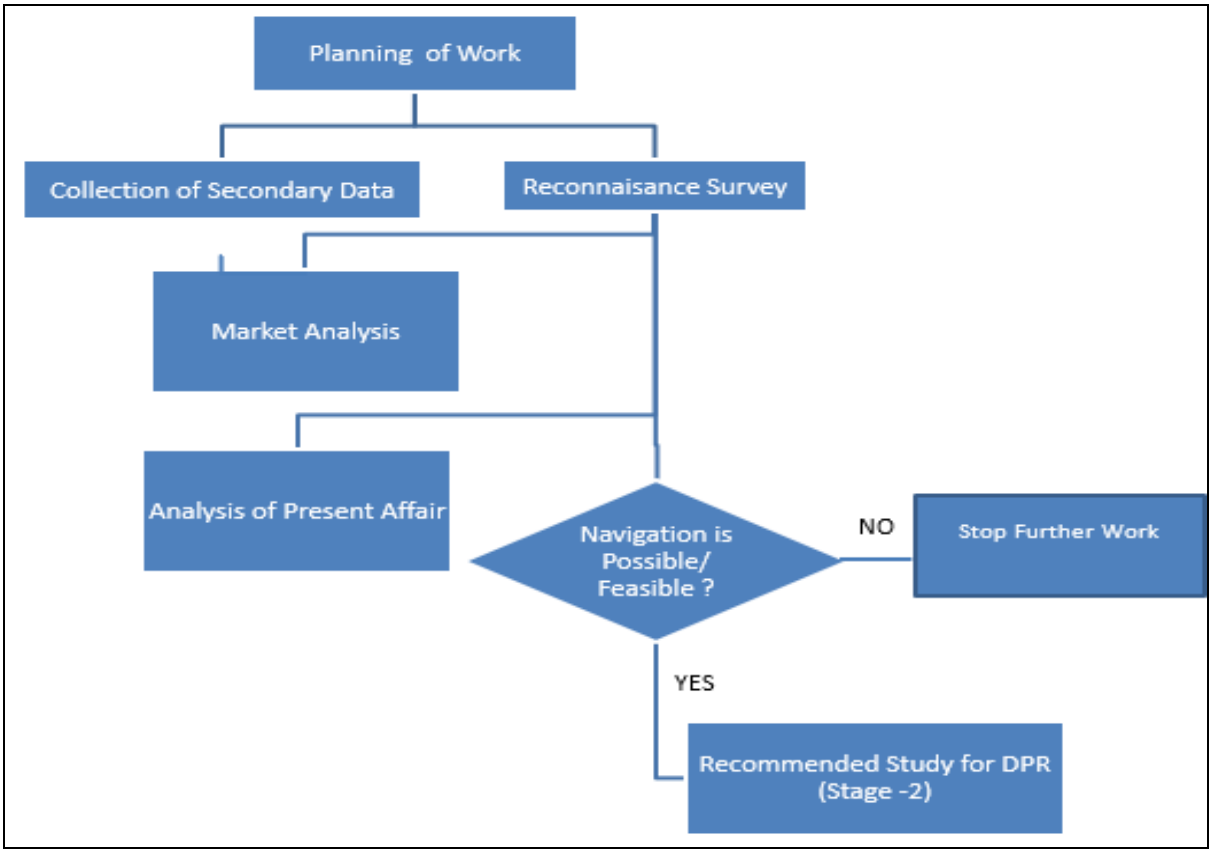


Figure 1.3: Execution Diagram of Stage I

1.6 Collection of Data

For evaluating the feasibility of the waterway in **Udayavara River** for year round navigation, the reconnaissance survey for collecting the Primary data has been taken up. Secondary data have also been collected from various sources. IWAI issued a letter in the name of M/s Tractebel, to all the concerned stakeholders for data collection from State/ Central Government.

(A) **Primary Data:** M/s Tractebel Engineering Pvt. Ltd. has appointed a separate survey agency **M/s Geoinfosys Technologies** for carrying out the reconnaissance survey for collection of following primary data:

(i) Single line longitudinal survey (Bathymetric survey or Topographic survey);

(ii) Details (horizontal and vertical clearances above High Flood Level of bridges, aqueducts, electric lines, telephone lines, pipe lines, cables en-route etc;)

(iii) Details of locations of permanent structures viz. Bridges, Barrages, Dams, Locks, Jetties, ports etc;

(iv) Photographs of important structures along the route;

(v) Topographical features of the proposed Inland Waterways;

(vi) Typical physical features along the alignment i.e. land use pattern;
(vii) Preliminary identification of stretches having year round flow;
(viii) Critical depth for navigational purpose;
(ix) Preliminary Traffic identification on the proposed Inland Waterways;
(x) Inland Waterway width, Terrain, Bridges and structures across the proposed Inland Waterways;
(xi) Urban areas (location & extent);
(xii) Geologically sensitive areas environmental features;
(xiii) Critical areas requiring detailed investigations;
(xiv) Soil (textural classifications) (only visual inspection at every 10km);
(xv) Drainage conditions;
(xvi) Existing utility services along the alignment;
(xvii) Present Status of navigation on different sub stretches of the waterway;

All the data derived from the above reconnaissance surveys shall be utilized for planning and programming the detailed surveys and investigations. All reconnaissance field studies including the traffic surveys have been taken up and the classification of proposed waterway has been carried out as per IWAI guidelines on this matter. The list of data collected and source of data is being enclosed as **Annexure 1.1**.

(B) **Secondary Data:** The following secondary data had been collected from concerned authorities as well as available on public domain.

(i) Benchmark Data from IWAI, Noida;
(ii) Chart Datum data from New Mangalore Port.
(iii) Various information about Distt from District Collector Office, Udipi;
(iv) Industry Details from District Industry Centre, Manipal, Uduipi;
(v) Agriculture Data from Deptt of Agriculture, Uduipi;
(vi) Fisheries Data form Deptt of Fisheries, Udipi;
(vii) Distt Statistical Data from Deptt of Economics and Statistics;
(viii) Disaster Mitigation Plan from Disaster Management Unit, Udipi.

All the data derived from the above reconnaissance surveys details shall be utilized for determining the navigability of the proposed national waterway. A review of the existing data available with the State Agencies and Central Water Commission for the proposed Inland Waterways has been done for determining the nature, extent, adequacy, validity of the available data and identifying the data gaps. Feasibility Report is to be prepared for the proposed national waterway based on the available data, reconnaissance survey and the market analysis. The structure of the report has been elaborated in succeeding section 1.9 of this chapter.

1.7 Expected Outcome of the Assignment

Combining knowledge on the physical constraints, actual and future uses of the river and the valley, economic potential and needs, or absence thereof, allows the characterization of the river for development as a waterway.

The reconnaissance survey data with regard to physical constraints may have cost implications for making the river stretch navigable. The potential of possible navigation in the stretches of proposed inland waterways have been determined using raw water depths reduced to the chart datum in the area of tide affected rivers. To define the navigability of river/creeks, several gradations can be distinguished:

- No or limited effort: navigable (for a specific draught) without measures;
- Limited to moderate effort: e.g. occasional dredging works at a limited number of location;
- Moderate to high: frequent dredging over a considerable length or large number of locations;
- High to very high: the construction of one or more weirs and or locks, or the construction of a canal;

In accordance to the above criteria, the stretch of the proposed waterway of **Udayavara River** under **Cluster-6** has been defined in the context of availability of navigable depth (more than 2m). Taking into account for further development in the stretches of less than 2m depth, the solutions for the navigation shall be proposed.

Combining economic potential and physical characteristics allows categorizing the river or specific stretches for navigation potential on the basis of following criteria.

(i) Water Availability
(ii) Flow Depth
(iii) Vertical & Horizontal Clearance
(iv) Nautical continuity
(v) Economic & social parameters

The analyses of physical and economic parameters have been the basis of a suggestion for classification of Inland waterways for further study. The waterways shall be classified between categories of Class-I to Class VII as per description derived from the compilation of Inland Waterways Authority of India (Classification of Inland Waterways in India) Regulations, 2006. Referring the data derived from the reconnaissance single beam bathymetry survey, cargo traffic details, market potential, vertical and horizontal clearances with respect to existing cross over structures, the proposed waterway has been classified into seven categories on the basis of IWAI guidelines for safe plying 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 DWT. A recommendation of a selection of

proposed inland waterway stretch has been done (based on IWAI classification) for further analysis and preparation of DPR in Stage II.

1.8 Description of Udayavara River (NW-105)

Udayavara River is situated in southwest part of Karnataka state of India and influenced by the coastal zone of Arabian Sea. Udayavara River originates in the foothills of the Western Ghats. It flows from East to West and turns Northward at Pithrody village. Finally, it flows for a considerable distance in the coastal plain and joins Arabian Sea near Malpe in Udupi district of Karnataka. The catchment receives an average annual rainfall of about 3624mm. The total length of the river from origin to its outfall into the Arabian Sea is about 53.0 km. A map showing Udayavara catchment basin is shown in **Figure 3.1**. The detail description of the river has been compiled in **Table 1.2**.

Table 1.2: Description of Udayavara River (NW-105)

Sl No.	Introductory Consideration	Description of the River
1	Name of the river / canal	Udayavara River (NW-105)
2	State/ District through which river passes	The Udayavara River mostly passes through Udipi Distt of Karnataka State.
3	Length of the river / canal	The length of the Udayavara main stream in the catchment from the origin to the outfall in the Arabian Sea is about 53km. Out of the total length of 53 km of river, 16 km length of the river from Arabian Sea Mouth at Malpe, Lat 13°20'57.24"N, Lon 74°41'28.22"E to Bridge near Manipura Lat 13°17'32.70"N, Lon 74°46'25.56"E has been declared as new national waterway and proposed to undertake the two stage DPR.
4	Map	The index map of Udayavara River showing proposed waterway stretch, topographic features and road networks are shown in **Figure1.2**. The section of the Udayavara River under feasibility study for inland waterway showing reconnaissance survey routes is presented in **Drawing No. P.009050-W-20201-011 R0 (Sheet-2 Nos):** Udayavara River (Karnataka) Proposed National Waterway Number 105 Layout Plan
Characteristic of River		
5	River Course	Udayavara River is situated in the southwest part of Karnataka state of India and influenced by the coastal zone of Arabian Sea. Udayavara River originates in the foothills of the Western Ghats. It flows from East to West and turns Northward at Pithrody village. Finally, it flows for a considerable distance in the coastal plain and joins Arabian Sea near Malpe in Udupi district of Karnataka. The catchment receives an average annual rainfall of about 3624mm. The total length of the river from origin to its outfall into the Arabian Sea is about 53km.
6	Tributaries / Network of Rivers / Basin	The major tributaries of Udayavara River are Alevoor River, Happanadha Hole, Durga Hole, Andar Hole and Kada Hole.

Sl No.	Introductory Consideration	Description of the River
7	Catchment Area	The total catchment area of Udayavara River basin is about 492sqkm.

1.9 Structure of the Feasibility Study Report (FSR)

The Feasibility Study Report for proposed Inland Waterways of **Udayavara River** has been prepared and 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-II study for preparation of DPR shall be carried out.

The Feasibility Study Report starts with a comprehensive report in form of executive summary giving description of the methods used for the data collection overview of the collected data followed by a description of the Present State of Affairs, Reconnaissance Survey and findings of Market Potential.

The executive summary concludes with Waterway Navigation Potential of the proposed waterway on **Udayavara River** followed with recommendations for going ahead with classification of river. The structure of FSR shall be as below;

I. **Executive Summary:** Executive summary shall describe the suitability of the proposed waterway in terms of its navigability and market potential. It shall contain a brief statement of the characteristics of the river, present use of the river, data captured in the reconnaissance survey, hindrances, acceptability of the waterway, enhanced connectivity to the region, capability to decongest the existing mode of transport, important aspects for techno commercial viability etc. The background information, concise analysis and main conclusions shall form part of the document. It will help to understand the overall scenario and decide the suitability of development of a specific waterway.

II. **Introduction:** This chapter shall describe about the Project Background of the present study, objective of the assignment, scope of the assignment, methodology adopted, outcome of the assignment, River characteristics and structure of the feasibility study report is presented.

III. **Analysis of Present State of Affairs**: In which the details about the existing town/ city/ taluka/ historical & tourist places, current utilization of proposed waterway, status of goods transport, road and rail transport as well as existing river facilities. The quantitative and qualitative description of the current utilization of proposed inland waterways are provided in the report. In addition, the descriptions about the status of goods transport, including utilization of road and transport services as well as river facilities have been covered.

IV. **Reconnaissance Survey:** The analysis of the data collected in the reconnaissance survey has been done to reflect the possibility of year round flow in the proposed Inland Waterways to achieve the commercial navigation. Bathymetry survey details, observed bed profiles and soil texture classification @ 10 km are compiled in this section. Observed waterway bed profile has been plotted with respect to existing Chart Datum in case of tidal affected rivers else the bed profile relates to CWC/ Irrigation water level data or FSL in case of canal. Maps of proposed Inland Waterways have been generated and referred with at the relevant locations indicating existing cross structures viz. bridges, jetties, established chart datum locations, dams, barrages, HT line, LT line, water pipe line, cables etc.

V. **Market Analysis:** The analysis of the market and potential usage of proposed Inland Waterways have been carried out. In the analysis, it has been examined both the existing market and the potential future market. The details of available existing Industries along the waterway, type of production in these industries, ferry services, cargo movement, type of crop along the waterway, previous history of movement of cargo in the waterway etc. have been collected and included in the report. All the data have been collected after discussion with local people while conducting reconnaissance survey etc. and also after interaction with State Govt. Officials, Irrigation / Water Resources Departments and various interconnected stakeholders.

VI. **Observations and Inferences**: In which the observations and Inferences of the feasibility study is presented in context of stretches of proposed inland waterways, which have potential of possible navigation for the approval of Stage II. Technical Feasibility has been discussed which shall establish the navigability and potential usage of proposed Inland Waterway. The stretches of proposed inland waterways which have potential of possible navigation have been categorized and classified between categories of Class-I to Class VII as per description derived from classification of rivers/canals by Inland Waterways Authority of India Regulations, 2006. SWOT analysis of Proposed Waterway has also been described covering the overall aspect of the proposed waterway in terms of its Strength, weakness, Opportunity and Threat to decide the suitability and the ranking of the waterway.

CHAPTER 2: ANALYSIS OF PRESENT STATE OF AFFAIRS

In order to establish the feasibility of waterways the present state of affairs as existing today along proposed inland waterway on Udayavara River (NW-105) is studied. Out of total 53 km length of the river, 16 km has been proposed by IWAI for feasibility study. This chapter provides details about the current affairs, status of goods transport including utilization of road and rail transport along or near by the waterway.

2.1 Current Utilization

Udayavara River originates from foothills of the Western Ghats. It flows from East to West and turns Northward at Pithrody village. The total length of the river from origin to its outfall into the Arabian Sea is about 53km. The major tributaries of Udayavara River are Alevoor River, Happanadha Hole, Durga Hole, Andar Hole and Kada Hole. The river is under tidal effect of the Arabian Sea (backwater effect) up to Manipura about 16 km from the sea.

Currently there is cargo movement in the river through Malpe Port and passenger ferry service between Malpe - Padukar is functional across Udayavara.

2.1.1 Existing Waterway Structures

There is Malpe port & shipyard, Malpe-Padukar ferry service, a boat repairing yard and one jetty existing in this waterway. **Table 2.1** below provides the details of existing facilities along Udayavara River waterway with current utilization status.

Table 2.1: Existing Facilities on Udayavara River (NW-105)

Sl. No.	Existing Facility	Chainage (km)	Coordinates	Remarks
1.	Malpe Ship Yard	0.50	13°20'53.41"N 74°41'49.35"E	Fishing Harbor and cargo
2.	Malpe Port	0.95	13°20'49.81"N 74°42'0.92"E	
3.	Malpe- Padukar Ferry Jetty	1.31	13°20'38.95"N 74°42'8.06"E	Ferry Service
4.	Boat Repairing	1.40	13°20'36.36"N 74°42'20.52"E	Boat Repairing
5.	Jetty	8.9	13°17'15.77"N 74°43'44.00"E	Fishing

Figures 2.1 to 2.3 show some of above mentioned facilities.

Figure 2.1: Shipyard Malpe

Figure 2.2: Port At Malpe

Figure 2.3: Ferry Jetty from Malpe to Padokar

2.1.2 Crossing Over Udayavara River (NW-105) Water Way

Apart from existing waterway facilities on banks of the river as described in 2.1.1, three road bridges and one railway bridge are existing in the study stretch of the river. **Table 2.2** shows the inventory of existing structures on Udayavara water waterway.

Table 2.2: Details of Rail and Road Bridges across Udayavara River (NW-105)

Sl. No.	Name of Structure	Chain age (km)	Vertical Clearance above MHWS (m)	Horizontal Clearance (m)	Center Position	
					Latitude	Longitude
1.	Under Construction Bridge	1.50	-	-	13° 20' 24.25"	74° 42' 27.68"
2.	Udayavara Road Bridge	11.56	2.0	20	13° 17' 48.37"	74° 44' 43.41"
3.	Konkan Railway Bridge	12.66	3.5	20	13° 17' 44.28"	74° 45' 18.51"
4.	Manipura Road Bridge	13.26	3.5	20	13° 17' 29.54"	74° 45' 30.13"
5.	Manipura – Kurkal Road Bridge	15.19	4.0	20	13° 17 '32.16"	74° 46' 25.63"

2.2 Connectivity of Waterway

Proposed stretch of Udayavara waterway lies in Udupi District of Karnataka which is well connected with the state capital, surrounding district headquarters, tehsils and villages through road and rail. **Figure 2.4** shows road and rail connectivity of the area adjacent of Udayavara River in the study stretch.

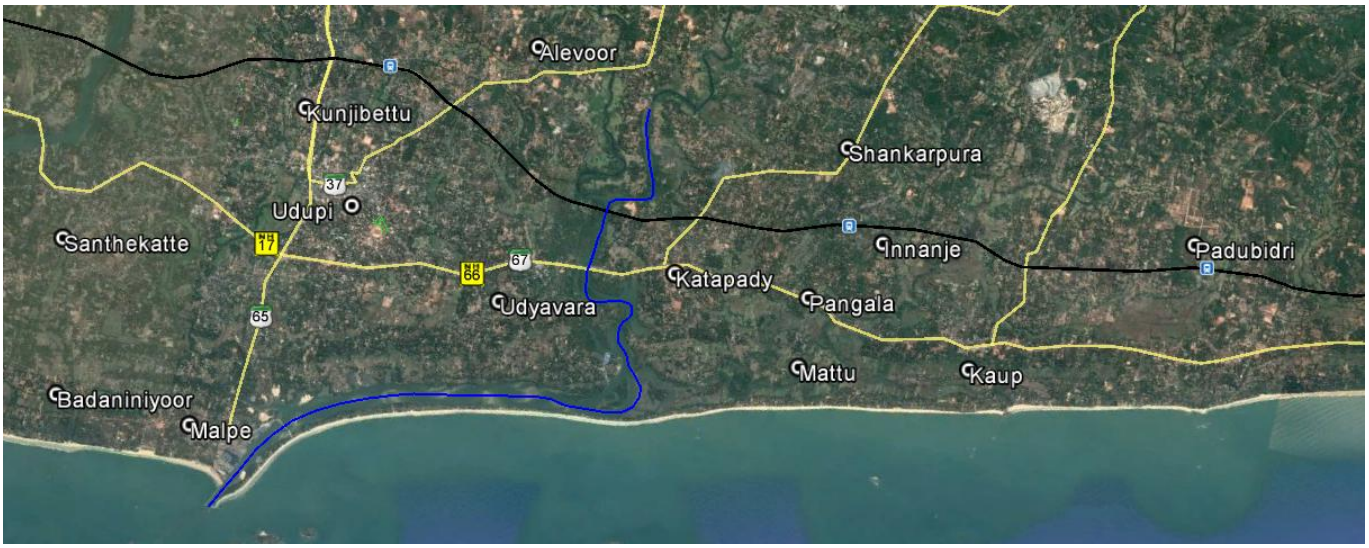


Figure 2.4: View of Rail and Road Network around Udayavara River

In **Figure 2.4**, Udayavara River is shown in blue color whereas yellow and black colors represent the road and rail network respectively around the Udayavara River.

2.2.1 Important Places

Udayavara River is in the vicinity of various important places of Udupi. **Table 2.3** shows the distance of Udayavara River from nearby important places.

Table 2.3: List of Important Places from Udayavara River Waterway (Length-16.0 km)

Sl. No.	Important Places	Category	Distance from River (km)	Bank
1.	Malpe	Village	0.42	Right bank
2.	Udayavara	Town	2.16	Right Bank
3.	Badaniniyoor	Village	3.00	Right Bank
4.	Katapady	Village	1.36	Left Bank
5.	Bagadikal	Village	2.21	Left Bank
6.	Udupi	District	6.00	Right Bank

2.2.2 Road Connectivity

Udayavara River in the study stretch is well connected with National Highway NH 17 and state highway SH-65 & SH-67 on right bank and left bank respectively. The roads surrounding Udayavara River connects to Edapallay Panvel Higwhay.

2.2.3 Rail Connectivity

Railway transport in Udayavara river catchment is developed under the Konkan Railway Project. The nearest railway station is at Udupi about 3km on Right bank from water way. Udupi railway station is about 250 km from Margao railway station.

2.3 Status of Goods Transport

Status of goods transport through River waterway is detailed in **Chapter 4 on Market Analysis of this report**.

2.4 Conclusion

a) Udayavara River originates from foothills of the Western Ghats. The total length of the river from origin to its outfall into the Arabian Sea is about 53km. The river is under tidal effect of the Arabian Sea (backwater effect) up to Manipura about 16 km from the sea.

b) Udayavara River has operating shipyard & port at Malpe and has passenger feery service from Malpe-Padukar Ferry Jetty.

c) Udayavara River in the study stretch is surrounded by national highway number NH-17 (Edappally – Panvel), state highway on right bank.

d) The waterway is connected to rail route. The nearest railway station is Udupi railway station of Konkan railways..

Three road bridges and one railway bridge are existing in the study stretch of the river and one is under construction in the proposed study stretch.

CHAPTER 3 RECONNAISSANCE SURVEY

3.1 River Profile

Udayavara River is situated in the southwest part of India influenced by the coastal zone of Arabian Sea. Udayavara River originates in the foothills of the Western Ghats. It flows from East to West and turns Northward at Pithrody village. Finally, it flows for a considerable distance in the coastal plain and joins Arabian Sea near Malpe in Udupi district of Karnataka. The total catchment area of Udayavara River basin is about 492sqkm. The catchment receives an average annual rainfall of about 3624mm. The total length of the river from origin to its outfall into the Arabian Sea is about 53km. A map showing Udayavara catchment basin is shown in **Figure 3.1**. The major tributaries of Udayavara River are Alevoor River, Happanadha Hole, Durga Hole, Andar Hole and Kada Hole.

Figure 3.1 indicates that the lower stretch of the river is expected to be tidal affected zone. Given the size of the river, most part of the study stretch may have navigation potential. IWAI expects the lower 16.00km, shown in green color in **Figure 3.1,** to have potential for navigation and thus, the subject of study under this assignment.

Figure 3.1: Catchment Area of Udayavara River

The stretch of the Udayavara River considered for assessment of navigation potential is defined as below:

16.00 km length of the river from Arabian Sea Mouth at Malpe to bridge near Manipura	From: 13°20'57.24"N, 74°41'28.22"E	Up to: 13°17'32.70"N, 74°46'25.56"E	National Waterway:105

3.2 Reconnaissance Survey

This section presents a stretch-wise description of Udayavara River. It also covers the Hydrological analysis of collected data viz., maximum and minimum water depths. The route map of Udayavara River is shown in **Figure 3.2** below.

Figure 3.2: Route Map of Udayavara River

3.2.1 Methodology of Survey

Single line longitudinal survey (Bathymetric survey or Topographic survey) was carried out along the deepest depths or lowest height lands, with the help of DGPS using Automatic Hydrographic Survey System. Bathymetric survey in the proposed waterway has been carried out in the deepest route. Deepest route has been accessed by taking two or three longitudinal line soundings at equal intervals. Topographic survey, wherever required, has been taken up at lowest ground levels, which can be decided on visual assessment.

Along with the bathymetry, other relevant data/information like horizontal and vertical clearances above high flood level of bridges, cross structures, electric lines, telephone lines, pipe lines, cables en-route were collected along with their coordinates and locations.

Soil samples were also collected along the survey area at about 10.0km interval. Texture of the collected soil samples was analyzed visually.

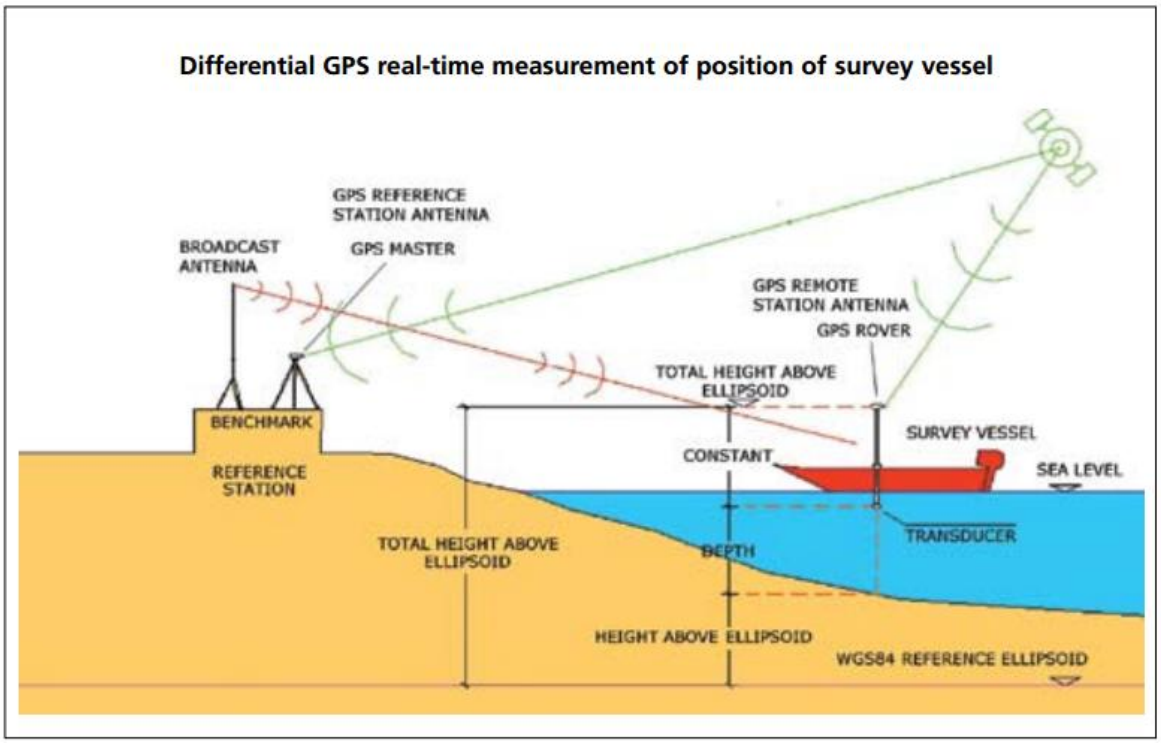


Figure 3.3: Differential GPS real-time measurement of position of survey vessel

The survey was conducted in WGS84 datum; UTM Projection (Zone 43 N, CM 075^0 E). The specification of the Echo sounder (Bathy-500DF) used for carrying out the survey and other inter related details are tabulated in **Table 3.1.**

Table 3.1: Bathy-500DF

Particulars	Specification
Depth Ranges	Units of 0-15, 0-30, 0-60, 0-120, 0-240, 0-480, 0-960, 0-1920 feet or 0-5, 0-10, 0-20, 0-40, 0-80, 0-320, 0-640 meters
Phasing	0-120, 60-180, 120-240, 180-300, etc. (displays 120ft range at 60 ft increments up to 1800-1920) feet, auto or 0-40, 20-60, 40-80, 60-100, 80-120, etc. (displays 40m range at 20m increments up to 600-640) meters, auto
Chart Record	8.5 inch x 90 feet High Contrast Thermal Paper
Digital Display	LCD (4 lines x 16 characters) 0.25 inch characters (Depth Display: 0.75 inch characters) (Back-lighting: Electro-luminescent)
Resolution	0.01 units for depths less than 100 meters;
Accuracy	Meets or exceeds all current IHO hydrographic requirements for single beam echo sounders At 33 Khz= 5 cm +/- 0.1% of depth At 200Khz= 1cm +/- 0.1% of depth

Particulars	Specification
Frequency	Interleaved Dual Frequency Selections of: 33/210kHz or 50/210kHz or any single frequency (all user selectable & changeable via keypad) from these: 33kHz, 40kHz, 50kHz, 210kHz (Acoustic output = 600 watts)
Depth Alarms	Shallow and Deep (selected by keypad)
Sound Velocity	4,600-5,250 feet/second (1393-1590 meters/second) (user selected via keypad)
Offset	0 to +30 feet or meters (allows the user, via keypad, to adjust for the net sum of transducer depth and tide)
Geographic Position	NMEA-0183 GGA or GLL Format from GPS/DGPS
Data I/O Compatibility	COM 1 provides bi-directional interface to PC or other peripheral device; This port accepts external annotation from external sources such as hydrographic software. COM 2 accepts GPS/DGPS inputs and provides additional (from COM 1) data outputs.
Data Outputs	-ODEC dt (Time, Lat, Long, Depth Hi, Depth Lo) -PMC dt (True Depth & Status) Atlas DESO-25 -Odom Digitrace -Odom Echotrac -NMEA DBT -NMEA DBS
Heave Compensation	Compatible with Teledyne TSS Format
Input Power	11-30 volts DC (1.5 amps @ 12v. 0.5 amp @ 30v.) or 115/230 volts AC 50/60 hertz (20 watts)
Dimensions	Height (including handle) 19 inches Width 17.5 inches Depth 9 inches
Weight	35lbs. (Recorder with P01540 Transducer)

The layout diagram of the equipment used for bathymetric survey has been shown in **Figure 3.4** below.

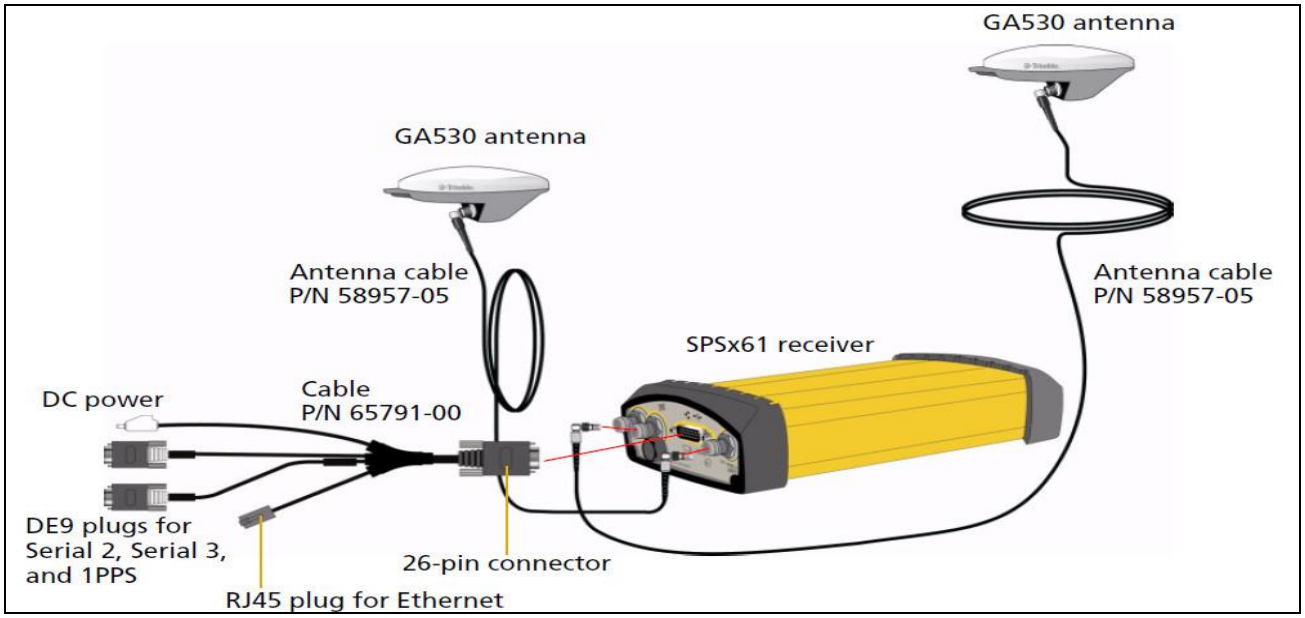


Figure 3.4: Equipment Diagram

Team surveying at site with equipment mounted on the boat is depicted in **Figure 3.5** as shown below:

Figure 3.5: Team Surveying at Site with Equipment Mounted on the Boat

The survey data has been processed using the latest version of "Hypack" software, thus to ensure a quality output of the survey.

An overview chart for Udayavara River bathymetry is enclosed as **Annexure 3.1**

3.2.2 Chart Datum of the Proposed Waterway

The water depths have been determined as a result of all soundings reduced to Chart Datum (the lowest tide level observed for a considerable period at specific location) in the area. Tidal heights predicted using New Mangalore Port data were used to reduce the raw water depths to Chart Datum. New Mangalore Port is nearer to the Udayavara River. Therefore, tidal heights predicted using New Mangalore Port data were used to reduce the raw water depths to Chart Datum *(Ref: Indian Tide Tables, 2016, Survey of India)*. The locations with coordinates of Chart Datum obtained from New Mangalore Port Trust (**Annexure 3.2**) have been used to reduce the soundings along the surveyed stretch as compiled in **Table 3.2**.

Table 3.2: Details of Chart Datum Used for Data Reduction

Sl. No.	Location	Latitude	Longitude	Z_0 *(m)
1	New Mangalore Port	12° 55'	74° 48''	0.95

**- Below Mean Sea Level*

3.2.3 Bathymetry and Site Data Collected

A. Udayavara River (Ch -0.57km to Ch 0.00km)

Udayavara River waterway starts from the Arabian Sea at Malpe. The start point (Lat 13° 20' 57.24" N, Lon 74° 41' 28.22" E) could not be approached by the survey boat due to the rough weather condition on the day of survey. The tide wave water started filling into the boat as it was going closer to the start point. Therefore, the bathymetric survey was carried out from a point (Ch 0.00km, Lat 13° 20' 49.49" N, Lon 74° 41' 45.45" E) which is about 570m away from the waterway starting point. However, it is supposed to have sufficient water depth available for navigation in this stretch.

B. Udayavara River (Ch 0.0km to Ch 5.00km)

Dry dock and Malpe Port are on the right bank of the river. Very narrow residential Coastal areas are on the left bank up to Ch 5.0km. Fishing harbor is on the right bank at Ch 1.3km. Bridge under construction is observed at Ch 1.5km. Swarna River joins the Udayavara River on the right bank at Ch 1.8km. A jetty is seen on the right bank at Ch 2.8km. Malpe and Kadekar village are on the right bank at Ch 3.1km. There is a suspension cable (33KV) crossing the river at Ch 3.18km. Agricultural area is seen on the right bank. There are Mangroves seen along both banks of the river. Due to sediment deposition, shallow depths are observed at some places. Also rocky patches have been observed along the river banks.

The minimum depth recorded w. r. t Chart Datum in this section is -0.17m at Ch 4.42km and the maximum depth is 5.71m at Ch 0.00km as given below in **Table 3.3.** The stretch is shown in **Figure 3.6**.

Table 3.3: Maximum – Minimum Depth in Udayavara River from Ch 0.00km – Ch 5.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
0.0	**5.0**	5.71	-0.17

Figure 3.6: Route Chart of the Survey from Ch 0.00km to Ch 5.00km

C. Udayavara River (Ch 5.00km to Ch 10.00km)

Narrow strip of residential Coastal area is on the left bank from Ch 5km to 9.0km.

Mixed residential and agricultural areas are on the right bank. There is one jetty at Ch 8.9km on the right bank. Pithrody village is located on the right bank at Ch 8.00km. At this location the river takes right turn from westward flows to northward. At this turning point, shoal is observed at Ch 7.8Km. There are mangroves seen along both the banks of the river with a few scattered settlements.

The minimum depth w. r. t. Chart Datum recorded in this section is -0.17m at Ch 5.39km and the maximum depth is 4.77m at Ch 9.87km as given below in **Table 3.4.** The stretch is shown in **Figure 3.7**.

Table 3.4: Maximum – Minimum Depth in Udayavara River from Ch 5.00km to Ch 10.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
5.0	**10.0**	4.77	-0.17

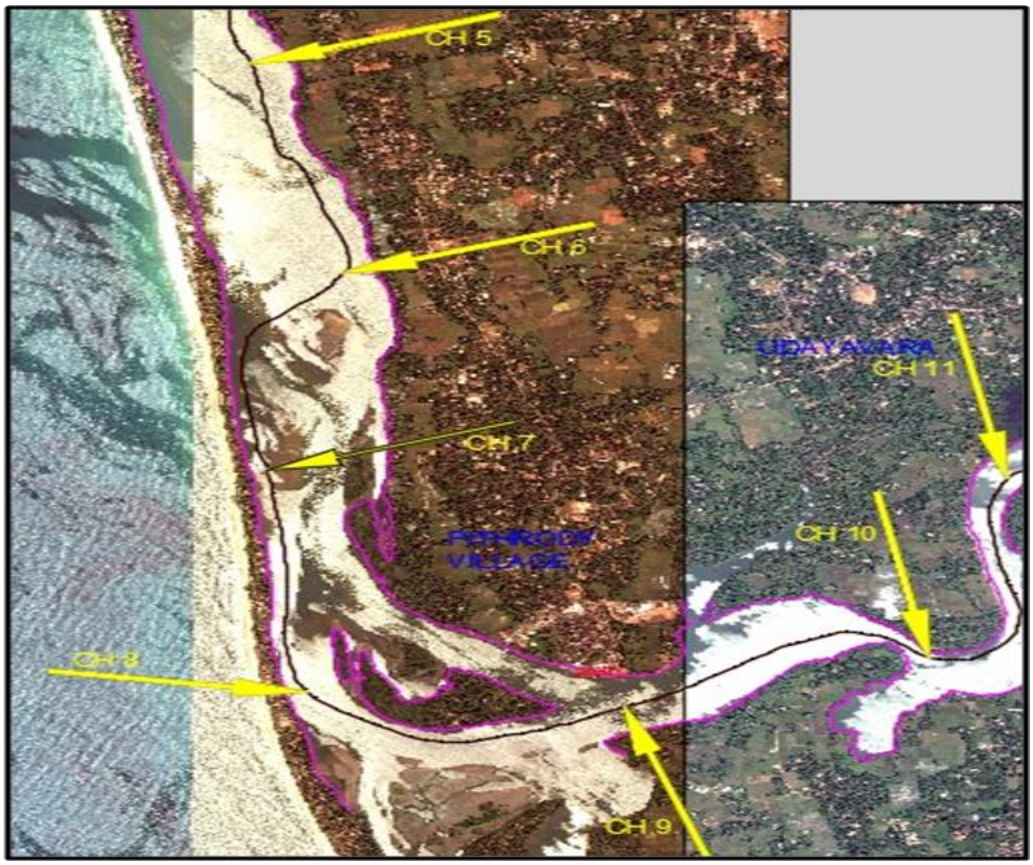


Figure 3.7: Route Chart of the Survey from Ch 5.00km to Ch 10.00km

D. Udayavara River (Ch 10.00km to Ch 15.19km)

Udayavara and Manipura villages are on the right bank whereas as Katpady village is on the left bank in this stretch. Two bars are seen in the middle of river at Ch 10.5km and 11.2km. Udayavara Road Bridge crosses the river at Ch 11.5km. Electric line (11KV) crosses the river at Ch 11.8km and cable at Ch 12.6km. Udayavara River Konkan Railway Bridge crosses the river at Ch 12.6km. Alevoor River joins the Udayavara River on the right bank at Ch 12.8km. Manipura Road Bridge crosses the river at Ch 13.2km. One LT line crosses the river at Ch 13.3km. LT and Cable cross the river at Ch 14.1km. Manipur Road Bridge crosses the river at Ch 15.19km. Waterway stretch end at this location (13°17'32.70"N, 74°46'25.56"E).

The minimum depth w. r. t. Chart Datum recorded in this section is 0.1m at Ch 15.01km and the maximum depth is 3.12m at Ch 12.58km as given below in **Table 3.5.** The stretch is shown in **Figure 3.8**.

Table 3.5: Maximum – Minimum Depth in Udayavara River from Ch 10.00km to Ch 15.19km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
10.0	15.19	3.12	0.1

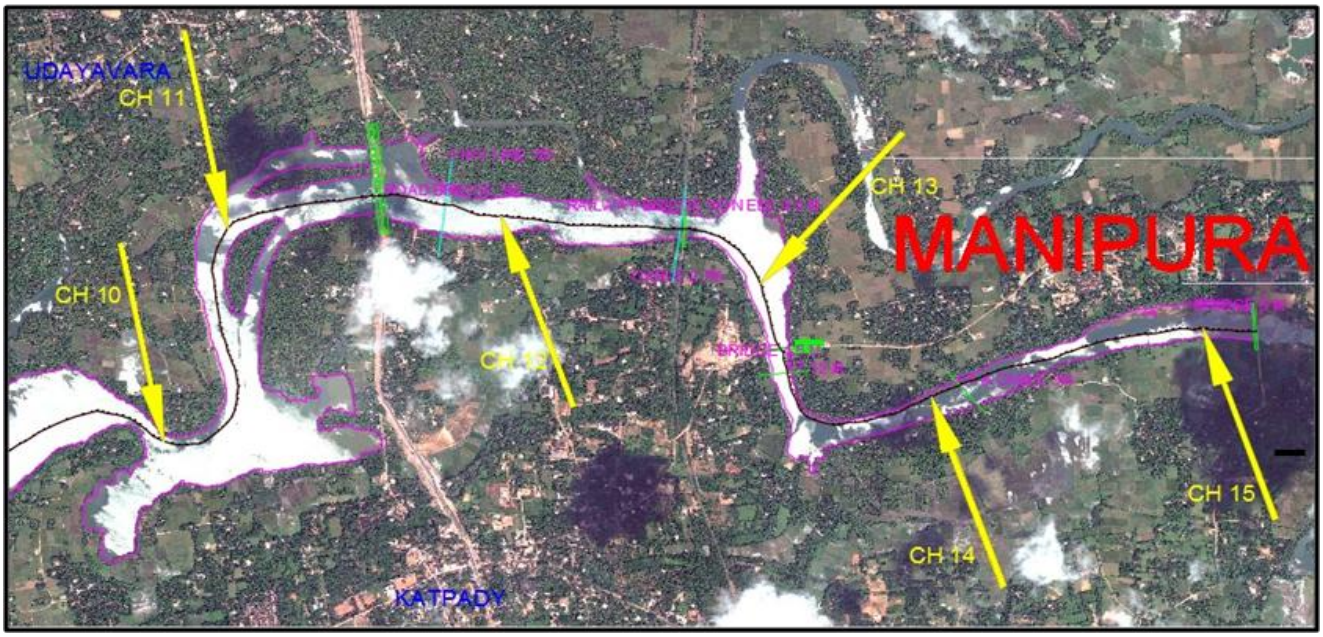


Figure 3.8: Route Chart of the Survey from Ch 10.00km to Ch 15.19km

The maximum and minimum depths with reference to the Chart Datum in the small intervals have been summarized in **Table 3.6** which describes the length of stretch showing various ranges of water depth available.

Table 3.6: Maximum – Minimum Depth in Udayavara River from Ch -0.57km to Ch 15.19km

Chainage (Km)	Draft Available		Length of River (Km)			
	Max. (m)	Min. (m)	>2m	1.5-2.0m	1-1.5m	<1m
-0.57-0.0	Could not be approached by the survey boat due to the rough weather condition. However, sufficient water depth is available for navigation in this stretch					
0.0-5	5.71	-0.17	1.56	0.75	0.78	1.91
5-10	4.77	-0.17	0.21	0.26	1.01	3.52
10-15.19	3.12	0.1	1.96	1.25	1.66	0.32
Total			**3.73**	**2.26**	**3.45**	**5.75**

The above data indicates that the availability of water depth is 2.0m and above up to 3.7km of the waterway under study, except in 2nd stretch (Ch 5km to 10km) where marginal dredging requirement has been observed. It confirms the availability of 2.0m and above water in 25% of river in the proposed stretch under study.

However, average water depth of 1.4m is available in the entire stretch. It may be noted that the above depths have been reckoned with CD. Since the majority of the study stretch of Udayavara River is under tidal influence, the available effective depths would be more than 0.9m (average tide height) which will be advantageous for safe navigation. The tides are semi-diurnal in nature which provides a tidal window of 6.00 hours, wherein the tide can be advantageously used for navigation. The detailed hydrographic survey information indicating location, observed water depth at each point of data reading has been given in **Annexure 3.3**.

3.2.4 Soil Texture Classification

The soil texture has been observed during the reconnaissance survey. The observed soil texture at 10km interval has been given in **Table 3.7**.

Table 3.7: Soil Texture in Udayavara River at 10.0km Interval

Chainage (Km)	Latitude	Longitude	Depth (m)	Soil Texture
0.00	13° 20' 49.46"	74° 41' 45.6"	6.66	Sandy soil
5.01	13° 18' 44"	74° 43' 12.71"	1.50	Sandy soil
10.02	13° 17' 18.31"	74° 44' 18.49"	2.45	Sandy soil
12.50	13° 17' 44.58"	74° 45' 13.49"	2.38	Sandy soil
15.19	13° 17' 31.96"	74° 46' 25.49"	1.26	Sandy soil

From the above table it is observed that sandy soil is found in the entire part of the river under study stretch.

3.3 Classification of Waterways

The Ministry of Shipping, Road Transport and Highways (Inland Waterways Authority of India) has classified the Inland waterways into seven categories for rivers and canals for safe plying of self propelled vessels up to 2000 Dead Weight Tonnage (DWT) and tug-barge formation in push-two units of carrying capacity up to 8000 DWT (Ref: IWAI, Gazette Notification 2006). The classification criteria of waterways are mentioned in **Table 3.8** for Rivers and in **Table 3.9** for canals.

Table 3.8: Classification of Inland Waterways for Rivers

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

Table 3.9: Classification of Inland Waterways for Canals

Class of Waterways	Rivers				
	Minimum Depth (m)	Bottom Width (m)	Bend Radius (m)	Vertical Clearance (m)	Horizontal Clearance (m)
I	1.5	20	300	4	20
II	1.8	30	500	5	30
III	2.2	40	700	7	40
IV	2.5	50	800	10	50
V	-	-	-	-	-
VI	3.5	60	900	10	60
VII	-	-	-	-	-

The vessel sizes for self propelled or tug and barge combination for different classes of waterways is described in **Table 3.10**.

Table 3.10: Classification of Vessel Size

Class of waterways	Self Propelled Vessel Tonnage (Size, L x B x Draft in m)	Tug and Barges Combination Tonnage (Size, L x B x Draft in m)
I	100 (32 x 5 x 1)	200 (80 x 5 x 10)
II	300 (45 x 8 x 1.2)	600 (110 x 8 x 1.2)
III	500 (58 x 9 x 1.5)	1000 (141 x 9 x 1.5)
IV	1000 (70 x 12 x 1.8)	2000 (170 x 12 x 1.8)
V	1000 (70 x 12 x 1.8)	4000 (170 x 24 x 1.8)
VI	2000 (86 x 14 x 2.5)	4000 (210 x 14 x 2.5)
VII	2000 (86 x 14 x 2.5)	8000 (210 x 28 x 2.5)

Vertical Clearance for power cables or telephone lines or cables for any transmission purpose for all classes:

- Low Voltage Transmission lines and Telephone line 16.5m
- High Voltage Transmission line not exceeding 110 kV 19.0m
- High Voltage Transmission line exceeding 110 kV 19.0m +1 cm per each additional kV

In case of underwater pipelines, power cables and other cables, norms are to be decided as per site condition and navigational requirement.

Reference level for vertical clearance for different types of channels

- For Rivers:- Over the Navigational High Flood Level (NHFL), which is the highest flood level at frequency of 5 % in any year over a period of last twenty years;
- For Tidal Canals:- Over the highest high water level;
- For Other Canal:- Over designed full supply level (FSL);

The above classification for rivers and channels shall be effective if:

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

The data gathered through the reconnaissance study has been analyzed from the parameters mentioned hereinabove and conclusions have been made with regard to the class of navigation channel that the relevant stretch of Udayavara River falls into. Furthermore, it is to be determined whether the entire 16.00km stretch can be classified under one class of channel or there is a possibility and advantage of developing sub-reaches under different classes of navigation channel.

3.3.1 Cross Over Structures

The details of High Tension lines, Low Tension lines, Cables and Bridges crossing the Udayavara River are given below in **Table 3.11** and **Table 3.12**.

Table 3.11: Details of High Tension and Electric Lines across Udayavara River

Sl. No.	Cross-Structure Name	Chainage (km)	Position (Above vessel track)		Vertical Clearance above MHWS (m)	Horizontal Clearance (m)
			Latitude	Longitude		
1	Suspended cable (33KV)	3.18	13° 19' 41.35"	74° 42' 59.44"	10.5	25
2	Electric Line (11KV)	11.79	13° 17' 47.21"	74° 44' 50.79"	5.5	25
3	Cable	12.64	13° 17' 44.31"	74° 45' 18.18"	3.0	30
4	LT	13.35	13° 17' 26.97"	74° 45' 30.63"	10.5	30
5	LT and Cable	14.10	13° 17' 25.52"	74° 45 '50.67"	3.0	30

Table 3.12: Details of Bridges across Udayavara River

Sl. No.	Name of Structure	Chainage (km)	Vertical Clearance above MHWS (m)	Horizontal Clearance (m)	Center Position	
					Latitude	Longitude
1	Under Construction Bridge	1.50	-	-	13° 20' 24.25"	74° 42' 27.68"
2	Udayavara Road Bridge	11.56	2.0	20	13° 17' 48.37"	74° 44' 43.41"
3	Konkan Railway Bridge	12.66	3.5	20	13° 17' 44.28"	74° 45' 18.51"
4	Manipura Road Bridge	13.26	3.5	20	13° 17' 29.54"	74° 45' 30.13"
5	Manipura – Kurkal Road Bridge	15.19	4.0	20	13° 17 '32.16"	74° 46' 25.63"

From the above information, waterway Ch 0.00km to Ch 11.79km, sufficient vertical clearance is available from LT line. Support base of LT lines and cable lines will have to be raised to about 6.0m and 13.0m respectively to get the required clearance. However horizontal clearance of about 30.0m is available and is coming under Class I standard.

The horizontal as well as vertical clearance up to upstream of Ch 11.56km is sufficient for all classes. Thereafter, the vertical as well as horizontal clearance of Bridges requires modification for plying of vessels with class zone. Manipura–Kurkal Road Bridge at Ch 15.19km located at the upstream end location of the proposed waterway; hence its vertical clearance has not been considered for analysis. Bridge under construction at Ch 1.50km is supposed to have sufficient vertical and horizontal clearance.

The horizontal clearance on the classification has been provisioned for two lane navigation. With due caution and with single lane mobility under the bridge (without any change in the structure modification), the class of the waterway can be considered as Class II beyond Ch 11.56km.

Photos of important structures such as port, bridges, jetties, transmission lines and plants as taken during site visit are shown in **Annexure 3.4**.

3.3.2 Dams, Barrages and Reservoirs

No dams, barrages & reservoirs exist there along the surveyed route.

3.3.3 Bends along the Route

On the proposed waterway route, there are many bends in Udayavara River, which are given below in **Table 3.13.**

Table 3.13: River Bend Radius in Udayavara River

Sl. No.	Chainage (Km)	Radius (m)
1	8.30	365.00
2	9.40	365.00
3	10.30	190.00
4	10.90	230.00
5	12.80	280.00
6	13.50	180.00

In the study stretch, based on the bend radius criteria, it can be considered for elevation to **Class I** by smoothening of the bends.

The pictorial detailed information showing the proposed waterway indicating various cross-structures (i.e. bridges, transmission lines etc.), major industrial locations and important places along the waterway have been shown in **Drawing No. P.009050-W-20201-011 R0 (Sheet-2 Nos)**. Drawing also depicts various information such as Jetties, Rail and Road location along the waterway.

3.3.4 Gauge & Discharge data

In the Udayavara River catchment, no gauge and discharge site as established by Central Water Commission was observed. For the Stage II study, the gauge data will be analyzed if the same is available within a reasonable reach and if found relevant.

3.3.5 Bed Profile of Waterway

All soundings were reduced to Chart Datum in the area. Tidal heights are predicted using New Mangalore Port data to reduce the raw water depths to Chart Datum. The observed bed profile of Udayavara River waterways is shown below in **Figure 3.9** and presented in **Annexure 3.5**.

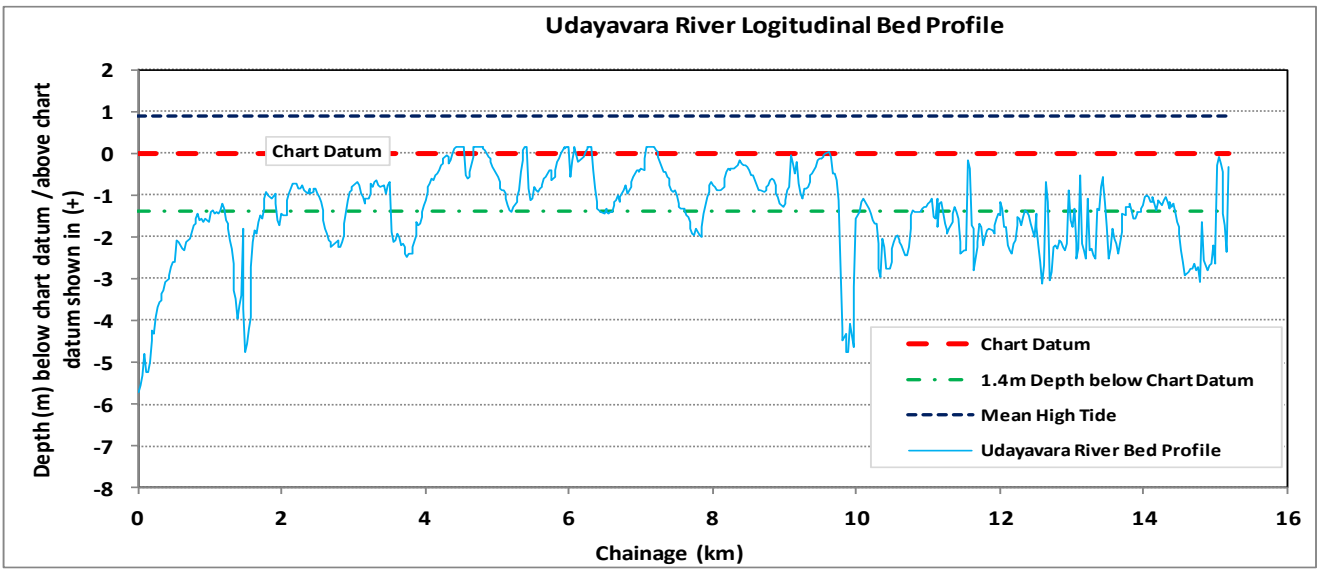


Figure 3.9: Longitudinal River Bed Depth Profile of Udayavara River from Ch 0.00km to Ch 15.19km

Figures 3.9 also shows the Chart Datum line, 1.4m below the Chart Datum line and mean tide variation 0.9m above Chart Datum. However, high tides in this region were observed in the range of about 0.03 to 1.68m (MHWS) *(Ref: Indian Tide Tables, 2016, Survey of India)*. The following key observations are made from **Figure 3.9:**

(i) The tidal effect of the Arabian Sea in the Udayavara River is affected up to the Manipura Town and upstream. Also, mangrove has been observed on both the banks of Udayavara River up to Manipura and upstream. Therefore, the river is considered under tidal affect for full length under study area. The tide in the region is Semi-Diurnal characteristics.

(ii) As observed from the site, the study stretch has the soil texture as Sandy.

(iii) The initial two third of the river stretch from the mouth is flatter with undulation in the middle stretch due to sediment deposition which gradually becomes mild steep having an average slope of 1 in 5333 in 16.00km of the river stretch under study.

(iv) Moderate dredging is required in the stretch from Ch 5.0km to 10.0km.

(v) With some minimum dredging between Ch 2.00km to Ch 4.00km (2.0km) and Ch 11.00km to Ch 14.00km (3.0km), a minimum depth of 1.4m for **Class II** may be achieved.

3.4 Tidal Effect on Navigability of Udayavara River

The tidal effect on the river navigability may be put to an advantage in order to optimize the cargo movement from import ships and taking bulk cargo to a jetty located upstream of the river bank near the industrial units for planned bulk consumption of the cargo. Industrial units e.g. steel plants/ thermal & gas based plants/ cement plants/ oil terminals are either operational or have been planned near the coast line as a preferred location either on the river banks near the mouth of the river or in creeks meeting high sea.

Shallow waterways in these rivers and creeks put a restriction on movement of large ships which calls for unloading of the cargo from ships at high sea into smaller Vessels / Vessels. These Vessels / Vessels transport the cargo to smaller jetties. Normally, there is a travel restriction of the movement of Vessels / Vessels by variation in the available draft in the river/creek due to tide. If the available draft in the river is adequate to sail a particular type of vessel, the vessel can move into the river/creeks or vice versa; else they wait for the high tide. Thus, movements of the Vessels / Vessels through the river depend upon the depth available, which is affected by the tide.

3.4.1 Present Usability of Udayavara River

With the information gathered during the reconnaissance survey, the study stretch is being used for fishing. Tide dependent water level in the Udayavara River can be used advantageously for the smooth movement of the Vessels in the River.

3.4.2 Chart Datum & Variation in Navigation Draft

The depth variation in the Udayavara River has been established from -0.17m to 5.71m with respect to Chart Datum during the reconnaissance survey. The tide tables are available for the region and water level in the creek can be forecasted at any point of time. It helps in knowing that a particular type of vessel can sail in the creek at given point of time. The tidal variation is of the order of 0.9m with it maximum depth of 1.68m in Udayavara as per the records available for this region *(ref: Indian Tide Tables, 2016, Survey of India)*. Hence, it is noted that if the high tide is considered for navigation, a higher water depth is actually available for navigation along the waterway although water depth with respect to Chart Datum shall depict a lower depth corresponding to the Least Available Depth (LAD). So, conceptually, navigation in a tidal river is more effective considering the tidal effect which is observed in such cases elsewhere. Arabian Sea at the confluence location of Udayavara River has a semidiurnal tide having two high and two low water each tidal day, with relatively small differences in the respective highs and lows effect which provides a tidal cycle of 6.0 hours.

The speed of the cargo Vessels / Vessels is normally 8 knots in a still river and the travel time of these Vessels / Vessels may be about 2.0 hours inclusive of the docking time in the study stretch. Hence, a six hour tidal window shall be advantageously used for optimization of vessel movement from sea to destined location as well as for unloading the material and the low tide shall be made use of to sail from local jetty to the high sea with a lower draft requirement of empty vessel which is again available during the low tide. Similar considerations shall be effective for other industrial units that are already either planned or that may be planned in future on this waterway. This shall also facilitate the classification of the water way either in one category or into various categories with a consideration of river length being actively used currently, and future possibilities for cargo movement beyond the present use.

3.4.3 Benefits of Tidal Effect

The above contention for using tidal window using high tide for facilitating navigation shall help to decide many other logistics which may consist of exact vessel size, loading time, unloading time, facilities available at loading and unloading locations etc. A better insight into tidal information shall help to decide the following:

(i) Classification of the waterway;

(ii) Vessel Size;

(iii) Scheduling of vessel movement;

(iv) Number of Vessels / Vessels for defined quantity of the cargo;

(v) Flotilla Combination;

(vi) Different size of Vessels / Vessels instead of only one size;

(vii) Handling facilities at the terminal location;

(viii) Desirability and quantum of dredging required;

(ix) Vessel allocation decision;

The benefits of tidal effect will be more useful in operation of Vessels / Vessels and in improving the efficiency of vessel operation.

3.5 Agencies to be approached for Clearance, if any

Based on the reconnaissance survey, interaction with the local people and consultation with the government officials, information regarding clearances and approvals required from the concerned authorities for operation of National Waterway NW-105 (Udayavara River) has been given in **Table 3.14**.

Table 3.14: List of Clearances and Approvals Required

Environment Clearance	Forest Clearance	Wildlife Clearance	Coastal Regulation Zone (CRZ) Clearance	Consent to Establish/ Operate	No Objection Certificate from Directorate of Fisheries	NOC from WRD/PWD/ Railways
√	To be ascertained at DPR Stage-II	To be ascertained at DPR Stage-II	√	√	√	√

3.5.1 Compilation of Data in Feasibility Format

The field information gathered through single line bathymetry survey, data collection from IWAI, data collection from various agencies, site visit and information derived from web has been compiled in the format as provided by IWAI for the Udayavara River. The consolidated data shall be useful in deriving basic information about each of the waterway in IWAI format enclosed in **Annexure 3.6**.

3.6 Conclusion

Based on the survey observation, the classification of proposed waterways based on various criteria has been summarized in below **Table 3.15**.

Table 3.15: Classification of Proposed Waterway

Criteria	Classification																		
Length of waterway from start (km)	1	2	2	3	4	5	6	6	7	8	9	10	10	11	12	13	14	14	15	16
Chainage length in %	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
Depth availble	C-II																			
Raod Bridge Vert. Clearance	All Class															Needs Modification				
Raod Bridge Hor. Clearance	All Class															Needs Modification				
HT Line Vert. Clearance	All Class															Needs Raising of HT Base				
Bend Radius	C-I																			
Index	All Class	Class-V		Class-IV		Class-III			Class-II		Class-I									

Finally, with due consideration of all aspects, the classification of the proposed Udayavara Waterway in light of technical navigability may be adopted as shown in **Table 3.16** below:

Table 3.16: Final Conclusion for Possible Navigation

River Stretch	0.00km 16.00km
Classification	**Class-II**
Horizontal clearance (m)	40
Vertical clearnce (m)	5
Minimum Depth (m)	1.4
Bottom Width (m)	40
Self Propelled Vessel	
Dead Weight Tonnage	300
Vessel size (m)	45 x 8 x 1.2
Tug + Barge	
Dead Weight Tonnage	600
Vessel size (m)	110 x 8 x 1.2

The above conclusion has been drawn keeping in view the present river condition and linking the same with various characteristics of classification viz., available draft; vertical clearance under Rail Bridge / Road Bridge/ HT Line and Bend Radius etc.

In order to consider full stretch as **Class II**, smoothening of bends along with moderate dredging is essential.

CHAPTER 4 MARKET ANALYSIS

Udayavara River flows from South East to North West starting from Dendurghat village and ends at the River Sea confluence near Malpe fishing harbour. It runs a length of approximately 16 km and covers Dendurghat, Kurkal, Yenagudde, Katpadi, Khandika, Udayavara, Padukere, Kutpadi, Kadekar, Kidiur, and Malpe villages on either bank.

The navigable length of the River is 16 km. Based on the single line bathymetry survey carried out during the study and as per the classification of "Inland water ways" as per Ministry of Shipping, it can be classified as "Class II" for the first 10 km. (**Refer Map 4.1**).

Malpe port & shipyard, Malpe-Padukar ferry service and one jetty are existing along the Udayavara waterway.

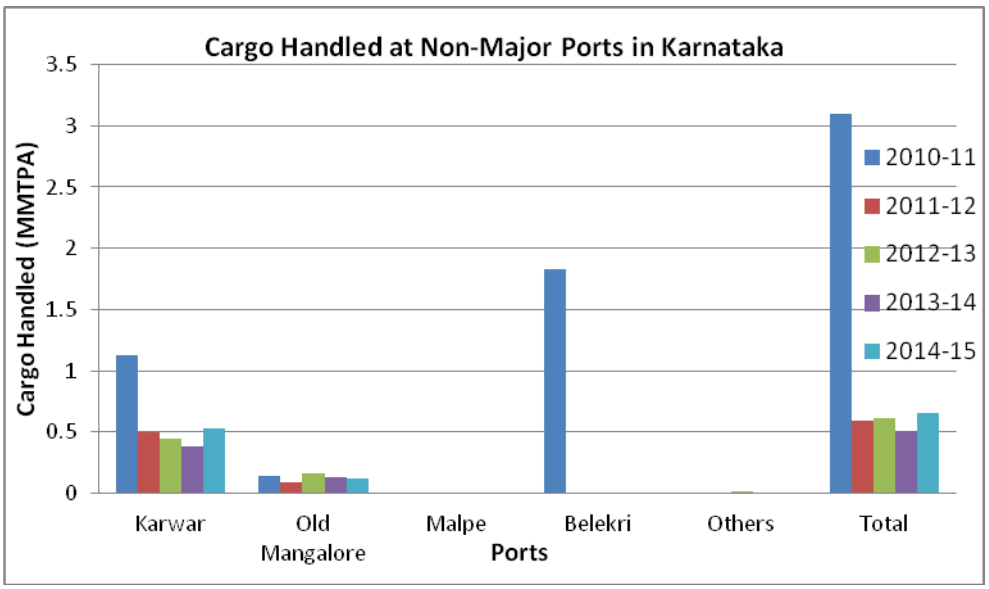


Figure 4.1: Cargo handled at Karnataka Non Major Ports in MMTPA

In the year 2014-15, 0.65 MMTPA of cargo handled at all nine Non-Major Ports in Karnataka. Cargo handled at Malpe Port was negligible. (**Figure 4.1**).

Passenger Ferry services are operating between Malpe-Padukere on the river and from Malpe to St. Mary's island.

4.1 Existing Traffic

- **Cargo:** Malpe Port is at Chainage 0.95km in the River. It is riverine port which was handling cargo since pre-independence, however, now the cargo is moving by Road. The Port is developed as a major fishing Harbour. The cargo handled at the Port during last 5 years is compiled below in **Table 4.1.**

Table 4.1: Cargo Handled at Malpe Port

Sl. No.	Year	Import Tonne Per Annum	Export Tonne Per Annum	Remarks
1.	2011-12	2738	-	Ship Block/Soda Ash
2.	2012-13	2508	397	Ship Block/Dumb Barge
3.	2013-14	1983	372	Ship Block/Dumb Barge
4.	2014-15	465	677	Ship Block/Dumb Barge
5.	2015-16	910	0	Ship Block/Dumb Barge

An area of 10 Acres within Malpe fishing Harbour has been allotted to M/S Tebma Shipyard for slipway and construction of medium size ships by Government BOOT system.

- **Passengers:** Passenger Ferry services are operating between Malpe-Padukere on the river and from Malpe to St. Mary's islands also. Passengers Ships from Mangalore and Mumbai were also running in the past, however have stopped since 1970.

4.2 Future Cargo Potential

- **District Profile:** Udupi District covers a total area of 3,880 Sq. Km. The district comprises of 3 taluks namely: Udupi, Kundapura, and Karkala, with Byndoor and Brahmmavar getting the special Taluka Status. The total number of Grama panchayaths is 146 with 248 Inhabited Villages. There is one City Municipality, two Town Municipalities and one Town Panchayath in the District. Udupi District has a total population of 11.8 lakh.

- **Connectivity**: The District has two National Highways passing through it with the length of NH 66 (NH 17) being 107 Km and NH 48 is 32 Km. Udupi-Manipal Road passes through Udupi. Other significant roads include the State Highways to Karkala and Dharmastala and to Shimoga and Sringeri. The NH 66 provides a link to Mangalore and Karwar via Kundapur.

  The District has a total Railway line of 100.86 km with 8 Railway Stations. The nearest international airport to Udupi is Mangalore (Bajpe) Airport, which is 50 km away.

- **Industries:** The catchment area of Udayavara River has 10 large and medium scale industries (**Annexure 4.1**) with an investment of over Rs 7000 Cr. The major industries include a 1,200 MW Udipi Power Corporation Limited (UPCL) Power Plant, Suzlon Wind Mill, SE Rotor Blade, Tebma Ship yard among others. UPCL also has a plan to increase the capacity of Power Plant from 1,200 MW to 2,800 MW at an investment of Rs 11,500 Cr.

The possibilities of moving the cargo are examined as follows:

- **Cargo from Industries:** The diversion of cargo from the Industrial area is very limited.
    - UPCL is connected with a Rail Head with New Mangalore Port and draws coal from there and based on preliminary assessment, there is no economic advantage to move cargo through Udayavara River.
    - SE Rotor Blades/Suzlon do manufacture Over Dimensional Cargo, however the Industry is located more than 8-10 km away from the River end. Moreover, based on the discussions, the Rotor Blades are largely distributed within Karnataka and are not moving to Mumbai or down south. (**Figure 4.2**)
    - Other industries in Manipal Industrial area are also 8-10 km away from the River End. (**Figure 4.3)**

Figure 4.2: Wind Turbine Blades Transported via Trailers

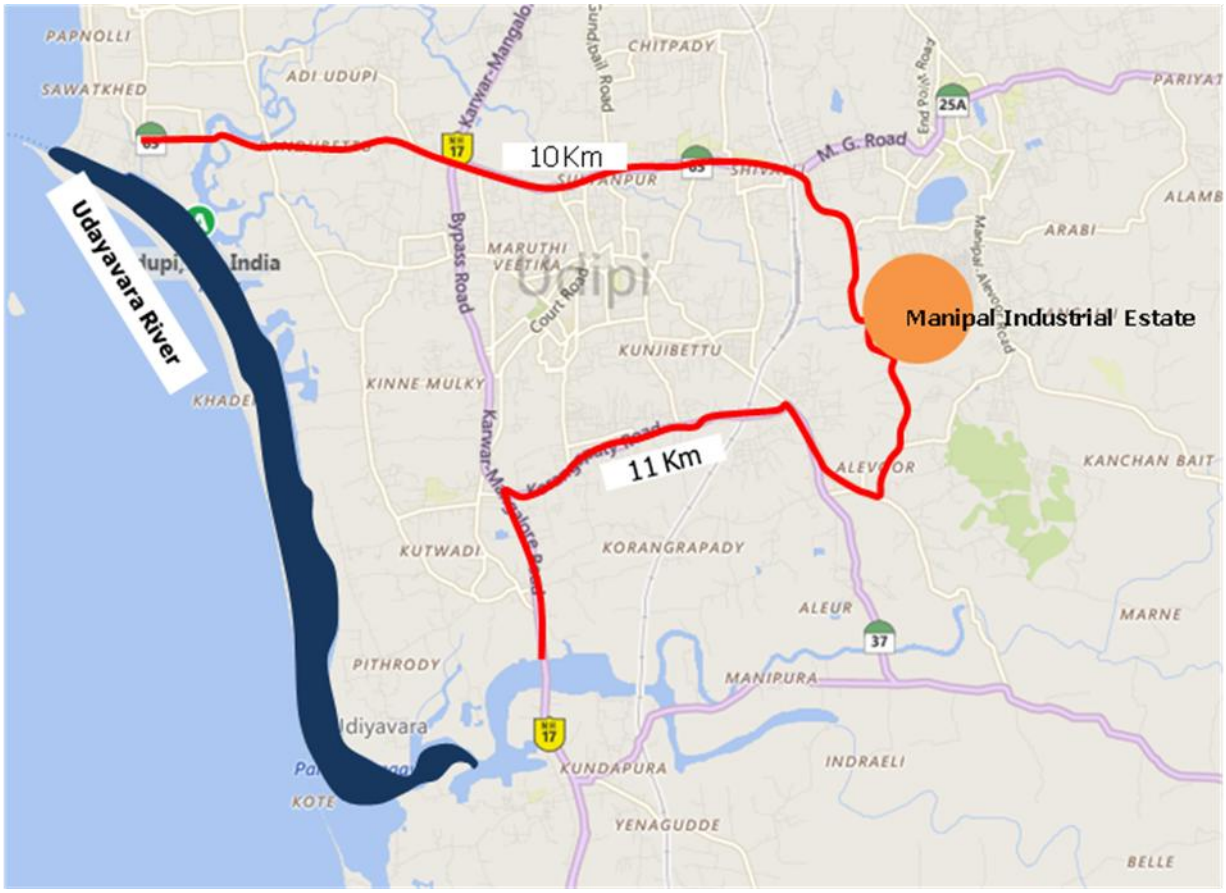


Figure 4.3: Access to Manipal Industrial Estate from Udayavara River

The scope to divert traffic from existing industrial areas very limited, however, will be examined in detail at the DPR stage.

- **Food grains:** About 2.22 lakh MT of Food grains, Rice, Pulses and oil seeds and 2.62 lakh Tonne of Horticulture products (**Table 4.2**) is produced in Udipi District of which about 1.77 lakh MT is produced in Udipi Taluka which lies in the catchment area. A small amount of cargo may be able to be moved through the River; however, this possibility will be examined in detail at DPR stage.

Table 4.2: Major Food grains/Horticulture productions in Udayavara catchment area in MTPA (2014-15)

Sl. No.	Taluk	Rice	Pulses (Blackgram, horse gram)	Oil seeds Ground nut, Sesamum	Sugarcane	Coconut	Areca nut	Cashew	Fruit crops	Total
1.	Udupi	81929	1490	1013	12036	61800	8901	2873	7828	177870
2.	Kundapur	84215	912	3623	2714	49398	25213	7324	12469	185868
3.	Karkala	49423	125	8	0	30612	28353	4643	7997	121161
	Total	215,567	2,527	4,644	147,50	1,41,810	62,467	14,840	28,294	484,899

- **Fisheries:** About 1.45 lakh MT of fishes (**Table 4.3**) are caught in Udipi District of which a significant amount is caught in Udipi Taluka. There are two Fish Product companies located close to the River. A small amount of cargo may be able to be moved through the River; however, this possibility will be examined in detail at DPR stage

Table 4.3: Fisheries in Udayavara catchment Area (2014-15)

Fish Production				
Sl. No.	**Taluk**	**Fish Catch (Tonnes)**	**Ice Plants (No/MT)**	**Cold Storage (No/MT)**
1.	Kundapura	25,379	28/685	Mar-95
2.	Karkala	2,005	0/0	0/0
3.	Udupi	1,18,101	62/1,752	5/470
Total		1,45,485	90/2,437	8/565

- **Passenger Ferry Services**

The current population of Udupi Taluka is 7 lakhs (Census 2011) and Taluka wise distribution is shown in **Table 4.4**.

Table 4.4: Population of Udipi District

Sl. No.	**Taluk**	**Area (sq. km)**	**Population**	
			2001 (No.)	**2011 (No.)**
1.	Kundapura	1,571	3,98,471	3,98,971
2.	Karkala	1,083	2,16,091	2,23,719
3.	Udupi	928	5,62,799	7,03,363
Total		3,582	11,77,361	13,26,053

The study on Development of IWT by Directorate of Ports & IWT assessed that for Udayavara River Catchment Area, there is a potential to develop eight Ferry routes as follows:

1. Malpe-Padukere
2. Kadekar-Padukere
3. Udyavar-Padukere
4. Kuspadi-Padukere
5. Kilanje-Heggar
6. Hireadka-Baje
7. Mudikukkahalla-Padukere
8. Kidiyar-Padukere

As per the study, about 4.9 lakh Passengers are likely to use these Ferry services in next 10 years, if the facilities are provided for the same. A total of 11 ferry points have been proposed in the Udayavara River area to cater to the forecasted passenger demand. The proposed locations of the same are:

1. Podukere,
2. Malpe,
3. Kadekar,
4. Kuspadi,
5. Udyavar,
6. Kilanje,
7. Hegger,
8. Hireadka,
9. Baje,
10. Mudikukkahala,
11. Kidiyar

The possibility of operating the Ferry services exists and will be examined in detail at the DPR stage.

- **Tourist Traffic**

Tourism potential in Udayavara River exists, and Ferry services are being provided to St Mary's line. The potential of the same will be studied at DPR stage.

4.3 Conclusion

Based on preliminary assessment a possibility of moving cargo through Udayavara River is very limited.

Potential of Passenger movement exists and in the catchment area and is expected to be 4-5 lakhs and Ferry points and Fleet and dredging will be required.

Tourism potential also exists in the River.

These are very preliminary observations and will be studied in detail at DPR stage.

CHAPTER 5 OBSERVATIONS AND INFERENCES

5.1 Waterway Feasibility

Based on the details presented under Chapter-3, following conclusions have been derived for establishing the navigability of the proposed waterway;

1. The river length as given by IWAI is 16.0km, whereas the total surveyed length along the river to capture the thalweg is only 15.19km. The initial 570m could not be surveyed and the distance surveyed to the end of the stretch is only 15.19km. The deepest channel route has been reckoned as 15.19km. All inferences derived for identifying the navigable length had been derived with reference to deepest channel length (15.19km).
2. The river is tidal affected for full length under study and relevant chart datum has been used. 25% of the surveyed length has water depth more than 2 m i.e. for about 3.73km, however not continuous.
3. Feasibility study suggests that the river is generally navigable without any obstruction, however after due modification to the Power cable lines / Bridges. Also after attending the dredging and smoothening of bends.
4. The lengths of the waterway, where a depth more than 2.0m, 1.5m and 1.0m with reference to the Chart Datum have been compiled in the main report. The brief of this is given in **Table 3.6** and being reproduced below:

Chainage (Km)	Draft Available		Length of River (Km)			
	Max. (m)	Min. (m)	>2m	1.5-2.0m	1-1.5m	<1m
-0.57-0.0	Could not be approached by the survey boat due to the rough weather condition. However, sufficient water depth available for navigation in this stretch					
0.0-5	5.71	-0.17	1.56	0.75	0.78	1.91
5-10	4.77	-0.17	0.21	0.26	1.01	3.52
10-15.19	3.12	0.1	1.96	1.25	1.66	0.32
Total			**3.73**	**2.26**	**3.45**	**5.75**

5. Five Power cables are crossing the study stretch, which are to be modified for safe navigation according to the required standards.
6. Three Bridges are crossing the study stretch, which are to be modified for safe navigation to meet the required standards. Further, the clearance requirements are to be appraised to the concerned bridge authorities to maintain the standards for the bridge under construction.

The above description & classification of the waterway has been presented schematically based on the survey observation and duly keeping in view the river classification criteria in **Table 3.15** as reproduced below:

Criteria	Classification																		
Length of waterway from start (km)	1	2	2	3	4	5	6	6	7	8	9	10	10	11	12	13	14	14	15	16
Chainage length in %	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
Depth availble	C-II																			
Raod Bridge Vert. Clearance	All Class															Needs Modification				
Raod Bridge Hor. Clearance	All Class															Needs Modification				
HT Line Vert. Clearance	All Class															Needs Raising of HT Base				
Bend Radius	C-I																			
Index	All Class		Class-V		Class-IV		Class-III		Class-II		Class-I									

5.2 Cargo Feasibility

Based on preliminary assessment a possibility of moving cargo through Udayavara River is very limited.

Potential of Passenger movement exists and in the catchment area and is expected to be 4-5 lakhs and Ferry points, fleet and dredging will be required.

Tourism potential also exists in the River. These are very preliminary observations and will be studied in detail at DPR stage.

5.3 SWOT Analysis

SWOT analysis has been carried out for deriving meaningful information specifying the objective of the study for development of the waterway for year round commercial navigation and identifying the internal & external factors that are favorable and unfavorable in the development of the waterway.

Strength

1. 27% of the 16km (15.19km + 0.57km) has waterway having more than 2m water depth available for navigation.
2. More than 2.0m is available for a length of 4.3km (3.73kms + 0.57kms) in the proposed waterway, however not continuous. Shoals have been observed, which may have to be attended by Dredging.
3. The maximum tidal fluctuation of 1.68m has been observed and this will strengthen the safe mobility of vessels in the waterway using the diurnal tidal window.
4. Approximately 7 lacs of population is residing in the Udupi Taluka.
5. Malpe Port is connected to the Udayavara River.
6. M/s Tebma Ship Yard is on the banks of Udayavara River.
7. Director, IWT, Karnataka State study assessed 8 Ferry Routes (11 Ferry points) to cater to the passenger mobility through IWT to an extent of 4.9 lacs in next 10 years.
8. Fishing activity is on in the study stretch of Udayavara River.
9. Good Road and Rail connectivity exists in the vicinity of the study stretch.

Weakness

1. Presently, there is no IWT movement.

Opportunity

1. 27% of the 16km is having more than 2m water depth available for navigation, which can be used advantageously for the mobility of hinterland cargo.
2. 2.0m water depth is available for about 4.3kms, which can be used advantageously for the mobility of hinterland cargo, since the balance stretch can be managed by Dredging activity.
3. The maximum tidal fluctuation of 1.68m, as observed, can be an opportunity for the safe mobility of vessels in the waterway.
4. The interconnectivity to Malpe Port may establish through IWT traffic.
5. Ro – Ro operation, if established, decongestion of Udupi Town may be a possibility.
6. The hinterland population will get direct or indirect benefit with the development of IWT in this river.
7. The existing fishing activity (through the Malpe Port) will get support with the development of this River.
8. The planning by local Government on 8 Ferry Routes (11 Ferry points) to cater to the passenger mobility through IWT to an extent of 4.9 lacs in next 10 years on the Udayavara River, Passenger mobility will flourish, if the Waterway is developed.
9. The presence of M/s Tebma Ship Yard on the banks of Udayavara River may attract good mobility of Repair Infrastructure.
10. The present Rail and Road connectivity though competing with IWT may also be an opportunity for creating an efficient intermodal hub for IWT.
11. Policies are to be firmed up for development of IWT in this stretch.

Threat

1. The Panvel Edappally Highway in the study area may create competing mode of transport.
2. NH 17, SH 66 and SH 67 in the vicinity may be a competing mode, if not effectively used for intermodal connectivity.
3. The Udayavara River banks covered by marginal mangrove trees in certain places may involve some socio-environmental issues and may require statutory approvals and clearances to construct the jetties/ terminals/ ports/ intermodal connectivity.

5.4 Development Cost (Tentative)

The reconnaissance survey data with regard to physical constraints may have cost implications for making the river stretch navigable to the required standards. Henceforth the development of the proposed national water way involves physical interference in the form of dredging, construction of terminals at the identified locations, modification of HT Lines at crossing locations to provide a minimum vertical clearance of 20.1m (with respect to 220 kVA) or the case may be combined with some unforeseen expenses. Moderate dredging effort has been envisaged with an average dredging of 1.0m required in 11.5m of the length of proposed waterway reckoned with reference to ascertained data. The cost of dredging has been considered @ INR 230 per cum. The cost of a small terminal has been estimated @ INR 10.0 crore each. The cost of modification of one transmission tower

has been estimated to be INR 20.00 lacs each and the stringing cost across the pair of towers shall be INR 4.0 lacs per pair of towers. The total estimated cost for modification to the Five power cables shall be INR 5 x 44.0 lacs = INR 220 lacs. Three nos. of Bridges may have to be modified with reconstruction at an estimated cost of INR 1.5 crores each amounting to INR 4.5 crores. The cost of navigational aids for day/night navigation has been considered as INR 150 lacs. 10% of the amount for dredging, terminal construction and night navigation has been envisaged as unforeseen. The tentative total cost of development to make the river navigable round the year to achieve safe navigation for the required classification of vessel mobility has been estimated to INR 31.70 crore.

Table 5.1: Tentative Development Cost of Udayavara River Waterway (NW-105)

Sl. No.	Name of Waterway	Length of Water way	Dredging Required (w. r. to 2m draft & 40.0m width)	Dredging Cost @ INR 230/ cum	Terminal Proposed	Terminal Cost @ INR 10 Cr each	Cost of Modification of Transmission line	Night Navigation	Total cost including 10% unforeseen
		(km)	(km)	INR in Cr.)	(Nos)	(INR in Cr.)	(INR in Cr.)	(INR in Cr.)	(INR in Cr.)
1	Udayavara River	16.00	11.5	10.60	1	10.00	6.70	1.50	31.70

5.5 Classification of Waterway

The Ministry of Shipping, Road Transport and Highways (Inland Waterways Authority of India) has classified the Inland waterways into seven categories for rivers and canals for safe plying of self propelled vessels up to 2000 DWT and tug-barge formation in push tug + four barge units of carrying capacity up to 8000 DWT (Ref: IWAI, Gazette Notification dated 26th January 2007).

As per the above Classification of Inland Waterways, the entire waterway of Udayavara River (NW-105) of 16km length has been classified based on the available minimum water depth, bottom width, minimum vertical and horizontal clearances of cross over structures and bend radius in the river. The classification of Udayavara River is described below.

Table 5.2: Classification of Udayavara River (NW-105)

Chainage (km)	Minimum Depth (m)	Bottom Width (m)	Minimum Vertical Clearance (m)	Minimum Horizontal Clearance (m)	Bend Radius (m)	Classification of Waterway (Proposed)
0.0 – 16.0	- 0.17	150	2.0 (Bridge) 3.0 (Power Cable)	20 (Bridge) 25 (Power Cable)	180	**Class – II**

The entire study stretch of the waterway is amenable for development as **Class II** waterway as explained above. However, considerable Dredging is required. Smoothening of the bends may be essential.

The above stretch of the waterway, hence, can be considered under Class II, which is navigable without any hindrance and shall be used for plying self-propelled vessel of carrying capacity up to 300 DWT (approximate size 45m overall length, 8m moulded breadth and 1.2m loaded draft) or one tug and two barges combination of 600 DWT (approximate size 110m overall length, 8m breadth and 1.2m loaded draft).

5.6 Recommendation

The national waterway-105 of Udayavara River has been identified having potential for development as waterway of Class II for the entire study stretch of 16km, as described above. This stretch of the river is, therefore, recommended for stage-II study for preparation of Detailed Project Report (DPR) to establish the viability for implementation as a project.

Accordingly, the national waterway NW-105 of Udayavara River is proposed for development as **Class II** waterway in the stretch of the waterway as depicted below:

River Stretch	0.00km 16.00km
Classification	**Class-II**
Horizontal clearance (m)	40
Vertical clearnce (m)	5
Minimum Depth (m)	1.4
Bottom Width (m)	40
Self Propelled Vessel	
Dead Weight Tonnage	300
Vessel size (m)	45 x 8 x 1.2
Tug + Barge	
Dead Weight Tonnage	600
Vessel size (m)	110 x 8 x 1.2

ANNEXURE 1.1

DATA COLLECTION & SOURCE OF DATA

Annexure 1.1: Data Collection Source of Data

(Cluster-6)

Sl. No	Name of Authority, place	Contacted Person	Designation	Contact Number	Required Data	Collected Data	Date of Receiving Data	Remarks
KARNATAKA								
1	Water Resources Deparment, Vikas Soudha, Banagalore	---	Additional Chief Secretary	---	River Gauge & Discharge Data/ Structure Detail	----	---	Official Letter Submitted to the Department. Data is Awaited
2	Public Works Ports and Inland Water Transport, Vikas Soudha, Bangalore	---	Principal Secretary	---	River Gauge & Discharge Data/ Structure Detail	Yes	3/4/2016	Official Letter Submitted to the Department. PS suggested to contact Director, Karwar for data collection.
3	Public Works Ports and Inland Water Transport, Karwar	Mr. Captain R Mohan	Director	---	River Gauge & Discharge Data/ Structure Detail/ Chart Datum	---	---	
4	Public Works Ports and Inland Water Transport, Karwar	Mr. Narayanappa	Inland water transport Engineer	9480431148	River Gauge & Discharge Data/ Structure Detail/ Chart Datum	Yes	3/3/2016	Official Letter Submitted to the Department. Data Received in the form of historical reports and studies.
5	public works ports and inland water transport, Karwar	Mr. YaganaKumar	Hydrographic Surveyor	9242850078	River Gauge & Discharge Data/ Structure Detail/ Chart Datum	Yes	3/4/2016	Official Letter Submitted to the Department. Data Received in the form of historical reports and studies.

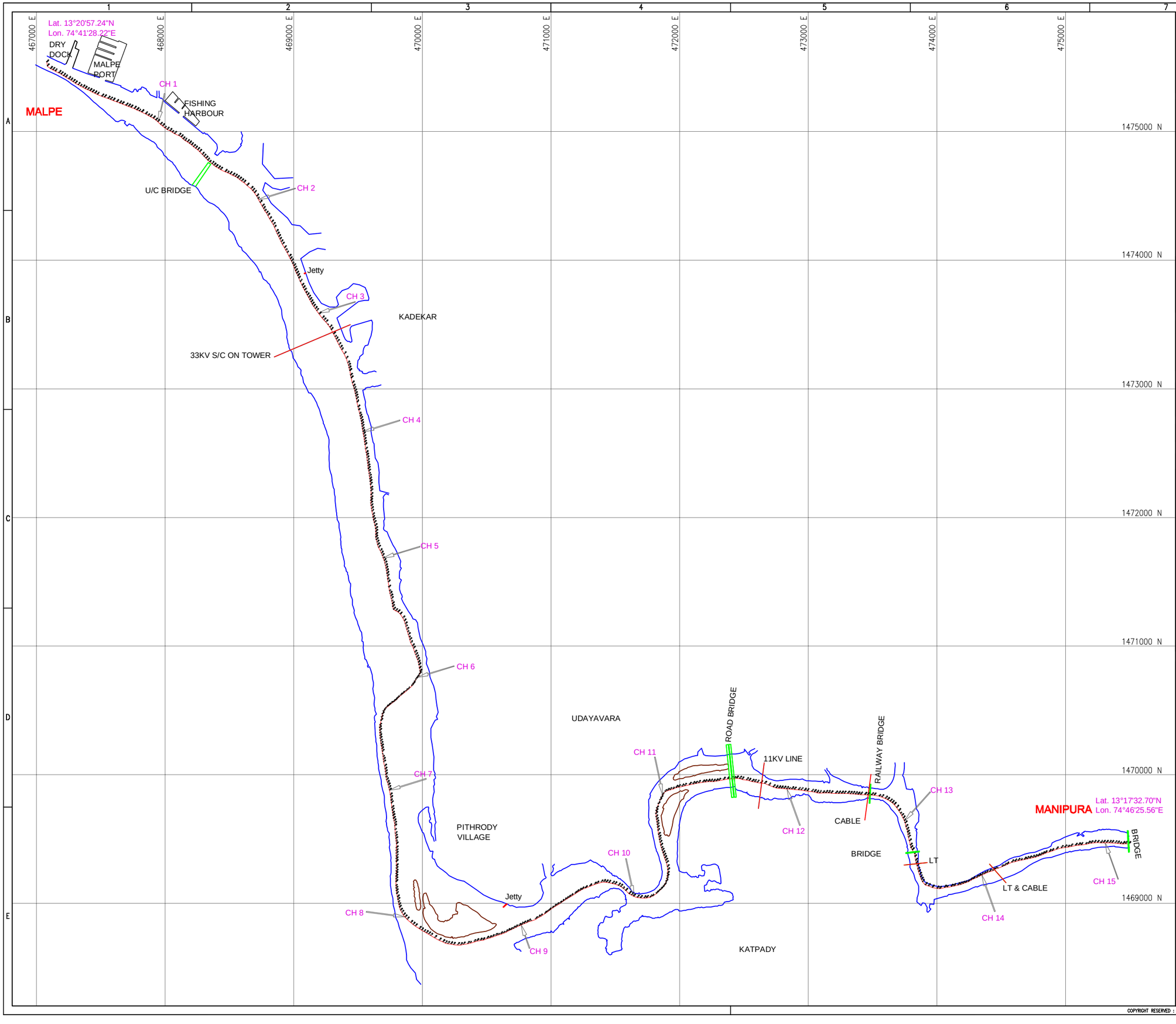
Annexure 1.1: Data Collection Source of Data

(Cluster-6)

KERALA								
1	Planing and Economics Affairs, Annex Building, Secretariat, Thiruvanathapuram	Mr. Alok Sheel	Additioan Chief Secretary	0471-2518444	Data on Urban Infrastructure & Transportation	---	---	Official Letter Submitted to the Department. Data is Awaited
2	LSGD - Urban Affairs, Secretariat, Thiruvanathapuram	Mr. APM Mohammed Hanish	Secretary	0471-2327451	Data on Urban Infrastructure & Transportation	---	---	Official Letter Submitted to the Department. Data is Awaited
3	Directorate of industries and commerce, Vikas Bhavan, Thiruvananathapuram	Mr. PM Francis	Director	---	District Industrial Production Data	---	---	Official Letter Submitted to the Department. Data is Awaited
4	Directorate of industries and commerce, Vikas Bhavan, Thiruvananathapuram	Mr. Ramesh Baskar	Additional Direcotor	9495940863	District Industrial Production Data	---	---	Official Letter Submitted to the Department. Data is Awaited
5	Revenue and Disaster Management	Mr. Viswas Mehta	principal Secretary	0471-2518113, 0471-2517162	District Gross Production Data	---	---	Official Letter Submitted to the Department. Data is Awaited
6	Deparment of Transport	Mr. Elaias George	Additional Chief Secretary	---	Transport Related data/ Current Use	---	---	Official Letter Submitted to the Department. Data is Awaited
7	Water Resources Secretariat Thiruvanathapuram	Mr. VJ Kurain	Additional Chief Secretary	---	River Gauge & Discharge Data/ Structure Detail	---	---	Official Letter Submitted to the Department. Data is Awaited
8	Water ResourcesDeptt.Public Offiece, Thiruvanthapuram	Mr. Hari Narayanan	Chief Engineer	---	River Gauge & Discharge Data/ Structure Detail	---	---	Official Letter Submitted to the Department. Data is Awaited
9	Water ResourcesDeptt.Public Offiece, Thiruvanthapuram	Mr. Srileka	Executive Engneer	9895324906	River Gauge & Discharge Data/ Structure Detail	---	---	Official Letter Submitted to the Department. Data is Awaited

ANNEXURE 3.1

OVERVIEW CHART FOR UDAYAVARA RIVER BATHYMETRY



LEGEND:

1.4	Sounding
1642000 N	UTM Grid
	BRIDGE
	HT/LT CABLE
	RIVER BOUNDARY
	SHOALS/BARS/ISLAND
CH2	CHAINAGE

GEODETIC INFORMATION

GEODETIC DATUM	:	WGS 1984
ELLIPSOID	:	WGS 1984
SEMI MAJOR AXIS	:	6378137.000 M
SEMI MINOR AXIS	:	6356752.314 M
INVERSE FLATTENING	:	298.257223563
FALSE NORTHING	:	0 M
SCALE FACTOR	:	0.9996 ON CM
UNIT OF MEASUREMENT	:	INTERNATIONAL METRES
PROJECTION	:	UNIVERSAL TRANSVERSE MERCATOR
GRID SYSTEM	:	UTM ZONE 43 N
CENTRAL MERIDIAN	:	75 DEGREE EAST
LATITUDE OF ORIGIN	:	0 DEGREE NORTH
FALSE EASTING	:	500000 M

NOTES:

1. Position Fixing was controlled by Trimble SPS 351 DGPS System.
2. Dual Frequency Echo Sounder Bathy 500 DF working on 200 kHz was used for recording water depths.
3. Depths are in Metres and Decimetres.

REVISION STATUS

Rev	Date	Description	Surveyed by	Processing & Charting by	Checked by	Approved by
0	15 Feb 2016	Final Drawing	AVS	JA	DKV	BS

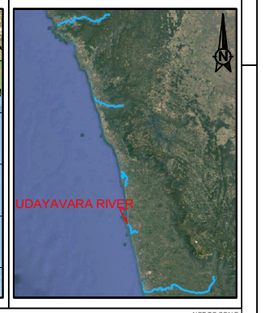
REFERENCE DRAWINGS

Rev. No:	Date:	Drawing No.	Source	Description:
-	-	-	-	-

OVERVIEW PLAN

LAYOUT PLAN

INDIA - WEST COAST



NOT TO SCALE

CLIENT

TRACTEBEL ENGINEERING PVT. LTD.
2nd FLOOR, BUILDING NO-10C,
DLF CYBER CITY,
GURGAON - 122002
HARYANA (INDIA)

SURVEY CONTRACTOR

GEOINFOSYS TECHNOLOGIES
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PROJECT TITLE

CONSULTANCY SERVICES FOR PREPARATION OF TWO STAGE DETAILDED REPORT OF PROPOSED 53 INLAND WATERWAYS (CLUSTER-VI (KARNATAKA AND KERALA) PROPOSED NATIONAL WATERWAY(NW-105)

CHART SHOWING

ANNEXURE 3.1
OVERVIEW CHART OF UDAYAVARA RIVER BATHYMETRY

SCALE 0 0.26 0.52 0.78 1.04 1.30KM

Sheet: 1 of 1

ANNEXURE 3.2

CHART DATUM OF NEW MANGALORE PORT FROM OIL SPILL CONTINGENCY PLAN

NEW MANGALORE PORT TRUST

OIL SPILL CONTINGENCY PLAN

REVIEWED AND UPDATED IN

SEPTEMBER 2008

CHAPTER 1

1. INTRODUCTION

1.1 Area Description:

New Mangalore Port is located on the West Coast of India midway between Kochi and Mormugao. It is an all weather port and the maritime gateway of Karnataka State.

The National Highway 17 passes just outside the port connecting Cape Comorin to Mumbai.

The Port is served by a Broad Gauge Railway line and is well connected with Southern portion of country through Mangalore, Kerala State and Chennai.

The nearest Airport, Bajpe (Mangalore Airport) is just 18 kms from the Port. There are daily flights to Mumbai, Bangalore and Chennai.

1.2. Location:

Latitude: 12^0 55' N
Longitude: 74^0 48' E

1.3. Meteorological Marine Data:

1.3.1. Wind:

The winds in the monsoon months of June, July and August are predominantly from Southwest and West with a maximum intensity of 5 in the Beaufort Scale (with occasional squall up to force 7). The winds in the remaining months of the year are predominantly from Northwest and maximum intensity during this period is also force 5 in the Beaufort scale.

1.3.2 Waves:

The predominant direction of waves in the vicinity of New Mangalore Port during Monsoon months of June, July and August is West and Southwest whereas during the fair months it is Northwest and North. Analysis of data collected from

ships in and around Mangalore revealed that 0.4% of the waves have a height of 4.9 metres. Maximum height recorded in 1974: 6.50 metres. The wave heights in the non-monsoon months are much less. The dominant wave period during the monsoon is approximately 10 seconds while longer wave periods are experienced during the monsoon.

1.3.3 Cyclones:

The location of the port is such it does not encounter cyclones..

1.3.4 Visibility:

Thirty years observations conducted by the Indian Meteorological Department reveal that poor visibility (visibility less than 4 kms.) is encountered for about 10 days during the South West monsoon period.

1.3.5 Currents:

The current along the coast during the South-West monsoon (from June to September) is in general towards sought. During the North-East monsoon (November to February) the current in general is towards North. During the period of heavy rains in the South-West monsoon there have been observations of reversal of set in the approach channel near the edge of the breakwater with a strong drift. Drift is variable in the approach channel and can be as high as 1.5 knots during the South-West monsoon.

1.3.6 Tides:

The tidal particulars at New Mangalore Port are as follows (with reference to Chart Datum):

Higher High Water Springs	**-**	**+1.68m**
Mean Higher High Water	**-**	**+1.48m**
Mean Lower High Water	**-**	**+1.26m**
Mean Sea Level	**-**	**+0.95m**
Mean Lower Low Water	**-**	**+0.26m**
Lower Low Water Springs near solstices	**-**	**+0.03m**

1.3.7 Climate:

Temperature	-	Max. 34^0 C / Min. 18^0 C
Annual Rainfall	-	About 3450mm
Weather	-	Tropical climate with high humidity

1.4 Important features of the Port:

1.4.1 Port Area:

Water Spread:	-	320 Acres (129 hectares)
Land Area	-	2030 Acres (822 hectares)
Total	-	2350 Acres (951.04 hectares)

1.4.2 Berth Particulars

Sl. No	NAME OF BERTH	TYPE OF BERTH	DRAUGHT (IN MTS.)	LENGTH (IN MTS.)	DWT
1.	BERTH NO.1	GEN.CARGO	7.00	125	4000
2.	BERTH NO.2	GEN.CARGO	10.50	198	30000
3.	BERTH NO.3	GEN.CARGO	10.30	198	30000
4.	BERTH NO.4	GEN.CARGO/LIQUID AMMONIA/ PHOSPHORIC ACID	9.50	198	30000
5.	BERTH NO.5	GEN.CARGO/BULK CEMENT/ EDIBLE OIL	9.50	198	30000
6.	BERTH NO.6	GEN.CARGO	9.50	198	30000
7.	BERTH NO.7	GEN.CARGO	9.50	198	30000
8.	BERTH NO.8	IRON ORE/ GEN.CARGO	13.00	300	60000
9.	BERTH NO.9	POL/LPG	10.50	330	45000
10.	BERTH NO.10	CRUDE OIL/POL	14.00	320	120000
11.	BERTH NO.11	CRUDE & POL	14.00	320	120000
12.	BERTH NO.12	POL & CHEMICALS	12.50	320	50000
13.	BERTH NO.13	Under construction	12.00	275	35000
14.	BERTH NO.14	GEN.CARGO/IRON ORE/COAL	14.00	350	85000

1.4.3. Floating crafts:

- 22.5 T Bollard Pull Tractor Tug (VSP) - 1 No.
- 32 T Bollard Pull Tug Tractor Tug (VSP) - 3 Nos.
- 50 T Bollard Pull Tractor Tug (VSP) - 1 No.
- Pilot Launches - 3 Nos.
- Mooring Launches - 5 Nos.
- Survey Launch - 1 No.
- Buoy Laying Tender cum Skimmer 50 T capacity - 1 No.

ANNEXURE 3.3

BATHYMETRIC SURVEY AS RECEIVED FROM HYDROGRAPHIC SURVEYOR

Annexure 3.3: Bathymetric Survey as Received from Hydrographic Surveyor

Digital Data, Chainage vs Water Depth

Chainage(KM)	Easting	Northing	Depth(M)	Reduced Depth w.r.t. CD (M)
0.00	74°41 '45.6"	13°20 '49.46"	6.66	5.71
0.03	74°41 '45.73"	13°20 '48.43"	6.49	5.54
0.06	74°41 '46.58"	13°20 '47.78"	6.25	5.30
0.08	74°41 '47.18"	13°20 '47.51"	5.74	4.79
0.11	74°41 '47.81"	13°20 '47.2"	6.17	5.22
0.14	74°41 '48.76"	13°20 '46.73"	6.19	5.24
0.16	74°41 '49.34"	13°20 '46.4"	5.94	4.99
0.18	74°41 '49.93"	13°20 '46.01"	5.43	4.48
0.20	74°41 '50.52"	13°20 '45.67"	5.21	4.26
0.23	74°41 '51.3"	13°20 '45.22"	5.27	4.32
0.25	74°41 '51.86"	13°20 '44.86"	4.87	3.92
0.27	74°41 '52.43"	13°20 '44.49"	4.65	3.70
0.29	74°41 '53.00"	13°20 '44.15"	4.52	3.57
0.31	74°41 '53.75"	13°20 '43.72"	4.47	3.52
0.33	74°41 '54.35"	13°20 '43.39"	4.30	3.35
0.35	74°41 '54.96"	13°20 '43.1"	4.25	3.30
0.37	74°41 '55.54"	13°20 '42.78"	4.05	3.10
0.40	74°41 '56.18"	13°20 '42.48"	4.01	3.06
0.42	74°41 '56.81"	13°20 '42.2"	3.95	3.00
0.44	74°41 '57.4"	13°20 '41.9"	3.86	2.91
0.46	74°41 '58.06"	13°20 '41.59"	3.69	2.74
0.48	74°41 '58.69"	13°20 '41.3"	3.54	2.59
0.52	74°41 '59.86"	13°20 '40.81"	3.54	2.59
0.54	74°42 '0.52"	13°20 '40.62"	3.03	2.08
0.57	74°42 '1.46"	13°20 '40.26"	3.08	2.13
0.59	74°42 '2.1"	13°20 '40.02"	3.15	2.20
0.61	74°42 '2.78"	13°20 '39.79"	3.25	2.30
0.64	74°42 '3.73"	13°20 '39.42"	3.27	2.32
0.67	74°42 '4.5"	13°20 '39.1"	3.07	2.12
0.69	74°42 '5.14"	13°20 '38.89"	3.02	2.07
0.72	74°42 '6.1"	13°20 '38.55"	2.99	2.04
0.74	74°42 '6.75"	13°20 '38.32"	2.82	1.87
0.76	74°42 '7.4"	13°20 '38.07"	2.66	1.71
0.79	74°42 '8.27"	13°20 '37.73"	2.63	1.68
0.81	74°42 '8.94"	13°20 '37.39"	2.53	1.58
0.83	74°42 '9.54"	13°20 '37.11"	2.40	1.45
0.85	74°42 '10.2"	13°20 '36.86"	2.55	1.60
0.89	74°42 '11.21"	13°20 '36.38"	2.51	1.56
0.91	74°42 '11.87"	13°20 '36.01"	2.60	1.65
0.93	74°42 '12.44"	13°20 '35.68"	2.51	1.56
0.95	74°42 '13.16"	13°20 '35.26"	2.54	1.59
0.98	74°42 '13.79"	13°20 '34.8"	2.61	1.66
1.00	74°42 '14.34"	13°20 '34.41"	2.34	1.39
1.03	74°42 '15.04"	13°20 '33.73"	2.31	1.36
1.05	74°42 '15.57"	13°20 '33.33"	2.33	1.38
1.07	74°42 '16.17"	13°20 '32.86"	2.40	1.45
1.09	74°42 '16.76"	13°20 '32.44"	2.34	1.39
1.12	74°42 '17.49"	13°20 '32.11"	2.39	1.44
1.14	74°42 '18.1"	13°20 '31.78"	2.30	1.35
1.16	74°42 '18.69"	13°20 '31.4"	2.16	1.21
1.20	74°42 '19.8"	13°20 '30.93"	2.26	1.31

Chainage(KM)	Easting	Northing	Depth(M)	Reduced Depth w.r.t. CD (M)
1.22	74°42 '20.39"	13°20 '30.56"	2.56	1.61
1.24	74°42 '20.84"	13°20 '30.03"	2.62	1.67
1.26	74°42 '21.38"	13°20 '29.65"	2.77	1.82
1.28	74°42 '21.99"	13°20 '29.32"	3.02	2.07
1.30	74°42 '22.53"	13°20 '28.95"	3.23	2.28
1.32	74°42 '23.06"	13°20 '28.55"	3.61	2.66
1.34	74°42 '23.58"	13°20 '28.1"	4.22	3.27
1.36	74°42 '24.1"	13°20 '27.67"	4.44	3.49
1.38	74°42 '24.65"	13°20 '27.28"	4.93	3.98
1.40	74°42 '25.15"	13°20 '26.82"	4.58	3.63
1.43	74°42 '25.84"	13°20 '26.12"	4.37	3.42
1.45	74°42 '26.29"	13°20 '25.62"	2.76	1.81
1.47	74°42 '26.79"	13°20 '25.14"	4.66	3.71
1.49	74°42 '27.26"	13°20 '24.67"	5.71	4.76
1.51	74°42 '27.8"	13°20 '24.23"	5.50	4.55
1.54	74°42 '28.35"	13°20 '23.79"	5.15	4.20
1.56	74°42 '28.86"	13°20 '23.37"	4.88	3.93
1.58	74°42 '29.4"	13°20 '22.99"	3.69	2.74
1.60	74°42 '30"	13°20 '22.65"	3.08	2.13
1.62	74°42 '30.59"	13°20 '22.34"	2.78	1.83
1.66	74°42 '31.79"	13°20 '21.79"	2.87	1.92
1.68	74°42 '32.41"	13°20 '21.51"	2.60	1.65
1.70	74°42 '33.03"	13°20 '21.24"	2.43	1.48
1.72	74°42 '33.75"	13°20 '20.88"	2.52	1.57
1.74	74°42 '34.37"	13°20 '20.59"	2.29	1.34
1.76	74°42 '34.96"	13°20 '20.24"	2.03	1.08
1.78	74°42 '35.47"	13°20 '19.82"	1.88	0.93
1.80	74°42 '36.01"	13°20 '19.41"	1.95	1.00
1.82	74°42 '36.59"	13°20 '19.04"	1.98	1.03
1.86	74°42 '37.43"	13°20 '18.31"	2.04	1.09
1.90	74°42 '38.45"	13°20 '17.49"	1.92	0.97
1.92	74°42 '38.87"	13°20 '16.98"	2.16	1.21
1.94	74°42 '39.33"	13°20 '16.46"	2.54	1.59
1.97	74°42 '39.92"	13°20 '15.56"	2.67	1.72
1.99	74°42 '40.23"	13°20 '14.96"	2.40	1.45
2.03	74°42 '40.8"	13°20 '13.99"	2.42	1.47
2.06	74°42 '41.36"	13°20 '13.02"	2.44	1.49
2.08	74°42 '41.7"	13°20 '12.44"	2.07	1.12
2.10	74°42 '42.02"	13°20 '11.86"	1.90	0.95
2.12	74°42 '42.44"	13°20 '11.28"	1.81	0.86
2.15	74°42 '42.8"	13°20 '10.69"	1.69	0.74
2.17	74°42 '43.28"	13°20 '9.84"	1.67	0.72
2.20	74°42 '43.77"	13°20 '8.99"	1.68	0.73
2.23	74°42 '44.21"	13°20 '8.36"	1.79	0.84
2.25	74°42 '44.5"	13°20 '7.69"	1.81	0.86
2.29	74°42 '44.97"	13°20 '6.57"	1.73	0.78
2.31	74°42 '45.26"	13°20 '5.95"	1.82	0.87
2.33	74°42 '45.59"	13°20 '5.28"	1.89	0.94
2.35	74°42 '45.9"	13°20 '4.66"	1.91	0.96
2.38	74°42 '46.24"	13°20 '4.02"	1.81	0.86
2.40	74°42 '46.58"	13°20 '3.41"	1.91	0.96
2.43	74°42 '47.09"	13°20 '2.51"	1.89	0.94
2.45	74°42 '47.44"	13°20 '1.89"	1.80	0.85
2.47	74°42 '47.79"	13°20 '1.28"	1.80	0.85

Chainage(KM)	Easting	Northing	Depth(M)	Reduced Depth w.r.t. CD (M)
2.50	74°42 '48.33"	13°20 '0.34"	1.92	0.97
2.52	74°42 '48.63"	13°19 '59.74"	2.01	1.06
2.55	74°42 '48.93"	13°19 '59.15"	2.12	1.17
2.57	74°42 '49.22"	13°19 '58.55"	2.30	1.35
2.59	74°42 '49.5"	13°19 '57.95"	2.56	1.61
2.61	74°42 '49.74"	13°19 '57.33"	2.74	1.79
2.63	74°42 '49.98"	13°19 '56.69"	2.86	1.91
2.65	74°42 '50.26"	13°19 '56.05"	3.03	2.08
2.67	74°42 '50.54"	13°19 '55.45"	3.06	2.11
2.69	74°42 '50.79"	13°19 '54.83"	3.21	2.26
2.72	74°42 '51.18"	13°19 '53.98"	3.14	2.19
2.75	74°42 '51.65"	13°19 '53.01"	3.07	2.12
2.77	74°42 '51.97"	13°19 '52.38"	3.03	2.08
2.79	74°42 '52.31"	13°19 '51.78"	3.21	2.26
2.82	74°42 '52.68"	13°19 '51.13"	3.20	2.25
2.84	74°42 '53"	13°19 '50.56"	3.07	2.12
2.86	74°42 '53.35"	13°19 '49.98"	2.93	1.98
2.88	74°42 '53.67"	13°19 '49.4"	2.64	1.69
2.90	74°42 '53.98"	13°19 '48.83"	2.35	1.40
2.92	74°42 '54.3"	13°19 '48.24"	2.06	1.11
2.94	74°42 '54.65"	13°19 '47.66"	1.86	0.91
2.96	74°42 '55.06"	13°19 '47.13"	1.82	0.87
2.98	74°42 '55.46"	13°19 '46.6"	1.74	0.79
3.01	74°42 '56.12"	13°19 '45.73"	1.68	0.73
3.05	74°42 '56.9"	13°19 '44.75"	1.63	0.68
3.07	74°42 '57.33"	13°19 '44.23"	1.73	0.78
3.09	74°42 '57.83"	13°19 '43.75"	1.93	0.98
3.12	74°42 '58.37"	13°19 '43.11"	2.00	1.05
3.14	74°42 '58.88"	13°19 '42.45"	2.15	1.20
3.16	74°42 '59.22"	13°19 '41.85"	2.02	1.07
3.20	74°42 '59.82"	13°19 '40.74"	2.02	1.07
3.23	74°43 '0.22"	13°19 '40"	1.90	0.95
3.25	74°43 '0.49"	13°19 '39.4"	1.67	0.72
3.27	74°43 '0.81"	13°19 '38.79"	1.76	0.81
3.30	74°43 '1.2"	13°19 '37.99"	1.65	0.70
3.32	74°43 '1.57"	13°19 '37.29"	1.59	0.64
3.34	74°43 '1.9"	13°19 '36.72"	1.71	0.76
3.38	74°43 '2.56"	13°19 '35.67"	1.74	0.79
3.42	74°43 '3.07"	13°19 '34.51"	1.73	0.78
3.46	74°43 '3.5"	13°19 '33.37"	1.91	0.96
3.48	74°43 '3.7"	13°19 '32.73"	1.72	0.77
3.50	74°43 '3.84"	13°19 '32.09"	1.63	0.68
3.52	74°43 '4.03"	13°19 '31.46"	2.85	1.90
3.55	74°43 '4.19"	13°19 '30.25"	3.06	2.11
3.57	74°43 '4.39"	13°19 '29.59"	3.05	2.10
3.61	74°43 '4.68"	13°19 '28.33"	2.86	1.91
3.64	74°43 '4.95"	13°19 '27.53"	2.97	2.02
3.66	74°43 '5.14"	13°19 '26.89"	3.17	2.22
3.68	74°43 '5.33"	13°19 '26.25"	3.12	2.17
3.70	74°43 '5.48"	13°19 '25.6"	3.19	2.24
3.72	74°43 '5.61"	13°19 '24.96"	3.36	2.41
3.74	74°43 '5.73"	13°19 '24.32"	3.45	2.50
3.77	74°43 '5.88"	13°19 '23.49"	3.37	2.42
3.81	74°43 '6.16"	13°19 '22.22"	3.35	2.40

Chainage(KM)	Easting	Northing	Depth(M)	Reduced Depth w.r.t. CD (M)
3.83	74°43 '6.34"	13°19 '21.51"	3.20	2.25
3.86	74°43 '6.59"	13°19 '20.57"	2.90	1.95
3.88	74°43 '6.73"	13°19 '19.91"	2.61	1.66
3.90	74°43 '6.87"	13°19 '19.28"	2.66	1.71
3.92	74°43 '7.02"	13°19 '18.61"	2.63	1.68
3.94	74°43 '7.12"	13°19 '17.96"	2.46	1.51
3.96	74°43 '7.21"	13°19 '17.32"	2.34	1.39
3.98	74°43 '7.31"	13°19 '16.66"	2.21	1.26
4.00	74°43 '7.45"	13°19 '16.01"	2.07	1.12
4.02	74°43 '7.55"	13°19 '15.36"	1.86	0.91
4.04	74°43 '7.66"	13°19 '14.69"	1.76	0.81
4.07	74°43 '7.76"	13°19 '13.99"	1.66	0.71
4.09	74°43 '7.83"	13°19 '13.32"	1.54	0.59
4.11	74°43 '7.96"	13°19 '12.65"	1.59	0.64
4.14	74°43 '8.11"	13°19 '11.57"	1.49	0.54
4.17	74°43 '8.27"	13°19 '10.66"	1.42	0.47
4.19	74°43 '8.38"	13°19 '10.01"	1.35	0.40
4.21	74°43 '8.48"	13°19 '9.35"	1.25	0.30
4.23	74°43 '8.59"	13°19 '8.64"	1.18	0.23
4.25	74°43 '8.67"	13°19 '7.97"	1.07	0.12
4.27	74°43 '8.74"	13°19 '7.31"	1.02	0.07
4.29	74°43 '8.81"	13°19 '6.66"	0.98	0.03
4.31	74°43 '8.93"	13°19 '6"	1.04	0.09
4.33	74°43 '9.03"	13°19 '5.34"	1.20	0.25
4.35	74°43 '9.13"	13°19 '4.69"	1.12	0.17
4.37	74°43 '9.22"	13°19 '4.02"	0.97	0.02
4.40	74°43 '9.31"	13°19 '3.36"	0.82	-0.13
4.42	74°43 '9.38"	13°19 '2.64"	0.78	-0.17
4.45	74°43 '9.48"	13°19 '1.69"	0.78	-0.17
4.47	74°43 '9.51"	13°19 '1.02"	0.79	-0.16
4.50	74°43 '9.54"	13°19 '0.04"	0.78	-0.17
4.52	74°43 '9.52"	13°18 '59.23"	0.78	-0.17
4.54	74°43 '9.48"	13°18 '58.57"	0.85	-0.10
4.56	74°43 '9.46"	13°18 '57.9"	1.48	0.53
4.58	74°43 '9.56"	13°18 '57.24"	1.56	0.61
4.61	74°43 '9.67"	13°18 '56.51"	1.52	0.57
4.63	74°43 '9.78"	13°18 '55.86"	1.41	0.46
4.65	74°43 '9.97"	13°18 '54.99"	1.02	0.07
4.67	74°43 '10.06"	13°18 '54.34"	0.81	-0.14
4.70	74°43 '10.2"	13°18 '53.65"	0.79	-0.16
4.72	74°43 '10.38"	13°18 '52.99"	0.78	-0.17
4.74	74°43 '10.61"	13°18 '52.23"	0.78	-0.17
4.77	74°43 '10.75"	13°18 '51.45"	0.78	-0.17
4.79	74°43 '10.78"	13°18 '50.72"	0.78	-0.17
4.81	74°43 '10.79"	13°18 '49.98"	0.83	-0.12
4.83	74°43 '10.78"	13°18 '49.32"	0.86	-0.09
4.85	74°43 '10.92"	13°18 '48.66"	0.95	0.00
4.87	74°43 '11.09"	13°18 '48.03"	1.03	0.08
4.89	74°43 '11.24"	13°18 '47.37"	1.08	0.13
4.91	74°43 '11.51"	13°18 '46.72"	1.16	0.21
4.94	74°43 '11.97"	13°18 '45.89"	1.27	0.32
4.96	74°43 '12.24"	13°18 '45.24"	1.35	0.40
4.98	74°43 '12.47"	13°18 '44.63"	1.43	0.48
5.01	74°43 '12.71"	13°18 '44"	1.50	0.55

Chainage(KM)	Easting	Northing	Depth(M)	Reduced Depth w.r.t. CD (M)
5.03	74°43 '12.95"	13°18 '43.37"	1.64	0.69
5.05	74°43 '13.15"	13°18 '42.73"	1.79	0.84
5.07	74°43 '13.3"	13°18 '42.07"	1.82	0.87
5.09	74°43 '13.42"	13°18 '41.43"	1.84	0.89
5.11	74°43 '13.55"	13°18 '40.78"	1.92	0.97
5.13	74°43 '13.69"	13°18 '40.11"	2.04	1.09
5.15	74°43 '13.79"	13°18 '39.45"	2.21	1.26
5.17	74°43 '13.88"	13°18 '38.69"	2.30	1.35
5.19	74°43 '14.02"	13°18 '38"	2.36	1.41
5.23	74°43 '14.17"	13°18 '36.68"	2.24	1.29
5.27	74°43 '14.34"	13°18 '35.69"	2.10	1.15
5.29	74°43 '14.5"	13°18 '35.04"	1.99	1.04
5.31	74°43 '14.68"	13°18 '34.41"	1.82	0.87
5.33	74°43 '14.81"	13°18 '33.76"	1.39	0.44
5.35	74°43 '14.95"	13°18 '33.11"	1.10	0.15
5.37	74°43 '15.1"	13°18 '32.44"	0.87	-0.08
5.39	74°43 '15.16"	13°18 '31.75"	0.78	-0.17
5.41	74°43 '15.4"	13°18 '31.05"	0.79	-0.16
5.43	74°43 '15.97"	13°18 '30.7"	1.79	0.84
5.45	74°43 '16.58"	13°18 '30.43"	2.06	1.11
5.48	74°43 '17.13"	13°18 '29.85"	2.04	1.09
5.51	74°43 '17.8"	13°18 '28.86"	1.75	0.80
5.54	74°43 '18.16"	13°18 '28.09"	1.83	0.88
5.56	74°43 '18.44"	13°18 '27.37"	1.86	0.91
5.58	74°43 '18.6"	13°18 '26.73"	1.80	0.85
5.61	74°43 '18.83"	13°18 '25.93"	1.76	0.81
5.63	74°43 '19.04"	13°18 '25.3"	1.70	0.75
5.65	74°43 '19.23"	13°18 '24.65"	1.56	0.61
5.67	74°43 '19.43"	13°18 '23.99"	1.50	0.55
5.69	74°43 '19.6"	13°18 '23.36"	1.43	0.48
5.72	74°43 '19.86"	13°18 '22.61"	1.37	0.42
5.74	74°43 '20.28"	13°18 '21.82"	1.36	0.41
5.76	74°43 '20.54"	13°18 '21.19"	1.59	0.64
5.80	74°43 '20.89"	13°18 '20.21"	1.52	0.57
5.82	74°43 '21.15"	13°18 '19.56"	1.36	0.41
5.84	74°43 '21.38"	13°18 '18.93"	1.16	0.21
5.86	74°43 '21.62"	13°18 '18.31"	1.08	0.13
5.88	74°43 '21.83"	13°18 '17.66"	0.97	0.02
5.90	74°43 '21.96"	13°18 '17.01"	0.86	-0.09
5.93	74°43 '22.12"	13°18 '16.18"	0.81	-0.14
5.95	74°43 '22.26"	13°18 '15.37"	0.83	-0.12
5.97	74°43 '22.11"	13°18 '14.73"	0.79	-0.16
5.99	74°43 '21.68"	13°18 '14.1"	0.80	-0.15
6.02	74°43 '21.16"	13°18 '13.42"	1.52	0.57
6.04	74°43 '20.79"	13°18 '12.87"	1.11	0.16
6.06	74°43 '20.49"	13°18 '12.28"	0.89	-0.06
6.08	74°43 '20.1"	13°18 '11.75"	0.78	-0.17
6.12	74°43 '19.15"	13°18 '10.85"	1.17	0.22
6.14	74°43 '18.57"	13°18 '10.4"	1.13	0.18
6.17	74°43 '17.79"	13°18 '9.79"	1.09	0.14
6.19	74°43 '17.22"	13°18 '9.32"	1.02	0.07
6.22	74°43 '16.61"	13°18 '8.79"	0.90	-0.05
6.25	74°43 '15.97"	13°18 '8.15"	0.83	-0.12
6.27	74°43 '15.4"	13°18 '7.68"	0.79	-0.16

Chainage(KM)	Easting	Northing	Depth(M)	Reduced Depth w.r.t. CD (M)
6.30	74°43 '14.68"	13°18 '7.17"	0.79	-0.16
6.32	74°43 '14.12"	13°18 '6.71"	0.81	-0.14
6.34	74°43 '13.59"	13°18 '6.31"	1.36	0.41
6.36	74°43 '13.12"	13°18 '5.82"	1.80	0.85
6.38	74°43 '12.77"	13°18 '5.25"	2.13	1.18
6.40	74°43 '12.48"	13°18 '4.58"	2.28	1.33
6.43	74°43 '12.29"	13°18 '3.75"	2.31	1.36
6.45	74°43 '12.15"	13°18 '2.92"	2.35	1.40
6.49	74°43 '11.87"	13°18 '1.75"	2.41	1.46
6.51	74°43 '11.85"	13°18 '1.1"	2.27	1.32
6.53	74°43 '11.86"	13°18 '0.42"	2.36	1.41
6.55	74°43 '11.88"	13°17 '59.74"	2.40	1.45
6.57	74°43 '11.93"	13°17 '59.05"	2.37	1.42
6.59	74°43 '11.99"	13°17 '58.39"	2.35	1.40
6.61	74°43 '12.09"	13°17 '57.74"	2.21	1.26
6.63	74°43 '12.21"	13°17 '57.09"	2.13	1.18
6.65	74°43 '12.31"	13°17 '56.43"	2.08	1.13
6.68	74°43 '12.4"	13°17 '55.76"	1.97	1.02
6.70	74°43 '12.51"	13°17 '55.12"	2.12	1.17
6.72	74°43 '12.64"	13°17 '54.44"	2.00	1.05
6.74	74°43 '12.73"	13°17 '53.74"	1.90	0.95
6.76	74°43 '12.82"	13°17 '53.07"	1.82	0.87
6.78	74°43 '12.9"	13°17 '52.4"	1.73	0.78
6.81	74°43 '13.12"	13°17 '51.34"	1.93	0.98
6.84	74°43 '13.24"	13°17 '50.59"	1.85	0.90
6.86	74°43 '13.33"	13°17 '49.9"	1.76	0.81
6.88	74°43 '13.41"	13°17 '49.24"	1.64	0.69
6.90	74°43 '13.48"	13°17 '48.57"	1.50	0.55
6.92	74°43 '13.63"	13°17 '47.9"	1.43	0.48
6.94	74°43 '13.88"	13°17 '47.26"	1.37	0.42
6.96	74°43 '14.05"	13°17 '46.58"	1.35	0.40
6.98	74°43 '14.23"	13°17 '45.94"	1.39	0.44
7.00	74°43 '14.38"	13°17 '45.27"	1.33	0.38
7.04	74°43 '14.61"	13°17 '44.06"	1.35	0.40
7.06	74°43 '14.71"	13°17 '43.41"	1.09	0.14
7.08	74°43 '14.8"	13°17 '42.74"	0.80	-0.15
7.10	74°43 '14.9"	13°17 '42.05"	0.79	-0.16
7.14	74°43 '15.02"	13°17 '40.86"	0.79	-0.16
7.16	74°43 '15.13"	13°17 '40.21"	0.78	-0.17
7.18	74°43 '15.25"	13°17 '39.51"	0.81	-0.14
7.20	74°43 '15.32"	13°17 '38.84"	0.86	-0.09
7.22	74°43 '15.42"	13°17 '38.16"	0.93	-0.02
7.25	74°43 '15.58"	13°17 '37.52"	1.05	0.10
7.27	74°43 '15.72"	13°17 '36.88"	1.15	0.20
7.29	74°43 '15.74"	13°17 '36.22"	1.28	0.33
7.31	74°43 '15.84"	13°17 '35.27"	1.40	0.45
7.34	74°43 '15.92"	13°17 '34.35"	1.41	0.46
7.36	74°43 '15.98"	13°17 '33.67"	1.51	0.56
7.38	74°43 '16.04"	13°17 '33.02"	1.55	0.60
7.40	74°43 '16.11"	13°17 '32.34"	1.70	0.75
7.43	74°43 '16.18"	13°17 '31.67"	1.83	0.88
7.46	74°43 '16.16"	13°17 '30.67"	1.86	0.91
7.48	74°43 '16.14"	13°17 '29.94"	1.84	0.89
7.50	74°43 '16.15"	13°17 '29.28"	1.96	1.01

Chainage(KM)	Easting	Northing	Depth(M)	Reduced Depth w.r.t. CD (M)
7.52	74°43 '16.17"	13°17 '28.6"	2.14	1.19
7.54	74°43 '16.15"	13°17 '27.92"	2.22	1.27
7.56	74°43 '16.16"	13°17 '27.23"	2.29	1.34
7.59	74°43 '16.19"	13°17 '26.18"	2.29	1.34
7.62	74°43 '16.18"	13°17 '25.49"	2.31	1.36
7.64	74°43 '16.16"	13°17 '24.78"	2.42	1.47
7.66	74°43 '16.12"	13°17 '24.13"	2.49	1.54
7.68	74°43 '16.08"	13°17 '23.47"	2.59	1.64
7.70	74°43 '16.08"	13°17 '22.81"	2.74	1.79
7.72	74°43 '16.08"	13°17 '22.14"	2.88	1.93
7.75	74°43 '16.08"	13°17 '21.12"	2.90	1.95
7.77	74°43 '16.14"	13°17 '20.45"	2.77	1.82
7.79	74°43 '16.19"	13°17 '19.8"	2.85	1.90
7.81	74°43 '16.29"	13°17 '19.15"	2.91	1.96
7.84	74°43 '16.48"	13°17 '18.29"	2.95	2.00
7.86	74°43 '16.61"	13°17 '17.62"	2.73	1.78
7.88	74°43 '16.76"	13°17 '16.98"	2.40	1.45
7.90	74°43 '16.89"	13°17 '16.33"	2.21	1.26
7.92	74°43 '17.04"	13°17 '15.69"	2.01	1.06
7.94	74°43 '17.3"	13°17 '14.93"	1.88	0.93
7.96	74°43 '17.64"	13°17 '14.36"	1.72	0.77
7.99	74°43 '18.03"	13°17 '13.73"	1.65	0.70
8.01	74°43 '18.48"	13°17 '13.19"	1.72	0.77
8.03	74°43 '19.02"	13°17 '12.65"	1.76	0.81
8.07	74°43 '19.97"	13°17 '11.84"	1.85	0.90
8.09	74°43 '20.55"	13°17 '11.37"	1.84	0.89
8.11	74°43 '21.11"	13°17 '10.97"	1.83	0.88
8.15	74°43 '22.17"	13°17 '10.31"	1.76	0.81
8.17	74°43 '22.76"	13°17 '9.95"	1.57	0.62
8.19	74°43 '23.37"	13°17 '9.58"	1.41	0.46
8.21	74°43 '23.98"	13°17 '9.25"	1.33	0.38
8.23	74°43 '24.57"	13°17 '8.94"	1.34	0.39
8.25	74°43 '25.14"	13°17 '8.59"	1.31	0.36
8.29	74°43 '26.15"	13°17 '8.02"	1.32	0.37
8.33	74°43 '27.33"	13°17 '7.39"	1.26	0.31
8.36	74°43 '28.24"	13°17 '6.97"	1.24	0.29
8.38	74°43 '28.86"	13°17 '6.68"	1.13	0.18
8.40	74°43 '29.53"	13°17 '6.55"	1.21	0.26
8.42	74°43 '30.28"	13°17 '6.42"	1.23	0.28
8.45	74°43 '30.99"	13°17 '6.31"	1.25	0.30
8.48	74°43 '32.05"	13°17 '6.23"	1.28	0.33
8.50	74°43 '32.81"	13°17 '6.23"	1.34	0.39
8.52	74°43 '33.51"	13°17 '6.37"	1.46	0.51
8.56	74°43 '34.61"	13°17 '6.52"	1.49	0.54
8.58	74°43 '35.29"	13°17 '6.73"	1.60	0.65
8.61	74°43 '36.33"	13°17 '7.03"	1.71	0.76
8.63	74°43 '37.03"	13°17 '7.21"	1.82	0.87
8.66	74°43 '37.91"	13°17 '7.36"	1.85	0.90
8.68	74°43 '38.6"	13°17 '7.48"	1.85	0.90
8.71	74°43 '39.62"	13°17 '7.82"	1.88	0.93
8.73	74°43 '40.31"	13°17 '8"	1.83	0.88
8.76	74°43 '40.99"	13°17 '8.21"	1.76	0.81
8.78	74°43 '41.86"	13°17 '8.58"	1.72	0.77
8.80	74°43 '42.5"	13°17 '8.74"	1.60	0.65

Chainage(KM)	Easting	Northing	Depth(M)	Reduced Depth w.r.t. CD (M)
8.83	74°43 '43.17"	13°17 '8.96"	1.57	0.62
8.85	74°43 '43.89"	13°17 '9.21"	1.60	0.65
8.87	74°43 '44.51"	13°17 '9.47"	1.72	0.77
8.89	74°43 '45.11"	13°17 '9.8"	1.92	0.97
8.91	74°43 '45.73"	13°17 '10.05"	2.01	1.06
8.93	74°43 '46.42"	13°17 '10.41"	2.14	1.19
8.95	74°43 '47.06"	13°17 '10.7"	2.19	1.24
8.98	74°43 '47.91"	13°17 '11.12"	2.25	1.30
9.00	74°43 '48.53"	13°17 '11.37"	2.14	1.19
9.02	74°43 '49.14"	13°17 '11.67"	2.06	1.11
9.04	74°43 '49.82"	13°17 '11.89"	1.83	0.88
9.07	74°43 '50.42"	13°17 '12.18"	1.77	0.82
9.09	74°43 '51.08"	13°17 '12.35"	1.00	0.05
9.12	74°43 '52.12"	13°17 '12.74"	1.19	0.24
9.15	74°43 '52.87"	13°17 '13.2"	1.45	0.50
9.17	74°43 '53.45"	13°17 '13.51"	1.16	0.21
9.20	74°43 '54.56"	13°17 '14.16"	1.69	0.74
9.22	74°43 '55.1"	13°17 '14.55"	1.90	0.95
9.25	74°43 '55.67"	13°17 '14.97"	2.03	1.08
9.28	74°43 '56.5"	13°17 '15.58"	1.80	0.85
9.30	74°43 '57.06"	13°17 '15.95"	1.78	0.83
9.32	74°43 '57.69"	13°17 '16.31"	1.76	0.81
9.35	74°43 '58.45"	13°17 '16.74"	1.65	0.70
9.37	74°43 '59.07"	13°17 '17.16"	1.46	0.51
9.39	74°43 '59.63"	13°17 '17.54"	1.43	0.48
9.41	74°44 '0.19"	13°17 '17.9"	1.34	0.39
9.43	74°44 '0.76"	13°17 '18.23"	1.27	0.32
9.45	74°44 '1.35"	13°17 '18.6"	1.13	0.18
9.49	74°44 '2.34"	13°17 '19.21"	1.09	0.14
9.51	74°44 '2.88"	13°17 '19.59"	1.07	0.12
9.53	74°44 '3.57"	13°17 '19.98"	1.03	0.08
9.55	74°44 '4.18"	13°17 '20.32"	0.99	0.04
9.58	74°44 '5.06"	13°17 '20.65"	0.96	0.01
9.62	74°44 '6.21"	13°17 '21.13"	0.92	-0.03
9.65	74°44 '7.4"	13°17 '21.58"	1.03	0.08
9.68	74°44 '8.06"	13°17 '21.8"	1.45	0.50
9.71	74°44 '9.1"	13°17 '22.13"	1.45	0.50
9.73	74°44 '9.76"	13°17 '22.2"	1.59	0.64
9.75	74°44 '10.44"	13°17 '22.15"	2.06	1.11
9.77	74°44 '11.1"	13°17 '22.01"	3.64	2.69
9.80	74°44 '12.05"	13°17 '21.8"	5.15	4.20
9.82	74°44 '12.71"	13°17 '21.65"	5.42	4.47
9.85	74°44 '13.59"	13°17 '21.32"	5.28	4.33
9.87	74°44 '14.19"	13°17 '21.02"	5.72	4.77
9.89	74°44 '14.85"	13°17 '20.55"	5.70	4.75
9.92	74°44 '15.49"	13°17 '20.02"	5.03	4.08
9.95	74°44 '16.38"	13°17 '19.23"	5.59	4.64
9.97	74°44 '16.95"	13°17 '18.87"	4.14	3.19
9.99	74°44 '17.55"	13°17 '18.58"	2.51	1.56
10.02	74°44 '18.49"	13°17 '18.31"	2.45	1.50
10.05	74°44 '19.32"	13°17 '18.2"	2.34	1.39
10.08	74°44 '20.21"	13°17 '18.16"	2.12	1.17
10.10	74°44 '20.87"	13°17 '18.21"	2.04	1.09
10.12	74°44 '21.77"	13°17 '18.35"	2.13	1.18

Chainage(KM)	Easting	Northing	Depth(M)	Reduced Depth w.r.t. CD (M)
10.14	74°44 '22.41"	13°17 '18.66"	2.20	1.25
10.18	74°44 '23.4"	13°17 '19.3"	2.26	1.31
10.20	74°44 '23.94"	13°17 '19.8"	2.41	1.46
10.22	74°44 '24.44"	13°17 '20.26"	2.54	1.59
10.24	74°44 '24.92"	13°17 '20.74"	2.64	1.69
10.27	74°44 '25.52"	13°17 '21.47"	2.64	1.69
10.30	74°44 '25.87"	13°17 '22.28"	3.13	2.18
10.32	74°44 '26.06"	13°17 '22.92"	3.71	2.76
10.34	74°44 '26.18"	13°17 '23.61"	3.92	2.97
10.36	74°44 '26.24"	13°17 '24.29"	2.99	2.04
10.39	74°44 '26.34"	13°17 '25.21"	3.19	2.24
10.42	74°44 '26.22"	13°17 '26.03"	3.72	2.77
10.45	74°44 '26"	13°17 '26.99"	3.73	2.78
10.47	74°44 '25.8"	13°17 '27.64"	3.72	2.77
10.49	74°44 '25.55"	13°17 '28.26"	3.56	2.61
10.51	74°44 '25.32"	13°17 '28.88"	3.25	2.30
10.53	74°44 '25.1"	13°17 '29.5"	3.06	2.11
10.55	74°44 '24.89"	13°17 '30.15"	2.94	1.99
10.57	74°44 '24.73"	13°17 '30.78"	2.90	1.95
10.59	74°44 '24.5"	13°17 '31.41"	3.03	2.08
10.61	74°44 '24.33"	13°17 '32.17"	3.09	2.14
10.63	74°44 '24.18"	13°17 '32.82"	3.17	2.22
10.66	74°44 '24.08"	13°17 '33.49"	3.26	2.31
10.68	74°44 '23.93"	13°17 '34.13"	3.38	2.43
10.71	74°44 '23.78"	13°17 '35.15"	3.41	2.46
10.73	74°44 '23.68"	13°17 '35.95"	3.21	2.26
10.75	74°44 '23.61"	13°17 '36.6"	2.77	1.82
10.77	74°44 '23.52"	13°17 '37.26"	2.43	1.48
10.79	74°44 '23.43"	13°17 '37.95"	2.31	1.36
10.81	74°44 '23.29"	13°17 '38.6"	2.34	1.39
10.84	74°44 '23.22"	13°17 '39.45"	2.35	1.40
10.86	74°44 '23.3"	13°17 '40.15"	2.36	1.41
10.88	74°44 '23.44"	13°17 '40.83"	2.34	1.39
10.92	74°44 '23.86"	13°17 '41.94"	2.27	1.32
10.95	74°44 '24.27"	13°17 '42.88"	2.25	1.30
10.97	74°44 '24.56"	13°17 '43.5"	2.22	1.27
11.00	74°44 '24.9"	13°17 '44.2"	2.17	1.22
11.03	74°44 '25.61"	13°17 '45.05"	2.11	1.16
11.05	74°44 '26.22"	13°17 '45.33"	2.04	1.09
11.07	74°44 '26.87"	13°17 '45.52"	2.47	1.52
11.10	74°44 '27.67"	13°17 '45.78"	2.50	1.55
11.12	74°44 '28.45"	13°17 '46.07"	2.04	1.09
11.14	74°44 '29.12"	13°17 '46.25"	2.72	1.77
11.17	74°44 '30"	13°17 '46.43"	2.17	1.22
11.19	74°44 '30.67"	13°17 '46.58"	2.12	1.17
11.23	74°44 '31.93"	13°17 '46.85"	2.63	1.68
11.26	74°44 '32.83"	13°17 '47.01"	2.79	1.84
11.28	74°44 '33.5"	13°17 '47.13"	2.89	1.94
11.30	74°44 '34.28"	13°17 '47.29"	2.76	1.81
11.33	74°44 '35.34"	13°17 '47.45"	2.59	1.64
11.35	74°44 '36"	13°17 '47.55"	2.41	1.46
11.37	74°44 '36.74"	13°17 '47.63"	2.22	1.27
11.40	74°44 '37.43"	13°17 '47.65"	2.37	1.42
11.42	74°44 '38.09"	13°17 '47.63"	2.52	1.57

Chainage(KM)	Easting	Northing	Depth(M)	Reduced Depth w.r.t. CD (M)
11.44	74°44 '38.82"	13°17 '47.75"	3.09	2.14
11.46	74°44 '39.48"	13°17 '47.89"	3.36	2.41
11.49	74°44 '40.68"	13°17 '48.13"	3.28	2.33
11.53	74°44 '41.83"	13°17 '48.32"	3.27	2.32
11.56	74°44 '42.76"	13°17 '48.31"	1.11	0.16
11.58	74°44 '43.43"	13°17 '48.33"	1.31	0.36
11.60	74°44 '44.08"	13°17 '48.45"	2.68	1.73
11.62	74°44 '44.9"	13°17 '48.38"	2.76	1.81
11.64	74°44 '45.55"	13°17 '48.19"	3.77	2.82
11.68	74°44 '46.68"	13°17 '48.05"	3.19	2.24
11.70	74°44 '47.33"	13°17 '47.88"	3.08	2.13
11.72	74°44 '48.12"	13°17 '47.66"	2.65	1.70
11.74	74°44 '48.79"	13°17 '47.57"	2.71	1.76
11.76	74°44 '49.44"	13°17 '47.42"	3.14	2.19
11.79	74°44 '50.37"	13°17 '47.25"	2.94	1.99
11.82	74°44 '51.37"	13°17 '47.15"	2.79	1.84
11.86	74°44 '52.47"	13°17 '46.69"	2.77	1.82
11.89	74°44 '53.61"	13°17 '46.26"	2.78	1.83
11.92	74°44 '54.33"	13°17 '46.05"	2.87	1.92
11.94	74°44 '55"	13°17 '45.98"	2.69	1.74
11.96	74°44 '55.67"	13°17 '45.93"	2.53	1.58
11.98	74°44 '56.35"	13°17 '45.9"	2.39	1.44
12.00	74°44 '57.04"	13°17 '45.82"	2.42	1.47
12.02	74°44 '57.71"	13°17 '45.79"	2.10	1.15
12.04	74°44 '58.38"	13°17 '45.75"	2.29	1.34
12.06	74°44 '59.05"	13°17 '45.69"	2.72	1.77
12.09	74°45 '0.13"	13°17 '45.58"	2.71	1.76
12.11	74°45 '0.8"	13°17 '45.51"	3.14	2.19
12.14	74°45 '1.64"	13°17 '45.37"	3.27	2.32
12.16	74°45 '2.32"	13°17 '45.29"	3.34	2.39
12.20	74°45 '3.55"	13°17 '45.13"	3.11	2.16
12.22	74°45 '4.21"	13°17 '45.02"	3.03	2.08
12.24	74°45 '4.86"	13°17 '44.84"	2.67	1.72
12.26	74°45 '5.53"	13°17 '44.77"	2.47	1.52
12.28	74°45 '6.44"	13°17 '44.79"	2.51	1.56
12.31	74°45 '7.15"	13°17 '44.8"	2.66	1.71
12.33	74°45 '7.86"	13°17 '44.79"	2.47	1.52
12.35	74°45 '8.55"	13°17 '44.75"	2.32	1.37
12.38	74°45 '9.72"	13°17 '44.69"	2.35	1.40
12.41	74°45 '10.47"	13°17 '44.67"	2.44	1.49
12.43	74°45 '11.23"	13°17 '44.67"	2.63	1.68
12.45	74°45 '11.9"	13°17 '44.64"	2.78	1.83
12.48	74°45 '12.83"	13°17 '44.67"	2.95	2.00
12.50	74°45 '13.49"	13°17 '44.58"	2.38	1.43
12.52	74°45 '14.16"	13°17 '44.56"	2.72	1.77
12.54	74°45 '14.83"	13°17 '44.48"	3.16	2.21
12.56	74°45 '15.49"	13°17 '44.4"	3.55	2.60
12.58	74°45 '16.17"	13°17 '44.39"	4.07	3.12
12.61	74°45 '17.26"	13°17 '44.36"	3.62	2.67
12.63	74°45 '17.92"	13°17 '44.26"	1.63	0.68
12.66	74°45 '19.03"	13°17 '44.28"	2.13	1.18
12.68	74°45 '19.69"	13°17 '44.23"	4.01	3.06
12.72	74°45 '21"	13°17 '43.95"	3.80	2.85
12.74	74°45 '21.66"	13°17 '43.79"	3.19	2.24

Chainage(KM)	Easting	Northing	Depth(M)	Reduced Depth w.r.t. CD (M)
12.77	74°45 '22.58"	13°17 '43.4"	3.15	2.20
12.80	74°45 '23.18"	13°17 '43.08"	3.25	2.30
12.82	74°45 '23.81"	13°17 '42.64"	3.06	2.11
12.84	74°45 '24.35"	13°17 '42.26"	3.04	2.09
12.86	74°45 '24.87"	13°17 '41.83"	3.06	2.11
12.89	74°45 '25.5"	13°17 '41.1"	3.18	2.23
12.92	74°45 '26.07"	13°17 '40.27"	3.27	2.32
12.94	74°45 '26.48"	13°17 '39.59"	3.10	2.15
12.96	74°45 '26.8"	13°17 '39.02"	1.84	0.89
12.98	74°45 '27.15"	13°17 '38.4"	2.55	1.60
13.01	74°45 '27.47"	13°17 '37.78"	2.70	1.75
13.03	74°45 '27.68"	13°17 '37.16"	2.28	1.33
13.06	74°45 '27.88"	13°17 '36.23"	3.12	2.17
13.08	74°45 '28.12"	13°17 '35.51"	3.48	2.53
13.10	74°45 '28.29"	13°17 '34.8"	3.23	2.28
13.12	74°45 '28.4"	13°17 '34.15"	1.46	0.51
13.14	74°45 '28.55"	13°17 '33.51"	3.12	2.17
13.17	74°45 '28.79"	13°17 '32.61"	3.28	2.33
13.20	74°45 '29.02"	13°17 '31.52"	3.46	2.51
13.22	74°45 '29.15"	13°17 '30.87"	2.02	1.07
13.24	74°45 '29.54"	13°17 '30.34"	3.29	2.34
13.28	74°45 '30.13"	13°17 '29.4"	3.24	2.29
13.30	74°45 '30.2"	13°17 '28.64"	3.41	2.46
13.33	74°45 '30.39"	13°17 '27.66"	3.48	2.53
13.35	74°45 '30.55"	13°17 '27.03"	2.27	1.32
13.38	74°45 '30.79"	13°17 '26.31"	2.31	1.36
13.40	74°45 '30.96"	13°17 '25.41"	1.75	0.80
13.42	74°45 '31.13"	13°17 '24.78"	1.52	0.57
13.45	74°45 '31.42"	13°17 '24.12"	1.62	0.67
13.47	74°45 '31.66"	13°17 '23.51"	2.11	1.16
13.49	74°45 '31.89"	13°17 '22.9"	2.72	1.77
13.51	74°45 '32.18"	13°17 '22.31"	3.47	2.52
13.54	74°45 '32.9"	13°17 '21.54"	3.25	2.30
13.57	74°45 '33.76"	13°17 '21.28"	2.77	1.82
13.60	74°45 '34.72"	13°17 '20.9"	2.98	2.03
13.63	74°45 '35.95"	13°17 '20.65"	3.12	2.17
13.65	74°45 '36.62"	13°17 '20.61"	3.36	2.41
13.69	74°45 '37.85"	13°17 '20.88"	2.83	1.88
13.71	74°45 '38.51"	13°17 '20.98"	2.40	1.45
13.75	74°45 '39.62"	13°17 '21.15"	2.45	1.50
13.77	74°45 '40.28"	13°17 '21.29"	2.24	1.29
13.80	74°45 '41.3"	13°17 '21.51"	2.25	1.30
13.82	74°45 '41.98"	13°17 '21.69"	2.15	1.20
13.84	74°45 '42.62"	13°17 '21.9"	2.31	1.36
13.86	74°45 '43.26"	13°17 '22.11"	2.50	1.55
13.88	74°45 '43.98"	13°17 '22.38"	2.50	1.55
13.91	74°45 '44.65"	13°17 '22.74"	2.41	1.46
13.93	74°45 '45.25"	13°17 '23.03"	2.35	1.40
13.96	74°45 '46.16"	13°17 '23.43"	2.36	1.41
13.98	74°45 '46.78"	13°17 '23.74"	2.29	1.34
14.00	74°45 '47.4"	13°17 '24.03"	2.18	1.23
14.02	74°45 '48.04"	13°17 '24.32"	1.99	1.04
14.04	74°45 '48.66"	13°17 '24.59"	1.97	1.02
14.07	74°45 '49.47"	13°17 '24.9"	1.99	1.04

Chainage(KM)	Easting	Northing	Depth(M)	Reduced Depth w.r.t. CD (M)
14.09	74°45 '50.32"	13°17 '25.18"	2.13	1.18
14.12	74°45 '50.95"	13°17 '25.59"	2.11	1.16
14.14	74°45 '51.59"	13°17 '25.8"	2.00	1.05
14.17	74°45 '52.73"	13°17 '26.19"	2.30	1.35
14.19	74°45 '53.34"	13°17 '26.45"	2.11	1.16
14.21	74°45 '54.02"	13°17 '26.76"	2.07	1.12
14.25	74°45 '55.23"	13°17 '27.3"	2.18	1.23
14.28	74°45 '56.04"	13°17 '27.5"	2.07	1.12
14.30	74°45 '56.83"	13°17 '27.66"	1.98	1.03
14.33	74°45 '57.66"	13°17 '27.84"	2.10	1.15
14.36	74°45 '58.51"	13°17 '27.99"	2.26	1.31
14.38	74°45 '59.18"	13°17 '28.15"	2.13	1.18
14.40	74°45 '59.89"	13°17 '28.31"	2.23	1.28
14.42	74°46 '0.65"	13°17 '28.48"	2.17	1.22
14.44	74°46 '1.31"	13°17 '28.62"	2.36	1.41
14.46	74°46 '2.02"	13°17 '28.85"	2.59	1.64
14.48	74°46 '2.65"	13°17 '29.07"	2.73	1.78
14.50	74°46 '3.26"	13°17 '29.35"	2.86	1.91
14.53	74°46 '3.88"	13°17 '29.61"	3.28	2.33
14.56	74°46 '4.95"	13°17 '29.94"	3.57	2.62
14.58	74°46 '5.63"	13°17 '30.17"	3.87	2.92
14.62	74°46 '6.79"	13°17 '30.59"	3.79	2.84
14.66	74°46 '8.06"	13°17 '30.92"	3.73	2.78
14.69	74°46 '8.99"	13°17 '31.08"	3.73	2.78
14.71	74°46 '9.82"	13°17 '31.2"	3.60	2.65
14.73	74°46 '10.53"	13°17 '31.35"	3.74	2.79
14.77	74°46 '11.71"	13°17 '31.56"	3.67	2.72
14.79	74°46 '12.48"	13°17 '31.66"	4.02	3.07
14.81	74°46 '13.15"	13°17 '31.72"	2.61	1.66
14.85	74°46 '14.35"	13°17 '31.89"	3.50	2.55
14.87	74°46 '15"	13°17 '32.05"	3.63	2.68
14.89	74°46 '15.72"	13°17 '32.16"	3.75	2.80
14.92	74°46 '16.56"	13°17 '32.27"	3.64	2.69
14.94	74°46 '17.38"	13°17 '32.3"	3.61	2.66
14.97	74°46 '18.24"	13°17 '32.23"	3.17	2.22
14.99	74°46 '18.91"	13°17 '32.27"	3.59	2.64
15.01	74°46 '19.69"	13°17 '32.27"	3.26	2.31
15.03	74°46 '20.43"	13°17 '32.23"	1.23	0.28
15.05	74°46 '21.1"	13°17 '32.21"	1.05	0.10
15.08	74°46 '21.92"	13°17 '32.16"	1.19	0.24
15.10	74°46 '22.59"	13°17 '32.09"	1.39	0.44
15.12	74°46 '23.27"	13°17 '32.04"	2.40	1.45
15.14	74°46 '23.96"	13°17 '31.98"	2.69	1.74
15.16	74°46 '24.62"	13°17 '32.04"	3.31	2.36
15.19	74°46 '25.49"	13°17 '31.96"	1.26	0.31

Note: The Observed depth has been worked out after duly applying the tidal correction.

ANNEXURE 3.4

PHOTOS CAPTURED BY SURVEY TEAM DURING RECONNAISSANCE SURVEY

Annexure 3.4: Photos Captured by Survey Team during Reconnaissance Survey

Photo 1: Ship Yard Malpe

Photo 2: Ship near Malpe

Photo 3: Under Construction Bridge at Ch 1.50km

Photo 4: Bridge at Ch 11.56km

Photo 5: Railway Bridge at Ch 12.66km

Photo 6: Bridge at Ch 13.26km

Photo 7: River Bank at Ch 14.00km

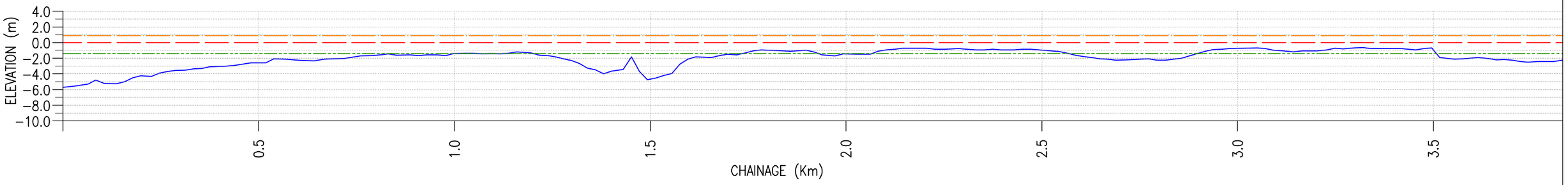
Photo 8: Udayavara River

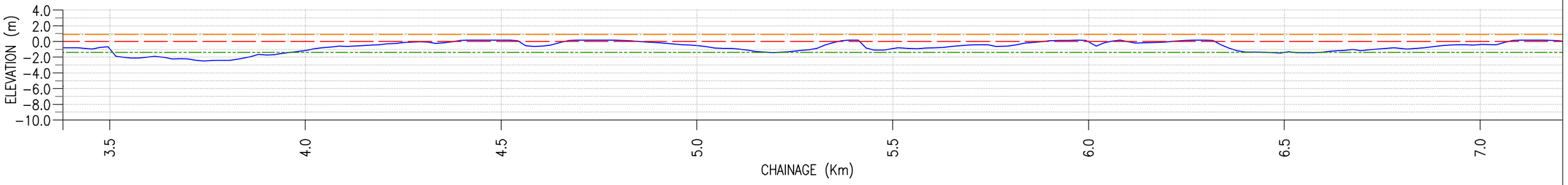
Photo 9: Sand from River at Ch 15.00km

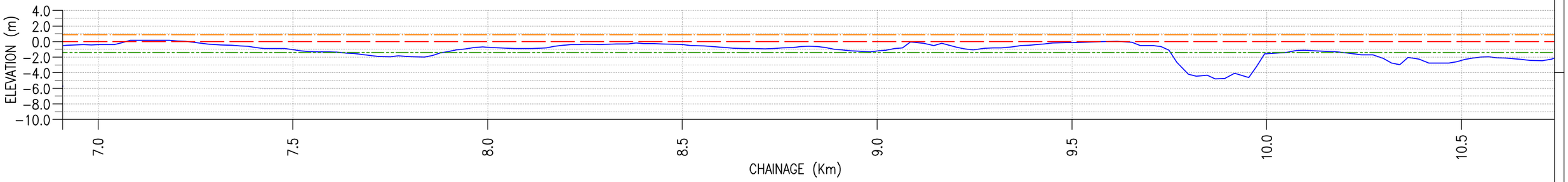
Photo 10: Manipur Bridge Highway at Ch 15.19km

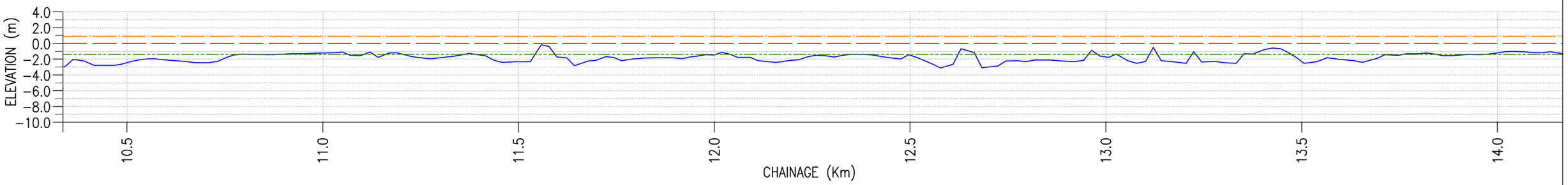
ANNEXURE 3.5

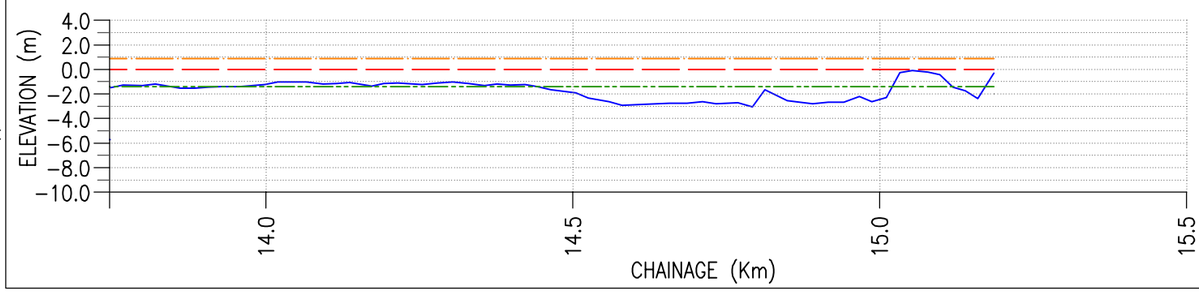
UDAYAVARA RIVER LONGITUDINAL BED PROFILE











LEGENDS

- MEAN HIGH TIDE
- CHART DATUM
- 1.4m DEPTH BELOW CHART DATUM
- UDAYAVARA RIVER BED PROFILE

ANNEXURE 3.5

OBSERVED BED PROFILE OF UDAYAVARA RIVER WATERWAY

ANNEXURE 3.6

COMPILATION OF FIELD INFORMATION OF UDAYAVARA RIVER IN IWAI FORMAT

Annexure 3.6: Compilation of Field Information of Udayavara River in IWAI Format

SL#	DESCRIPTION	DETAILS	REMARKS
	NAME OF THE FIRM		
	REGION / CLUSTER NO.	**Cluster-6/ Stage-1/ Karnataka**	
1	NAME OF THE WATERWAY	Udayavara River	
2	LENGTH OF THE WATERWAY (km)	16	
3	WATERWAY IN THE STATES OF	Karnatka	
4	FIELD WORK COMPLETED FOR THE LENGTH OF THE WATERWAY (km)	16	
TIDAL WATERWAYS			
5	Length of the waterway having tidal effects (km)	16 K.M.	
6	Start & end location name having tidal effects	Starting Point: Mouth of Sea near Malpe , End Point: Manipura Village	
7	Tidal variation (m)		
DEPTH INFORMATION			
8	Length of the waterway, where depths more than 2m is observed	3.73 km	Depths are w.r.t. CD
9	Length of the waterway, where depths more than 1.5m is observed	5.99 km	
	Length of the waterway, where depths more than 1.0m is observed	9.44 km	
10	Existing Water level (m)	Malpe : 6 m, Manipura 1 m	Acoording to DGPS (MSL)
11	Minimum Water Level (m)		
12	Highest Flood level (m)	1.5 M of current water leval	As discussed with local Boatman
CROSS-STRUCTURE INFORMATION			
13	Existing list of Dam, Barrages, Locks	Not Available	
14	Existing Bridges (nos.)	5	one is under construction and one is located at the end stretch of waterway.
15	Minimum Vertical and Horizontal clearances (m) as per visual estimation	HC: 20 m , VC: 2.0 m to 3.5 m	Vertical clearance above MHWS
16	High Tension lines	1	3 LT and one cable line
NAVIGATIONAL OBSTRUCTION			
17	Rocks	No	
18	Steep gradients	No	
ENVIRONMENTAL & OTHER ISSUES			
19	Details of wildlife /forest area	Not Available	
20	Protected areas		
21	Security clearances		

SL#	DESCRIPTION	DETAILS	REMARKS
CARGO AND OTHER DETAILS			
22	Availability of passenger ferry services along the waterway	Malpe- Padukar Ferry Jetty	
23	Estimated cargo movement through proposed waterway, road and rail	-	
24	Type of crops (in different seasons) and industries along the waterway	Rice, Pulses, oil seeds & Coconut	
25	Availability of Prominent towns / City along the waterway.	Malpe , Uduipi, Udayvara	
26	Historical and tourist places along waterway	Malpe	
27	Existing water sport and recreational activities and future probability	Malpe Beach	
28	Existing Jetties and Terminals	MALPE Sjhipyard, Padukar Jetty	

ANNEXURE 4.1

LIST OF INDUSTRIES IN UDAYAVARA RIVER CATCHMENT REGION

ANNEXURE 4.1: LARGE AND MEDIUM SCALE INDUSTRIES IN UDYAVARA CATCHMENT REGION

Sl. No.	Name of the unit	Product Manufactured	Investment (Rs. In Crores)	Taluka
1	Manipal Media & Network Pvt. Ltd.,	Printing	52.29	Udupi
2	Suzlon Wind International Ltd.,	Assembly of Nacelle for Wind Mills	144.05	Udupi
3	SE Blades Ltd (Formerly S.EComposite Ltd.),	Rotar Blade Manufacturing unit for Wind Mills	282.64	Udupi
4	Tebma Shipyards Limited.,	Manufacture of small sized Ocean going vessels	177.52	Udupi
5	Tebma Shipyards Limited.,	Manufacture of small sized Ocean going vessels	65.29	Udupi
6	Manipal Technologies Limited., (Formerly Manipal Press Ltd),	Printing	335.77	Udupi
7	Udupi Power Corporation Limited.	Electricity	6288.53	Udupi
8	M/s. Keltech Energies	Industrial Explosives & Expanded Perlite Products.	8.19	Udupi
9	M/s. Raj Fish Meal & Oil Company	Fish Meal	8.30	Udupi
10	M/s. Goan Fresh Marine Exports Pvt. Ltd	Fish, Fishery Products	18.06	Udupi
		Total	**7384.64**	

Source: District Industries Centre, Udipi District.

ANNEXURE 4.2

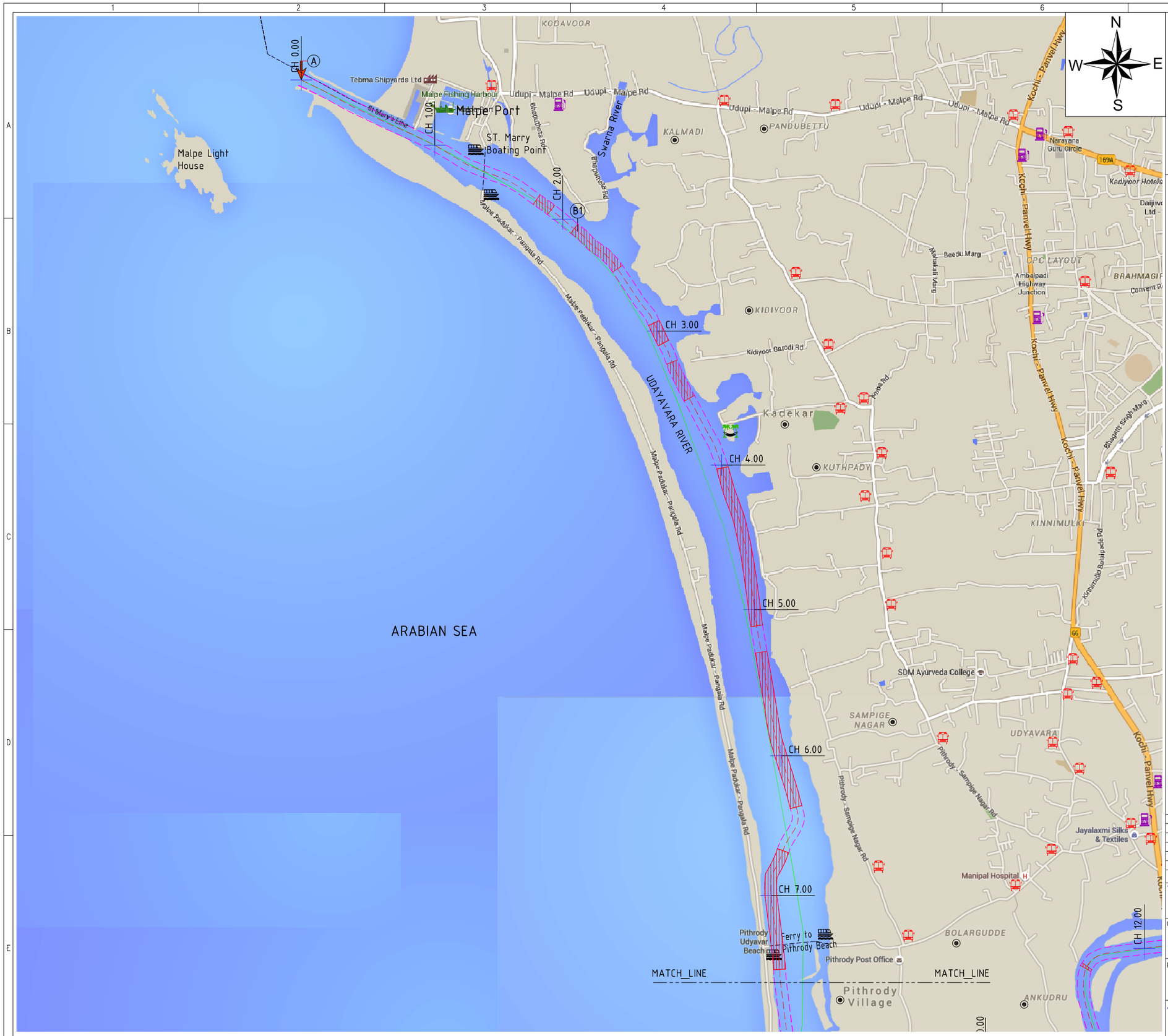
MEETINGS AND DISCUSSIONS

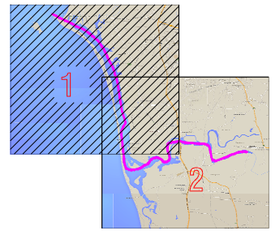
Annexure 4.2: Meetings and Discussions

District	S. No.	Department	Persons met
Dakshina Kannada District	1	Old Mangalore Port Office	Port Conservator
	2	Directorate of Industries	Jt. Director
	3	Association of Industries	Treasurer
	4	District Collector Office Dakshina Kannada	JD Agriculture, DFO Forest, Fisheries, Disaster Management Unit
Udipi District	1	Malpe Port Office	Ports Officer
	2	Hannover Port	Ports officer
	3	Directorate of Industries	Jt. Director
	4	District Collector Office Udipi District	JD Agriculture, DFO Forest, Fisheries, Disaster Management Unit, Department of Economics and Statistics
North Kannada District	1	Directorate of Ports and Inland Water Transport	Director Port, Ports Engineer, Superintending Engineer
	2	Directorate of Industries	Jt. Director
	3	District Collector Office Uttar Kannada District	JD Agriculture, DFO Forest, Fisheries, Disaster Management Unit, Department of Economics and Statistics

DRAWINGS

P.009050-W-20201-011 R0 (SHEET-2): UDAYAVARA RIVER (KARNATAKA) PROPOSED NATIONAL WATERWAY NUMBER 105 LAYOUT PLAN





KEY PLAN

LEGEND

	BUS STOP
	FUEL STATION/PUMP
	PLACE NAME
	PORT
	JETTY
	INDUSTRY
	RESORT
	NATIONAL/STATE HIGHWAY (Hwy)
	ROAD
	EXISTING WATERWAY/FERRY LINE
	FERRY LINE
	ROUTE PROVIDED BY IWAI
	SURVEY VESSEL TRACK (THALWEG) (ABOUT 40m WIDE)
	DREDGING REQUIRED
	RAILWAY LINE
A	START POINT FROM ARABIAN SEA MOUTH AT MALPE AT LAT. 13°20'57.24" N LON. 74°41'28.22" E
B	END POINT AT BRIDGE NEAR MANIPURA AT LAT. 13°17'32.70" N LON. 74°46'25.56" E

BRIDGE DETAILS

BRIDGE No.	CHAINAGE (Km)
B1	2.080

PROPOSED WATERWAY LENGTH 16.0Km (AS PER TENDER)
TOTAL WATERWAY LENGTH FROM POINT 'A' TO POINT 'B' 15.77Km

SCALE 0 0.5 1.25KM

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

REV.	DATE	SIGN	SIGN	SIGN	SIGN	
REVISION		DRAWN	DESIGNED	CHECKED	APPROVED	SUBJECT OF REVISION
–	–	–	–	–	–	–
–	–	–	–	–	–	–
–	–	–	–	–	–	–
–	–	–	–	–	–	–

TITLE
UDAYAVARA RIVER (KARNATAKA)
PROPOSED NATIONAL WATERWAY NUMBER 105
LAYOUT PLAN

CLIENT
INLAND WATERWAYS AUTHORITY OF INDIA
MINISTRY OF SHIPPING

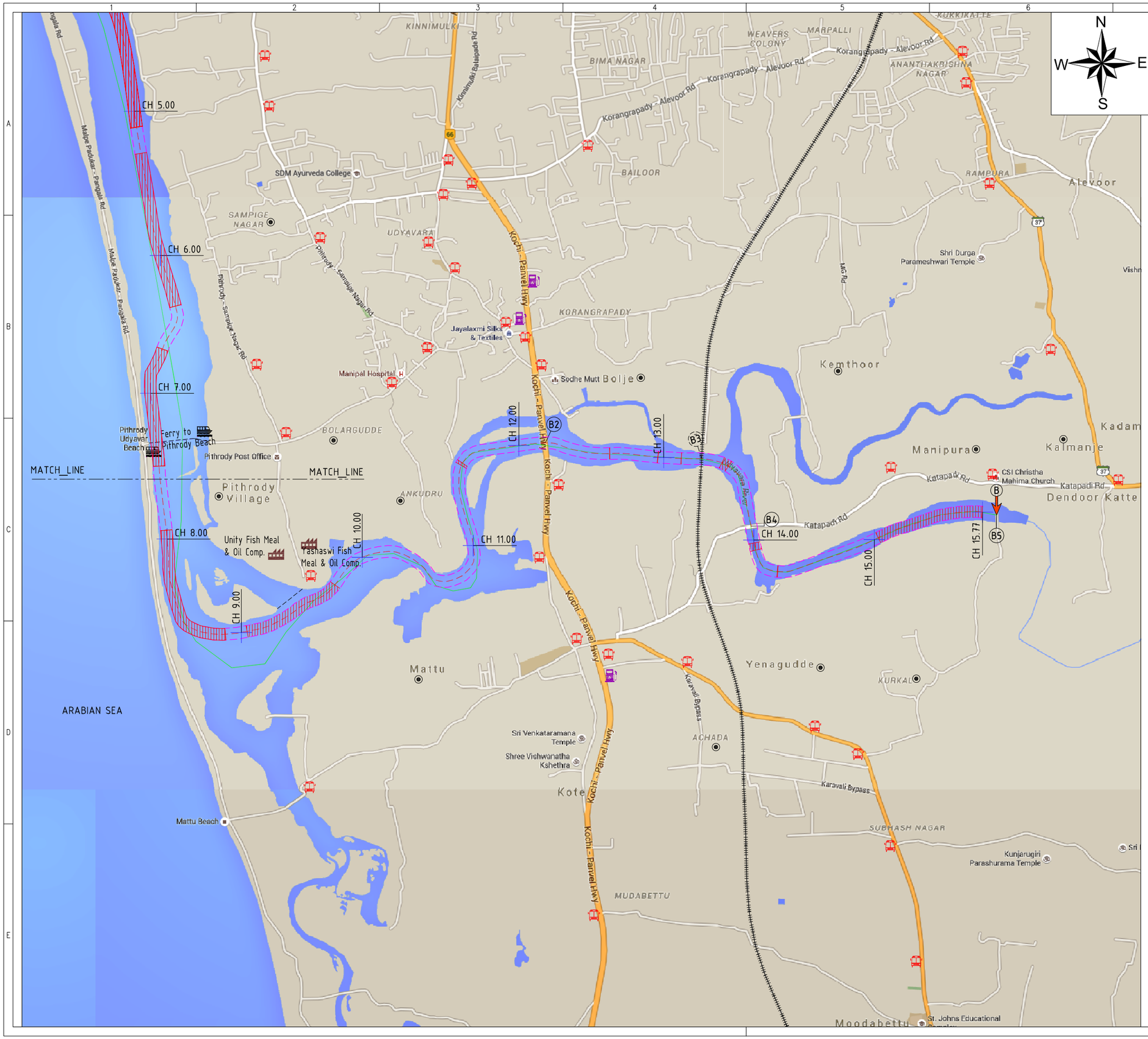
PROJECT
CONSULTANCY SERVICES FOR PREPARATION OF TWO STAGE DETAILED PROJECT REPORT (DPR) OF CLUSTER 6 OF PROPOSED 53 NATIONAL WATERWAYS.
STAGE 1 – FEASIBILITY REPORT

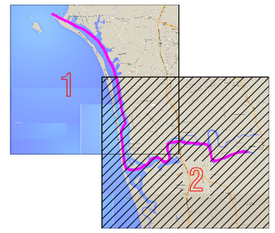
PROJECT NO. **P.009050**

TRACTEBEL Engineering GDF SUEZ

SIZE: A3 | SCALE: 1:25000 | SHEET: 1–2

DRAWING NUMBER
P.0090 50-W-2020 1-0 1 1 REV. 0





KEY PLAN

LEGEND	
	BUS STOP
	PORT
	INDUSTRY
	FUEL STATION/PUMP
	JETTY
	PLACE NAME
	RESORT
	NATIONAL/STATE HIGHWAY (Hwy)
	ROAD
	EXISTING WATERWAY/FERRY LINE
	FERRY LINE
	ROUTE PROVIDED BY IWAI
	SURVEY VESSEL TRACK (THALWEG) (ABOUT 40m WIDE)
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BRIDGE DETAILS

BRIDGE No.	CHAINAGE (Km)	BRIDGE No.	CHAINAGE (Km)
B2	12.145	B4	13.840
B3	13.240	B5	15.770

PROPOSED WATERWAY LENGTH 16.0Km (AS PER TENDER)
TOTAL WATERWAY LENGTH FROM POINT 'A' TO POINT 'B' 15.77Km

SCALE 0 0.5 1.25KM

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

REV.	DATE	SIGN	SIGN	SIGN	SIGN	SUBJECT OF REVISION
	REVISION	DRAWN	DESIGNED	CHECKED	APPROVED	
–	–	–	–	–	–	–
–	–	–	–	–	–	–
–	–	–	–	–	–	–
–	–	–	–	–	–	–

TITLE: UDAYAVARA RIVER (KARNATAKA)
PROPOSED NATIONAL WATERWAY NUMBER 105
LAYOUT PLAN

CLIENT: **INLAND WATERWAYS AUTHORITY OF INDIA**
MINISTRY OF SHIPPING

PROJECT: CONSULTANCY SERVICES FOR PREPARATION OF TWO STAGE DETAILED PROJECT REPORT (DPR) OF CLUSTER 6 OF PROPOSED 53 NATIONAL WATERWAYS.
STAGE 1 - FEASIBILITY REPORT

PROJECT NO. **P.009050**

TRACTEBEL Engineering GDF SUEZ

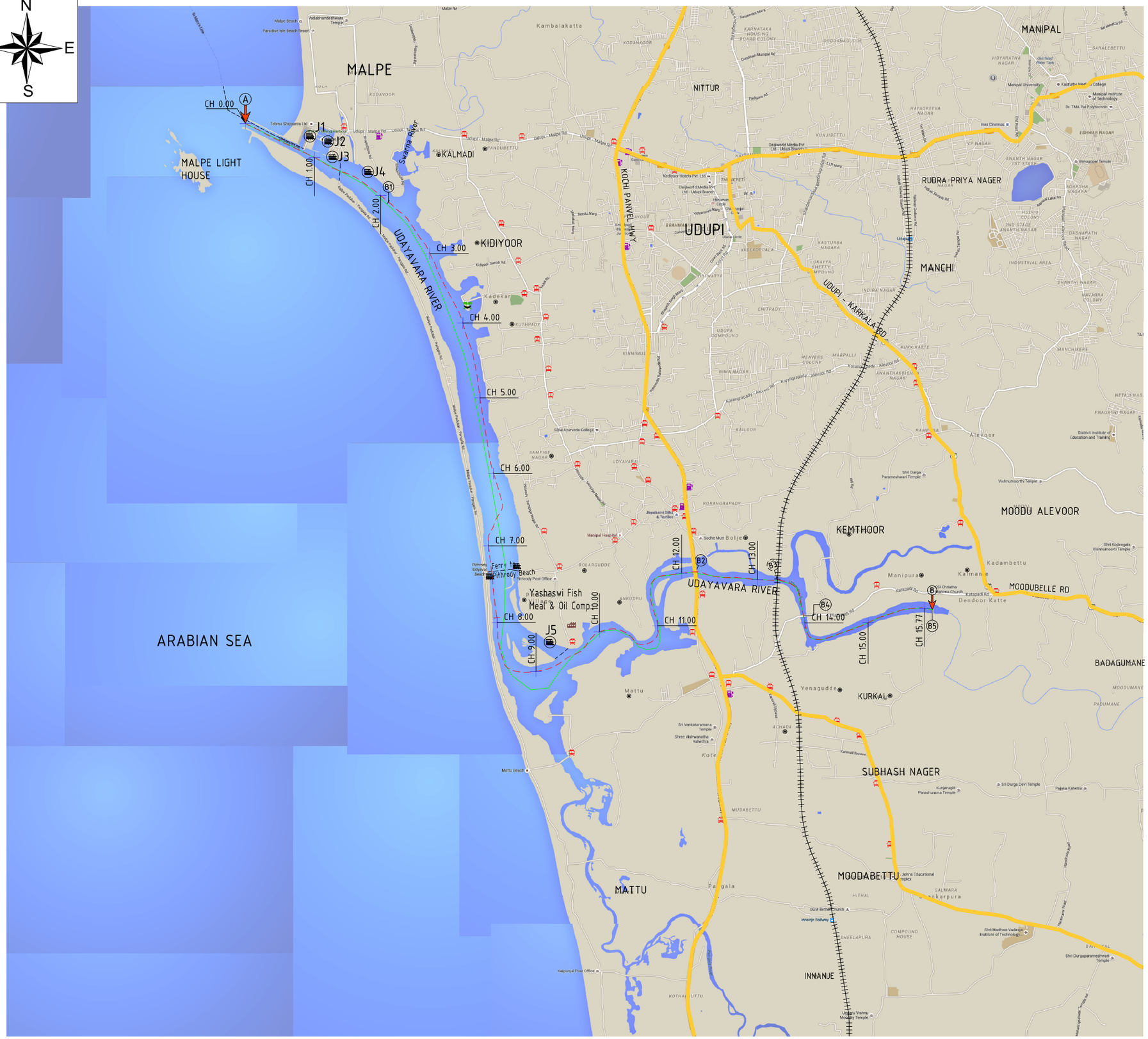
SIZE: A3 | SCALE: 1:25000 | SHEET: 2–2

DRAWING NUMBER: P.009050-W-20201-011 REV 0

MAPS

MAP 4.1 – LAYOUT MAP SHOWING EXISTING JETTIES AND INDUSTRIES IN VICINITY OF UDAYAVARA RIVER (KARNATAKA)

MAP 4.1



LEGEND

	BUS STOP
	FUEL STATION/PUMP
	PLACE NAME
	PORT
	JETTY
	INDUSTRY
	RESORT
	NATIONAL/STATE HIGHWAY (Hwy)
	ROAD
	FERRY LINE
	EXISTING WATERWAY/FERRY LINE
	ROUTE PROVIDED BY IWAI
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BRIDGE DETAILS

BRIDGE No.	CHAINAGE (Km)
B1	2.080
B2	12.145
B3	13.240

BRIDGE No.	CHAINAGE (Km)
B4	13.840
B5	15.770

PROPOSED WATERWAY LENGTH 16.0Km (AS PER TENDER)

TOTAL WATERWAY LENGTH FROM POINT 'A' TO POINT 'B' 15.77Km

SCALE 0 1.0 2.5KM

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

LIST OF JETTIES

SL.	DESCRIPTION	SYMB.
1	MALPE SHIP YARD	J1
2	MALPE PORT	J2
3	MALPE - PADUKAR FERRY JETTY	J3
4	BOAT REPAIRING	J4
5	JETTY	J5

SL. NO.	DESCRIPTION	NUMBER
1	INDUSTRY	NIL

TITLE: LAYOUT MAP SHOWING EXISTING JETTIES & INDUSTRIES IN VICINITY OF UDAYAVARA RIVER (KARNATAKA) (MAP 4.1)

CLIENT: INLAND WATERWAYS AUTHORITY OF INDIA
MINISTRY OF SHIPPING

PROJECT: CONSULTANCY SERVICE FOR PREPARATION OF TWO STAGE DETAILED PROJECT REPORT (DPR) OF CLUSTER 6 OF PROPOSED 53 NATIONAL WATERWAYS.
STAGE 1 – FEASIBILITY REPORT

PROJECT NO. P.009050

TRACTEBEL Engineering GDF SUEZ

At the helm of the Energy Transition, Tractebel provides a full range of engineering and consulting services throughout the life cycle of its clients' projects, including design and project management. As one of the world's largest engineering consultancy companies and with more than 150 years of experience, it's our mission to actively shape the world of tomorrow. With about 4,400 experts and offices in 33 countries, we are able to offer our customers multidisciplinary solutions in energy, water and infrastructure.

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