CONSULTANCY SERVICES FOR PREPARATION OF SECOND STAGE DPR OF CLUSTER-6 NATIONAL WATERWAYS: KERALA (NW-9)

DETAILED PROJECT REPORT: ALAPPUZHA-KOTTAYAM-MANIYAPARAMBU CANAL (55.41 KM)
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DPR – ALAPPUZHA / KAINAKARY – KOTTAYAM / KODIMATHA AND KANJIRAM – MANIYAPARAMBU CANAL (55.41KM) NW – 9

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Subject: **DETAILED PROJECT REPORT – ALAPPUZHA / KAINAKARY – KOTTAYAM / KODIMATHA AND KANJIRAM – MANIYAPARAMBU CANAL (55.41 KM) NW – 9**

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LIST OF VOLUMES

VOLUME-I MAIN REPORT

VOLUME-II DRAWINGS

VOLUME-IIIA HYDROGRAPHIC SURVEY REPORT

VOLUME-IIIB HYDROGRAPHIC SURVEY CHARTS

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

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

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(B. C. JHA)

Tractebel Engineering Pvt Ltd

DISCLAIMER / PROPREITORY RIGHTS

M/s Tractebel Engineering Pvt., Ltd., (M/s TEPL), Gurgaon has been assigned with the Consultancy Services for the “Preparation of Second Stage Detailed Project Report (DPR) of Cluster – 6 (Kerala) of National Waterways” by Inland Waterways Authority of India (IWAI). Accordingly, the study on ALAPPUZHA / KAINAKARY – KOTTAYAM / KODIMATHA and KANJIRAM – MANIYAPPARAMBU CANAL (51.70KM) NW – 9 has been carried out for this assignment / analysed / compiled based on the findings of the following field studies / investigations.

Detailed Hydrographic Survey along with the Topographical Survey was carried out from 26/03/2017 to 21/11/2017.

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

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

BJha.

(B. C. JHA)
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LIST OF ABBREVIATIONS

Abbreviations	Acronyms
BFL	Bombay Floating Light
CD	Chart Datum
Ch	Chainage
CPT	Cochin Port Trust
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
MbPT	Mumbai Port Trust
MHWS	Mean High Water Spring
MMTPA	Million Metric Tonne Per Annum
MnT	Million Tonnes
MOEFCC	Ministry of Environment, Forest & Climate Change
MOS	Ministry of Shipping
MRPL	Mangalore Refineries and Petrochemicals Ltd.
MSME	Micro Small & Medium Enterprises
MTPA	Metric Tonne per Annum
NH	National Highway
NMPT	New Mangalore Port Trust
NW	National Waterway
OMPT	Old Mangalore Port Trust
PGCIL	Power Grid Corporation of India Limited
PWD	Public Works Department
SEB	State Electricity Board
SH	State Highway
UPCL	Udupi Power Corporation Ltd
VC	Vertical Clearance
WRD	Water Resources Department
WRIS	Water Resources Information System of India

SALIENT FEATURES

#	Particulars	Details		
A	**GENERAL**			
1	***Location***			
a	Cluster	Cluster-6		
b	State(s)	Kerala		
c	Co-ordinates & Name of Place			
		9 (A)		
		Start	**End**	
	Place	Near Alappuzha	Kodimatha	
	Latitude	09°31'01.31"N	09°34'39"N	
	Longitude	76°22'44.15"E	76°31'08"E	
		9 (B)		
		Start	**End**	
	Place	Near Kodimatha	Maniyapparambu	
	Latitude	09°34'32.96"N	09°38'40.18"N	
	Longitude	76°30'53.39"E	76°28'42.71"E	
		9 (C)		
		Start	**End**	
	Place	Near Alappuzha	Near Kodimatha	
	Latitude	09°31'01.31"N	09°34'09.06"N	
	Longitude	76°22'44.15"E	76°29'21.91"E	
B	**TECHNICAL**			
1	***Waterway***			
a	National Waterway Number	NW-9		
b	Class	III (Total 55.41 km) – NW9a -22.45kms/ NW9b - 17.82kms/ NW9c -15.14kms		
c	Type (Tidal/Non-Tidal)	Tidal		
	Length (Km.)	**Total**	**Tidal**	**Non-Tidal**
		55.41km		---
d	Average Tidal Variation, if applicable	Non tidal during survey period due to gate closure of Thinumukhum		
e	Chart Datum			
		9 (A)		
	Description/Basis	CHRY-1	KOD-2	KOD-1
	Value (Chart Datum below MSL)	-0.500	-0.428	-0.400
		9 (B)		
	Description/Basis	KOD-1	KOD-3	ATH-2
	Value (Chart Datum below MSL)	-0.400	-0.408	-0.444
		9 (C)		
	Description/Basis	CHRY-1	KOD-3	
	Value (Chart Datum below MSL)	-0.500	-0.408	
f	LAD Status (w.r.t. Observed Depth / CD)			

#	Particulars	Details		
		Stretch-1 (km)	**Stretch-2 (km)**	**Total (km)**
	LAD status wrt Observed Depth (9A)	**0.00 – 10.00km**	**10.00 – 22.45 km**	
	Length with LAD < 1.5 m	0.000	3.750	3.750
	With LAD from 1.5-1.8 m	0.600	0.000	0.600
	With LAD from 1.8-2.2 m	0.450	0.450	0.900
	With LAD from 2.2 -2.5 m	3.600	4.300	7.900
	With LAD > 2.5 m	5.350	3.950	9.300
	Total	10.000	12.450	22.450
	LAD status w.r.t. CD (9A)	**Stretch-1 (km)**	**Stretch-2 (km)**	**Total (km)**
		0.00 – 10.00km	**10.00 – 22.45 km**	**Total (km)**
	Length with LAD < 1.5 m	2.100	2.650	4.750
	With LAD from 1.5-1.8 m	3.400	2.800	6.200
	With LAD from 1.8-2.2 m	1.500	3.900	5.400
	With LAD from 2.2 -2.5 m	2.850	1.250	4.100
	With LAD > 2.5 m	0.150	1.850	2.000
	Total	10.000	12.450	22.450
	LAD status w.r.t. Observed Depth (9B)	**0.00 – 17.82km**	**Total (km)**	
	Length with LAD < 1.5 m	8.250	8.250	
	With LAD from 1.5-1.8 m	3.350	3.350	
	With LAD from 1.8-2.2 m	3.400	3.400	
	With LAD from 2.2 -2.5 m	2.820	2.820	
	With LAD > 2.5 m	0.000	0.000	
	Total	17.820	17.820	

#	Particulars	Details		
	LAD status w.r.t. CD (9B)	**0.00 – 17.82km**	**Total (km)**	
	Length with LAD < 1.5 m	16.450	16.450	
	With LAD from 1.5-1.8 m	0.450	0.450	
	With LAD from 1.8-2.2 m	0.920	0.920	
	With LAD from 2.2 -2.5 m	0.000	0.000	
	With LAD > 2.5 m	0.000	0.000	
	Total	17.820	17.820	
	LAD status w.r.t. Observed Depth (9C)	**0.00 – 15.14km**	**Total (km)**	
	Length with LAD < 1.5 m	4.850	4.850	
	With LAD from 1.5-1.8 m	0.790	0.790	
	With LAD from 1.8-2.2 m	1.750	1.750	
	With LAD from 2.2 -2.5 m	3.650	3.650	
	With LAD > 2.5 m	4.100	4.100	
	Total	15.140	15.140	
	LAD status w.r.t. CD (9C)	**0.00 – 15.14km**	**Total (km)**	
	Length with LAD < 1.5 m	13.040	13.040	
	With LAD from 1.5-1.8 m	0.800	0.800	
	With LAD from 1.8-2.2 m	0.550	0.550	
	With LAD from 2.2 -2.5 m	0.600	0.600	
	With LAD > 2.5 m	0.150	0.150	
	Total	15.140	15.140	
g	Target Depth of Proposed Fairway (m)	2.2 m Class III Canal		
h	Conservancy Works Required	1. Dredging work of 3.61 Lakhs Cu. M in 9 A, 11.89 Lakhs Cu. M in 9 B and 12.32 Lakhs in 9 C is required. 2. Bank Protection requirement has been		

#	Particulars	Details				
		worked out to 600 m in 9 (A); 30,000 m in 9 (B) and 6,000 m in 9 (C)				
i)	Existing Cross Structures					
	Name of Structure	**Type**	**Nos.**	**Range of Horizontal Clearance**	**Range of Vertical Clearance w.r.t. MHWS/HFL**	
	Dams/Barrages/Weirs/Aqueducts etc.	Nil	Nil	Nil	Nil	
	Bridges					
	9A	Foot-Over/ Road	1	15-50 m	2-8 m	
	9B		19			
	9C		1			
	HT/Tele-communication lines					
	9A	HT\LT Lines	25	66.99-192.15 m	8-12 m	
	9B		52	37.19-89.51 m	5-8 m	
	9C		14	33.47-199.72 m	5-11 m	
	Pipelines, underwater cables, etc.	Nil	Nil	Nil	Nil	
2	***Traffic***					
a	Present IWT Operations (type of services)	Passenger ferry services are operational in both Alappuzha & Kottayam districts. Passenger services are operated by State Water Transport Department, Government of Kerala. Following Ferry stations fall under both Alappuzha & Kottayam districts. • Alappuzha- Alappuzha, Nedumudy, Kavalam, Pulinkunnoo, Edathua, Vaikom, Mohamma & Panuavally • Kottayam- Kottayam & Changanassery				
b	Major industries in the hinterland (i.e. within 25 km. on either side)	• Alappuzha- Garment cluster in Alappuzha, Coir cluster in S.L.Puram, Paddy cluster in Kuttanad and Crabgrass Cluster in Cherthala. Major industries in Alappuzha are The Alleppey Company Ltd., Kanti Floor Furnishers, VKL Seasoning, Plam Fibre, Petrogas, Babu Coir Works, Detilish Rugs • Kottayam- There are 3 industrial clusters, Ethnic Food Cluster in Pala, Screw Pine Products in Vaikom and Rubber Products in Changanassery. Major industries in Kottayam are Travencore Cements, MRF, Oil Palm India, Midas Precured Tread, Ceyenar Chemicals, Hi-Tech Cast Iron Industry, TJP Rubber Industries etc.				
c	Connectivity of major industries with Rail / Road network (Distances / Nearest Railway Stations etc.)	✓ Major roads - NH 66, NH 183, NH 47, SH 11, SH 15, SH 42 are the major highways. ✓ Major railway – The Southern Railway network of Indian Railways serves Alappuzha & Kottayam districts. The Thiruvananthapuram division of Southern Railways connects the				

#	Particulars	Details				
		catchment of NW 9. In Kottayam district, Chingavanam, Kottayam, Kumarnallor are the railway stations, which are closer to NW 9. There is no major freight loading station on the railway line. Only Kottayam railway station has facility for goods shed. In Alappuzha district, Chengannur, Kayamkulam, Mavelikkara railway stations are the main stations for good transportation, and goods are loaded and dispatched to other regions.				
d	Commodities	**In-bound**	**Out-bound**			
1.	Container	ICTT (Cochin Port)	KPACT			
		KPACT	Export through ICTT			
2.	Grey Cement	Travancore Cements Ltd.	Export through Cochin Port			
3.	White Cement					
4.	Clinker/ Limestone	Cochin Port	Travancore Cements Ltd.			
5.	Passenger	Alappuzha	Kottayam			
6.	Tourism	Indian & Foreign States	Kottayam & Alappuzha			
e	Future Potential					
	Name of Commodity	5 yr. (Fy-20)	10 yr. (Fy-25)	15 yr. Fy-30)	20 yr. (Fy-35)	25 yr. (Fy-40)
	Container (ICTT- KPACT) (TEU)	3800	3800	3800	3800	3800
	Container (KPACT- ICTT) (TEU)	700	1200	1200	1200	1200
	Grey Cement (000 tons)	-	500	500	1000	1000
	White Cement (000 tons)	30	50	50	60	60
	Clinker/ Limestone (000 tons)	30	350	300	700	700
	Proposed IWAI Terminal on NW-9A					
1	Cargo	--				
2	***Terminals/Jetties***					
a	Terminal/Jetty	Lo-Lo / Ro-Ro in 2 Captive Terminal locations of KPACT and TCL, Nattakkom, Kottayam				
	Location (Bank/city/district)	Lat 09°33'33.17"N and Long 76°30'22.63"E of KPACT, Nattakkom, Kottayam Lat 09°33'37.87"N and Long 76°30'36.18"E of TCL, Nattakkom, Kottayam				
	Type/Services	Bulk / Break Bulk / TEUs / Ro-Ro				
	Facilities	01 No. 125 T output per hour crane + 02 Nos. 05 T Fork Lifts + 1 No. Ambulance are provisioned				
	Approach	Road is available				
	Land Ownership					
	Area (ha.)	**Govt.**	**Private**			
		M/s TCL	of M/s KPACT			
3	***Design Vessel***					
a	Type	SPV / Ro-Ro Vessels				
b	No. & Size	50 m – 55 m LOA x 9 m to 12 m width				

#	Particulars	Details	
c	Loaded Draft	1.6 m – 1.8 m	
d	Capacity	300 T – 500 T / 15 TEU – 21 TEU	
4	***Navigation Aids***		
a	Type	Buoy and Light	
b	Nos.	50 in 9 A, 41 in 9B, 40 in 9C	
b	Communication Facilities	Not Suggested.	
C	**FINANCIAL**		
1	***Project Cost (NW-9A)***		
a	Capital Cost	Fairway	Lo-Lo
	Cost (INR) – **Option-1**	15.28 Cr	22.00 Cr
b	Cost (INR) – **Option-2**	15.53 Cr	22.00 Cr

This financial analysis for the navigation infrastructure (fairways), and terminal operations (Ro-Ro) has been shown in the table below while the detail analysis is discussed in chapter 13. t

NW-9A				
Scenario	**Project Components**	**Cost In Lakhs (Rs.)**	**Financial Internal Rate of Return (FIRR)**	**Economical Internal Rate of Return (EIRR)**
Scenario I :- Project Cost Option 1 and IWAI Tariff	Fairway Cost	1528.20	Non-Existent	75.50%
	Lo-Lo Cost	2200.94	Non-Existent	Non-Existent
Scenario II :- Project Cost Option 1 and CPT Tariff	Fairway Cost	1528.20	-1.50%	77.70%
	Lo-Lo Cost	2200.94	7.70%	17.80%
Scenario III :- Project Cost Option 2 and IWAI Tariff	Fairway Cost	1553.20	Non-Existent	55.20%
	Lo-Lo Cost	2200.94	Non-Existent	Non-Existent
Scenario IV :- Project Cost Option 2 and CPT Tariff	Fairway Cost	1553.20	-1.60%	77.00%
	Lo-Lo Cost	2200.94	7.70%	17.80%

Development of NW-9 Waterway in Scenario II may be considered.

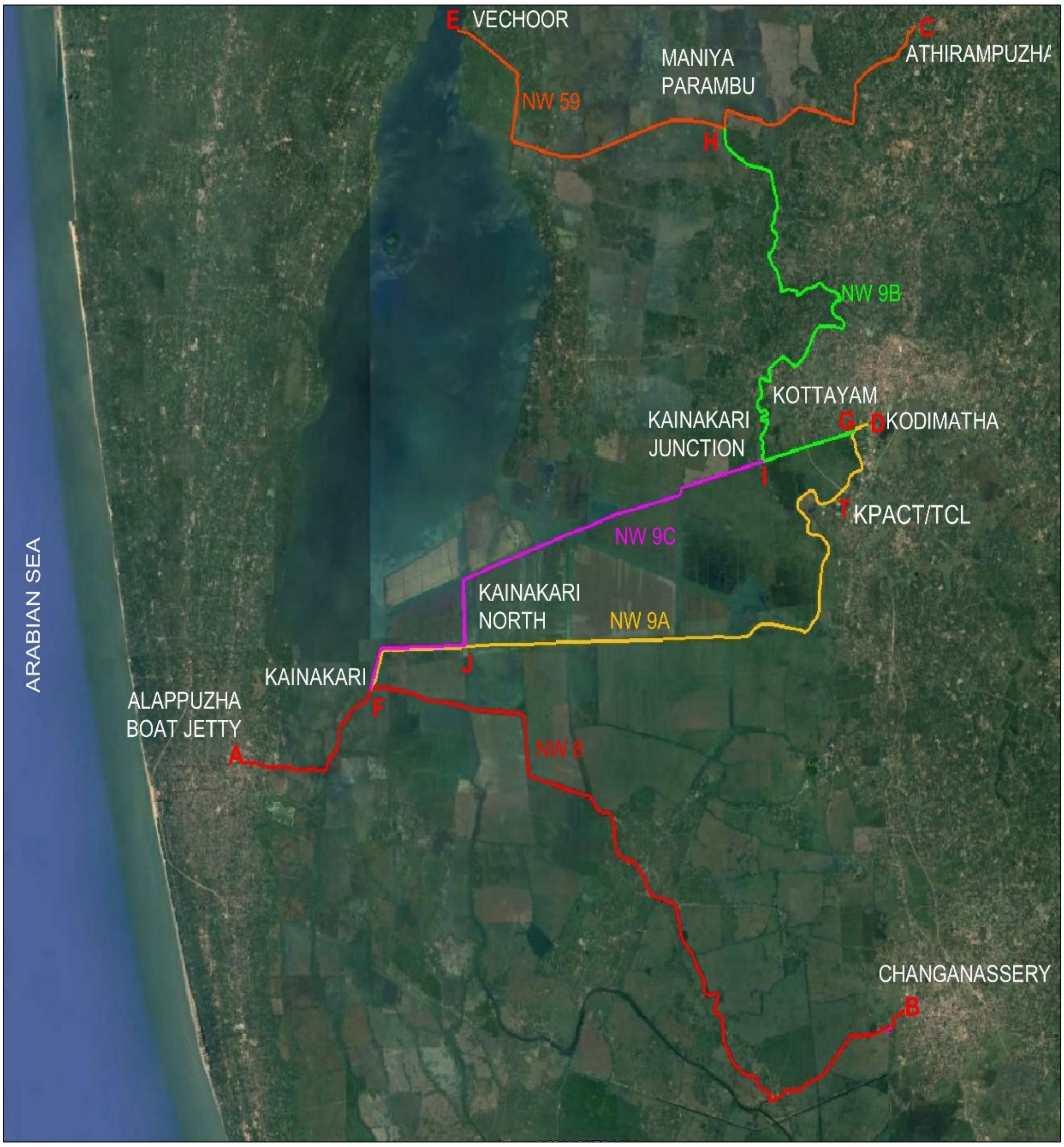
EXECUTIVE SUMMARY

The Canal stretch Alappuzha – Kottayam – Maniyapparambu canal stretch is one of the waterways declared as National Waterway in March, 2016 as NW 9. The study stretch of NW 9 is greatly depended for discharging water from the paddy polders to the Pallathuruthy River with Agricultural plots on either side of the canal, small markets Pallom, Nattakom, Muppaikad, Kodimatha, Vellor etc., and Large Agricultural Lands, Lake Vembanadu etc..National Waterways NW 8, NW 9 and NW 59 are traversing within the Vembanad Lake area in Kerala. The diversified ecological system of Vembanad Lake will have its impact on the Development of the above waterways, particularly due to its identification in the Ramsar Wet Land List. The lake is fed by 10 rivers flowing into it including the six major rivers of central Kerala namely Achenkovil, Manimala, Meenachil, Muvattupuzha, Pamba and Periyar. The Vembanad Wet Land System covers an area of over 2033 km² thereby making it the largest wetland system in India.

The NW 9 stretch has been proposed for undertaking the two stage DPR. M/s Tractebel has been assigned with the work of Preparation of the two stage DPR. Subsequent to the Stage 1 preliminary findings, the Waterway stretch NW 9 of 51.70 kms has been segregated into Three parts as 9 A from Alappuzha / Kainakari to Kottayam / Kodimatha of 22.45 Kms + 9 B from Kanjiram Junction to Maniyapparambu of 17.82 Kms + 9 C Kainakary North to Kottayam of 15.14 Kms has been taken up for the Stage 2 Detailed Project Report (DPR) so as to assess the required developments and the IWT Traffic potential along with inter alia activities including the working out of Cost / Return factors for taking a decision on developments / investments.

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

The study stretch has been redefined for working and depicted herewith.



DISTANCE DETAILS (in Kms)

NW 9 (A)	***F to D i.e., F Ch 0 km to D Ch 22.40 km***	
	[AFJGD]	AF – 5.10; FJ – 3.70; JG – 18.10; GD – 0.60
T	{Terminals of KPACT & TCC Ltd., are near Ch. 19.70 km}	
NW 9 (B)	***G to H i.e., G Ch 0 km to H Ch 17.80 km***	
	[GIH]	GI – 2.80; IH – 15.00
NW 9 (C)	***F to I i.e., F Ch 0 km to I Ch 15.20 km***	
	[FJI]	FJ – 3.70 km; JI – 11.50;
NW 8	[AFB]	AF – 5.10; FB – 24.20;
NW 59	[EHC]	EH – 10.8; HC – 8.0;

Distance from E along NW 3 crossing AF is approx. 20.5 kms.

Based on the Hydrographic Survey inputs and other site data collected on NW 9, it has been noticed that 9 A is having 1 No. Bridge and 25 Nos. of Power cables; 9 B is having 19 Nos. of Bridges and 52 Nos. Power Cables and 9 C is having 1 No of Bridge and 14 Nos. of Power Cables. No Dams / Barrages / Locks / Weirs / Anicuts / Aqueducts are located. 12 Nos; 26 Nos. and 4 Nos. of Bend locations have been identified respectively in 9 A, 9 B and 9 C in the study stretch. Further, the Land Acquisition requirement for widening the stretch has been worked out as 1.5 Ha in 9 A; 42 Ha in 9 B and 8.5 Ha in 9 C. Most of the Bends will vanish, while widening. The Bank Protection requirement has been worked out to 0.6 Kms in 9 A; 30 Kms in 9 B and 6 Kms in 9 C. BY keeping the above all in view, a comparative analysis has been considered and found that the most viable stretch is only 9 A and accordingly, the working has been considered for development of 9 A of NW 9.

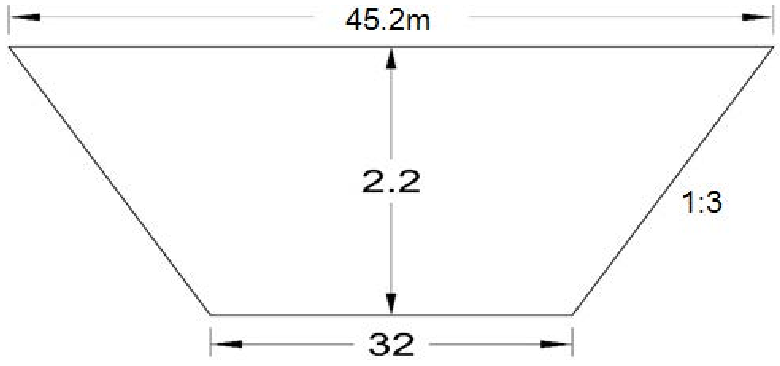
The Geographical advantage of NW 9 is that the same is interconnected with the existing NW 3 and inter alia connecting Kottappuram in the North and Kollam in the south and also the Kochi area including the ICTT, Kochi through Waterway. The study stretch is already having 2 Captive Terminals being operated by Kottayam Port and Container Terminal (KPACT) and Travancore Cements Limited (TCL). KPACT handled about 4,233 TEU / 4500 TEU of export & import cargo till recently. 300 TEU containers are being handled at KPACT per month. TCL mainly produces white cement, named Vembanad White cement. Other end products of TCL are Vembanad white putty and Super Shelcem Cement Paint. The licensed capacity of the plant was 50,800 tonnes of Cement per annum. The Company used lime shell, White clay, White sand and Gypsum as raw material for producing finished product. The company used Vembanad lake for lime shell extraction which was the major raw material for manufacturing cement; but after ban on extraction from the lake, TCL stopped using Vembanad lake completely. TCL used to transport the raw materials and finished products by using the study stretch of NW 9, which is under consideration for expansion with the approvals for manufacturing Grey Cement. The proposals are under final stage of approval by Government of Kerala.

Present study stretch of NW 9 is also being used for Passenger Ferry mobility by Kerala State Water Transport Department (HQ: Alappuzha) by deploying the Passenger vessels.

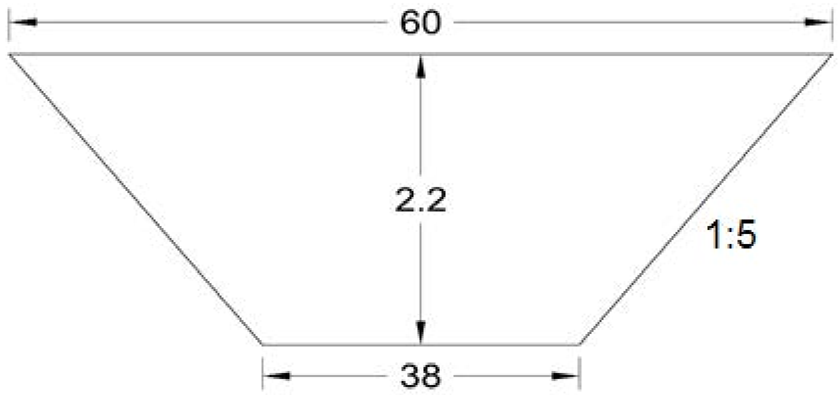
The identified Traffic for IWT for this Waterway is of Lo-Lo operation with specific criteria of achieving the operational volumes of about 3800 TEUs p.a (inward) + 1200 TEUs p.a (outward) at KPACT and 7 Lakhs T p.a (inward) + 10.60 Lakhs T p.a (outward) at TCL estimated in 2040.

The fairway requirements are being considered for analysis for its maximum / optimum utilization. Keeping in view the SPV / Ro-Ro vessel operation, the mobility of Class III vessel with Canal standard is being considered with 300 T / 15 TEUs equivalent capacity. The vessel requirement is 50 m (Length) x 9 m (Breadth) x 1.5 m / 2 m+ (Draft / Depth). The fairway requirement is 40 m (Bottom Width) x 2.2 m (Depth) with Bend Radius of 700m. Clearance corridor of 40 m Horizontal Clearance (HC) and 6 m Vertical Clearance (VC) is the requirement specified at Cross structures for safe passage of Vessel.

The fairway size and dredging quantities of the study stretch are placed below for Class III waterway for the study stretch of NW 9 A, in line with the present NW-3 standards so as to have throughout mobility interalia.



Narrow Reaches with 50 m Land Acquisition.



Wider Reaches with No Land Acquisition.

CLASS-III – NW 9 A

CLASS	Chainage (km)		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Max. Depth (m)	Min. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Max. Depth (m)	Min. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)
III	0	10	6.8	1.8	700	1747.54	5.6	0.6	7000	187051.31
III	10	22.45	9.1	0	4450	41014.20	8.3	-2.6	9350	142522.87
	Total				5150	42761.74			16350	329574.18

Accordingly, the shoal length is of 16350 m and the respective Dredging quantity has been taken into consideration for 3.29 Lakhs Cu. M. (3.61 Lakhs Cu. M considering the variations). Apart from the above Fairway developments, some Institutional Requirement has been suggested.

KPACT is having 5 Hectares of Back up land and other 7 Acres of land is under the proposal for taking over. The approximate Coordinates of the location is Lat 09°33'33.17"N and Long 76°30'22.63"E. It has already been confirmed by KPACT that they are very much interested to share the land / infrastructure on mutually agreed basis for development of IWT in this port area.

M/s TCL has given a written consent about the provision of 12500 Sq. m of land for construction of jetty structure with 100 m water-front land, which will be most suitable for developing the 2 Nos. of Terminal Jetties of 50 m x 15 m. The approximate Coordinates of the location is Lat 09°33'37.87"N and Long 76°30'36.18"E of TCL. The sharing of Land / infrastructure would be based on mutual agreement and revenue profit sharing with IWAI.

In order to meet the above combined cargo operation effectively, it is estimated to have 2 Berthing structures of 50 m x 15 m jetty each and the handling infrastructure for both the combined operations 125 Tons capacity per hour handling capacity of Crane – 01 + Fork Lifts of 5 T – 2 in Nos along with 01 Ambulance have been suggested in this area as an upgradation of the handling infrastructure to meet the estimated cargo for loading and unloading of containers from barges.

Preliminary Designs have been worked out for Spurs; Bank Protection with Gabions; Bank Protection with Pile & Slab; Navigational Aids through Buoys (Polyethylene) and Lights (4 NM); Lo-Lo / Ro-Ro Jetty.

The following Vessel standard is suggested for a cautious deployment as per the requirement.

SPV / Ro-Ro Vessel:	**(15 - 21 TEU)**	**INR 700 Lakhs each**
LOA	50.00 m – 55 m	
Breadth	9 m – 12 m	
Loaded Draft / Depth:	1.6 m – 1.8 m / 2.2 m +	
Propulsion:	Marine Diesel Engines of 2 x 325 Bhp	
Speed (with Load):	20 Kmph (Av)	

Regarding the Navigation & Communication System, it has been worked out the provision of RIS / AIS / Locating the Vessels / Buoys. An attempt has been made to ascertain the details on the Vessels Traffic Management System (VTMS). It was observed that the same is more costly than the RIS system and has not been discussed. Though an indicative cost is suggested, a feasible system could not be recommended at this point of time.

With regard to the Environmental aspects, considering the scale of construction and operation relating to the project, limited significant adverse impacts are anticipated on account of the project. Most of the impacts will be limited to the construction phase and can be suitably mitigated by following good industry practices. Since limited dredging is involved, impact on aquatic ecology is also anticipated to be negligible. No structures are present over the land identified for construction of terminals or related project components. Therefore, the project does not involve any dislocation of population. The entire project area falls under the tidal zone. As such the project shall require obtaining clearance under the CRZ Notification 2011. Consent to Establish and Consent to Operate from the SPCB shall be required under the Air and Water Acts. No other major clearances / approvals / permits relating to environmental and social aspects are applicable to the project. No wildlife clearance is envisaged for the proposed waterway. Since no structures of cultural, historical or archaeological are anticipated to be impacted due to the project, no clearance from the Archaeological Survey of India (ASI) or the State Department of Culture is envisaged for the project.

Regarding the Institutional requirements, it has been proposed that NW 9 will be a part of the present Kochi office and as a supporting system for NW 3. Hence, a nominal provision of INR 40 Lakhs (approx.) is only suggested for creating the infrastructure.

The cost estimates have been worked out for development of Fairway with a capital cost of 15.28 Cr and Terminal with a capital cost of 22.00 Cr. This is **Option-1** for the project development. Implementation of NW-9a is suggested from 2021. There is another consideration as suggested by Govt. of Kerala regarding implementation of some new structures on the fairway & reconstruction of cross over existing facilities/ structures. This letter has been duly considered in option-2 which will take into account the financial implication in light of suggestions received from Kerala Govt. The cost of **Option-1** is 37.28 Crores with its breakup is compiled in the table below:

Sl No.	Parameter	9 A INR (In Cr.)	9 B INR (In Cr.)	9 C INR (In Cr.)
1	Fairway	15.28	125.93	52.77
2	Ro-Ro Terminal	22.00	22.00	22.00
3	Financial Impact of Govt. of Kerala Letter dated 07.03.2020	0.00	0.00	0.00
	Total	**37.28**	**147.93**	**74.77**

The Cost of option -2 has been considered taking the financial impact of the suggestion of Govt. of Kerala vide their letter Coastal Shipping & Inland Navigation (A) Dept., Govt. of Kerala vide their letter no. A2/224/2018/CSIND dated 07.03.2020. So, this will entail the development cost as computed in the option-1 & considering the financial impact of structures suggested by the Govt. of Kerala.

Sl No.	Name of Structure	Type & Owner of Structure	Waterway (NW-9) Nos. of Structure			Cost Per Structure	Approximate Amount of Reconstruction (In Crores)		
			9-A	9-B	9-C		9-A	9-B	9-C
1)	Bridge	Cross Structure Under PWD	1	8	1	0	0	0	0
2)	Foot Bridges	Cross Structure Under PWD		2	0	1.2	0	2.4	0
2)	Foot Bridge	Cross Structure Under LSGD		9	0	1.2	0	10.8	0
3)	HT Lines	Kerala State Electricity Board	0	0	0	0.3	0	0	0
3)	LT Lines	Kerala State Electricity Board	25	52	14	0.01	0.25	0.52	0.14
4)	Regulator Cum Bridge & Navigation Lock	Irrigation Dept. & Navigation Dept.	0	0	0	0	0	0	0
5)	Water Pipe -line	Kerala water Authority	0	0	0	0	0	0	0
	Total						**0.25**	**13.72**	**0.14**

Therefore, the total cost as per the **Option-2** shall be as detailed in the below table.

Sl No.	Parameter	9 A INR (In Cr.)	9 B INR (In Cr.)	9 C INR (In Cr.)	Remarks
1	Fairway	15.28	125.93	52.77	Similar to as Per Option-1
2	Ro-Ro Terminal	22.00	22.00	22.00	Similar to as Per Option-1
3	Financial Impact of Govt. of Kerala Letter dated 07.03.2020	0.25	13.72	0.14	As detailed in table above
	Total	**37.53**	**161.65**	**74.91**	

Hence the total cost of project development in case of Option-1 & Option-2 for **NW-9A** is Rs.37.28 Crores and Rs.37.53 Crores respectively. The FIRR and EIRR have been worked out and the critical indicators are placed in the table below:

No	Factors	Section	Unit	Scenarios			
				I	II	III	IV
1	Project Cost	Fairway	Cr.	15.28	15.28	15.53	15.53
		Lo-Lo Terminal	Cr.	22.01	22.01	22.01	22.01
2	Tariff	Vessel Berthing	INR Vessel/Day	1,000.0	1,275.1	1,000.0	1,275.1
		Cargo Unloading	INR Per Ton	1.0	52.5	1.0	52.5
		Container Handling	INR Per TEU	50.0	410.6	50.0	410.6
		Fairway Usage	INR GRT-Km	0.02	1.0	0.02	1.0
2	Traffic	Break-Bulk	Million Tonnes	FY 23 - 0.06 and FY 40 - 1.76			
		Container	TEU	FY 23 - 4,500 and FY 40 - 5,000			
3	Revenue	Fairway (FY40)	Cr.	0.21	10.45	0.21	10.45
		Lo-Lo (FY40)	Cr.	4.92	33.43	4.92	33.43
4	FIRR	Fairway	-	Non-Existent	-1.5%	Non-Existent	-1.6%
		Lo-Lo Terminal	-	Non-Existent	7.7%	Non-Existent	7.7%
5	EIRR	Fairway	-	75.5%	77.7%	55.2%	77.0%
		Lo-Lo Terminal	-	Non-Existent	17.8%	Non-Existent	17.8%

Source: Consultant

The development of **NW-9A** can be taken up & recommended for about 22.4 Kms to meet the estimated IWT cargo growth with Class III Canal system of the NW standards, in order to meet the estimated cargo volumes of the existing 2 captive Terminals of KPACT and TCL, keeping in view the heavy road density of Kerala.

There are various large companies located on the banks of waterway needing NW 9 A for cargo transportation to/from Cochin Port via NW-3. NW-9 is acting as a feeder for cargo movement on NW 3. Container, Bulk Cement and Clinkers are prominent commodities on this waterway. Development of NW 9-A would ease out congestion on the narrow roads connecting to Cochin Port. KPACT has a terminal on the river. They are waiting for operationalization of this canal based waterway. The development of this NW-9A shall trigger capacity expansion of existing companies in the post development phase. These would lead to holistic development of region and transportation mode. Therefore the development is recommended.

Also the cumulative returns from both the terminals and fairway comes negative in case where IWAI tariff rates are considered. Tariff structure floated by IWAI is considerably low and thus enough revenue is not being generated. While, considering the CPT tariff structure project gives tangible return i.e. FIRR 4.5% and EIRR 26.6%. The option of considering a higher tariff can be exercised by IWAI to make the project commercially attractive which appears rational and in line with CPT.

CHAPTER 1 : INTRODUCTION

1.1 Project Background and Summary of previous study

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

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

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

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

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

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

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

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

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

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

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

TABLE 1-1: LIST OF RIVERS/CREEKS OF UNDER CLUSTER VI IN THE STATES OF KARNATAKA AND KERALA (LENGTH-453.895KM)

Sl. No.	Name of Rivers/ Creeks	National Water Way (NW)	Length(km)	State
1.	West Coast Canal	NW-3	169.794	Kerala
2.	**Alappuzha - Changanassery Canal**	**NW-8**	**29.300**	**Kerala**
3.	Alappuzha- Kottayam – Athirampuzha Canal	NW-9	51.700	Kerala
4.	Kottayam-Vaikom Canal	NW-59	18.800	Kerala
5.	Gurupur River	NW-43	10.041	Karnataka
6.	Kabini River	NW-51	23.56	Karnataka
7.	Kali River	NW-52	53.415	Karnataka
8.	Netravathi	NW-74	30.000	Karnataka
9.	Panchagangavali (Panchagangoli) River	NW-76	23.000	Karnataka
10.	Sharavati River	NW-90	28.674	Karnataka
11.	Udayavara River	NW-105	16.000	Karnataka
	Waterways restricted to Stage I study.	**Total**	**453.895**	

Accordingly, the Stage II study for the Alappuzha / Kainakary – Kottayam / Kodimatha and Kanjiram – Maniyaparambu canal (NW – 9) is under consideration in the present DPR.

A portion of the existing NW 3 from Kollam to Kottappuram; NW 8; NW 9 and NW 59 are traversing through the Vembanad Lake in Kerala. The Vembanad Lake is one of the identified sites of the Ramsar Convention, which is an international treaty for the conservation and sustainable use of wetlands. It is also known as the Convention on Wetlands.

A Macro Level Route Map of the National waterways in Vembanad Lake along with the major points and the route traversing is presented herewith for more understanding.

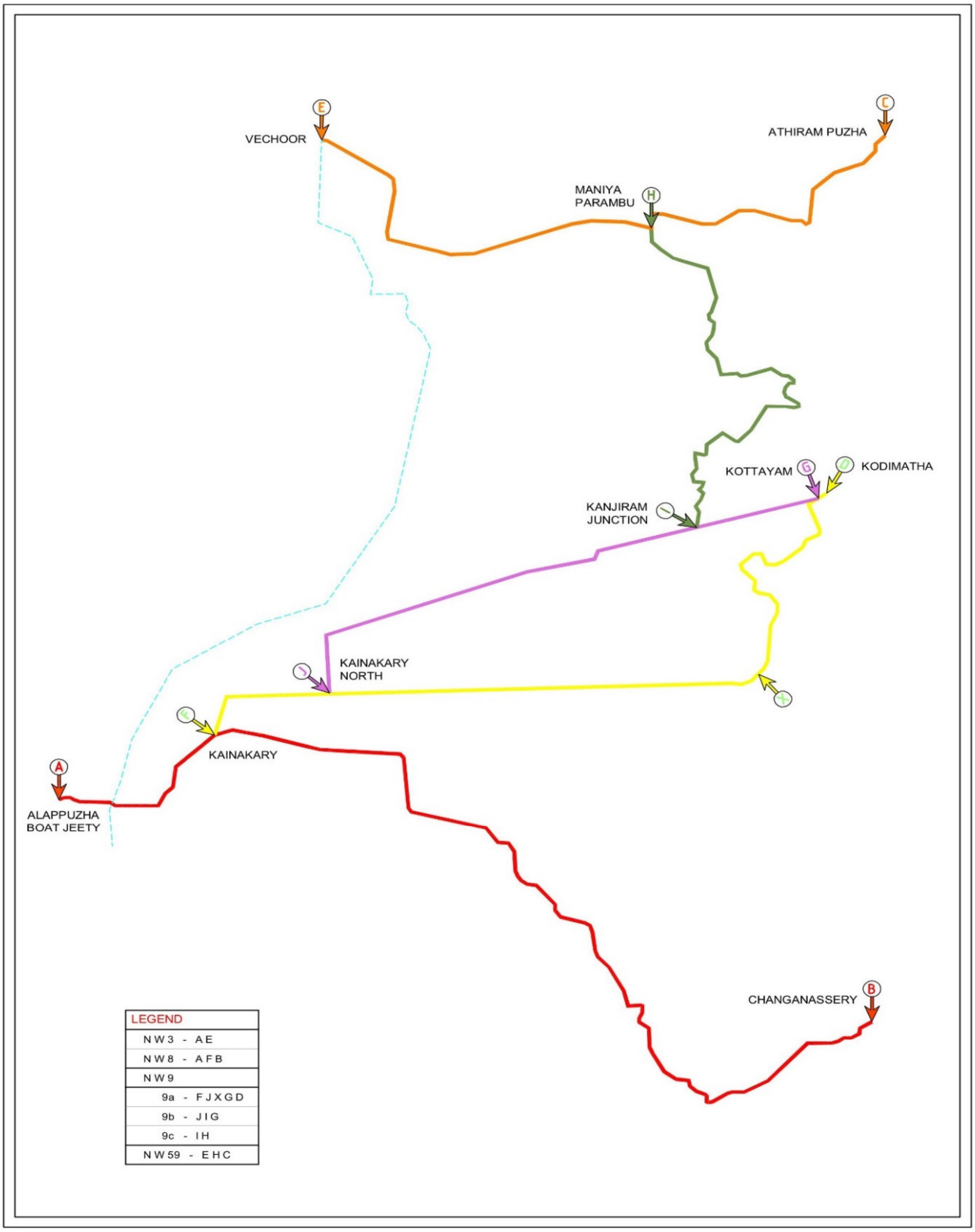


Figure 1-1 Lay out Drawing.

LENGTH AND POINTS OF NATIONAL WATERWAYS IN VEMBANAD LAKE

ORIGINAL		REVISED	
Name of the Place	Latitude / Longitude	Name of the Place	Latitude / Longitude
NW – 8			

Alappuzha – Changanassery Canal

From Boat jetty, Alappuzha (A) To Changanassery Jetty (B)	From 09°30'02.85"N, 76°20'37.05"E. To 09°26'41.61"N, 76°31'41.76"E	From Boat jetty, Alappuzha (A) To Changanassery Jetty (B)	From 09°30'03"N, 76°20'37"E. To 09°26'42"N, 76°31'42"E

NW – 9

Alappuzha – Kottayam – Maniyaparambu canal

From Boat jetty, Alappuzha (A) To Athirampuzha market (C)	From 09°30'02.85"N, 76°20'37.05"E To 09°40'04"N, 76°31'54"E	From Alappuzha (F) To Kottayam near Kodimatha (D) From Kanjiram Junction (I) To Maniaparambu (H) From Kainakary North (J) To Kottayam (G)	From 09°31'01.31"N, 76°22'44.15"E To 09°34'39"N, 76°31'08"E -------------------- From 09°34'09.06"N, 76°29'21.91"E To 09°38'40.18"N, 76°28'42.71"E -------------------- From 09°31'37.75"N, 76°24'19.33"E To 09°34'32.96"N, 76°30'53.39"E

NW – 59

Kottayam – Vaikom Canal

From Kottayam, near Kodimatha (D) To	From 09°34'38.67"N, 76°31'07.67"E To	From Vechoor joining National Waterway-3 (E)	From 09°40'00"N, 76°24'11"E To

Vechoor joining National Waterway no. 3 (E)	09°40'00.19"N, 76°24'10.65"E	To Athirampuzha Market (C)	09°40'04"N, 76°31'54"E

1.2 Brief Scope of Work and Compliance statement

The Scope of the Work for the present study is well defined in the Work allocation along with the Terms of Reference (ToR). The same is annexed herewith at Annexure 1.1. Compliance of the ToR is placed at Annexure 1.2.

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

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

1.2.1 Fairway Development

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

1.2.2 Traffic Confirmations

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

1.2.3 Terminal Development

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

1.2.4 Vessel Requirement

Based on the type of cargo, quantum of cargo, distance to be moved etc., also keeping in view the travel time, the type of vessel and No. of vessels requirement are to be worked out. As per the existing / present industry standards, the vessel deployment and its operation and maintenance will not form part of the development except the projection of the requirements for the project, as a whole. Hence this aspect is only indicative.

1.2.5 Financial Analysis

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

1.3 Brief Methodology & Approach:

The Terms of Reference of the subject study, the scope of work defined for the study itself are indicative about the Methodology to be adopted for the study. Further, the Approach and Methodology had already been explained in the Stage I report and at this juncture, it is prudent to mention the sequential and systematic approach to the project. Accordingly, a flow diagram has been placed at Annexure 1.3, which is self-explanatory and by following the activities as specified, the project report will be in complete shape.

1.4 Project Location / Details of Study Area:

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

TABLE 1-2: WATERWAYS FOR STAGE II STUDY

Sl. No.	NW-No. / Name of the Waterway	Defined Limits
Cluster 6 (Karnataka)		
1.	NW-43 / GURUPUR RIVER	10.041 kms from starting point Lat 12°50' 44.093" N, Long 74° 49' 44.783" E.
2.	NW-51 / KABINI RIVER	23.56 kms from starting point Lat 11°56'0.9311" N, Long 76°14'17.5004" E.
3.	NW-52 / KALI RIVER	53.415 kms from starting point Lat 14°50'33.5786" N, Long 74°07'19.7098" E.
4.	NW-74 /	30.00 kms from starting point Lat 12°50'44.6904"

Sl. No.	NW-No. / Name of the Waterway	Defined Limits
	NETRAVATHI RIVER	N, Long 74°49'33.3734" E.
5.	NW-90 / SHARAVATI RIVER	28.674 kms from starting point Lat 14°17'56.5621" N, Long 74°25'36.4534" E.
	Cluster 6 (Kerala)	
1.	NW-3 / WEST COAST CANAL	169.794 kms from starting point Lat 10°11'38.9421" N, Long 76°12'04.152" E.
2.	NW-8 / ALAPPUZHA – CHANGANASSERY CANAL	29.3 kms from starting point Lat 09°30'03"N, Long 76°20'37"E.
3.	NW-9 / ALAPPUZHA-KOTTAYAM-MANIYAPARAMBU CANAL	51.7 kms from starting point Lat 09°31'1.31"N, Long 76°22'44.15"E.
4.	NW – 59 / VECHOOR – ATHIRAMPUZHA CANAL	18.8 kms from starting point Lat 09°40'00"N, Long 76°24'11"E.

The present study is about the Alappuzha / Kainakary – Kottayam / Kodimatha and Kanjiram – Maniyaparambu canal (NW – 9) is a canal in the Vembanad Lake, in the state of Kerala.

TABLE 1-3: DESCRIPTION OF ALAPPUZHA / KAINAKARY – KOTTAYAM / KODIMATHA AND KANJIRAM – MANIYAPARAMBU CANAL (NW – 9)

Sl. No.	Introductory Consideration	Description of the Canal
1.	Name of the river / canal	Alappuzha / Kainakary – Kottayam / Kodimatha and Kanjiram – Maniyaparambu Canal (NW – 9).
2.	State / District through which river passes	The present study stretch is having Two different routes (Alappuzha – Kottayam) and an additional route connecting Northern part of NW 3 at Vechoor (through Maniyaparambu). The majority of alternative routes are in Kottayam District of Kerala State and a part near Kainakary is in Alappuzha District of Kerala State.
3	Length of the river / canal	As depicted above the alternate routes are as defined; 9 (A) is from Kainakary (Ch 0) to Kodimatha Ch 22.4) – 22.4 Km. 9 (B) is from Kottayam (Ch 0) to Maniyapparambu Ch 17.8) – 17.8 Km. 9 (C) is from Kainakary (Ch 0) to Kanjiram Junction (Ch 15.1) – 15.1 Km. The Second Stage DPR of the above alternative routes is

Sl. No.	Introductory Consideration	Description of the Canal
		under consideration.
4	Map	The index map of the study stretch showing proposed waterway stretch, topographic features and road networks are shown in Figure 1.2. The study stretch of NW 9 for the Detailed Project Report (DPR) is presented in **Drawing No. P. 010631-W-20301-A02 (A to C).**
	Characteristic of River	
5	River / Canal Course	The study stretch of NW 9 is greatly depended for discharging water from the paddy polders to the Pallathuruthy River with Agricultural plots on either side of the canal, small markets Pallon, Nattakom, Muppaikad, Kodimatha, Vellor etc., and Large Agricultural Lands, Lake Vembanadu etc..
6	Tributaries / Network of Rivers / Basin	National Waterways NW 8, NW 9 and NW 59 are traversing within the Vembanad Lake area in Kerala. The diversified ecological system of Vembanad Lake will have its impact on the Development of the above waterways, particularly due to its identification in the Ramsar Wet Land List. The lake is fed by 10 rivers flowing into it including the six major rivers of central Kerala namely Achenkovil, Manimala, Meenachil, Muvattupuzha, Pamba and Periyar.
7	Catchment Area	The Vembanad Wet Land System covers an area of over 2033 km² thereby making it the largest wetland system in India.

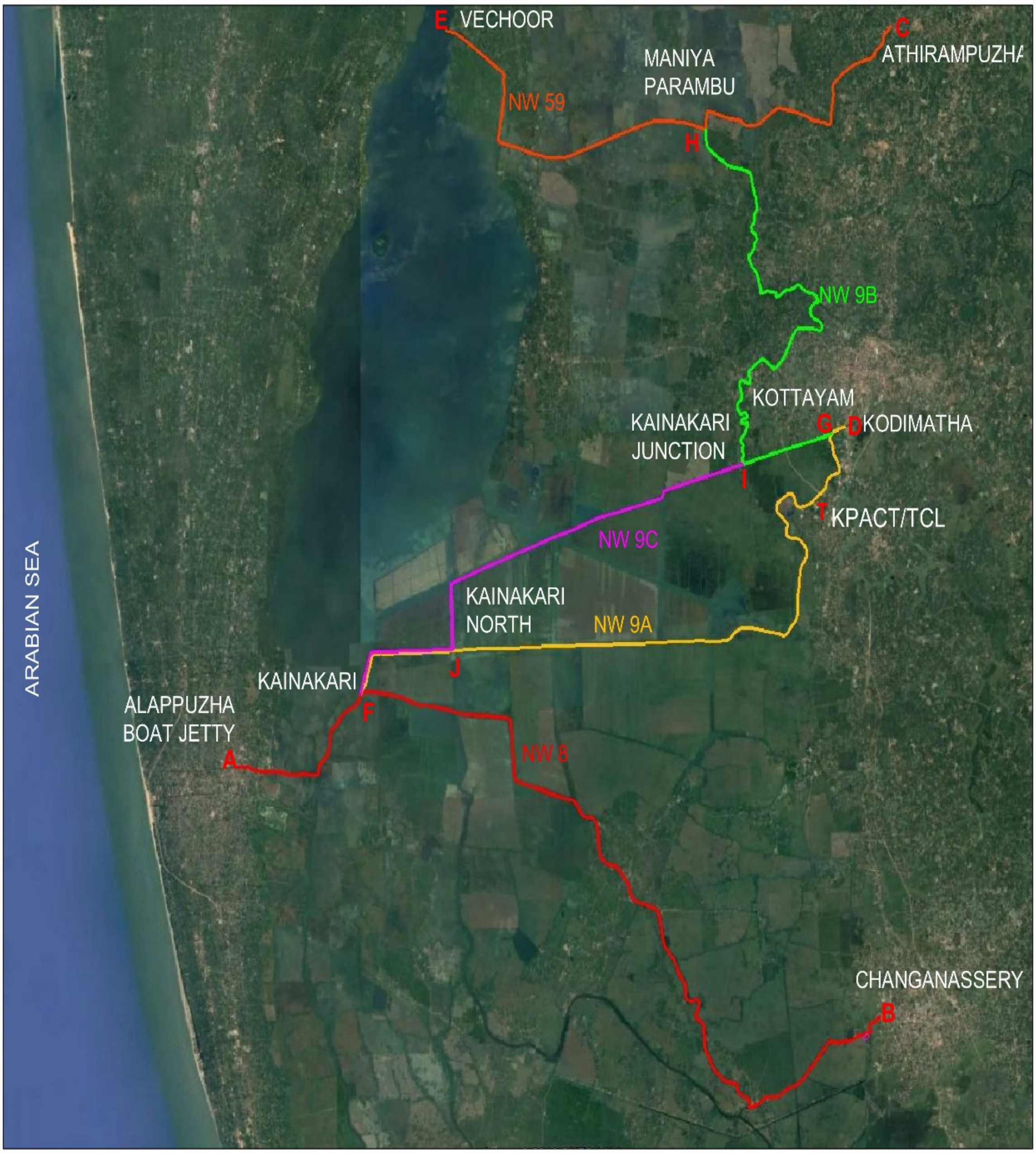


FIGURE 1-2: INDEX MAP with DISTANCE DETAILS (in Kms)

NW 9 (A) ***F to D i.e., F Ch 0 km to D Ch 22.40 km***

[AFJGD] AF – 5.10; FJ – 3.70; JG – 18.10; GD – 0.60

T {Terminals of KPACT & TCC Ltd., are near Ch. 19.70 km}

NW 9 (B) ***G to H i.e., G Ch 0 km to H Ch 17.80 km***

[GIH] GI – 2.80; IH – 15.00

NW 9 (C) ***F to I i.e., F Ch 0 km to I Ch 15.20 km***

[FJI] FJ – 3.70 km; JI – 11.50;

NW 8 [AFB] AF – 5.10; FB – 24.20;

NW 59 [EHC] EH – 10.8; HC – 8.0;

Distance from E along NW 3 crossing AF is approx. 20.5 kms.

CHAPTER 2 : WATERWAY / DETAILED HYDROGRAPHIC SURVEY

2.1 Hydrographic Survey

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

2.1.1 Waterway in General and Hydro-morphological Characteristics

Waterway in General

The Alappuzha-Kottayam-Maniyapparambu Canal or National Waterway No. 9 is a total of 51.70 km stretch of this inland navigational route located in Kerala, India and runs from Alappuzha / Kainakary to Kodimatha as 9 A of 22.40 kms + Kanjiram Junction to Maniyapparambu as 9 B of 14.90 km + Kainakary North to Kottayam as 9 C of 14.40 km proposed to undertake the two stage DPR. There is an overlap of this canal, while undertaking the study.

Alappuzha (or Alleppey) is a city on the Laccadive Sea coast in the southern Indian state of Kerala. It's best known for houseboat cruises along the rustic Kerala backwaters, a network of tranquil canals and lagoons. Alappuzha beach is the site of the 19th-century Alappuzha around the Lighthouse. The city's Mullakkal Temple features a traditional design. Punnamada lake's snake boat races are a well-known annual event.

Kottayam is a town in Kerala State and administrative capital of Kottayam District with an average elevation of 3 metres (9.8 ft) above sea level and is situated in the basin of the Meenachil River and in the basin of the Vembanad backwaters, which are formed from several streams in the Western Ghats. According to the division of places in Kerala based on altitudes, Kottayam is classified as being a midland area. The vegetation is mainly tropical evergreen and moist deciduous type.

National Waterway NW 9 is traversing within the Vembanad Lake area in Kerala. The diversified ecological system of Vembanad Lake will have its impact on the Development of the above waterways, particularly due to its identification in the Ramsar Wet Land List. The lake is fed by 10 rivers flowing into including the major rivers of central Kerala namely Achenkovil, Kodoor, Manimala, Meenachil, Muvattupuzha, Pamba and Periyar.

The climate of Kerala is tropical monsoon with seasonally excessive rainfall and hot summer. The Western Ghats plays a major role in the climatic conditions that prevail all along the state. The period of March to the end of May is the hot season, followed by South West Monsoon season that continued till the beginning of October. From October to December, it is the North East Monsoon season and two months, January and February, are the winter season. The state is extremely humid due to the existence of Arabian Sea in the west of it.

The annual rainfall ranges from 2435.9 to 3755.2 mm and the average annual rainfall of the district is 3169.28 mm. The South West monsoon contributes nearly 59 % of the total rainfall and while the North East monsoon contributes nearly 21% of the total rainfall in this area.

The soil types occurring in Kottayam district can be broadly grouped into four types on the basis of their physico-chemical properties and morphological features. They are (a) Lateritic soil. (b) Riverine alluvium, (c) Brown hydromorphic, and (d) Forest loams.

Vembanad Lake: National Waterways NW 8, NW 9 and NW 59 are traversing within the Vembanad Lake area in Kerala. The diversified ecological system of Vembanad Lake will have its impact on the Development of the above waterways, particularly due to its identification in the Ramsar Wet Land List.

In this context, it is to state that the Ramsar Wet Land Convention was signed way back in 1971 (2nd February, 1971) named after the location of convention where it was signed i.e., Ramsar, Iran consisting of 169 parties. The **Ramsar Convention** is an international treaty for the conservation and sustainable use of wetlands, it is also known as the **Convention on Wetlands**.

In spite of the conventions, treaties and other hard line decisions, study after study demonstrates that wetland area and quality continue to decline in most regions of the world; 64% of the world's wetlands have disappeared in the last century. As a result, the ecosystem services that wetlands provide to people are compromised. Hence, managing wetlands is a global challenge, and the Convention's 169 Contracting Parties recognize the value of having one international treaty dedicated to a single ecosystem. By setting international standards for wetland conservation and providing a forum for discussing global wetland issues, the Convention enables Contracting Parties to share information on wetlands and address issues together.

Many studies have been taken up on the Wet Lands / Estuaries in the World and in India. These studies are in progress on the Hydro Dynamic and Geo Morphological Characteristics on the water body. Regarding the Morphological Characteristics of the estuaries, it may be considered as the long-term changes in Sedimentological and Hydrodynamic features which tend to attain a steady state. Several factors including the Topography; Wave activity; Tides; Storms; Inflow Discharge; Hydrodynamics and Human Impacts seem to be the influencing factors on the Estuaries.

The study area of NW 8, NW 9 and NW 59 are within such identified zone of the wet land system viz., The Vembanad wetland system. It covers an area of over 2033.02 km^2 thereby making it the largest wetland system in India. Of this, an area of 398.12 km^2 is located below the MSL and a total of 763.23 km^2 area is located below 1 m MSL. The lake is bordered by Alappuzha, Kottayam and Ernakulam districts. It is separated from the Arabian Sea by a narrow barrier island.

The lake surrounds the islands of Pathiramanal, Perumbalam and Pallippuram. The Vembanad Lake is approximately 14 kilometres wide at its widest point. The lake is fed by 10 rivers flowing into it including the six major rivers of central Kerala namely Achenkovil, Manimala, Meenachil, Muvattupuzha, Pamba and Periyar.

A unique characteristic of the lake is the 1,252 metres (4,108 ft)-long Thanneermukkom salt-water barrier (Barrage) constructed as a part of the Kuttanad Development Scheme to prevent tidal action and intrusion of salt water into the Kuttanad low-lands. It is the largest mud regulator in India and essentially divides the lake into two parts, one with perennial brackish water and the other with fresh water from rivers draining into the lake. This barrier has helped farmers in Kuttanad by freeing the area of salinity and allowing them an additional crop in the dry season. The Thanneermukkom barrier is located at one of the narrower parts of the Vembanad Lake. Only two-thirds of the original number of gates is opened in July to release flood flow. These gates remain closed until mid-November. The main drawback of the structure has been the loss of opportunity for fish and prawns to migrate upstream, and also an increase in weed growth in the upstream, severely restricting the natural flushing of pollutants. In order to have the Navigation throughput, Locks have been provisioned in this Barrage.

The Vembanad Wetland system has formed an intricate network of estuaries, lagoons and canals which spans over 196 km in the north-south and 29 km in the east-west directions. Almost all villages in these areas can be accessed via water transport. The major rivers of Muvattupuzha, Meenachil, Pamba and Achencovil rivers, are all navigable up to distances of about 30 km upstream in the tidal reach. The Kottappuram-Kollam segment of the west coast canal system – NW 3, has a major chunk passing through the Vembanad Lake.

The most popular location on the shores of the lake is the Kumarakom Tourist Village situated on the east coast of the lake. The Kumarakom Bird Sanctuary is located on the northern fringes of Kumarakom village. The Lake is at the heart of Kerala Backwaters tourism with hundreds of kettuvallams plied on it and numerous resorts on its banks. The Kumarakom Bird Sanctuary is located on the east coast of the lake. The lake has become a major tourist attraction. The Nehru Trophy Boat Race is conducted in a portion of the lake.

Waterway Classification: According to the classification of the waterway from class I to class VII, the minimum and maximum width and depth requirements have been circulated and accordingly, maximum width and depth required have been specified as 100 m and 2.75 m for two-way navigation. The analysis in the present study is being relooked with the possibilities for a maximum possible width and depth. The NW 9 is having the connectivity to the existing NW 3, which is under operation and having connectivity to the Kochi Major Port. In view of the above, the class may have to be considered in line with the present movement of Class III standard to have the continuity of the mobility.

2.1.2 Existing Hydrological / Topographical Reference levels

The established benchmark value provided by IWAI office, Cochin at Alappuzha light house. Description of reference benchmark as given:

TABLE 2-1: Reference Bench Mark

Description	Height above		Benchmark No.
	MSL	CD	
In the middle of first stone step from Top of a flight leading to the entrance of light house at the port of Alappuzha.	11.109ft (3.387m)	13.019ft (3.969m)	6/5

TABLE 2-2: Accepted Station coordinates (WGS-84)

Station	Chainage (KM)	Latitude (N) Longitude (E)	Easting (m) Northing (m)	Height above MSL (m)	Height above CD (m)
CHRY-1	-5.190	076°20'37.9334"E 09°30'03.8083"N	647514.16E 1050534.10N	2.435	2.935
KOD-1	21.987 (NW-9A)	09°34'35.5231"N 076°30'55.9239"E	666324.75E 1058959.23N	2.164	2.564
KOD-2	14.725 (NW-9A)	09°32'00.6147"N 076°30'16.9567"E	665157.32E 1054195.02N	1.723	2.150
KOD-3	2.900 (NW-9B)	09°34'8.3051"N 076°29'16.5917"E	663299.55E 1058109.85N	1.197	1.612
ATH-2	17.82 (NW-9B)	09°38'40.7778"N 076°28'50.4115"E	662465.15E 1066477.08N	3.281	3.725

2.1.3 Chart Datum / Sounding Datum

The survey stretch of Alappuzha-Kottayam-Maniyaparambuu Canal is tidal water body, during the survey period the Thannermukkam bund lock is closed. Therefore no influence of tidal force throughout the survey period. However after discussed with IWAI, Cochin/Noida, CD was taken 0.5m below MSL at chainage 0.0km and 0.4m below MSL at end of the Chainage 22.45 km. The locations with coordinates of established gauge have been used to reduce the soundings along the surveyed stretch are tabulated below.

TABLE 2-3: Chart Datum / Sounding Datum and Reduction Table

Sl#	Location of CWC gauge / Dam / Barrage / Weir / Anicut / Bench Mark / tide gauges	Chainage (km)	Stretch for corrected soundings and topo levels (km)	Established Sounding Datum w.r.t. MSL (m) at col. A.	Sounding Datum of Tide Gauge w.r.t MSL (m)	Correction in WL data for Bathymetric survey (m)	Topo level data converted as depth for volume calculation w.r.t SD (m)
	A	B	C	D	E	F = (E- WL data in MSL)	G = (E- topo levels in MSL)
				+ve indicates above MSL			
				-ve indicates below MSL			
NW-9A	CHRY-1	-5.19	0.0-7.5	-0.500	-0.500	Details at Annexure-4 of Vol-III	A separate xyz file is created.
	KOD-2	14.723	7.5-18.5		-0.428		
	KOD-1	22.363	18.5-22.45	-0.400	-0.400		
NW-9B	KOD-1	-0.45	0.0-1.5	-0.400	-0.400		
	KOD-3	2.90	0.0-8.5		-0.408		
	ATH-2	17.82	8.5-17.82	-0.444	-0.444		
NW-9C	CHRY-1	-5.19	0.0-7.485	-0.500	-0.500		
	KOD-3	14.969	7.485-15.14	-0.400	-0.400		

2.2 Existing Waterway Structures

2.2.1 Bridges

There are 1 bridge in NW9A, 19 bridges in NW9B and 1 bridge in NW9C waterways. Details are given in table.

TABLE 2-4: Details of cross structures

Sl#	Structure Name and for road / rail	Chainage (km)	Type of Structure (RCC / Iron / Wooden)	Location	Position (Lat ,Long)	Position (UTM)	Length (m)	Width (m)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction), in use or not, condition
NW-9A					Left Bank Right Bank	Left Bank Right Bank						
1	Major Bridge	20.05	RCC	Near Mulankuzha	09°33'43.75"N 076°30'43.86"E 09°33'46.56"N 076°30'39.67"E	1057367.28N 665964.41E 1050539.79N 647601.38E	154.6	11	2	50	8	Complete
NW-9B												
1	Foot Over Bridge	0.466	RCC	Chavadiyil Junction	09°34'29.21"N 76°30'39.80"E	1058763.00N 665834.00E	16.0	2.0	2	20	2.0	Complete
					09°34'29.73"N 76°30'39.74"E	1058779.00N 665832.00E						
2	Foot Over Bridge	1.100	RCC	Near Pathinaril Chira Bus Stop	9°34'24.12"N 76°30'19.41"E	1058604.38N 665213.91E	20.0	2.0	2	20	2.0	Complete
					9°34'24.71"N 76°30'19.25"E	1058622.02N 665208.02E						
3	Foot Over Bridge	1.109	RCC	Near Pathinaril Chira Bus Stop	09°34'23.85"N 76°30'19.73"E	1058595.77N 665222.70E	20.0	1.50	2	20	8.0	Complete
					09°34'24.97"N 76°30'19.52"E	1058630.15N 665216.15E						
4	Road Bridge	1.109	RCC	Veloor bridge	9°34'23.79"N 76°30'19.44"E	1058594.00N 665214.00E	35.0	8.0	2	35	6.0	Complete
					09°34'24.90"N 76°30'19.22"E	1058628.00N 665207.00E						

Sl#	Structure Name and for road / rail	Chainage (km)	Type of Structure (RCC / Iron / Wooden)	Location	Position (Lat ,Long)	Position (UTM)	Length (m)	Width (m)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction), in use or not, condition
5	Foot Over Bridge	1.924	RCC	Pulinakkal boat jetty	9°34'17.32"N 76°29'53.60"E	1058391.69N 664426.82 E	25.0	2	2	20	2.4	Complete
					09°34'18.11"N 76°29'53.39"E	1058415.93N 664420.31 E						
6	Foot Over Bridge	2.349	RCC	Pathinachil kadavu	09°34'13.71"N 76°29'40.21"E	1058279.01N 664019.00 E	25.0	2.5	2	20	2.0	Complete
					09°34'14.49"N 76°29'40.38"E	1058303.07N 664024.00 E						
7	Foot Over Bridge	2.82	RCC	Near Kanjiram Junction	09°34'6.98"N 76°29'17.53"E	1058154.11N 663559.10 E	22.0	2.0	2	20	2.0	Complete
					09°34'9.17"N 76°29'17.02"E	1058175.10N 663556.04 E						
8	Foot Over Bridge	4.956	RCC	Panampady	9°34'53.28"N 76°29'14.50"E	1059491.26N 663229.80E	66.4	3.0	2	30	7	Complete
					9°34'52.19"N 76°29'16.16"E	1059457.99N 663280.56E						
9	Road Bridge	6.14	RCC	Kottayam Kumarakom Ellikkal junction	9°35'18.58"N 76°29'26.98"E	1060270.00N 663607.00E	45	8.5	2	45	5	Complete
					09°35'19.06"N 76°29'28.66"E	1060285.00N 663658.00E						
10	Iron Bridge Foot Over	7.273	RCC	Near Masjidul Vahid Masjid Ellikkal	09°35'27.01"N 76°29'54.31"E	1060532.75N 664439.14E	49	3.0	2	49	7	Complete
					09°35'25.50"N 76°29'54.82"E	1060486.43N 664454.90E						
11	Road Bridge	8.015	RCC	Near Alummood bus stop	09°35'44.2837" N 076°30'10.4346 "E	1061065.57N 664928.47E	42	6	2	40	6	Complete
					09°35'45.4885" N 076°30'08.3176 "E	1061102.30N 664863.76E						

Sl#	Structure Name and for road / rail	Chainage (km)	Type of Structure (RCC / Iron / Wooden)	Location	Position (Lat ,Long)	Position (UTM)	Length (m)	Width (m)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction), in use or not, condition
12	Road Bridge	10.338	RCC	Munniyel Bridge	09°36'21.0208" N 076°30'39.6046 "E	1062198.09N 665812.90E	42	6	2	40	6	Complete
					09°36'20.8176" N 076°30'38.2806 "E	1062191.67N 665772.56E						
13	Road Bridge	12.798	RCC	Kudayampadi Parippu Road	09°36'37.9209" N 076°29'38.6609 "E	1062709.15N 663952.52E	35	10	2	30	8	Complete
					09°36'37.6780" N 076°29'36.1803 "E	1062701.36N 663876.92E						
14	Iron Bridge Foot Over	13.529	RCC	Near Aymanam	09°36'57.6994" N 076°29'28.3148 "E	1063315.40N 663634.44E	32	2.5	2	30	5.5	Complete
					09°36'58.6674" N 076°29'27.8812 "E	1063345.08N 663621.09E						
15	Road Bridge	14.535	RCC	Aymanam Kallumathara Road	09°37'24.4219" N 076°29'32.9847 "E	1064136.97N 663773.24E	15	5	5	15	8	Complete
					09°37'24.6169" N 076°29'32.2406 "E	1064142.86N 663750.53E						
16	Road Bridge	14.95	RCC	Near Karppa bus stop	09°37'36.9071" N 076°29'36.2936 "E	1064520.97N 663872.45E	15	5	2	15	5	Complete
					09°37'37.0158" N 076°29'35.8569 "E	1064524.25N 663859.12E						
17	Road Bridge	15.633	RCC	Near Karipputhattu bus stop	09°37'58.2018" N 076°29'31.1666 "E	1065174.49N 663713.29E	36	5	2	20	7	Complete
					09°37'58.0380" N 076°29'29.9017 "E	1065169.29N 663674.75E						

Sl#	Structure Name and for road / rail	Chainage (km)	Type of Structure (RCC / Iron / Wooden)	Location	Position (Lat ,Long)	Position (UTM)	Length (m)	Width (m)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction), in use or not, condition
18	Iron Bridge Foot Over	17.050	RCC	Near ST Thoma church	09°38'19.6425" N 076°28'52.5305 "E	1065828.06N 662532.56E	20	3	2	15	7	Complete
					09°38'19.2695" N 076°28'52.1601 "E	1065816.55N 662521.32E						
19	FOB	17.806	RCC	Maniyaparambu Junction	09°38'39.6341" N 076°28'43.1043 "E	1066440.98N 662242.54E	18	2.5	2	15	5.5	Complete
					09°38'39.8101" N 076°28'42.4398 "E	1066446.30N 662222.26E						
NW-9C												
1	Road Bridge	11.345	RCC	Kanjiram Junction	09°34'6.98"N 76°29'17.53"E	1058069.26N 663328.34E	70	12.0	2	40	6.5	Complete
					09°34'9.17"N 76°29'17.02"E	1058136.48N 663312.50E						

2.2.2 Electric Lines / Communication Lines

There are 25 Nos. of Electric lines across 9 A; 52 Nos. of Electric lines across 9 B and 14 Electric lines across 9 C. The above Nos. are including HT & LT lines. Details are given in the Table.

TABLE 2-5: Details of High Tension Lines

Details of High Tension Lines of NW9A

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction)
1	LT 11KV (HT)	1.61	Near jetty	Left Bank: 09°31'36.27"N 76°23'11.96"E Right Bank: 09°31'38.38"N 76°23'11.78"E	Left Bank: 652200.13E 1053392.93N Right Bank: 652194.36E 1053457.78N	2	155.10	12	Complete
2	LT-2 11KV (HT)	1.91	Near Pump House	Left Bank: 09°31'34.05"N 76°23'22.51"E Right Bank: 09°31'39.13"N 76°23'21.81"E	Left Bank: 652522.00E 1053326.00N Right Bank: 652500.00E 1053482.00N	2	157.69	12	Complete
3	LT Line	2.14	Near Zero jetty	Left Bank: 09°31'34.08"N 76°23'30.05"E Right Bank: 09°31'39.19"N 76°23'29.71"E	Left Bank: 652752.02E 1053327.92N Right Bank: 652741.03E 1053484.86N	2	157.89	8	Complete
4	LT Line	3.79	Near Restaurant	Left Bank: 09°31'34.94"N 76°24'24.03"E Right Bank: 09°31'40.90"N 76°24'23.92"E	Left Bank: 654398.00E 1053361.00N Right Bank: 654394.00E 1053544.00N	2	183.15	10	Complete
5	LT Line	4.91	Near Pump Hose	Left Bank: 09°31'36.50"N 76°25'0.61"E	Left Bank: 650226.49m E 1050586.21 N	2		8	Complete

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction)
				Right Bank: 09°31'42.28"N 76°25'0.49"E	Right Bank: 655513.35E 1053413.47N		179.05		
6	LT Line	6.19	Near Pump Hose	Left Bank: 09° 31.630'N 76° 25.710'E Right Bank: 09° 31.722'N 76° 25.709'E	Left Bank: 656794.00 m E 1053459.00 m N Right Bank: 656791.00E 1053629.00N	2	169.90	10	Complete
7	LT Line	6.74	Near Pump Hose	Left Bank: 09° 31.642'N 76° 26.011'E Right Bank: 09° 31.736'N 76° 26.009'E	Left Bank: 657344.32E 1053483.06N Right Bank: 657339.95 E 1053656.31N	2	173.50	10	Complete
8	LT Line 11 KV	8.25	Near Pump Hose	Left Bank: 09°31'39.58"N 76°26'49.94"E Right Bank: 09°31'45.83"N 76°26'49.84"E	Left Bank: 658847.00E 1053522.00N Right Bank: 658843.00 E 1053714.00N	2	192.15	12	Complete
9	LT Line 11 KV	8.72	Near Jetty	Left Bank: 09°31'40.10"N 76°27'5.56"E Right Bank: 09°31'46.12"N 76°27'5.46"E	Left Bank: 659323.27 E 1053539.85N Right Bank: 659319.44E 1053724.78N	2	185.28	10	Complete
10	LT Line 11 KV	9.08	Near Pump House	Left Bank: 09°31'40.45"N 76°27'17.39"E	Left Bank: 659684.00 E 1053552.00N	2	183.04	9	Complete

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction)
				Right Bank: 09°31'46.40"N 76°27'17.32"E	Right Bank: 659681.00E 1053735.00N				
11	LT Line	9.72	Near Jetty	Left Bank: 9°31'41.33"N 76°27'38.84"E	Left Bank: 660338.00 E 1053581.91N	2	157.29	8	Complete
				Right Bank: 09°31'46.41"N 76°27'38.73"E	Right Bank: 660334.00 E 1053738.00N				
12	LT Line	10.35	Near Jetty	Left Bank: 09°31'41.61"N 76°27'58.94"E	Left Bank: 660951.00 E 1053593.00N	2	179.39	8	Complete
				Right Bank: 09°31'47.43"N 76°27'58.84"E	Right Bank: 660947.00E 1053772.00N				
13	LT Line	10.47	Pump House	Left Bank: 09°31'41.88"N 76°28'2.45"E	Left Bank: 661058.00 E 1053602.00N	2	167.55	9	Complete
				Right Bank: 09°31'47.32"N 76°28'2.54"E	Right Bank: 661060.00 E 1053769.00N				
14	LT Line	10.95	Near Jetty	Left Bank: 09°31'42.54"N 76°28'17.80"E	Right Bank: 661525.95 E 1053624.11 N		163.15	8	Complete
				Right Bank: 09°31'47.64"N 76°28'19.17"E	Right Bank: 661567.00 E 1053781.00N				
15	LT Line	11.72	Near Jetty	Left Bank: 09°31'43.33"N 76°28'43.96"E	Left Bank: 662323.61 E 1053651.78N	2	160.87	8	Complete

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction)
				Right Bank: 9°31'48.56"N 76°28'43.87"E	Right Bank: 662320.18E 1053812.44N				
16	11KV LT Line	14.58	Near Pallom Light house	Left Bank: 09°31'55.49"N 76°30'11.97"E Right Bank: 09°31'57.36"N 76°30'8.93"E	Left Bank: 665006.00 E 1054037.00N Right Bank: 664913.00 E 1054094.00N	2	109.70	12	Complete
17	LT Line	15.123	Near Pallom jetty	Left Bank: 09°32'11.49"N 76°30'20.25"E Right Bank: 09°32'12.21"N 76°30'15.60"E	Left Bank: 665256.40 E 1054529.56N Right Bank: 665114.40E 1054551.06N	2	109.70	10	Complete
18	LT Line	15.51	Near Pallom jetty	Left Bank: 09°32'24.17"N 76°30'20.26"E Right Bank: 09°32'24.08"N 76°30'16.82"E	Left Bank: 665255.00 E 1054919.00N Right Bank: 665150.00E 1054916.00N	2	105.26	9	Complete
19	LT Line132KV DC	15.65	Near Pallom jetty	Left Bank: 09°32'28.36"N 76°30'21.29"E Right Bank: 09°32'28.62"N 76°30'17.30"E	Left Bank: 665285.75 E 1055047.97N Right Bank: 665164.04 E 1055055.43N	2	122.17	12	Complete
20	11 KV Line	15.835	Near Pallom jetty	Left Bank: 09°32'34.51"N 76°30'22.21"E Right Bank: 09°32'34.46"N	Left Bank: 665313.00 E 1055237.00N Right Bank: 665187.00 E	2	126.62	11	Complete

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction)
				76°30'18.08"E	1055235.00 N				
21	LT	15.965	Near Kottayam Port	Left Bank: 09°32'38.48"N 76°30'21.81"E Right Bank: 09°32'38.94"N 76°30'18.54"E	Left Bank: 665300.26 E 1055358.94N Right Bank: 665200.48E 1055372.64N	2	100.97	8	Complete
22	LT 11KV	18.873	Near Mulamkuzha	Left Bank: 09°33'43.31"N 76°30'10.58"E Right Bank: 09°33'47.24"N 76°30'11.31"E	Left Bank: 664949.00 E 1057349.00N Right Bank: 664971.00E 1057470.00 N	2	100.97	8	Complete
23	LT 11KV	18.918	Near Mulamkuzha	Left Bank: 09°33'43.49"N 76°30'12.02"E Right Bank: 09°33'46.36"N 76°30'12.77"E	Left Bank: 664993.01 E 1057354.83N Right Bank: 665015.50 E 1057443.10N	2	91.19	8	Complete
24	LT	21.06	Kodimatha jetty	Left Bank: 09°34'6.58"N 76°31'2.03"E Right Bank: 09°34'6.24"N 76°30'59.87"E	Left Bank: 666515.00 E 1058071.00N Right Bank: 666449.00 E 1058060.00N	2	66.99	8	Complete
25	LT 11KV	21.295	Kodimatha jetty	Left Bank: 09°34'15.09"N 76°30'58.84"E Right Bank: 9°34'14.56"N 76°30'55.38"E	Left Bank: 666416.43 E 1058331.88N Right Bank: 666311.00E 1058315.14N	2	106.88	8	Complete

Details of High Tension Lines of NW9B

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction)
1	LT LINE	0.342	Near Kanjiram	Left Bank: 09°34'29.89"N 76°30'43.93"E	Left Bank: 665959.79 E 1058784.56N	2	53.71	8	Complete
				Right Bank: 09°34'31.25"N 76°30'43.54"E	Right Bank: 665947.72 E 1058826.29N				
2	LT LINE	0.534	Near Kanjiram	Left Bank: 09°34'28.01"N 76°30'37.89"E Right Bank: 09°34'29.64"N 76°30'37.41"E	Left Bank: 665776.00E 1058726.00N Right Bank: 665761.00 E 1058776.00N	2	52.11	8	Complete
3	LT LINE	0.803	Near Kanjiram	Left Bank: 09°34'24.63"N 76°30'23.40"E	Left Bank: 665515.00E 1058661.00N	2	52.78	6	Complete
				Right Bank: 09°34'25.99"N 76°30'23.03"E	Right Bank: 665501.00E 1058711.00N				
4	LT LINE	0.988	Near Thiruvarppu	Left Bank: 09°34'24.63"N 76°30'23.40"E	Left Bank: 665334.50 E 1058620.23N	2	43.13	8	Complete
				Right Bank: 09°34'25.99"N 76°30'23.03"E	Right Bank: 665323.04 E 1058661.96N				
5	LT LINE	1.036	Near Thiruvarppu	Left Bank: 09°34'24.17"N 76°30'21.93"E	Left Bank: 665046.00 E 1058551.00N	2	45.20	6	Complete

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction)
				Right Bank: 9°34'25.57"N 76°30'21.51"E	Right Bank: 665036.00 E 1058584.00N				
6	LT LINE	1.284	Near Thiruvarppu	Left Bank: 09°34'22.42"N 76°30'13.93"E	Left Bank: 665046.00 E 1058551.00N	2	34.66	6	Complete
				Right Bank: 09°34'23.49"N 76°30'13.61"E	Right Bank: 665036.00 E 1058584.00N				
7	LT LINE	1.832	Near Thiruvarppu	Left Bank: 09°34'18.03"N 76°29'56.53"E	Left Bank: 664516.00 E 1058414.00N	2	33.47	5	Complete
				Right Bank: 09°34'19.08"N 76°29'56.24"E	Right Bank: 664507.00E 1058446.00N				
8	LT LINE	2.88	Near Thiruvarppu	Left Bank: 09°34'8.71"N 76°29'23.19"E	Left Bank: 663500.69 E 1058123.16N	2	41.82	5	Complete
				Right Bank: 09°34'10.02"N 76°29'22.84"E	Right Bank: 663489.85 E 1058163.36N				
9	LT LINE	2.92		Left Bank: 09°34'8.44"N 76°29'23.10"E	Left Bank: 663498.00E 1058115.00 m N	2	77.30	5	Complete
				Right Bank: 09°34'9.53"N 76°29'20.81"E	Right Bank: 663428.00 E 1058148.00N				
10	LT LINE	3.573	Near Kanjiram	Left Bank: 9°34'28.14"N 076°29'19.23"E	Left Bank: 663377.37 E 1058719.55N	2	44.77	8	Complete

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction)
				Right Bank: 09°34'28.42"N 76°29'17.79"E	Right Bank: 663333.42 E 1058727.96N				
11	LT LINE	6.157	Ellikkal Bridge	Left Bank: 09°35'19.68"N 76°29'28.56"E Right Bank: 09°35'19.13"N 76°29'26.62"E	Left Bank: 663655.00E 1060304.00N Right Bank: 663596.00E 1060287.00N	2	61.87	8	Complete
12	LT LINE	6.697	Ellikkal Bridge	Left Bank: 09°35'30.24"N 76°29'38.78"E Right Bank: 09°35'32.59"N 76°29'37.83"E	Left Bank: 663965.20 E 1060629.92N Right Bank: 663935.92 E 1060701.99N	2	78.20	8	Complete
13	LT LINE	6.942	Ellikkal Bridge	Left Bank: 09°35'29.86"N 76°29'44.48"E Right Bank: 09°35'32.10"N 76°29'46.00"E	Left Bank: 664139.00 E 1060619.00N Right Bank: 664185.00 E 1060688.00N	2	82.91	8	Complete
14	LT LINE	8.363	Ellikkal Near MOSQUE	Left Bank: 09°35'54.24"N 76°30'15.35"E Right Bank: 09°35'55.74"N 76°30'13.62"E	Left Bank: 665077.00 E 1061372.10N Right Bank: 665024.35 E 1061418.56N	2	70.06	7	Complete
15	LT LINE	9.149	Nera Aloomud	Left Bank: 09°35'55.71"N 76°30'38.57"E	Left Bank: 665784.78E 1061420.37N	2	53.05	6	Complete

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction)
				Right Bank: 09°35'57.38"N 76°30'39.02"E	Right Bank: 665798.27E 1061471.73N				
16	LT LINE	9.312	Nera Aloomud bridge	Left Bank: 09°35'58.63"N 76°30'44.36"E Right Bank: 09°35'58.52"N 76°30'41.54"E	Left Bank: 665961.00 E 1061511.00N Right Bank: 665875.00 E 1061507.00N	2	85.73	6	Complete
17	LT LINE	9.469	Nera Aloomud bridge	Left Bank: 09°36'3.63"N 76°30'42.29"E Right Bank: 09°36'2.15"N 76°30'39.73"E	Left Bank: 665897.13 E 1061664.18N Right Bank: 665819.27E 1061618.37N	2	89.51	7	Complete
18	LT LINE	9.785	Nera Aloomud bridge	Left Bank: 09°36'8.55"N 76°30'33.35"E Right Bank: 09°36'7.22"N 76°30'31.08"E	Left Bank: 665624.00 E 1061814.00N Right Bank: 665555.00 E 1061773.00N	2	79.91	7	Complete
19	LT LINE	10.597	Nera Aloomud bridge	Left Bank: 09°36'27.28"N 76°30'33.58"E Right Bank: 09°36'25.59"N 76°30'32.97"E	Left Bank: 665628.37 E 1062389.57N Right Bank: 665610.00 E 1062337.57N	2	56.13	6	Complete
20	LT LINE	11.463	Near Thazhathangadi	Left Bank: 09°36'28.51"N 76°30'7.40"E	Left Bank: 664844.00 E 1062492.00N	2	70.70	6	Complete

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction)
				Right Bank: 09°36'30.73"N 76°30'7.87"E	Right Bank: 664830.00 E 1062424.00N				
21	LT LINE	11.487	Near Thazhathangadi	Left Bank: 09°36'28.97"N 76°30'7.10"E	Left Bank: 664820.79E 1062437.95N	2	49.88	6	Complete
				Right Bank: 09°36'30.51"N 76°30'6.72"E	Right Bank: 664809.00 E 1062485.21N				
22	LT LINE	11.644	Near Thazhathangadi	Left Bank: 09°36'25.96"N 76°30'2.73"E	Left Bank: 664687.96 E 1062344.90N	2	69.83	7	Complete
				Right Bank: 09°36'28.11"N 76°30'2.22"E	Right Bank: 664672.12 E 1062410.88N				
23	LT LINE	11.793	Near Thazhathangadi	Left Bank: 09°36'23.64"N 76°29'58.49"E	Left Bank: 664559.00E 1062273.00N	2	64.55	7	Complete
				Right Bank: 09°36'25.63"N 76°29'58.01"E	Right Bank: 664544.00 E 1062334.00N				
24	LT LINE	12.45	Near Thazhathangadi	Left Bank: 09°36'25.97"N 76°29'38.95"E	Left Bank: 663962.93E 1062342.04N	2	65.33	6	Complete
				Right Bank: 09°36'27.61"N 76°29'40.29"E	Right Bank: 664003.57E 1062392.60N				
25	LT LINE	12.592	Near Secrad heart church	Left Bank: 09°36'31.05"N 76°29'38.09"E	Left Bank: 663936.00 E 1062498.00N	2	66.70		Complete

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction)
				Right Bank: 09°36'31.76"N 76°29'40.13"E	Right Bank: 663998.00 E 1062520.00N				
26	Cable	12.666	Near Secrad heart church	Left Bank: 09°36'33.43"N 76°29'37.45"E Right Bank: 09°36'34.02"N 76°29'39.60"E	Left Bank: 663916.20 E 1062571.02N Right Bank: 663981.00 E 1062589.00N	2	69.40		Complete
27	LT LINE	12.777	Near Secrad heart church	Left Bank: 09°36'37.24"N 76°29'36.57"E Right Bank: 09°36'37.10"N 76°29'38.35"E	Left Bank: 663889.00 E 1062688.00N Right Bank: 663943.00 E 1062684.00N	2	54.41		Complete
28	LT LINE	13.170	Near Secrad heart church	Left Bank: 09°36'46.91"N 76°29'30.09"E Right Bank: 09°36'48.47"N 76°29'31.72"E	Left Bank: 663690.00 E 1062984.17N Right Bank: 663739.49 E 1063032.31N	2	69.58		Complete
29	LT LINE	13.969	Near Secrad heart church	Left Bank: 09°37'10.03"N 76°29'34.62"E Right Bank: 09°37'9.96"N 76°29'36.26"E	Left Bank: 663825.00 E 1063695.00N Right Bank: 663875.00 E 1063693.00N	2	49.55		Complete
30	LT LINE	14.123	Near Secrad heart church	Left Bank: 09°37'14.13"N 76°29'32.91"E	Left Bank: 663772.34 E 1063820.78N	2	72.64	7	Complete

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction)
				Right Bank: 09°37'15.05"N 76°29'35.11"E	Right Bank: 663839.29 E 1063849.33N				
31	LT LINE	14.468	Near Parippu bridge	Left Bank: 09°37'22.94"N 76°29'30.12"E	Left Bank: 663686.00 E 1064091.00N	2	82.37	7	Complete
				Right Bank: 09°37'22.41"N 76°29'32.74"E	Right Bank: 663766.00 E 1064075.00N				
32	LT LINE	14.489	Near Parippu bridge	Left Bank: 9°37'23.28"N 76°29'31.24"E	Left Bank: 663720.20 E 1064101.66N	2	45.46	6	Complete
				Right Bank: 09°37'22.99"N 76°29'32.69"E	Right Bank: 663764.45 E 1064092.94N				
33	LT LINE	14.718	Near Parippu bridge	Left Bank: 09°37'30.13"N 76°29'31.43"E	Left Bank: 663725.00 E 1064312.00N	2	78.07	5	Complete
				Right Bank: 09°37'30.67"N 76°29'33.92"E	Right Bank: 663801.00 E 1064329.00N				
34	cable	14.919	Near Parippu bridge	Left Bank: 09°37'36.20"N 76°29'35.13"E	Left Bank: 663837.68 E 1064499.71N	2	44.27	6	Complete
				Right Bank: 09°37'35.90"N 76°29'36.57"E	Right Bank: 663881.01 E 1064490.68N				
35	cable	15.130	Near Parippu bridge	Left Bank: 09°37'42.57"N 76°29'34.39"E	Left Bank: 663813.00 E 1064694.00N	2	54.86	8	Complete

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction)
				Right Bank: 9°37'42.94"N 76°29'36.08"E	Right Bank: 663865.00 E 1064706.00N				
36	LT LINE	15.515	Near Parippu bridge	Left Bank: 09°37'54.19"N 76°29'30.29"E Right Bank: 09°37'54.50"N 76°29'31.80"E	Left Bank: 663687.10 E 1065051.13N Right Bank: 663733.10 E 1065060.85N	2	47.18	7	Complete
37	cable	15.613	Near Parippu bridge	Left Bank: 09°37'57.35"N 76°29'29.87"E Right Bank: 09°37'57.60"N 76°29'31.02"E	Left Bank: 663674.00 E 1065148.00N Right Bank: 663709.00 E 1065156.00N	2	35.88	7	Complete
38	LT LINE	15.813	Near Parippu bridge	Left Bank: 09°38'3.36"N 76°29'28.28"E Right Bank: 09°38'4.28"N 76°29'29.06"E	Left Bank: 663624.60 E 1065332.57N Right Bank: 663648.26 E 1065360.94N	2	37.06	6	Complete
39	LT LINE	15.823	Near Parippu bridge	Left Bank: 09°38'3.67"N 76°29'28.13"E Right Bank: 09°38'4.67"N 76°29'28.99"E	Left Bank: 663620.00 E 1065342.00N Right Bank: 663646.00E 1065373.00N	2	40.92	6	Complete
40	LT LINE	15.899	Near Aymanam Villege	Left Bank: 09°38'4.80"N 76°29'26.20"E	Left Bank: 663560.99 E 1065376.54 N	2	37.19	6	Complete

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction)
				Right Bank: 09°38'5.92"N 76°29'26.60"E	Right Bank: 663573.04 E 1065411.00N				
41	LT LINE	16.059	Near Aymanam Villege	Left Bank: 09°38'6.24"N 76°29'21.16"E Right Bank: 09°38'7.70"N 76°29'21.59"E	Left Bank: 663407.00 E 1065420.00N Right Bank: 663420.00 E 1065465.00N	2	45.60	6	Complete
42	LT LINE	16.126	Near Aymanam Villege	Left Bank: 09°38'6.99"N 76°29'19.15"E Right Bank: 09°38'8.39"N 76°29'19.59"E	Left Bank: 663345.77 E 1065442.88N Right Bank: 663359.00 E 1065485.95N	2	44.65	6	Complete
43	LT LINE	16.441	Near Aymanam Villege	Left Bank: 09°38'8.70"N 76°29'8.90"E Right Bank: 09°38'10.42"N 76°29'9.43"E	Left Bank: 663033.00 E 1065494.00N Right Bank: 663049.00E 1065547.00N	2	56.13	7	Complete
44	LT LINE	16.675	Near Aymanam Villege	Left Bank: 09°38'12.22"N 76°29'1.98"E Right Bank: 9°38'13.28"N 76°29'2.88"E	Left Bank: 663033.00 E 1065494.00N Right Bank: 662821.63 E 1065601.28N	2	42.20	8	Complete
45	cable	16.75	Near Aymanam Villege	Left Bank: 09°38'13.75"N 76°29'0.06"E	Left Bank: 662763.00 E 1065648.00N	2	37.42	6	Complete

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction)
				Right Bank: 09°38'14.69"N 76°29'0.89"E	Right Bank: 662788.00E 1065677.00N				
46	LT LINE	16.828	Near Aymanam Villege	Left Bank: 9°38'14.79"N 76°28'57.78"E Right Bank: 09°38'15.90"N 76°28'58.67"E	Left Bank: 662693.24 E 1065679.68N Right Bank: 662720.23 E 1065713.90N	2	43.21	6	Complete
47	LT LINE	17.029	Near Maniyaparambu	Left Bank: 09°38'18.37"N 76°28'52.28"E Right Bank: 09°38'19.44"N 76°28'53.20"E	Left Bank: 662525.00 E 1065789.00N Right Bank: 662553.00 E 1065822.00N	2	43.27	7	Complete
49	LT LINE	17.041	Near Maniyaparambu	Left Bank: 09°38'18.79"N 76°28'52.12"E Right Bank: 09°38'19.73"N 76°28'52.93"E	Left Bank: 662520.16 E 1065801.81N Right Bank: 662544.73 E 1065830.80N	2	37.54	8	Complete
50	LT LINE	17.288	Near Maniyaparambu	Left Bank: 09°38'23.38"N 76°28'45.54"E Right Bank: 09°38'24.48"N 76°28'46.53"E	Left Bank: 662319.00 E 1065942.00N Right Bank: 662349.00 E 1065976.00N	2	45.17	6	Complete
51	LT LINE	17.44	Near Maniyaparambu	Left Bank: 09°38'27.95"N 76°28'42.40"E	Left Bank: 662222.62 E 1066081.94N	2	55.41	6	Complete

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction)
				Right Bank: 09°38'28.07"N 76°28'44.25"E	Right Bank: 662279.00 E 1066085.87N				
52	LT LINE	17.507	Near Maniyaparambu	Left Bank: 09°38'30.04"N 76°28'41.96"E Right Bank: 09°38'30.16"N 76°28'43.77"E	Left Bank: 662209.00E 1066146.00N Right Bank: 662264.00 E 1066150.00N	2	56.80	5	Complete

Details of High Tension Lines of NW9C

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long) Left Bank Right Bank	Position (UTM) Left Bank Right Bank	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction)
1	LT LINE	4.314	R Block Near jetty	Left Bank: 09°31'59.69"N 76°24'22.20"E Right Bank: 09°32'0.27"N 76°24'15.67"E	Left Bank: 654339.10 E 1054121.07N Right Bank: 654140.01 E 1054138.13N	2	199.72	8	Complete
2	LT LINE	4.586	R Block Near jetty	Left Bank: 09°32'8.48"N 76°24'21.34"E Right Bank: 09°32'8.04"N 76°24'15.76"E	Left Bank: 654311.81E 1054391.01N Right Bank: 654141.71 E 1054376.80N	2	170.20	9	Complete
3	LT LINE	8.245	Near Pump House	Left Bank: 09°32'50.02"N 76°25'17.59"E	Left Bank: 656022.00 E 1055674.00N	2	198.92	8	Complete

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long) Left Bank Right Bank	Position (UTM) Left Bank Right Bank	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction)
				Right Bank: 09°32'56.49"N 76°25'17.46"E	Right Bank: 656017.00 E 1055873.00N				
4	LT LINE 11KV Line	10.479	Near jetty	Left Bank: 09°33'23.60"N 76°26'57.99"E	Left Bank: 659079.08 E 1056718.47N	2	188.19	11	Complete
				Right Bank: 09°33'29.68"N 76°26'57.85"E	Right Bank: 659074.03 E 1056905.23N				
5	LT LINE 11KV Line	10.853	Near Pump House	Left Bank: 09°33'27.41"N 76°27'10.53"E	Left Bank: 659461.00E 1056837.00 N	2	161	11	Complete
				Right Bank: 09°33'32.42"N 76°27'9.11"E	Right Bank: 659417.00 E 1056991.00N				
6	LT LINE	11.866	Near Veloor village	Left Bank: 09°33'34.56"N 76°27'43.03"E	Left Bank: 660451.06 E 1057060.96N	2	191	8	Complete
				Right Bank: 09°33'40.55"N 76°27'41.41"E	Right Bank: 660400.88 E 1057244.77N				
7	LT LINE	12.528	Near Vetlikkad	Left Bank: 09°33'46.15"N 76°27'59.21"E	Left Bank: 660943.00 E 1057419.00N	2	63.94	8	Complete
				Right Bank: 09°33'48.23"N 76°27'59.32"E	Right Bank: 660946.00 E 1057483.00N				
8	LT LINE	12.731	Near Veloor village	Left Bank: 09°33'47.96"N 76°28'5.99"E	Left Bank: 661149.42E 1057475.60N	2	60.57	6	Complete
				Right Bank: 09°33'49.91"N	Right Bank: 661139.71 E				

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long) Left Bank Right Bank	Position (UTM) Left Bank Right Bank	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction)
				76°28'5.68"E	1057535.46N				
9	LT LINE	12.801	Near Veloor village	Left Bank: 09°33'48.94"N 76°28'8.05"E Right Bank: 09°33'50.21"N 76°28'7.82"E	Left Bank: 661212.00 E 1057506.00N Right Bank: 661205.00E 1057545.00N	2	39.95	7	Complete
10	HT LINE	12.826	Near Veloor village	Left Bank: 09°33'49.18"N 76°28'8.85"E Right Bank: 09°33'50.35"N 76°28'8.68"E	Left Bank: 661236.47 E 1057513.45N Right Bank: 661231.13 E 1057549.37N	2	36.58	10	Complete
11	LT LINE 6M	13.273	Near Pump House	Left Bank: 09°33'52.69"N 76°28'23.18"E Right Bank: 09°33'54.31"N 76°28'22.73"E	Left Bank: 661673.00 E 1057623.00N Right Bank: 661659.00 E 1057673.00N	2	51.12	6	Complete
12	LT LINE 6M	13.604	Veloor	Left Bank: 09°33'55.82"N 76°28'33.55"E Right Bank: 09°33'57.10"N 76°28'33.20"E	Left Bank: 661988.76 E 1057720.65N Right Bank: 661977.92 E 1057759.93N	2	41.35	6	Complete
13	LT LINE 5M	13.974	Veloor	Left Bank: 09°33'58.87"N 76°28'45.28"E Right Bank: 09°34'0.37"N 76°28'44.86"E	Left Bank: 662346.00 E 1057816.00N Right Bank: 662333.00 E 1057862.00N	2	48.00	5	Complete

Sl No	Type of line	Chainage (km)	Location	Position (Lat Long) Left Bank Right Bank	Position (UTM) Left Bank Right Bank	No of Piers	Horizontal clearance (clear distance Between piers) (m)	VC w.r.t. MHWS (m)	Remarks (complete / under - construction)
14	LT LINE	14.736	Jetty & Temple	Left Bank: 09°34'5.29"N 76°29'9.48"E	Left Bank: 663083.10 E 1058016.29N	2	35.80	5	Complete
				Right Bank: 09°34'6.41"N 76°29'9.14"E	Right Bank: 663072.58 E 1058050.65N				

2.2.3 Pipe Lines / Cables

There are no Pipe-line and no underwater cable present in the entire survey stretch of waterways.

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

There are no Dams, barrages, weirs, anicut, Locks etc. in this entire survey stretch.

2.3 Bends

The Bend Radius observed in the stretch of NW 9 is tabulated here under.

9 (A)

FJXGD

FJ Ch 0.00 km to Ch 3.65 km; JD Ch 3.65 km to Ch 22.38 km

(G is @ Ch 21.80 km)

(Terminal of Travancore Cements Ltd., is @ Ch 19.70 km)

CHAINAGE (IN KM)	BEND RADIUS (IN METER)
1.1	145
12.35	250
12.80	400
14.20	120
16.50	315
17.35	125
17.60	125
18.20	200
18.80	150
19.20	135
20.90	60
21.80	150

9 (B)

IH

IH Ch 2.89 km to 17.82 km

(G is @ Ch 0.0 km)

CHAINAGE (IN KM)	BEND RADIUS (IN METER)
2.90	20
3.50	50
4.00	20
4.25	60
4.50	40

CHAINAGE (IN KM)	BEND RADIUS (IN METER)
4.60	45
4.75	150
5.00	115
5.25	140
5.60	52
6.00	35
6.20	105
6.80	90
7.20	75
8.45	120
9.20	90
9.80	195
10.25	45
11.00	150
11.80	30
11.90	25
12.40	50
13.45	110
14.00	150
14.35	55
15.80	240

9 (C)
JI
JI Ch 3.65 km to 15.15 km
(F is @ Ch 0.0 km)

CHAINAGE (IN KM)	BEND RADIUS (IN METER)
3.70	160
5.30	50
12.35	130
12.55	50

2.4 Velocity and Discharge Details

The details of velocity and discharge in the NW-9 waterways are given below in Table, as observed.

TABLE 2-6: Current meter deployment locations and discharge details

Stretch No.	Chainage (km)	Latitude Longitude	Northing N (m) Easting E (m)	Obs. Depth (m) (D)	Velocity (M/sec.) 0.5 D	Avg. Vel. (m/sec.)	X-Sectional area (sq. m.)	Discharge (Cu.m/sec)
1	22.40 (NW9A)	09°34'39.3758"N	666701.03 E	3.6	1.8	0.25	163.905	40.976

Stretch No.	Chainage (km)	Latitude Longitude	Northing N (m) Easting E (m)	Obs. Depth (m) (D)	Velocity (M/sec.) 0.5 D	Avg. Vel. (m/sec.)	X-Sectional area (sq. m.)	Discharge (Cu.m/sec)
		076°31'08.2813"E	1059079.25 N					
2	14.715 (NW9B)	09°32'02.4247"N 076°30'16.9181"E	665155.90 E 1054250.62 N	4.1	2.05	0.31	343.505	106.486
3	11.510 (NW9C)	09°34'09.3143"N 076°29'22.7094"E	663485.96 E 1058141.66 N	2.1	1.05	0.27	38.540	10.406

2.5 Waterway description

The Waterway of Alappuzha–Kottayam–Maniyaparambu Canal coming within survey limits is divided in to four stretches (in 3 alternative routes of 9 A; 9 B and 9 C) in accordance with the topographic feature and nature of river stream. The details are as follows

2.5.1 Alappuzha–Kottayam-Maniyaparambu Canal Stretch NW9A (Ch 0.0km – Ch 10.0km)

Figure 2-1 Ch 0.00km to Ch 10.00km

TABLE 2-7: Reduced depth from Ch 0.00km to Ch 10.00km

Class III (NW-9A)												
								Reduced w. r. t. Sounding Datum				
Location	Chainage (km)		Observed depth (m)		Length of Shoal (m)	Dredging quantity (cu.m.)		Reduced depth (m)		Length of Shoal (m)	Dredging quantity (cu.m.)	
	From	To	Max.	Min.		Per km drg	Accum. drg.	Max.	Min.		Per km drg	Accum. drg.
Near punchiri jetty	0	1	6.8	1.8	250.0	1257.4	1257.4	5.6	0.6	650	26932.83	26932.83
	1	2	6.2	2.4	0.0	0.0	1257.4	5.0	1.2	50	4530.40	31463.23
	2	3	4.2	2.3	0.0	0.0	1257.4	2.9	1.0	750	13497.07	44960.30
Near R block	3	4	3.8	2.2	0.0	0.0	1257.4	2.5	1.0	850	17583.22	62543.52
Near R block jetty	4	5	3.7	2.7	0.0	0.0	1257.4	2.3	1.5	100	5580.64	68124.16
	5	6	6.4	2.3	0.0	0.0	1257.4	5.2	1.1	750	15630.99	83755.15
	6	7	4.3	2	100.0	222.5	1479.9	3.1	0.8	850	28898.73	112653.88
	7	8	2.9	2	300.0	262.4	1742.3	2.1	0.8	1000	35470.31	148124.19
	8	9	2.9	2	50.0	5.3	1747.5	2.2	1.3	1000	19361.71	167485.90
	9	10	2.9	2.2	0.0	0.0	1747.5	2.2	1.2	1000	19565.41	187051.31
					700.0	1747.5				7000	187051.31	

The maximum and minimum LAD for the above mentioned stretch is given in the above table (as per class III). The starting point of survey was about 5.1km after Alappuzha IWAI terminal. In this waterway stretch, the banks of canal are mostly agriculture field. There are 8 jetties in this stretch, out of which 4 jetties are on the left side and 4 jetties are on the right side. In this stretch 11 Low Tension line cross over the canal. In this stretch the width of canal is more than 50m.

Alappuzha-Kottayam-Maniyamparambu Canal is well connected with National Highway 66; it connects Alappuzha with Cochin in the north and Thiruvananthapuram in the south. National Highway 183 connects Kottayam with Tamil Nadu in the East and Changanassery in the South. The three stretches of NW-9 are well surrounded by numbers of state highway, namely SH 42, SH 40, SH 32, SH 15 and SH 11. Both the towns of Alappuzha and Kottayam are well connected by a network of State and National Highways.

Kainakary is connected to the State Highway 11 at Nedumudy in Alappuzha district by secondary roads. State Highway or National Highway network doesn't pass through Maniyamparambu (termination point of NW-9B), but the town is accessible from State Highway 1 via secondary road network.

Railway transport in Alappuzha-Kottayam-Maniyamparamb Canal catchment is developed under the Southern Railways. The Thiruvananthapuram division of Southern Railways connects the catchment of National Waterway-9 with Indian Railways network. This division connects to Palakkad division at Thrissur further connecting the region to Mangalore and further towards North. Direct rail connectivity is available at Alappuzha and Kottayam. The nearest railhead to Maniyamparamb is at Ettumanoor and the nearest railhead for Kainakary is at Alappuzha.

A total of 34 minor inland fish landing centers are available in the districts of Alappuzha & Kottayam. Out of these, no landing centers are located in vicinity to proposed National Waterway 9. However, a Govt. fish farm is located in vicinity to N.W. 9a at Pallom. Keeping this in view, the potential of fishing activities and its shipment via N.W. 9 is negligible.

There are few tourist spots in the catchment of NW-9A and some water transport services (operated by SWTD, Govt. of Kerala) are already available to these tourist locations.

Presently passenger ferry services are operational in both Alappuzha & Kottayam districts. Passenger services are operated by State Water Transport Department, Government of Kerala. The water transport department has a total of 14 stations under its control, out of which 8 fall under Alappuzha district & 2 falls under Kottayam District.

Wildlife, defense, atomic power plants, industries, Ghats, sand mining, nala, polluted water discharge in to the canal and treatment plant found in the whole survey stretch. The whole stretch is protected.

2.5.2 Alappuzha – Kottayam – Maniyaparambu Canal Stretch NW9A (Ch 10.0km – Ch 22.4km)

Figure 2-2 Ch 10.0km to Ch 22.45km

TABLE 2-8: Reduced depth from Ch 10.0km to Ch 22.45km

Class III (NW-9A)												
								Reduced w. r. t. Sounding Datum				
Location	Chainage (km)		Observed depth (m)		Length of Shoal (m)	Dredging quantity (cu.m.)		Reduced depth (m)		Length of Shoal (m)	Dredging quantity (cu.m.)	
	From	To	Max.	Min.		Per km drg	Accum. drg.	Max.	Min.		Per km drg	Accum. drg.
Near Chingavanam	10	11	2.5	1.8	350.0	302.6	302.6	1.8	1.1	1000	24713.42	24713.42
	11	12	3.5	0	400.0	4204.9	4507.5	2.8	-0.2	1000	23336.69	48050.11
Pallom Light house	12	13	7.2	0	750.0	12889.4	17396.9	6.5	-0.2	750	28172.23	76222.34
	13	14	6.1	0	950.0	12279.4	29676.3	5.3	-0.2	950	24559.88	100782.22

Class III (NW-9A)												
								Reduced w. r. t. Sounding Datum				
Location	Chainage (km)		Observed depth (m)		Length of Shoal (m)	Dredging quantity (cu.m.)		Reduced depth (m)		Length of Shoal (m)	Dredging quantity (cu.m.)	
	From	To	Max.	Min.		Per km drg	Accum. drg.	Max.	Min.		Per km drg	Accum. drg.
Pallom Jetty	14	15	8.7	0.3	250.0	1111.1	30787.4	7.9	-0.8	700	4602.93	105385.15
Kottayam Port	15	16	6.3	1.1	100.0	108.1	30895.5	5.5	-0.4	650	3061.38	108446.53
	16	17	9.1	1	50.0	17.1	30912.6	8.3	-0.6	700	1012.03	109458.56
Near Nattakam Village	17	18	6.6	2.2	0.0	0.0	30912.6	5.8	0.1	450	398.09	109856.65
	18	19	8.4	1.4	50.0	25.9	30938.5	7.6	-0.1	250	430.83	110287.48
Good shepherd college	19	20	5.5	1.1	400.0	1546.7	32485.1	5.1	0.3	700	3666.71	113954.19
	20	21	6.1	0.6	450.0	6317.8	38802.9	5.6	-0.5	850	17238.14	131192.33
Near lions club	21	22	5.4	0.6	300.0	1649.9	40452.8	4.9	-0.9	900	6218.78	137411.11
Kodimatha jetty	22	22.45	4.2	0.1	400.0	561.4	41014.2	3.6	-2.6	450	5111.76	142522.87
Total					4450.0	41014.2				9350	142522.9	

The maximum and minimum LAD for the above-mentioned stretch is given in the above table (as per class III). In this section, residential area lies in the right bank side while agricultural area lies in the left bank side. There are 4 jetties in this stretch. 2 jetties are located in the left bank while other is located in the right bank. In this stretch 13 LT lines and 1 HT line having 132 kv D/C at Ch 15.65 km cross the canal. From Ch 12.00km to Ch 14.00 km the proposed waterway route is passing through dense water hyacinth area. Due to water hyacinth, the sounding boat could not move along the proposed waterways in this reach. Therefore, sounding boat deviates the waterway path near Ch 12.00km and follows the route where local boats are moving. At Ch 20.05km, there is a Mulankuzha bridge with 8m vertical and 50 m horizontal clearances. In this sub stretch the width of canal is varying from 25.00m to 30.00m.

2.5.3 Alappuzha – Kottayam – Maniyaparambu Canal Stretch NW9B (Ch 0.0km – Ch 17.823km)

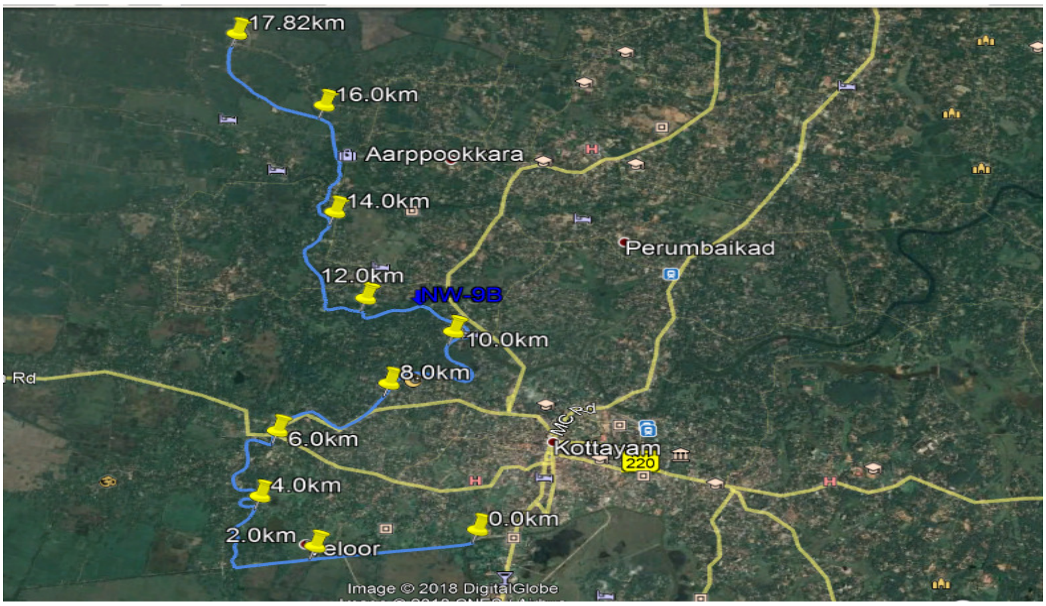


Figure 2-3 Ch 0.0km to Ch 17.823km (NW9B)

TABLE 2-9: Reduced depth from Ch 0.0km to Ch 17.823km (NW9B)

Class III (NW-9B)													
								Reduced w. r. t. Sounding Datum					
Location	Chainage (km)		Observed depth (m)		Length of Shoal (m)	Dredging quantity (cu.m.)		Reduced depth (m)		Length of Shoal (m)	Dredging quantity (cu.m.)	
	From	To	Max.	Min.		Per km drg	Accum. drg.	Max.	Min.		Per km drg.	Accum. drg.
Lions club kottayam	0.0	1.0	3.6	0.0	1000.0	30802.91	30802.91	2.9	-2.1	1000.0	78576.06	78576.06
	1.0	2.0	2.0	0.0	1000.0	43927.06	74729.97	1.1	-2.2	1000.0	133144.69	211720.75
	2.0	3.0	3.8	0.0	1000.0	41253.67	115983.64	1.8	-2.1	1000.0	123390.39	335111.14
Kanjiram jetty	3.0	4.0	7.0	0.0	500.0	1133.64	117117.28	4.9	-1.9	1000.0	38815.72	373926.86
	4.0	5.0	5.4	0.0	1000.0	4519.48	121636.76	3.4	-2.0	1000.0	47098.46	421025.32
	5.0	6.0	5.9	0.0	1000.0	1960.07	123596.83	3.8	-2.3	1000.0	47226.82	468252.14
Near Ellikkal	6.0	7.0	5.6	0.0	550.0	1080.45	124677.28	3.6	-2.6	1000.0	35247.29	503499.43
Ellikkal Bridge	7.0	8.0	4.5	0.0	850.0	3035.95	127713.23	2.4	-2.3	1000.0	44497.41	547996.84
Ellikkal Mosque	8.0	9.0	4.7	0.0	600.0	1742.29	129455.52	4.1	-2.5	1000.0	24790.86	572787.70
	9.0	10.0	5.9	0.0	250.0	729.43	130184.95	5.2	-2.6	1000.0	5763.87	578551.57
Aloommud bridge	10.0	11.0	5.0	0.0	600.0	12122.33	142307.28	4.4	-2.6	1000.0	42873.88	621425.45
	11.0	12.0	5.4	0.0	850.0	8561.40	150868.68	4.8	-2.6	1000.0	34156.25	655581.70
Thazhathangadi	12.0	13.0	7.9	0.0	1000.0	24393.42	175262.10	7.3	-2.7	1000.0	74579.47	730161.17
	13.0	14.0	4.9	0.0	1000.0	27041.82	202303.92	4.3	-2.9	1000.0	68006.79	798167.96
sacred heart church	14.0	15.0	2.9	0.0	1000.0	32254.74	234558.66	2.2	-2.7	1000.0	84064.29	882232.25
	15.0	16.0	2.4	0.0	1000.0	26903.66	261462.32	1.8	-2.5	1000.0	69934.04	952166.29
Parippu bridge	16.0	17.0	3.0	0.0	1000.0	23222.83	284685.15	2.4	-2.7	1000.0	73348.85	1025515.14
Maniyaparambu	17.0	17.8	3.6	0.0	800.0	14018.16	298703.31	2.7	-2.8	800.0	55616.48	1081131.62
Total					15000.0	298703.31				17800.0	1081131.62	

The maximum and minimum LAD for the above mentioned stretch is given in the above table (as per class III). On both side of the canal, there are area with residences, agriculture and plantations. In this section 52 electric lines including Low Tension lines are crossing. In this stretch the width of canal is varying from 20.00m to 30.00m. Marginal land acquisition may require. In this chainage, there are coconut trees and houses on the both sides of bank. There are 19 bridges including foot over bridges in this stretch which crosses the canal.

There were no prominent dams/barrages, tidal, stretch tidal range, pondage stretch, weirs, anicut, locks, encroachment, wildlife, defence, atomic power plants, industries, Ghats, sand mining, nala, polluted water discharge in to the canal, Water spot recreation facilities and treatment plant found in the whole survey stretch. The whole stretch is protected.

2.5.4 Alappuzha–Kottayam-Maniyaparambu Canal Stretch NW9C (Ch 0.0km to 15.14km)

Figure 2-4 Ch 0.0km to Ch 15.14km (NW9C)

TABLE 2-10: Reduced depth from Ch 0.0km to Ch 15.1km (NW9C)

Class III (NW-9C)												
								Reduced w. r. t. Sounding Datum				
Location	**Chainage (km)**		**Observed depth (m)**		**Length of Shoal (m)**	**Dredging quantity (cu.m.)**		**Reduced depth (m)**		**Length of Shoal (m)**	**Dredging quantity (cu.m.)**	
	From	**To**	**Max.**	**Min.**		**Per km drg**	**Accum. drg.**	**Max.**	**Min.**		**Per km drg.**	**Accum. drg.**
Vembanadu kayal	0.0	1.0	6.8	1.8	450.0	835.42	835.42	5.6	0.6	950.0	26085.56	26085.56
	1.0	2.0	6.2	2.4	0.0	0.00	835.42	5.0	1.2	350.0	4925.63	31011.19
	2.0	3.0	4.2	2.3	0.0	0.00	835.42	2.9	1.0	1000.0	16209.48	47220.67
R Block	3.0	4.0	3.7	1.5	200.0	3210.84	4046.26	2.4	0.3	950.0	36887.73	84108.40
	4.0	5.0	2.9	1.5	500.0	5664.91	9711.17	1.7	0.3	1000.0	55665.03	139773.43
R Block Near jetty	5.0	6.0	3.2	2.2	0.0	0.00	9711.17	1.9	1.0	1000.0	39530.62	179304.05
	6.0	7.0	2.8	2.2	0.0	0.00	9711.17	1.5	1.0	1000.0	41734.32	221038.37
	7.0	8.0	2.6	1.8	500.0	2413.52	12124.69	1.2	-0.2	1000.0	74336.81	295375.18
	8.0	9.0	3.9	2.0	100.0	271.09	12395.78	1.9	-0.1	1000.0	72916.85	368292.03
Near Vettilkkad	9.0	10.0	4.3	1.2	500.0	9646.07	22041.85	2.2	-0.9	1000.0	95017.52	463309.55
	10.0	11.0	2.4	1.0	1000.0	29327.44	51369.29	0.4	-1.0	1000.0	137989.48	601299.03
	11.0	12.0	1.9	1.0	1000.0	39024.15	90393.44	0.0	-1.0	1000.0	149487.17	750786.20
Near thiruvarppu	12.0	13.0	2.6	0.0	1000.0	32975.28	123368.72	0.5	-1.8	1000.0	122933.57	873719.77
	13.0	14.0	2.6	0.0	1000.0	27986.14	151354.86	0.6	-1.9	1000.0	115735.23	989455.00
	14.0	15.0	2.5	0.0	1000.0	35022.75	186377.61	0.5	-1.8	1000.0	119707.92	1109162.92
Kanjiram jetty	15.0	15.1	1.8	0.0	140.0	3735.34	190112.95	0.0	-1.5	140.0	11334.69	1120497.61
Total					7390.0	190112.95				14390.0	1120497.61	

The maximum and minimum LAD for the above-mentioned stretch is given in the above table (as per class III). The Survey Works Starts from Kanjiram junction and ends at Maniapparambu. On both side of the canal, there are area with residences, agriculture and plantations. There are three jetties located at Ch 0.20km, Ch 1.97km and Ch 3.43km. In this section 14 Electric lines including LT are crossing. There is one RCC road bridge at Ch 11.345km. In this stretch the width of canal is varying from 20.00m to 30.00m.

There were no prominent dams/barrages, tidal, stretch tidal range, pondage stretch, weirs, anicut, locks, encroachment, wildlife, defence, atomic power plants, industries, Ghats, sand mining, nala, polluted water discharge in to the canal, Water spot recreation facilities and treatment plant found in the whole survey stretch. The whole stretch is protected.

2.5 Water and Soil Samples analysis and Results

Bed soil and water sampling was undertaken at average 10 Km. evenly distributed throughout the Canal Stretch. The Vanveen grab and Naskin water bottles were kept standby for the collections of samples. The canal water is slightly basic in nature with average pH being 7.14. The Test Results of soil and water sample locations are as given in table.

Table 2-11 Water Test Result

Sample No.	Chainage (km)	Easting (m)	Northing (m)	Sediment concentration (ppm)	ph
1	22.40 (NW9A)	666695.46	1059078.67	21	7.23
2	14.715 (NW9B)	665155.90	1054250.62	13	7.09
3	11.510 (NW9C)	663485.08	1058146.93	9	7.11

Table 2-12 Soil Test Result

#	Chainage (km)	Easting (m)	Northing (m)	Specific gravity	Fine Gravel (20mm to 4.75mm)	Coarse Sand (4.75 mm to 2.00mm)	Medium Sand (2.00mm to 0.425mm)	Fine Sand (0.425mm to 0.075mm)	Silt (0.075 mm to 0.002mm)	Clay (<0.002mm)	Cu	Cc
1	22.40 (NW9A)	666695.46	1059078.67	2.59	0	6	23	26	37	8	68.571	0.8679
2	14.715 (NW9B)	665155.90	1054250.62	2.61	31	5	18	19	21	6	122.440	1.9133
3	11.510 (NW9C)	663485.08	1058146.93	2.68	27	4	15	16	19	6	116.150	2.3994

CHAPTER 3 : FAIRWAY DEVELOPMENT

3.1 Proposed Class / Type of Waterway

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

The detailed Hydrographic survey and charts have been referred. As per the data available, the study stretch of the waterway is amenable for development up to class III of the waterway from the Fairway point of view, so as to have the inter connectivity with the existing / developed NW 3.

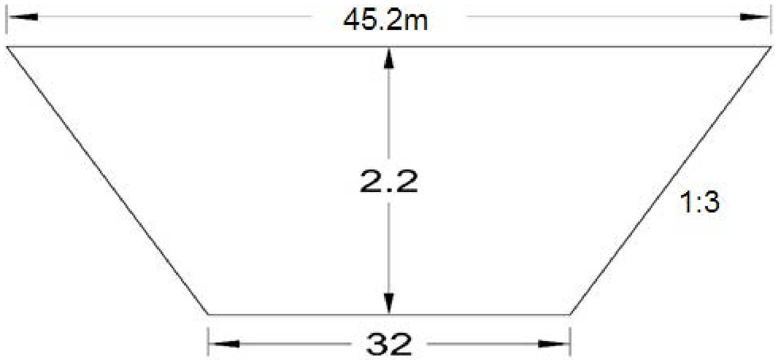
The NW 9 is having connectivity to Cochin Port; ICTT, Kochi through NW 3 towards north and to Kollam towards south and hence it is most preferred to develop the fairway with Class III waterway, so as to have the compatibility of mobility in this region. The NW 9 is connected to 2 Nos. of captive Terminals viz., Kottyam Port and Container Terminal (KPACT) and Travancore Cements Ltd., (TCL), where presently the operations are on with the developed infrastructure by these two Captive Terminals. The estimated traffic volumes as projected are expected with a positive growth.

NW 9 is the waterway as a canal system not of the river system, which is having a distinct standard made available as per the Classification of Waterways. NW 9 system is having 3 alternative routes, 9 (A); 9 (B) and 9 (C), as depicted in the Index Plan. The NW 9 is to be meticulously studied with these alternatives.

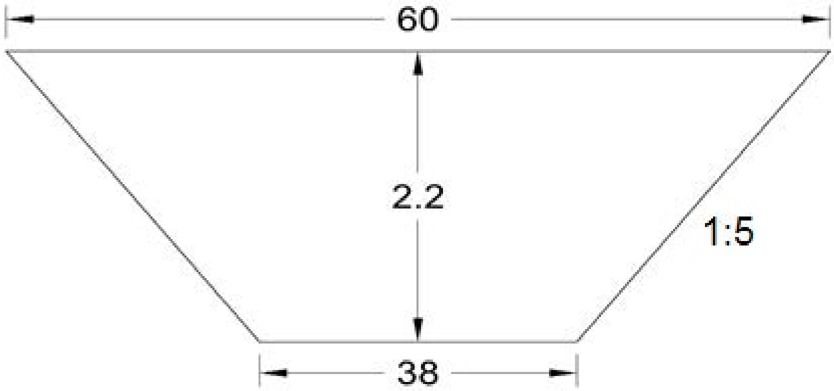
The present Study stretch of NW 9 can be considered for development as a ***Class III*** waterway and already having considerable mobility and hence, provision of infrastructure and the development can be taken up on immediate basis and can be considered as 36 months.

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

Dredging quantities have been worked out for the suggested Class III Waterway standards for the canal system with 32 m in the Narrow Reaches and 38 m in the Wider Reaches. The canal Cross section for both the reaches are depicted herewith.



Narrow Reaches with 50 m Land Acquisition.



Wider Reaches with No Land Acquisition.

9 (A) CLASS-III

Observed						Reduced w. r. t. Sounding Datum			
Chainage (km)		Observed depth (m)		Length of Shoal (m)	Dredging quantity (cu.m.)	Reduced depth (m)		Length of Shoal (m)	Dredging quantity (cu.m.)
From	To	Max	Min		Per km drg	Max	Min		Per km drg
0.0	10.00	PARTIALLY TIDAL ZONE				5.6	0.6	7000	187051.31
10.00	22.45					8.3	-2.6	9350	142522.87
Total								**16350**	**329574.18**

9 (B) CLASS-III

Observed						Reduced w. r. t. Sounding Datum			
Chainage (km)		Observed depth (m)		Length of Shoal (m)	Dredging quantity (cu.m.)	Reduced depth (m)		Length of Shoal (m)	Dredging quantity (cu.m.)
From	To	Max	Min		Per km drg	Max	Min		Per km drg
0.0	17.8	PARTIALLY TIDAL ZONE				7.3	-2.9	17800	1081131.62
Total								**17800**	**10,81,131.62**

9 (C) CLASS-III

Observed						Reduced w. r. t. Sounding Datum			
Chainage (km)		Observed depth (m)		Length of Shoal (m)	Dredging quantity (cu.m.)	Reduced depth (m)		Length of Shoal (m)	Dredging quantity (cu.m.)
From	To	Max.	Min.		Per km drg	Max	Min		Per km drg
0.0	15.1	PARTIALLY TIDAL ZONE				5.6	-1.8	14390	1120497.61
Total								**14,390**	**11,20,497.61**

3.3 Proposed Conservancy Activities

The present study stretch of NW 9 is the Canal system in the Vembanad Lake area and as such no need of taking up of any conservancy activity. However, to maintain the safe fairway, Widening / Dredging and side protection are required.

3.3.1 Dredging

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

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

Dredging used to be carried out in the Sheltered Waterways by various types of Dredgers viz., Bucket and grab dredgers; Suction and cutter-suction dredgers; Trailing hopper dredgers etc., However, the most acceptable form of the dredger is "Cutter Suction Dredger" (CSD) being deployed on National Waterways by IWAI. The type of soil, if hard, may have to be tackled with the appropriate dredger. The advantage of "Cutter Suction" type of Dredger is that the spoil can be taken out from the fairway area to an appropriate specified location.

In the study stretch of NW 9, it is a canal system identified with Class III standards of National Waterway for which the Dredging has been identified along with Land Acquisition with widening, in order to meet the vessel mobility of Class III NW standards. The identified Dredging quantity is of 3.29Lakhs Cu.m along 9 A; 10.81 Lakhs Cu.m along 9 B and 11.20 Lakhs Cu. M along 9 C. Accordingly, the most economical route for development is 9 A. By allowing 10 % excess volume for depth variation / fairway dimensional allowances, the same is working out to 3.61 Lakhs in NW 9 A; 11.89 Lakhs Cu. M in NW 9 B and 12.32 Lakhs Cu. M in NW 9 C, which have been taken into account. The mode of measurement shall be in cum and as per the actual dredged quantity.At this juncture, it is very much pertinent to mention that the Travancore Cements Limited used to carry out the dredging in the vembanad lake area, which is abundantly having lime shell (using their own dredgers and other boats / barges) and is the raw material for the cement industry. The barges and boats available with TCL is in the process of disposal / sale on discontinuation of lime shell dredging from Vembanad lake. Regarding the Cutter Suction Dredgers (2 in No), they are presently idling at factory now. The specifications of the dredgers are detailed below.

DREDGER- RUDINGER

Dredger	-	Mechanically operated Cutter Suction Dredger
Main Engine	-	680 ALM Leyland Engine
Main Pump	-	Morris
Suction line	-	12 inches dia
Delivery line	-	10 inches dia
Dredge capacity	-	3000 gallons/minute
Cutting Depth	-	45 feet

DREDGER – LOKANATHAN

Dredger	-	Hydraulic operated Cutter Suction Dredger
Main Engine	-	350 HP Caterpillar
Main Pump	-	AMSCO (USA) make
Suction line	-	12 inches dia
Delivery line	-	10 inches dia
Dredge capacity	-	5000 gallons/minute
Cutting Depth	-	50 feet

It is suggested / recommended the effective utilization of these TWO dredgers, while carrying out the above proposed Dredging operation, since they are amenable for the proposed Dredging activity.

3.3.2 River Training

NW 9 is basically a canal stretch available with a lesser natural width of the channel than the standard criteria. This is probing the Land Acquisition / Widening / Bank Protection etc.

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

3.4 Bank Protection / Embankment Strengthening

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

NW 9 is a canal system proposed for development of Class III standards. The majority of the stretch is under thick habitation. Since the Land Acquisition is involved in this stretch, a micro level analysis has been considered and a Km wise LA / Bank Protection requirement has been worked out. The below given Table is being provided with the details for the same.

Details of Land Acquisition and Bank Protection Requirement for all the three (03) alternate Routes are placed herewith. (Reference to the Index Plan).

9 (A) – FJTGD

FJ Ch 0.00 km to Ch 3.70 km; JD Ch 3.70 km to Ch 22.40 km
(G is @ Ch 21.80 km)
(Terminal of Travancore Cements Ltd., is @ Ch 19.70 km)

Sl. No.	Chainage (in Km) From------ To----------	Existing Width (in m)	Extra Width Requirement (L / R in m)	Length (in m)	Area of Land Acquisition (in Sq. m)	Bank Protection Requirement (L in m / R in m)	Remarks, if any
(1)	(2)	(3)	(4)	(5)	(6) = (4) x (5)	(7)	(8)
1	0 to 3.70	*	-	3700	-	=	* > 50 / 60 m
2	3.70 to 21.80	*	-	18100	-	=	
3	21.80 to 22.36	40	20	560	11200	L x 560	= No B P
	** 10 m corridor will be very less and hence considered 20 m only for this location				11200 ** Say 1.5 Ha	560 Say 0.6 kms	

9 (B) – IH

IH Ch 2.80 km to 17.80 km
(G is @ Ch 0.0 km)

Sl. No.	Chainage (in Km) From------ To----------	Existing Width (in m)	Extra Width Requirement (L / R in m)	Length (in m)	Area of Land Acquisition (in Sq. m)	Bank Protection Requirement (L in m / R in m)	Remarks, if any
(1)	(2)	(3)	(4)	(5)	(6) = (4) x (5)	(7)	(8)
1	0 to 2.8	25	25	2800	70000	L x 2800	* > 50 m
2	2.8 to 4	20	30	1200	36000	R x 1200	
3	4 to 5	20	30	1000	30000	L x 1000	= No B P
4	5 to 6	20	30	1000	30000	2 x 1000	
5	6 to 7	40	30	1000	10000	2 x 1000	
6	7 to 8	40	30	1000	10000	2 x 1000	
7	8 to 9	40	30	1000	10000	2 x 1000	
8	9 to 10	40	30	1000	10000	R x 1000	
9	10 to 11	25	25	1000	25000	2 x 1000	
10	11 to 12	25	25	1000	25000	2 x 1000	
11	12 to 13	25	25	1000	25000	2 x 1000	
12	13 to 14	25	25	1000	25000	2 x 1000	
13	14 to 15	20	30	1000	30000	2 x 1000	
14	15 to 16	20	30	1000	30000	2 x 1000	
15	16 to 17.8	20	30	1800	54000	2 x 1800	
					420000 Say 42 Ha	29,600 Say 30 kms	

9 (C) – JI
JI Ch 3.70 km to 15.20 km
(F is @ Ch 0.0 km)

Sl. No.	Chainage (in Km) From------ To----------	Existing Width (in m)	Extra Width Requirement (L / R in m)	Length (in m)	Area of Land Acquisition (in Sq. m)	Bank Protection Requirement (L in m / R in m)	Remarks, if any
(1)	(2)	(3)	(4)	(5)	(6) = (4) x (5)	(7)	(8)
1	0 to 3.7	-	-	3700	-	-	Covered under 9 (a)
2	3.7 to 12.4	*	-	8700	-	=	* > 50 m
3	12.4 to 13	20	30	600	18000	2 x 600	= No B P
4	13 to 15.2	20	30	2200	66000	2 x 2200	
					84000 Say 8.5 Ha	5,600 Say 6 kms	

As above, the Bank Protection requirement has been worked out to 600 m in 9 (A); 30,000 m in 9 (B) and 6,000 m in 9 (C). In canals, the usual types of Bank Protection in Kerala are Revetment / Rip-Rap or Pile & Slab. Since the NW 9 is traversing through the Lake area and keeping in view the Land Acquisition requirement, the preferred type is Pile & Slab for which a preliminary Drawing with the details are provisioned in the Chapter 6. Accordingly, the Pile & Slab Bank Protection is suggested and recommended herewith in the alternative routes, as explained. However, on comparison, the development of 9 A is most economical, which is having only 1.5 Hectare requirement of Land Acquisition and 600 m of Bank Protection.

3.5 Navigation Markings / Navigation Aids

Keeping in view the River width / Channel width etc., the Navigational Markings can be considered, either in the Shore or in the River with floating condition. The Shore Markings can be considered with a reasonable Beacon type structure fitted with Light at the top, whereas, the marking in the river can be considered with the floating Buoys as per the IALA standards fitted with Light at the top.

NW 9, being a canal system, the beacon type structure is not amenable and not suggested. i.e., suggested with Buoy & Light system.

Regarding the Buoy & Light system, it is proposed to consider the same type of Buoy and Light deployed in NW 3. The Technical specifications of Buoy & Light, as available in the Market as a proprietary item are detailed in Chapter 6.

Considering 500m interval and in Zigzag position (i.e., 1 Left then 1 Right Mark and 1 Left Mark), it is estimated to provide 50 Nos. in the stretch for about 25 kms {25000 / 500) duly taking the overlap of development under NW 9 and existing NW 3. It is working out to 41 Nos in 9 B and 40 Nos in 9 C.

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

In the present study stretch of NW 9 A, one Bridge is existing at Ch. 20 km and having sufficient Horizontal and Vertical clearances for Class III standard and hence there is no need of any provision for modification of structure on account of Bridges. The routes of 9 B and 9 C are not amenable for any comparison as detailed.

For Class III Vessel, with single lane operation, the critical clearances in horizontal direction is taken as 13.5m to 15m

Horizontal Clearance = 13.5 m

Vertical Clearance = 6.0 m

SL No	Chainage	Center Position		Location	Type of structure	Type of super structure	Width	No of span (Nos) x Length of Span (m)	Hz clearance	Height wrt MSL	Modification Required		Estimated Cost of Modification (INR)
		Latitude	Longitude								Hz	Vt	
9 -A													
1	20.02	9°33'43.75”	76°30'43.86”	Near Mulankuzha	Major Bridge	RCC	11	3x50	50	8	No	No	-
											Total Cost		**-**
9-C													
1	11.345	9°34'6.98”	76°29'17.53”	Kanjiram Junction	Road Bridge	RCC	12	2x40	40	6.5	No	No	-
											Total Cost		**-**
9-B													
1	0.466	9°34'29.21”	76°30'39.80”	Chavdiyali Junction	Foot Over Bridge	RCC	2	1x20	16	2	No	Yes	33,50,000

SL No	Chainage	Center Position		Location	Type of structure	Type of super structure	Width	No of span (Nos) x Length of Span (m)	Hz clearance	Height wrt MSL	Modification Required		Estimated Cost of Modification (INR)
		Latitude	Longitude								Hz	Vt	
2	1.1	9°34'24.12"	76°30'19.41"	Near Pathinaril Chira Bus Stop	Foot Over Bridge	RCC	2	1x20	20	2	No	Yes	33,50,000
3	1.109	9°34'23.85"	76°30'19.73"	Near Pathinaril Chira Bus Stop	Foot Over Bridge	RCC	2	1x20	20	8	No	No	
4	1.109	9°34'23.79"	76°30'19.44"	Veloor Bridge	Road Bridge	RCC	8	1x35	35	6	No	No	
5	1.924	9°34'17.32"	76°29'53.6"	Pulinakkal Boat jetty	Foot Over Bridge	RCC	2	1x25	20	2.4	No	Yes	33,50,000
6	2.349	9°34'13.71"	76°29'40.21"	Pathinachil Kadavu	Foot Over Bridge	RCC	2.5	1x25	20	2	No	Yes	33,50,000
7	2.82	9°34'6.98"	76°29'17.53"	Near Kamjiram Junction	Foot Over Bridge	RCC	2	1x20	20	2	No	Yes	33,50,000
8	4.956	9°34'53.28"	76°29'14.50"	Panampady	Foot Over Bridge	RCC	3	2x30	30	7	No	No	
9	6.14	9°35'18.58"	76°29'26.98"	Kottayam Kumarakom Elikkal Junction	Road Bridge	RCC	8.5	1x45	45	5	No	Yes	51,00,000

SL No	Chainage	Center Position		Location	Type of structure	Type of super structure	Width	No of span (Nos) x Length of Span (m)	Hz clearance	Height wrt MSL	Modification Required		Estimated Cost of Modification (INR)
		Latitude	Longitude								Hz	Vt	
10	7.273	9°35'27.01"	76°29'54.31"	Near Masjidul Majid Elikkal	Foot Over Bridge (Iron)	Iron	3	1x49	49	7	No	No	
11	8.015	9°35'44.28"	76°30'10.46"	Near Alimmood Bus Stop	Road Bridge	RCC	6	1x40	40	6	No	No	
12	10.338	9°36'21.02"	76°30'39.6"	Munniyel Bridge	Road Bridge	RCC	6	1x40	40	6	No	No	
13	12.798	9°36'37.92"	76°29'38"	Kudayampadi Parippu Road	Road Bridge	RCC	10	1x30	30	8	No	No	
14	13.529	9°36'57.69"	76°29'28.31"	Near Aymanam	Foot Over Bridge (Iron)	RCC	2.5	1x30	30	5.5	No	Yes	30,25,000
15	14.535	9°37'24.42"	76°29'32.98"	Aymanam Kallimathara Road	road Bridge	RCC	5	1x15	15	8	No	No	
16	14.95	9°37'36.9"	76°29'36.29"	Near Karappa Bus Stop	Road Bridge	RCC	5	1x15	15	5	No	Yes	51,00,000
17	15.633	9°37'58.20"	76°29'31.16"	Near Karipputha Bus Stop	Road Bridge	RCC	5	1x20	20	7	No	No	

SL No	Chainage	Center Position		Location	Type of structure	Type of super structure	Width	No of span (Nos) x Length of Span (m)	Hz clearance	Height wrt MSL	Modification Required		Estimated Cost of Modification (INR)
		Latitude	Longitude								Hz	Vt	
18	15.05	9°38'19.64"	76°28'52.53"	Near St Thomas Church	Foot Over Bridge (Iron)	Iron	3	1x15	15	7	No	No	
19	17.806	9°38'39.63"	76°28'43.10"	Maniyaparambu Junction	Foot Over Bridge	RCC	2.5	1x15	15	5.5	No	Yes	30,25,000
												Total Cost	**3,30,00,000**

SUMMARY	
NW	**Cost**
9A	NIL
9B	3,30,00,000
9C	NIL

NOTES

NOTE 1 No modification is required for structures in 9A.

NOTE 2 No modification is required for structures in 9C.

NOTE 3 For 9B, out of 19 Cross structures, 9 need modification. Road bridges at Chainages 6.14 and 14.95 and Foot Over Bridges at chainages 0.644, 1.10, 1.924, 2.349, 2.820, 13.529 and 17.806 require modification for vertical clearances.

Since, this is single span, the top level is increased approximately by 1.0m to make vertical clearance of 6m and suitable gradient is provided at both

SL No	Chainage	Center Position		Location	Type of structure	Type of super structure	Width	No of span (Nos) x Length of Span (m)	Hz clearance	Height wrt MSL	Modification Required		Estimated Cost of Modification (INR)
		Latitude	Longitude								Hz	Vt	

ends.

The Abutments will increase by required heights at both ends.

Foundation will also need modification as per the increased height.

NOTE 4 Foot Over Bridges and Road Bridges may be modified / replaced according to condition of bridge at site.

NOTE 5 The cost of modification may have to be updated before construction at Detailed Engineering Stage.

Regarding the Power Cables, 25 Nos. in 9 A; 52 Nos. in 9 B and 14 Nos. in 9 C are existing. Most of the cables may not require any modification. However, anticipated the stringing of Cables for which Lump-sum provision of INR 12.50 Lakhs; 12.5 Lakhs and 7.0 Lakhs have been provisioned respectively.

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

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

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

3.8 Land Acquisition

The Table placed in para 3.4 may be referred, wherein the Land Acquisition requirement have been worked out and accordingly, the requirement is working out to 1.5 Hectares in NW 9 A stretch; 42 Hectares in NW 9 B stretch and 8.5 Hectares in NW 9 C stretch. Land Acquisition requirement for Terminal purpose is being considered, as a part of Terminal development, wherever required.

3.9 Fairway Costing

3.9.1 Capital Cost

The identified Traffic for IWT for this Waterway is of Lo-Lo operation with specific criteria of achieving the operational volumes of about 3800 TEUs p.a (inward) + 1200 TEUs p.a (outward) at KPACT and 7 Lakhs T p.a (inward) + 10.60 Lakhs T p.a (outward) at TCL estimated in 2040.

Investment is suggested with Positive growth and confirmations.

The Capital Cost for the fairway 9 A (which is comparatively most amenable for development) has been considered for 3.61 Lakhs Cu. M of Dredging in soils (INR 886.66 Lakhs); 600 m of Bank Protection at the identified chainages (INR 86.10 Lakhs); Land Acquisition of about 1.5 Hectares (INR 143.75 Lakhs); 50 Nos. of Buoy with Light (INR 176.53 Lakhs) and Modification of Structure i.e., No Bridge and Stringing of 25 Power Cables (INR 12.5 Lakhs). Cost estimates are placed with details in Chapter 11.

3.9.2 O&M Cost

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

CHAPTER 4 : TRAFFIC STUDY

4.1 General

The study stretch of National Waterway 9 (Alappuzha-Kottayam-Maniyaparambu Canal) has been divided into 3 sub-parts, namely, National Waterway 9a (from Alappuzha to Kottayam near Kodimatha), National Waterway 9b (from Kanjiram Junction to Maniyaparambu) and National Waterway 9c (from Kainakary North to Kottayam). NW 9a and NW 9c fall in the catchment of Kottayam & Alappuzha district and NW 9b stretch falls in Kottayam district.

The total navigable length of the proposed waterway NW 9 is 52 km; of which NW 9a, 9b & 9c comprise of 22, 15 & 14 km respectively. The study stretches of NW 8, NW 9 & NW 59 are connected to existing NW 3 at Vembanad Lake. All the three waterways (NW 8, 9 & 59) are located in Kottayam & Alappuzha districts. The proposed waterways would serve as an access to the existing NW 3 (from Kollam to Kottapuram), which further extends the waterway connectivity of proposed waterways to Cochin & Kollam. The combined length of existing National Waterway 3 section (from Kollam to Kottapuram) and the proposed section of NW 9 will provide continuous waterway connectivity to the identified study area.

Based on the deepest bathymetry single line survey carried out during the study and as per the classification of “Inland water ways” by Ministry of Shipping, Govt. of India notification, NW 9a and NW 9b can be classified as “Class III” and NW 9c can be classified as “Class I”.

The proposed waterway in Alappuzha-Kottayam-Maniyaparambu Canal lies in Alappuzha and Kottayam districts. Both Alappuzha and Kottayam are nearby towns with road distance of 48 km and arial distance of 25 km. The proposed waterway serves as an access from Alappuzha and Kottayam district to existing NW 3, which further enhances the connectivity of the identified study stretch to districts of Cochin & Kollam through IWT. The proposed NW 9a & 9c connect Kottayam with Alappuzha town & Kainakary North. Both the waterways also connect the city of Kottayam with Vembanad Lake & NW 3.

At present, NW 3 is the only existing waterway, which has navigational facility at all stretches. All the potential cargo for NW 9 would get diverted to NW 3 at Alappuzha for further transportation to Cochin port/ ICTT or for the distribution in the hinterland. Following map shows all the proposed IWT waterways and their connectivity with existing NW 3. It is clearly visible from below map that NW 9 connects with NW 3 at Alappuzha.

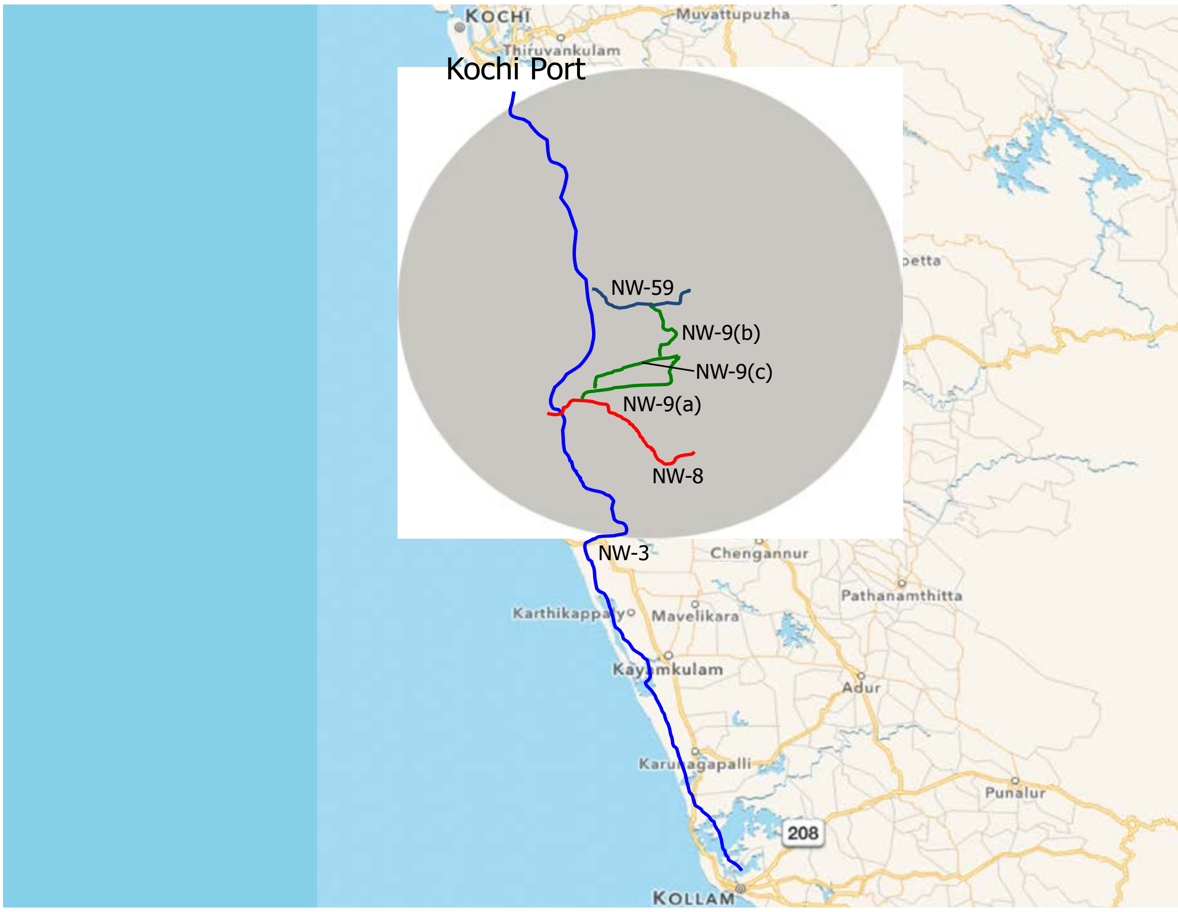


FIGURE 4-1: CONNECTIVITY WITH OTHER PROPOSED WATERWAYS IN KERALA

FIGURE 4-2: ALAPPUZHA-KOTTAYAM-MANIYAPARAMBU CANAL

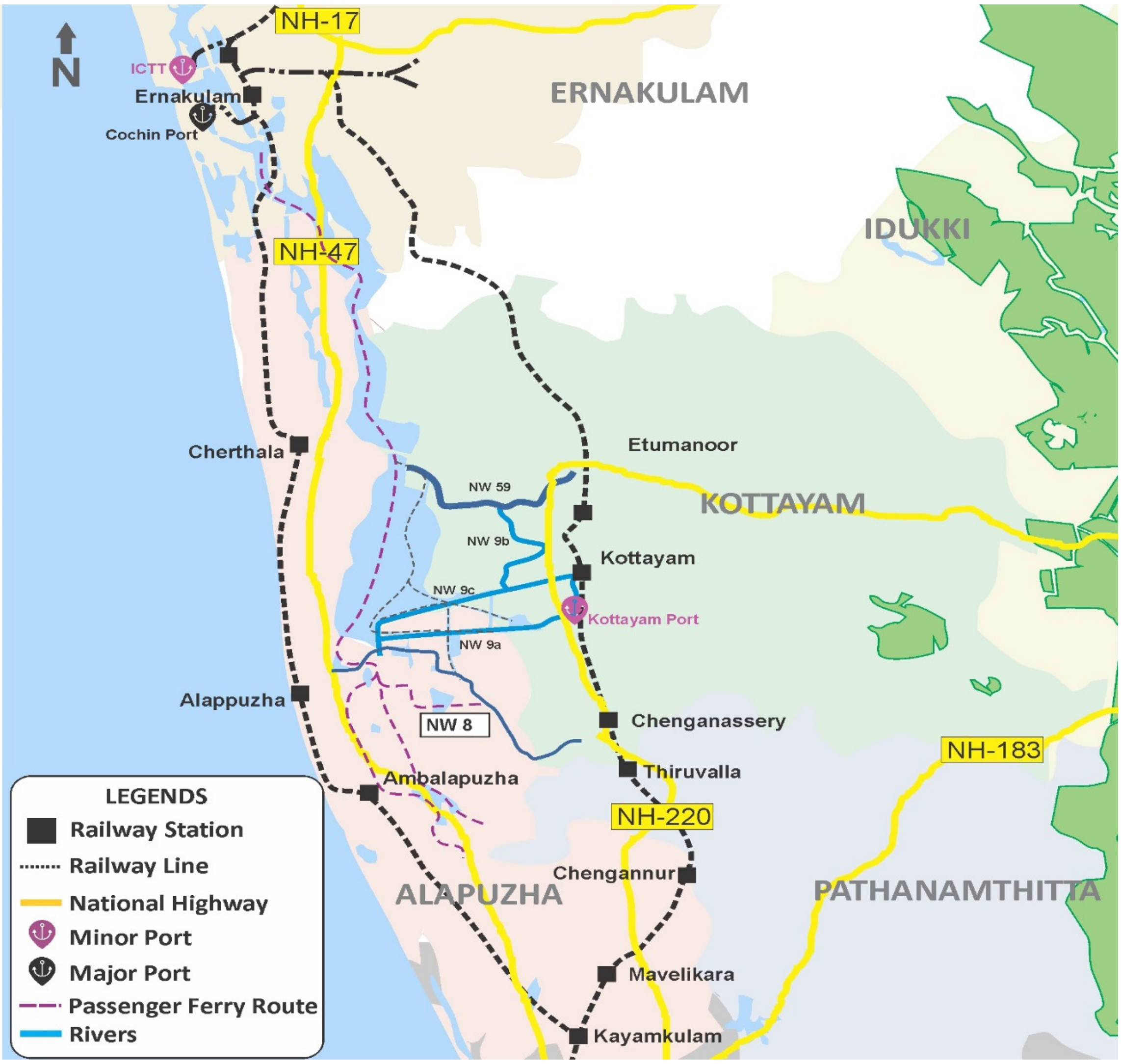


FIGURE 4-3 MACRO MAP OF NW

4.2 Hinterland Analysis

NW 8 and NW 59 come under the primary catchment area of NW 9. NW 8 is on the southern side and NW 59 is in northern side of NW 9. The districts that come under the primary catchment area of NW 9 are Alappuzha and Kottayam. These two districts are also primary catchment area for NW 8 & NW 59.

Alappuzha is famous for its backwaters and local rural population. It is the only district in Kerala with no high lands area. The entire area of the district lies in the low land and the midland divisions. R block field closer to NW 9a & c is known for its scenic backwater region of Vembanad Lake in Alappuzha. Reclaimed lands of R block have private farms, which are used for farming purpose, mainly coconut and banana plantation.

Kottayam district has a total area of 220,442 Hectares, which forms 5.67% of the total area of the State. Kottayam is famous for panoramic backwater stretches, lush paddy fields, highlands, hills and hillocks and extensive rubber plantations. It is an important trading center of spices and commercial crops, especially rubber. Around 109,582 ha. land of Kottayam is used for rubber plantations. The district houses the headquarters of the Indian Rubber Board.

Ernakulum and Pathanamittha districts come under the secondary catchment area of NW 9. As these two districts are not located within the primary catchment area; i.e. within 25 km; hence they would not be considered and analysed for the study.

4.2.1 Demography Profile of Hinterland

As per Census 2011, Kottayam district has higher population than Alappuzha. Majority of people residing in Kottayam are engaged in rubber industries. Alappuzha is famous for its backwaters for tourism purpose. Majority of population of Alappuzha are engaged in agriculture and coir units as workers.

The below table presents a list of districts, along with talukas and their population, that come in the catchment area of NW 9.

TABLE 4-1 POPULATION OF THE CATCHMENT AREA OF NW 9

District	Taluka	Population
Kottayam	Kottayam	6,31,885
	Changanassery	3,55,736
	Meenachil	4,06,471
	Vaikom	3,10,414
	Kanjirappally	2,70,045
Alappuzha	Cherthala	5,42,657
	Ambalappuzha	4,54,864
	Karthikappally	4,06,524
	Kuttanad	1,93,007
	Chengannur	1,97,419
	Mavelikkara	3,33,318
Total		35,71,603

Source: Census 2011

4.2.2 Economic profile

Tertiary sector dominates Kerala's economy; it constitutes around 62% of the state's economy in Fy 16. TABLE 4-2 indicates the distribution of different sectors with respect to historical annual growth rate.

TABLE 4-2 SECTOR WISE HISTORIC CONTRIBUTION TO THE STATE'S ECONOMY (%)

Sectors	FY 13	FY 14	FY 15	FY 16
Primary	9	9	13	12
Secondary	24	20	26	26
Tertiary	67	71	61	62

Source: Economics Statistics, Kerala Govt.

There is 3% growth in Primary sector since FY 14. Secondary sector i.e. manufacturing industry has shown approximately 6% growth between FY 14 to FY 15. Tertiary sector also has witnessed fall between FY 14 and FY 16.

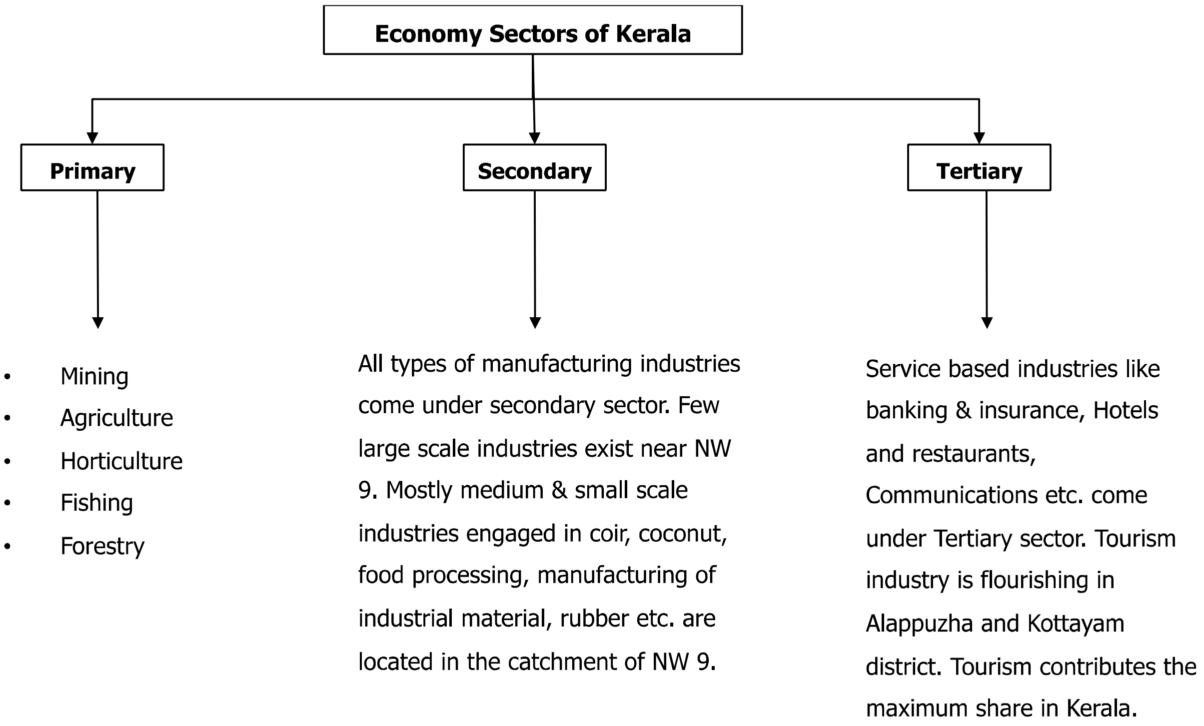


FIGURE 4-4 CONTRIBUTION OF DIFFERENT SECTORS IN ECONOMY OF KERALA

Alappuzha- Alappuzha district is the commercial and trading center of Kerala. Its economy is based on tourism and exports specifically spices, coconut oil, coir, sugar etc. Cargo transportation takes place using all modes of transportation including IWT routes. All the business and economy is dependent upon Agriculture, Marine Product, Coir Product, Coconut and Tourism. Alappuzha is traditional hub of coir industry.

Kottayam- Agriculture and other industries of cities and surrounding region contribute to Kottayam economy. Rubber industry and spice exports are major contributors to Kottayam economy. The companies in the district have improved infrastructure in the cities and act as backbone of the economy.

4.2.2.1 PRIMARY SECTOR

Primary sector consists of Agriculture, Forestry, Fishing and Mining. The main occupations of majority of people are fishing, agriculture, mining work etc. Table 4-3 shows break up of primary sector of the catchment area of NW 9.

Table 4-3 District wise GSDP of Primary Sector (FY 13)

(INR in Lakhs)

Primary Sector	Alappuzha	Kottayam
Agriculture	58,690	1,85,648
Forestry & Logging	14,542	13,785
Fishing	37,719	1,827
Mining	2,063	4,368
Total	1,13,014	2,05,628

Source: Directorate of Economics and Statistics, Kerala

a. Agriculture

The importance of the agricultural sector in Kerala's economy can be understood by the fact that 96% of country's entire yield of pepper and 91% of natural rubber is produced in Kerala alone. Other major crops in the region are coconut, tea, coffee, cashew, and spices like cardamom, vanilla, cinnamon and nutmeg. Rice is the staple food of the natives and is grown at a large scale in the state. Government of Kerala is planning to become self-sufficient in cultivating vegetables.

Paddy, coconut, tapioca, jackfruit, mango and plantain are the major crops cultivated in Alappuzha district. Other than paddy, coconut is produced in a large scale, which forms 36.26% of the total cropped area of Alappuzha.

The important crops cultivated in Kottayam are rubber, pepper and paddy. The district is famous for major rubber production in the state. In Kottayam, annual crops like pineapple and plantain, seasonal crops like tubers and ginger are grown on large scale. Jackfruit and mango are also grown in the district and nearby areas. R block is one of the few places, where farming is done below water level. Major occupation of people is farming and rice is the main agriculture product.

TABLE 4-4 AGRICULTURE PRODUCTION IN THE CATCHMENT AREA OF NW 9 (FY 15)

(Production in '000 T)

District	Taluka	Rice	Spices	Others
Alappuzha	Cherthala	1,029	23	248
	Ambalappuzha	11,000	10	255
	Karthikappally	11,440	47	291
	Mavelikkara	9,255	149	191
	Chengannur	3,561	239	227
	Kuttanad	60,762	5	618
Total of Alappuzha		**97,047**	**473**	**1,830**
Kottayam	Kottayam	1,398	343	638
	Changanassery	6,529	225	314
	Meenachil	1,067	864	1,379
	Vaikom	11,701	79	866
	Kanjirappally	26,203	382	1,013
Total of Kottayam		46,898	1,893	4,210
Total of Alappuzha & Kottayam		**1,43,945**	**2,366**	**6,040**

Source: Department of Economics and Statistics, Kerala

b. Horticulture

Jackfruit and coconut are major fruits produced, followed by Plantain, Pineapple, Banana and Mango. The below table shows volume of horticulture production in Alappuzha & Kottayam districts. Others section in the table includes Raw Cashew Nuts, Tapioca, Betel leaves and Cocoa.

TABLE 4-5 HORTICULTURE PRODUCTION IN THE CATCHMENT AREA OF NW 9 (FY 15)

(Production in '000 T)

District	Taluka	Fruits	Coconut (Million Nuts)*	Others
Alappuzha	Cherthala	623	44	1
	Ambalappuzha	338	19	1
	Karthikappally	712	62	10
	Mavelikkara	1,814	27	45
	Chengannur	2,090	15	29
	Kuttanad	299	27	0
Total of Alappuzha		**5,876**	**1,94**	**86**
Kottayam	Kottayam	2,996	21	44
	Changanassery	1,851	14	20
	Meenachil	4,958	35	106
	Vaikom	1,407	35	10
	Kanjirappally	2,788	28	36
Total of Kottayam		**14,000**	**133**	**216**
Total of Alappuzha & Kottayam		**19,876**	**327**	**302**

Source: Department of Economics and Statistics, Kerala

(*- Only coconut in million nuts)

c. Fishing

Alappuzha has both marine & inland fish catch. Fishing is the major activity in the district. Feeder road, connecting the district roads with seacoast has been developed for fishermen to carry out their activity and help fishing community. There are more than 1,30,000 fishermen in Alappuzha district. More than 60% of fishermen are engaged in sea farming and rest are carrying out inland fishing activity. Marine fishing season is from October to May and inland fishing is done throughout the year. Majority of fishermen are indirectly engaged in fishing operation. Kottayam is not located near the coast; so there is no marine fishing in the district, but only inland fishing. There are several fish landing centers in the catchment area, which are listed below.

TABLE 4-6 FISH LANDING CENTER IN THE CATCHMENT AREA

District	Taluka	Landing Center
Alappuzha	Ambalappuzha	Punnamada Jetty Kadavu
	Chengannur	Pandanad
		Pavukkara
		Ennakkattu
	Karthikappally	Muttathumannel Kadavu
		Vettathu Kadavu
		Kanakakkunnu
		Paippad
		Veeyapuram
		Karichal
	Mavelikkara	Prayikkara
		Erakkadavu
		Munduvelik Kadavu
	Cherthala	Thanneermukkam Kadavu
		Kasnnankkarajetty Kadavu
		Puthanangadi Kadavu
		Depokadavu
		S N Kavalayku Kezhzkku
		Muhamma panchayathu Kadavu
		Kovilakom Resort Kadavu
		Perumthuruthu Kadavu
		Ambala Kadavu
		Kalluchira Kadavu
		Madayanthodu Kadavu
		Shanmughan Jetty Kadavu
		Purity Resort Kadavu
		Panavally
		Perumbalam
		Makke Kadavu
		Thavanak Kadavu
		Arukkutty
Kottayam	Vaikom	Murinjapuzha
		Nerekadavu
		Kolothum Kadavu

Source: Kerala Inland Fisheries Statistics, 2013

Majority of inland fish productions are marked in domestic market and consumed locally.

TABLE 4-7 FISH PRODUCTION IN THE HINTERLAND OF NW 9 (FY 16)

	Number of Fishing Villages		Annual Fish Production (MT)	
District	**Marine**	**Inland**	**Marine**	**Inland**
Alappuzha	30	24	44,388	34,930

	Number of Fishing Villages		Annual Fish Production (MT)	
District	**Marine**	**Inland**	**Marine**	**Inland**
Kottayam	-	8	-	12,308
Total	30	32	44,388	47,238

Source: Directorate of Fisheries, Kerala

Volume of Inland fishing in Alappuzha and Kottayam is 47,238 MT, which is slightly higher than marine production. There exist total 34 minor inland fish landing centres in Alappuzha & Kottayam districts. Out of these, no landing centre is located in the catchment of the proposed NW 9. However, a Government fish farm is located in the catchment of NW 9a at Pallom. Also, fish catch is transported by trucks from Cochin to Kodimatha, which is hardly 1 km from NW 9a. Considering all these points, it is estimated that there exists negligible potential from fishing activities via the proposed waterway in NW 9.

Matsyafed Ice and Freezing Plant under Department of Fisheries of Kerala freezes and exports processed fish, especially Tuna to different countries like Thailand, China, Iran, Turkey, France, Spain, Oman, Dubai, Tunisia, Algeria, Sri Lanka, etc. These fish export would not provide any opportunity for the waterway as the volume for export fish in Alappuzha & Kottayam district is very less.

d. Forestry

Alappuzha does not have dense forest cover area and total forest cover of the district is also very less, compared to other districts. Kottayam, however, has moderate forest cover and open forest area. Forest is the main source of raw material for wooden based industries.

TABLE 4-8 DISTRICT WISE FOREST COVER (HA.)

District	Geographical area ('000 Ha.)	Very dense forest	Moderate dense forest	Open forest	Total
Alappuzha	1,414	0	12	26	**38**
Kottayam	2,203	12	542	335	**889**

Source: iesenvis.nic.in, Kerala

Forest area is very less in the catchment of NW 9 and volume of forest products from Alappuzha & Kottayam is negligible; hence they would not provide any opportunity for the proposed waterway.

e. Minerals

Kottayam district has rich mineral deposits of lime shell and graphite. Lime shell deposits are consumed by industries like Travancore Cements Limited, Travancore Electro Chemicals Ltd etc. Granite is also available in highland position of Kanjirappally taluka, which can be utilized by industries engaged in the stone crushing granite and polishing etc. Another mineral that is available in the district abundantly in Vaikom, Meenachil and Changanassery talukas, is clay. Clay is utilized for manufacturing bricks, blocks, Tiles and other pottery items.

Extensive deposits of silica sand are found in the coastal tract between Alappuzha and Aroor in Alappuzha district. Silica sand reserves are spread over an area of 470 Ha. in villages, namely Pallipuram, Thycauttuserry & Panavally in Cherthala, Alappuza district. Other than silica sand, minerals like Sand and Laterite are also found in Alappuzha district. The largest lime shell reserve is found in Vembanad lake and adjoining portions of Alappuzha, Kottayam and Ernakulam districts; however since Vembanad Lake is declared a wetland, defined by the Ramsar Convention; extraction of lime shell and excavation in the lake is banned.

TABLE 4-9 DISTRICT WISE MINERALS PRODUCTION IN THE CATCHMENT OF NW 9 (FY 16)

District	Type of Mineral	Production ('000 T)
Major Mineral		
Alappuzha	Granite Building Stone	2
Kottayam	Lime Shell	28
Total		30
Minor Mineral		
Alappuzha	Laterite	11
	Sand	266
	Silica Sand	66
Kottayam	Granite Building Stone	1,821
	Sand	5
	Ordinary Earth	1,347
	Laterite	19
	Brick Clay	60
Total		3,595

Source: Department of Economics and Statistics, Kerala

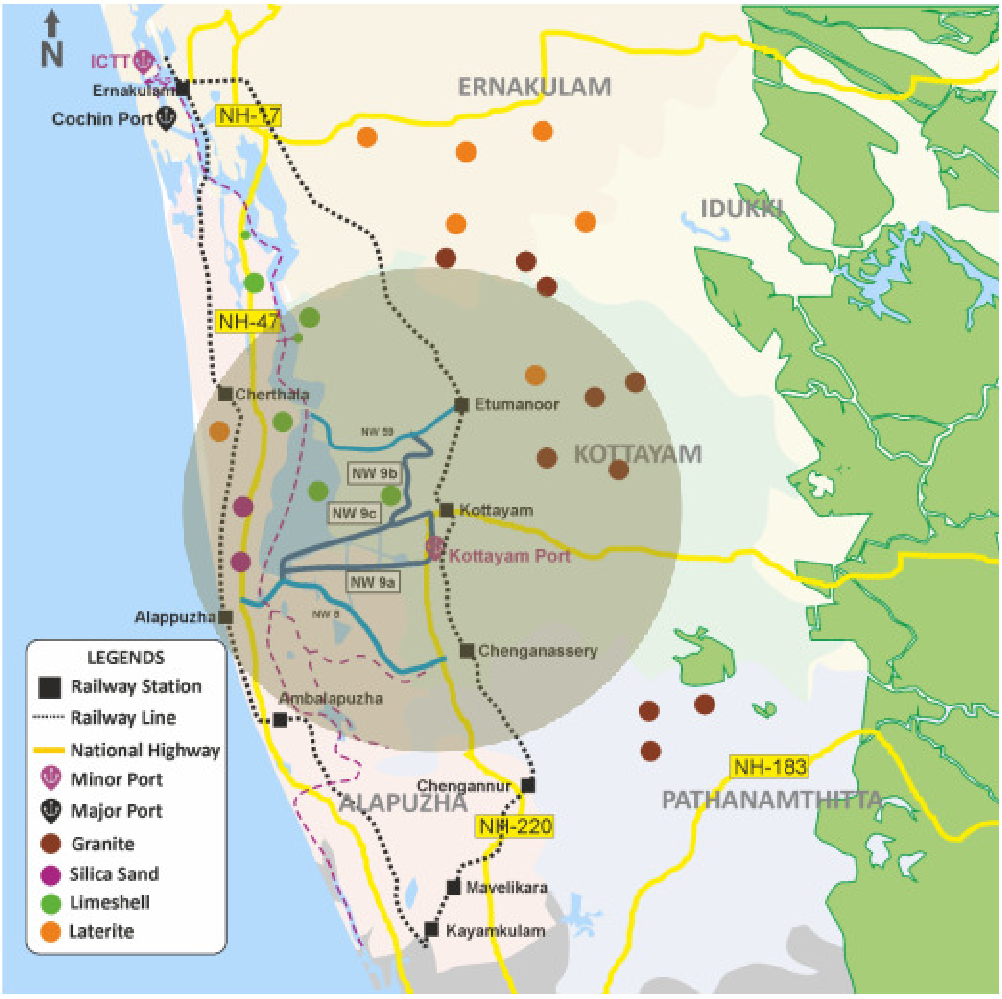


FIGURE 4-5 MINERALS IN THE CATCHMENT AREA OF NW 9

Minerals like Granite building stones are found majorly in Pathanamthitta and Ernakulam districts. Ernakulam alone produces 6,659 ('000 tonnes) building stones. Other minor minerals found in Pathanamthitta and Ernakulam are Laterite, Ordinary sand & Brick clay. However, mineral produced in Pathanamthitta and Ernakulam districts would not be considered for the study as they are far from the catchment area of NW 9.

Minerals would not provide any opportunity for NW 9 because they are not in considerable volume to be moved through waterway and most of the minerals are consumed by local industries.

4.2.2.2 SECONDARY SECTOR

Alappuzha is the main industrial growth center, compared to Kottayam in the primary hinterland of NW 9. Travancore Chamber of Commerce Institution was founded in 1929 to protect and promote trade, agriculture, industry and commerce. Industrial growth center Cherthala, which is 32 km away from Cochin and 37 km away from Kottayam port, offers good opportunity for investors. This is the largest industrial park in Alappuzha district and got basic infrastructure facility and direct road connectivity with Cochin port. Seafood and coir industry is found in the coastal region and concentrated in Alappuzha district. These two products are the main exported items from the district.

Industries located in Kottayam district are commercial crop and agro based. Small and medium size industries are scattered in the district. Such industries are mainly processing rubber latex or products. The establishment of tyre industry in Kottayam has further boosted the rubber industry. Major exportable items from Kottayam are Food Products, Procured Tread rubber, cushion Gum, Rubber Mats & Coir Mats, Poly propaline Mats, Bio fertilizers, Spices & Centrifuged Latex.

Table 4-10 Contribution of Secondary sector in economy (FY 13)

(INR in Crore)

Sector	Alappuzha	Kottayam
Manufacturing	1,020	758
Registered	456	339
Un-registered	565	419
Construction	1,994	1,891
Other	450	481
Total	3,239	2,889

Source: Directorate of Economics and Statistics, Kerala

4.2.2.3 TERTIARY SECTOR

Tourism and other sectors like transportation, communication etc. come in tertiary sector. Government of Kerala has projected that tourism sector will contribute 20% to GSDP in the coming five years. At present, tourism contributes about 12% to GSDP. Kerala's backwaters are famous worldwide. Kerala attracts foreign tourists as well as domestic tourists. Foreign exchange earnings from tourism have shown a steady growth over the years. In FY 2015, Kerala has earned INR 6949.88 Crores as foreign exchange earnings from tourism against INR 6398.93 Crores in FY 2014, showing a growth of 8.61%.

The below table presents a list of types of industries that come under the Tertiary Sector and their contribution in GSDP in the catchment of NW 9.

TABLE 4-11 INDUSTRIES & GSDP OF THE TERTIARY SECTOR IN THE CATCHMENT OF NW 9 (FY 13)

(INR in Lacs)

Industries	Alappuzha	Kottayam
	3,26,008	2,93,286
Transport, Storage & Communication	2,03,811	2,54,102
Railways	5,279	4,699
Transport by other means	87,618	99,802
Storage	1,158	2,002
Communication	1,09,755	1,47,599
Trade, Hotel & Restaurants	2,65,910	2,56,454
Banking & Insurance	1,19,527	1,36,257
Real estate ownership, Business, Legal	1,69,277	1,51,314

Industries	Alappuzha	Kottayam
Public administration	56,683	61,525
Other Services	16,966	1,69,473
Total of Tertiary Sector	9,85,173	10,29,125

4.2.3 Infrastructure Analysis

Infrastructure plays major role in the development. It is essential to understand various types of infrastructure around the canal and new development that would become support-connecting waterway with other modes of transportation. It becomes backbone for any new development.

4.2.3.1 CONNECTIVITY ANALYSIS

The various cities and towns located in the vicinity of NW 9 are well connected by an extensive road & rail network. Below Figure shows the road & rail connectivity of the region. Apart from roadway, railway and airway, Kerala's canals and inland waterways are developed to facilitate easy transportation for people. There are certain villages in Kerala, which are accessible only by IWT route. Following section describes all the connectivity with respect to NW 9.

FIGURE 4-6 CONNECTIVITY AROUND NW-9

a. Roadway

Alappuzha and Kottayam districts are connected to other towns in the state of Kerala by network of State & National Highways. The connectivity map Figure 4 5 shows the road network connectivity for NW 9 catchment area.

National Highway (NH) 66 is a major highway, which connects Panvel to Kanyakumari and criss-crosses through Alappuzha town. NH 66 connects Alappuzha with Cochin in the North and Thiruvananthapuram in the South.

NH 183 connects Kottayam with Tamil Nadu in the East and Changanassery in the South. There are total eight state highways in Alappuzha district, of which three of them originates from Alappuzha town.

State Highway (SH) 11 connects Alappuzha town with Kottayam district. Kainakary is connected to SH 11 at Nedumudy in Alappuzha district by secondary roads. SH 42 connects Kottayam with NH 66 at Cherthala in Alappuzha. SH 15 connects the district with Thrissur & Calicut/Kozhikode and SH 32 connects Kottayam with Pala. State Highway or National Highway network doesn't pass through Maniyaparambu (termination point of NW 9b), but the town is accessible from SH 1 via secondary road network.

The stretch of NW 9, i.e. NW 9a from Alappuzha side is not connected with roadway directly; however, Alappuzha Veliyanadu ferry route connects it with NH 47 via Punnamada Finishing Point Road. From Kottayam side, NW 9a has good connectivity with NH 183. NW 9c is connected to NW 9a from both the points. NW 9b starts from Veloor and connected with NW 9c from one end. From other end NW 9b is connected with NW 59. NW 9b runs almost parallel with roadways from one side.

b. Railway

Direct rail connectivity is available at Alappuzha and Kottayam. The Southern Railways network of Indian Railways serves Alappuzha & Kottayam districts. Railway is also being used for transportation of goods.

Alappuzha is linked by Ernakulam–Kayamkulam coastal railway line and connects to cities like Trivandrum, Kollam, Cochin, Coimbatore, Chennai, Delhi, Bokaro and Mumbai. The Thiruvananthapuram division of Southern Railways connects the catchment of NW 9. This division connects to Palakkad division at Thrissur, connecting the region to Mangalore & further towards North.

Eastern part of the canal is closer to railway station as compared to western part. In Kottayam district, Chingavanam, Kottayam, Kumarnallor are the railway stations, which are closer to NW 9. There is no major freight loading stations on the railway line. Only Kottayam railway station has facility for goods shed.

In Alappuzha district, Chengannur, Kayamkulam, Mavelikkara railway stations are used for transporting goods. These are the main stations from where goods are loaded and dispatched to other regions. These railway stations are on Ernakulam- Alleppey (Alappuzha) rail route. Out of these stations, Chengannur railway station only comes in the primary catchment area of NW 9 (9a).

c. Airport

Kozhikode and Cochin are well-connected airports in Kerala. They are connected to all major cities in India. Cochin International Airport is located more than 97 km away from NW 9. There does not exist any operational airport within the primary catchment area of NW 9.

d. Ferry Terminal

At present passenger ferry services are operational in both Alappuzha & Kottayam districts. Passenger services are operated by State Water Transport Department (SWTD), Government of Kerala. The water transport department has a total of 14 stations under its control; out of which 8 fall under Alappuzha district & 2 fall under Kottayam district. For details of existing ferry terminals in the catchment area of NW 9, refer to Section 0 Passenger Traffic.

4.2.3.2 EXISTING INFRASTRUCTURE

There does not exist any dam or bridge which crosses over the given canal stretch at present. Agricultural fields surround this stretch.

There is one non-major port in the catchment area of NW 9, i.e. Kottayam Port & Container Terminal. There does not exist any major port in the catchment area. Cochin port is located more than 75 km from Kottayam port by road. At present, cargo from Kottayam port goes to Cochin port via roadway.

a. Kottayam Port and Container Terminal (KPACT)

The Port is based on 5 Ha. of land. At present, authorized custom clearance and EXIM activity are being carried out. The Port has handled about 4,233 TEU of export & import cargo till present. 300 TEU is getting handled at the port per month. Companies like Malayala Manorama, MRF use this port. The Port has acquired additional 7 acres of land for the 2nd phase expansion; this land is adjacent to the existing facility. MAERSK has commenced an empty container yard, which would help in storing empty containers at the yard, so that exporters could pick their nominated export containers.

KPACT is mainly handling rubber products, automobile spare parts, RMG which gets exported through Cochin port. At present these commodities move via roadways.

FIGURE 4-7 KOTTAYAM PORT & CONTAINER TERMINAL

Source: Site Visit

As per discussion with the Chief Executive Officer of KPACT, Mr. Cherian K. Varghese, KPACT needs IWAI to develop certain facilities, which includes a jetty and smooth navigation in the proposed waterway. At present, the port has a terminal but due to some technical problems, it is not used effectively. KPACT has plan to develop a jetty with berthing facility for barges, measuring 50m X 12m. Barges of 10 TEU capacity are handled at the port.

KPACT also require cranes for handling cargo. Shortage of loading equipment creates hindrance for starting barge movement on waterway; therefore 45 Tons capacity of cranes (Double Grinder Gantry crane) would be used for loading and unloading of containers from barges.

Domestic cargo movement is 10 times higher than EXIM cargo. Loading platform, hydra cranes, forklifts and covered cargo storage would be developed in the port for smooth operation.

Existing facilities at KPACT

- ✓ Existing 40,000 sq. ft. Warehouse is used for export, import and hazardous goods. There is planning to construct 20,000 sq. ft. of additional warehouse.

b. Cochin Port Trust

Cochin Port is a major port of South India. It is an all-weather natural Port and located strategically close to the busiest international sea routes. It is operating as a major liquid & bulk terminal.

Existing facilities at Cochin Port

- ✓ The main inward shipping channel of the port divides into the Ernakulam and Mattancherry channels. The Ernakulum Channel is 4.90 Km long, with 250 -500 m width and has a draft of 12.5 m up to the Oil Terminal and Q8/Q9 and a draft of 9.14 m up to the wharves and the north and south tanker berths.
- ✓ The 1024 m long Ernakulam Wharf has six alongside berths, five for general cargo and a fertilizer berth. There are also three oil berths in the Ernakulum channel.
- ✓ The Mattancherry channel has 4.08 km length, 180 -250 m width and a draft of 9.14 m except at Boat Train Pier where the draft is 10 m. There are four alongside berths on the Mattancherry Channel, for general cargo, one Boat Train Pier and two jetties for miscellaneous cargo.
- ✓ Cochin Port has a 5 MMTPA LNG Terminal, which can berth LNG vessels up to 2,16,000 m3 with a length of 300 m and a draft of 12 m.
- ✓ There are total 11 transit sheds & overflow sheds and total 7 Warehouses in the port.
- ✓ There are 4 tugs, 4 mooring launches, 2 pilot boats, Grab Hopper Dredger, Floating Crane and Water barge are also available in the port.
- ✓ Pipelines are available for liquid cargo handling.
- ✓ Bunker supply can be done at all berths by barge/trucks/pipeline.
- ✓ A Single Point Mooring System (SPM) is set up by Kochi Refineries Ltd (BPCL-KRL). This SPM is used as captive reception for the import of Crude oil. The facility is capable of receiving Very large Crude Carriers (VLCCs) of 300,000 DWT. The SPM is connected by a pipeline of 19.5 km to tank storage facilities at Puthuvypeen.

4.2.3.3 UPCOMING INFRASTRUCTURE

Five sites are shortlisted in Kottayam and Pathanamthitta district for developing Greenfield International Airport at a project cost of INR 2,500 Crore. These five locations are namely Kootickal, Cheruvally Estate, Laha Estate, Malayalapuzha-Kumbazha Estate and Kalleli. All these locations are more than 35 km away from the given stretch of NW 9. Exact location for the same has not been decided yet.

The Government of Kerala has already decided to develop five minor ports through PPP mode. These Ports are Azheekal, Beypore, Ponnani, Alappuzha and Kollam. Apart from these ports, a major port, Vizhinjam Deepwater International Container Trans-shipment Terminal is going to be developed.

At the beginning of FY 17, State Government has started Solar ferry service, which runs between Vaikom to Tavanakkadavu (near Vembanad Lake) ferry route distance is about 2.5 km. Roadway distance between these two locations is 27 km. Seating capacity of this new boat is 75 persons. On this route, total 22 numbers of ferries would ply between 7 am to 7 pm. A proposal of additional 10 solar ferry boats is in the pipeline of State Government.

4.2.4 Existing & Proposed Industries

4.2.4.1 EXISTING INDUSTRIES

Majority of industrial and commercial centers in Kerala are located in the coastal area. Alappuzha is center of exporting coconut oil, spices, sugar etc. Roadways and inland waterway carry trade in the region. In Alappuzha, major industrial clusters are located in different areas, like Garment cluster is centred in Alappuzha, Coir cluster in S.L.Puram, Paddy cluster in Kuttanad and Crabgrass Cluster in Cherthala. In Kottayam, there are 3 industrial clusters, Ethnic Food Cluster in Pala, Screw Pine Products in Vaikom and Rubber Products in Changanassery.

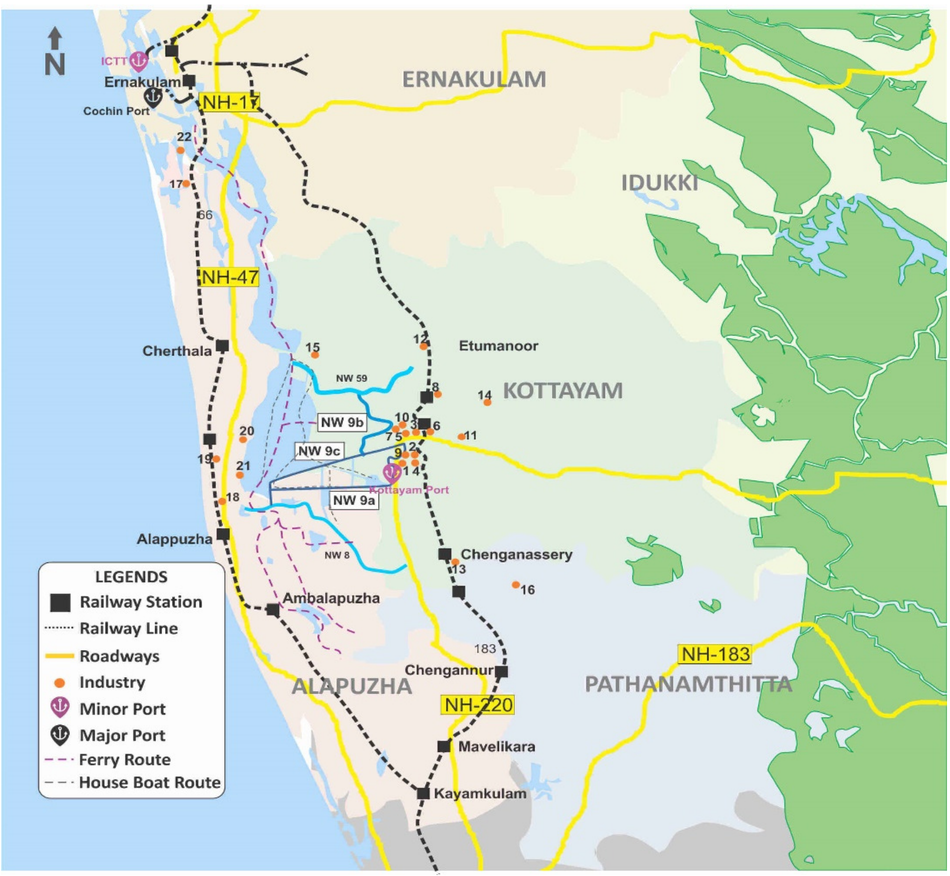


FIGURE 4-8 INDUSTRIES IN THE CATCHMENT AREA OF NW 9

The above image shows various industries located on the catchment area of NW 9 and the connectivity around them. All the industries marked on the map are listed in the below table with the same serial number.

TABLE 4-12 presents a list of industries that are located within 25 km hinterland of NW 9. Some large & medium scale industries are located in Alappuzha & Kottayam districts which are involved in production of rubber tyres, cement etc. These industries include The Travancore Cements Limited at Nattakom and MRF Limited at Vadavathoor.

TABLE 4-12 INDUSTRIES IN THE PRIMARY CATCHMENT OF NW 9

Sr. No.	District	Company	Location	Distance (Km) NW 9	Distance (Km) Cochin Port	Distance (Km) Kottayam Port	Potential	Reasoning
1	Kottayam	Travancore Cements Ltd. (TCL)	Nattakom	0	70	1	✓	TCL would transport raw material from Cochin Port and send its finished product to the port through NW 9 and further NW 3.
2		Oil Palm India	Kodimatha	0	67	4	✗	The company uses roadways to distribute finished products to other states. The company is not willing to use the proposed waterway.
3		Midas Precured Tread	Kottayam	1	66	8	May be	The company uses Kottayam Port to export products. Cargo is moved to the port through roadways, which could be shifted to the proposed waterway.
4		Diamond Roller Flour mill	Pallom	2	71	3		It uses Cochin Port. Rail & Coastal Shipment is used for raw material movement and road is used for transporting finished products. The major hurdle of present mode of transportation is that Rail transportation in full rake load entails demurrage. The company is willing to use waterway, if it is cost effective.
5		MRF	Vadavathoor	4	66	6		MRF uses Cochin Port for EXIM trade. Roadway is used to transport cargo to/from Cochin Port. The company faces road congestion problem everyday on highway. If transportation cost by waterways were cheaper, then MRF would prefer waterway for cargo transportation.
6		Perumacheril Casting Industries	Kottayam	2	66	5	✗	Industries in the catchment area distribute their finished products in the state and in other states. Majority of the industries' production is less in volume, which could not be moved through waterways, as it would not be commercially viable.
7		Ceyenar Chemicals	Kottayam	2	66	6		
8		Hi-tech Cast Iron Industries	Olessa	2	63	12		
9		TJP Rubber Industries	Kottayam	3	71	3		
10		Sanson Chemical Industries	Poovanthuruthu	3	67	6		

Sr. No.	District	Company	Location	Distance (Km)			Potential	Reasoning
				NW 9	Cochin Port	Kottayam Port		
11		Rubberwood India	Manganam	8	72	11		
12		Kottayam Textiles	Vedagiri	12	53	20		
13		Canara Paper Mills	Changanassery	13	87	16		
14		Integrated Power Loom Industrial Co-Op Society Ltd	Ayarkunnam	13	68	16		
15		Modern Rice Mill	Vechoor	22	44	27		
16	Alappuzha	Kanti Floor Furnishers	Alappuzha	11	59	42	✗	Majority of industries in Alappuzha district are located near Vembanad Lake and existing waterway NW 3; hence it is unlikely that these industries would use NW 9 for cargo movement.
17		VKL Seasoning Pvt. Ltd.	Alappuzha	13	59	44		
18		Palm Fibre	Pathirappally	18	52	49		
19		BABU Coir Works	Alappuzha	18	55	49		
20		Detilish Rugs	Kalavoor	21	49	46		
21		Petrogas	Pathirappally	19	74	41		
22		The Alleppey Company Ltd.	Alappuzha	24	48	40	✓	The company exports to USA & UK through Cochin Port. The company already uses the existing waterway to move its bulk cargo. Bulk goods are transported to Cochin Port through waterways for export.

Source: Consultant's Analysis

Travancore Cement Ltd. and Oil Palm India are the nearest industries from the canal, as they are located on the bank of Alappuzha-Kottayam-Maniyaparambu Canal (NW 9).

There are several industries in the secondary catchment area; which are located more than 25 km far from NW 9. The industries in Kottayam include Cochin Cements and St. Marys Rubbers Pvt. Ltd. Alappuzha also has many industries, like Ram Coir mill, Oxide India, D.C. Mills, The Travancore E Mats & Matting Company, Alleppey Co-operative Spinning Mills Ltd., Evershine Chemical, Wilton Weavers Pvt. Ltd., Autocast Ltd., Conso Feeds etc. The industries in the secondary catchment area may use the proposed waterway if it is commercially viable. However due to their distance from the waterway, it is not very likely that these industries would prefer waterway.

Travancore Cements

a. The company mainly produces white cement, named Vembanad White cement. Other end products of TCL are Vembanad white putty and Super Shelcem Cement Paint. The licensed capacity of the plant was 50,800 tonnes of Cement per annum. Earlier, the company's grey cement annual production volume was 20,000 tonnes. The plant produces around 1,000 tonnes of white cement per month. Travancore has expansion plan to increase production of grey cement to 10,00,000 tonnes (1 mn T) and white cement to 60,000 tonnes by FY 2035.

b. The Company used lime shell, White clay, White sand and Gypsum as raw material for producing finished product. The company used Vembanad lake for lime shell extraction which was the major raw material for manufacturing cement; but after ban on extraction from the lake, TCL stopped using Vembanad lake completely. TCL also used to procure limestone from Tirunelveli, Tamil Nadu through roadways, however at present TCL stopped using limestone also as raw material.

c. At present, the company uses clinker as a substitute raw material because Limestone and lime shell are calcium carbonate and clinker also is made of the same material. The company's expansion plans are also depended on clinker as raw material. TCL imports Clinker from Gulf countries through Cochin Port. TCL has 3 cement mills with clinker grinding capacity of 60 tons per hour and other two has capacity of 50 tons per hour. Three silos are developed in the plant area.

d. TCL plant was down for a substantial period due to diminished demand of cement. However, the plant has recently resumed its operation. The company and the state government are trying to revive the plant with expansion plans. At present, only white cement is produced. For grey cement production, the company needs expansion, as the current plant's capacity would be exhausted. If expansion of the plant takes place in near future, only then grey cement would provide opportunity for IWT movement through NW 9. As per TCL, both grey cement and white cement would be transported using NW 9.

Oil Palm India

The company functions as a joint venture of the Government of Kerala and Government of India with share participation of 51% and 49% respectively.

The Company has a plant spread over 3,646 Ha. in three estates namely Yeroor, Chithara and Kulathupuzha in Kollam district. It has wholesale distribution center at Kodimatha in Kottayam district. As per the discussion with the company representative, the company produces 20 tonnes per hour palm oil. The company's annual production is around 0.17 million tonnes/annum. The finished product, refined oil is distributed in different states of India through roadways, using lorries. The company does not export its products to other countries. Oil Palm India is not willing to use waterways for transportation of its cargo; hence the company would not provide any opportunity for the waterway.

Midas Precured Tread

It is a popular brand into tyre retreading material sector. The plant is located in Kottayam. Every year the company sells more than 24,000 T of material. At present, the company is using Kottayam Port to export products. Cargo is moved to the port through roadways. There is potential to shift this cargo from roadways to the proposed waterway.

Diamond Roller Flour Mill

Based on Pollam, Kottayam this is a very famous flour mill in the region. The mill manufactures premium quality wheat flour, fine flour, semolina etc. The annual capacity of the plant is 66,000 MT. The plant procures raw material from Rajasthan, Gujarat, MP, UP and sometimes imports from other countries too through Cochin Port. The plant distributes the finished product to Kerala and Tamil Nadu; it also exports to other countries. Rail & Coastal Shipment is used for raw material movement, whereas road is used for transporting finished products.

As per discussion with the company representative, the major hurdle of present mode of transportation cargo is that Rail transportation in full rake load entails demurrage. The company is willing to use waterway, if it is cost effective.

Perumacheril Casting Industries

This company is into machine manufacturing business. It manufactures machines, like Mixing Mills, Cracker Mills, Refiner Mills, Hydraulic Press, Pre-cured Press, Crepe Mill, Grinding Mill, Calender Machine, Tyre Cutter and Debeader Machine.

Ceyenar Chemicals

The Plant is located in Kottayam district. The company manufactures and supplies Rubber Chemicals & Synthetic Rubber. The Company exports natural and synthetic rubber. The company specializes in producing Styrine Butadine Rubber, Poly Butadine Rubber, Nytrile Rubber etc, Stearic Acid & Zinc Oxide.

Hi-tech Cast Iron Industry

The Company is into gate manufacturing sector. It manufactures 200 models of modern gates and 600 models of cast iron gates. Their products also get exported to Ireland, England, America, Australia and Gulf countries.

TJP Rubber Industries

The Plant is based on 5,000 sq. ft. area and exports its products to USA, Europe and Middle East.

MRF

The annual capacity of MRF, Kottayam plant is 56,000 tonnes. The plant produces around 160 tonnes per day. The plant uses Cochin Port for EXIM trade. Synthetic rubber is used as raw material and is imported from Russia, Japan & USA. Natural rubber is imported from Malaysia. The company also uses Cochin Port for export to different countries. At present, MRF is using roadways to transport cargo to/from Cochin Port. The company faces road congestion problems on highways on a daily basis.

If the waterway is developed by IWAI and the transportation cost by waterways is cheaper, then definitely MRF would prefer waterway for cargo transportation.

Canara Paper Mill

The Company is into recycling mill business. The plant manufactures multi-layer craft paper and paperboard. All the finished products are made from recycled material. The Plant has capacity to recycle about 100 tons of paper everyday. The annual capacity of the mill is 25,000 T. Most of the times, raw material used is old container cartons. The Plant's end product is used as a raw material by corrugated box manufacturers. The company distributes its products in domestic market; hence it would not provide much opportunity for NW 9.

Petrogas

The company specializes in manufacturing and supply of catalyst and support material required for oil processing, fertilizer, refinery, petrochemical, steel, cement and catalyst manufacturing industries. The plant of Petrogas is situated in Pathirapally, Alappuzha. The products of Petrogas includes Inert Bed Support & Topping,

Tabular Alumina, High Purity Alumina Balls, Fused Alumina, ceramic balls, quartz pebbles, porous balls, Alumina gel, Silica gel, Gamma Alumina Catalyst Carriers, Ceramic Grinding Media, Molecular Sieves, Zinc Oxide Desulphurization/Sulfur Catalysts, Alkylation, Defluorination Catalysts, Polymer Feed Purification Catalysts, Arsenic Removal Catalysts, Activated Carbon etc.

Petrogas India doesn't import anything. However, the company exports its products to other countries through Cochin Port. The company also distributes its products in domestic market through roadways. Export quantity varies according to order. On an average, it exports around 30 tonnes product per month. The plant is located near the existing waterway NW 3 (from Kollam to Kottapuram); hence it would not use NW 9 for cargo movement.

Kottayam Textiles

Kottayam Textile is part of Kerala State Textile Corporation Ltd (KSTC). It is a textile company situated in Vedagiri. The Mill is presently running at a commissioned capacity of 24,956 Spindles and is equipped to process finer counts rather than coarser counts. Kottayam Textiles is presently having 57 Ring Frames out of which 9 numbers are imported Ring Frames. The main product of the Mill is Yarn, 100% Cotton Yarn or Polyester Cotton Yarn in variety of product mixes.

If run at maximum utilization, the mill's annual turnover could be approximately INR 20 Crore. The major raw materials used are Raw Cotton and Polyester, which is usually procured from outside of Kerala. Distribution of finished products is mostly done in domestic market through roadways and waterways. The production volume of the company is not much that could be diverted to the proposed waterway.

Kanti Floor Furnishers

The annual capacity of the company's production of PVC backed coir mat is 20 Million Square feet, Poly Propylene washable mat is 60 Million Square feet and Printing is 10 Million Square feet. The Surging capacity is 200 Million RM/Year.

The Alleppey Company Ltd.

The Company manufactures Coir products. It distributes its finished products to different states and imports to different countries. The company mostly exports to USA and UK through Cochin Port and Tuticorin port.

Export is usually done in containers. Goods are loaded from Alappuzha and reaches Cochin through railways. Bulk goods are transported to Cochin Port through waterways for exports.

Diversion from Industries

Travancore Cements Ltd. would provide a definite potential to the waterway. The company is already using the waterway. After development of NW 9, it would use it for the movement of its raw material and finished product. TCL has expansion plan to increase production of grey cement to 1 mn T and white cement to 60,000 tonnes by FY 2019. As per discussion with TCL, it can be estimated that entire volume of TCL's raw material clinker, which is imported from Cochin Port could be diverted to the waterway. The finished product of TCL, i.e. cement could also be transported to Cochin Port through the waterway.

The industrial cargo of few companies based in Kottayam, like MRF, Midas Precured Tread, Diamond Roller Flour Mill and The Alleppy Company Limited in Alappuzha could be shifted to the proposed waterway in NW 9. These industries use Cochin Port; hence cargo could be moved through NW 9 and merge with NW 3 and can be directly shipped to Cochin Port.

Most of the industries in Alappuzha are located near NW 3; so it is very unlikely that these industries would use the proposed waterway in NW 9. After the development of the waterways, other industries of Alappuzha & Kottayam would also likely use NW 9 and further use NW 3 for cargo transportation to/from Cochin Port or distribution in the hinterland. Waterway is a good alternate to avoid road congestion problem and save time.

4.2.5 Traffic from Major & Non Major Ports

There exist two ports in the primary catchment of NW 9, Cochin Port (major port) and Kottayam Port & Container Terminal (KPACT) (non-major port). Industries in the hinterland use these ports for their EXIM trade and hence traffic of these two ports could be diverted to the proposed waterway.

a. Non Major Port

Kottayam Port and Container Terminal (KPACT)

Kottayam Port is an Inland Container Terminal & Minor Inland port located on the banks of NW 9a. KPACT is connected to Cochin ICTT (Vallarpadam ICTT) via Inland Waterway & Road Network. TABLE **4-13** shows the cargo handled at Kottayam Port during the past 4 years.

TABLE 4-13 EXIM CONTAINER TRAFFIC AT KPACT

(in TEU)

Year	Import	Export	Total
FY 13	697	60	757
FY 14	1,523	90	1,613
FY 15	2,012	113	2,125
FY 16	2,470	173	2,643
FY 17*	2,139	173	2,312

Source: KPACT

(* Till December, 2016)

2,643 TEU's of cargo was handled annually at KPACT in 2015-16. The traffic has grown at a CAGR of 52% from FY 13 to FY 16 and is expected to increase further when barge operations are started at the Port.

The cargo handled at KPACT is EXIM (Export-Import) cargo, which is either destined to, or originates from ICTT Cochin. Since, the proposed waterway will be providing direct connectivity between Kottayam Port and Vallarpadam ICTT terminal via proposed NW 9 (9c), therefore, most of the traffic is expected to shift to IWT for shipping from/to Cochin Port. This is because the same will reduce the handling time at the Container terminal and travel time to ICTT terminal as freight vehicles are not allowed to pass the cities surrounding Kottayam Port during day time, which leads to the traffic being stuck at the Terminal till night. Additionally, the transportation costs will also come down by using waterways as compared to road transport.

- **Diversion from Kottayam Port and Container Terminal (KPACT)**

The infrastructure of KPACT has been built adjacent to Inland Waterways with the objective of moving all containers from Kottayam and its hinterland to Vallarpadam ICTT exclusively by container barges. However, these containers are currently being shipped to the ICTT using trucks, due to non-availability of cranes and re-stacker for Container handling. The trial runs of container barge have already been done by KPACT. Once these container barges become commercially operational, they would offer a huge potential for NW 9, as the traffic from Kottayam port can use NW 9a to access NW 3 near Alappuzha in one option and can also use NW 9a, NW 9b, NW 9c & NW 59 an alternative route to access NW 3.

b. Major Ports

There exists one major port in the catchment area, i.e. Cochin Port.

Cochin Port Trust

The proposed waterway in NW 9 is connected to Cochin Port via the existing national waterway, i.e. NW-3 (from Kollam to Kottapuram). This connectivity is crucial for the development of the proposed waterway, as the existing waterway would provide a direct connectivity to Cochin Port for the cargo traffic.

Cochin Port is an all-weather port, which handles all types of commodities including POL & non-POL products. TABLE 4-14 shows the traffic handled at Cochin Port from FY 10-11 to FY 14-15. In FY 14-15, approximately 21.59 MMTPA of cargo has been handled at Cochin Port Trust, which is 3% higher than the preceding year. The traffic has grown at a CAGR of 5% from FY 11 to FY 15.

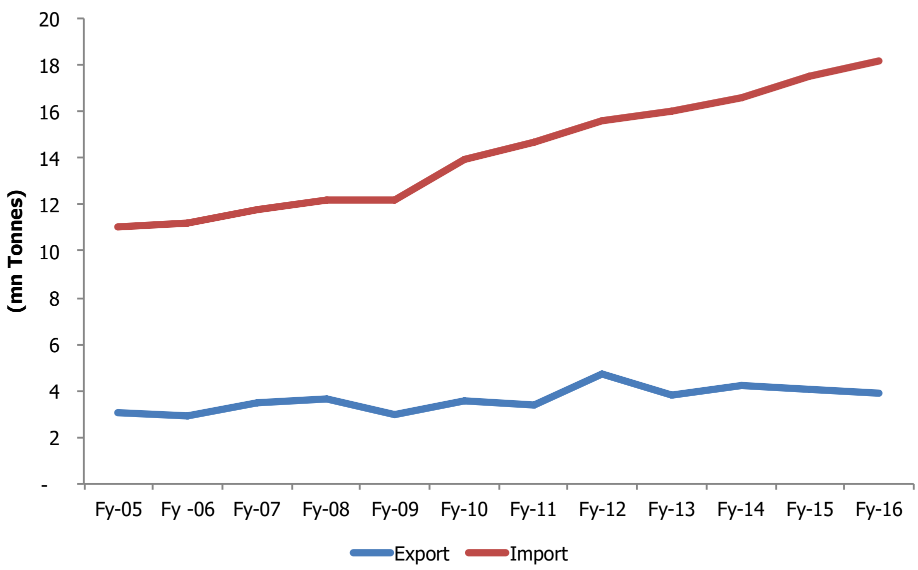
TABLE 4-14 CARGO HANDLED AT COCHIN PORT

Sl. No.	Commodity	FY 11	FY 12	FY 13	FY 14	FY 15
(Liquid Cargo, in '000' Tonnes)						
1	Crude oil	8,863	10,027	10,186	10,228	10,746
2	POL	3,318	3,983	3,709	4,093	3,271
3	LNG	0	0	0	115	395
4	Phosphoric Acid	154	100	143	154	82
5	Others	147	129	161	242	271
Total		**12,482**	**14,239**	**14,199**	**14,832**	**14,816**
(Bulk Cargo, in '000' Tonnes)						
Sl. No.	**Commodity**	**FY 11**	**FY 12**	**FY 13**	**FY 14**	**FY 15**
1	Muriate of Potash (MOP)	76	59	22	36	68

Sl. No.	Commodity	FY 11	FY 12	FY 13	FY 14	FY 15
2	Urea	-	56	-	-	-
3	Sulphur	194	171	148	148	173
4	Rock Phosphate	158	145	183	123	204
5	Cement	259	350	311	604	703
6	Coal	40	34	28	-	98
7	River sand	-	-	-	32	163
8	Shredded Scrap	27	27	29	27	-
9	Others	146	185	194	122	78
Total		**900**	**1,027**	**915**	**1,092**	**1,487**
(Break Bulk, in '000' Tonnes)						
Sl. No.	**Commodity**	**FY 11**	**FY 12**	**FY 13**	**FY 14**	**FY 15**
1	Machinery	-	-	-	-	11
2	Iron & Steel	-	43	14	6	16
3	Timber Logs	61	64	95	156	11
4	Others	11	3	15	16	8
Total		**72**	**110**	**124**	**178**	**46**
(Container Traffic)						
1	TEU's	3,12,189	3,37,053	3,34,925	3,46,204	3,66,377
2	Weight ('000' Tonnes)	4,419	4,715	4,607	4,785	5,246
Total		**4,419**	**4,715**	**4,607**	**4,785**	**5,246**
Grand Total (Cargo Handled, '000' Tonnes)		**FY 11**	**FY 12**	**FY 13**	**FY 14**	**FY 15**
		17,873	20,091	19,845	20,887	21,595

Source: Cochin Port, Kerala

Liquid Bulk cargo of 14.8 mn T has highest trade at Cochin Port. The below graph depicts the historical EXIM trade of Cochin Port.



Source: Cochin Port, Kerala

FIGURE 4-9 EXIM TRADE OF COCHIN PORT

Export Traffic of Cochin Port- Container & liquid cargo contributes majority of share to export traffic. There is no drastic change in the container volume handled over the last 10 years. Rubber, textile based and food processing industries are found in Alappuzha & Kottayam district, which are also export based. There is BPCL refinery at Cochin with a crude oil refining capacity of 9.5 MMTPA. At Puthuvypeen near Cochin, there is planning to develop liquid terminal to handle increased demand in near future. As per IOC Kerala, demand of LPG in India is growing at 11% rate.

Import Traffic of Cochin Port- Volume of import traffic handled at Cochin port is more than export traffic and it has steadily grown over the years. Majority of the commodities are imported in Kerala either from other countries or from neighboring states. Kerala being a consumer state depends on other states for almost all commodities of daily consumption.

- **ICTT Cochin (Vallarpadam ICTT)**

The International Container Trans-shipment Terminal (ICTT), locally known as the Vallarpadam Terminal, is a container transshipment facility, which is part of the Cochin Port. The terminal is the country's first international transshipment gateway facility. It is a 14.5 metre draft Transshipment Terminal, operated by DP World capable of handling post panamax ships. The terminal has a design capacity of around 4 million TEUs. Out of this, most of the traffic around 3 lakh TEU is handled by ICTT to/from North Kerala using trucks. Around 1 lakh TEU from ICTT is handled to/from South Kerala, which falls in the catchment area of NW 9.

Traffic of ICTT has witnessed 19% growth in container traffic in FY 15-16. ICTT has been handling an average of 40,000 TEUs per month consistently over the past six months in FY 16. The terminal handled the highest monthly volume of more than 45,000 TEU in March 2017. The launch of a weekly train service connecting Karnataka and Kerala and the existing rail links between Tamil Nadu and Kochi contributed to the growth in container traffic. During FY 16-17, the terminal recorded an increase in coir exports, along with apple and orange imports. Vallarpadam ICTT also facilitated the direct imports of East African raw cashew. The cashew was further transshipped to the other ports, including Mangaluru and V O Chidambaranar Port, Tuticorin.

- **Diversion from Cochin Port/ ICTT Cochin**

The above mentioned commodities which are handled at Cochin Port, as mentioned in TABLE 4-14 could be potential commodities and could be transported through the proposed waterway. As Cochin Port is the only major port in the catchment area of NW 9, majority of the industries in the catchment area of NW 9 use Cochin Port for their EXIM trade. These industries would very likely use the proposed waterway to transport their cargo to/from Cochin Port. At present these industries use roadways for cargo transportation; however, this mode of transportation faces problem of heavy traffic and road congestion. Using waterway would be a beneficial alternative for industries. Industries could use NW 9 and move further ahead in existing NW 3 to reach Cochin Port and visa-versa.

Travancore Cements Limited (TCL), which is one of the major cement companies in the region, uses Cochin Port for importing clinker from gulf countries. The company uses the port for importing limestone also. However, at present the company only imports clinker, but in future they may also import limestone. These imported raw materials would provide opportunity for the proposed waterway in NW 9. TCL also uses Cochin Port for exporting its finished products, which could also be diverted to the proposed waterway.

ICTT, Cochin- Containers are transported from ICTT of Cochin Port to Kottayam Port and Container Terminal (KPACT) and visa versa. Currently, some traffic from the catchment of NW 9 is expected to be accessing the transshipment terminal using trucks. There exists potential of diverting this traffic to IWT for direct connectivity to ICTT (via proposed NW 9 & existing NW 3). Once the barge service at Kottayam Port becomes operational, the container traffic is expected to increase at Kottayam Port because of the improved connectivity with the Cochin Port.

4.3 Commodity Composition

At present, the waterway is not being used for cargo movement. NW 9a originates near Alappuzha and terminates at Kottayam (near Kodimatha) and connects the towns of Kottayam & Alappuzha. In addition to these towns, NW 9a also provides direct connectivity to Kottayam Port & Container Terminal (KPACT) and The Travancore Cements Limited at Nattakom.

NW 9b originates at Kanjiram Junction and terminates at Maniyaparambu. NW 9b passes through the periphery of Kottayam town and terminates at Maniyaparambu (Arpookara Village). The waterway doesn't connect major towns or settlements. The potential of this waterway depends on traffic originating from KPACT and other developments in vicinity.

NW 9c originates at Kainakary North & terminates at Kottayam. The waterway connects Kottayam town with Kainakary North Village. The waterway merges with NW 9a at both ends. The stretch mostly comprises of agricultural fields. No major industries or settlements are located along the waterway. NW 9c directly connects Kottayam to NW 3; hence this waterway would be used for the traffic originating from/destined to KPACT for accessing Cochin ICTT.

4.3.1 Mineral

Mineral like Sand, Silica Sand, and Laterite are found in Alappuzha district and Graphite & Lime shell are major minerals found in Kottayam district. But most of these mineral mining areas are not located in the vicinity of NW 9 Canal. Also, the major source of lime shell Vembanad Lake is declared a wetland, defined by the Ramsar Convention. In the lake, extraction of lime shell and excavation is banned. Therefore, minerals would not provide any potential to IWT.

4.3.2 Cement

Travancore Cements Ltd. (TCL)

Travancore cement is the only major cement manufacturing company in the catchment area of NW 9. The Company used to extract raw material from Vembanad Lake; however, since Vembanad Lake is declared a wetland, defined by the Ramsar Convention; extraction of lime shell and excavation in the lake is banned. Travancore cement has its own jetty in Kadoor river, which is a part of NW 9.

Travancore has expansion plan to increase production of grey cement to 10,00,000 tonnes (1 mn T) and white cement to 60,000 tonnes in near future. The company uses clinker as raw material, which is imported from Gulf countries through Cochin Port. The imported clinker and finished product, Cement would provide definite opportunity for NW 9, as the company is willing to use the waterway to move its cargo to/from Cochin Port.

Cochin Port

Containers are transported from ICTT of Cochin Port to Kottayam Port and Container Terminal (KPACT) and vice versa. These containers could be moved using NW 3 and NW 9.

Travancore Cements Limited (TCL), which is one of the major cement companies in the region, uses Cochin Port for importing clinker from gulf countries. The company uses the port for importing limestone also. However, at present the company only imports clinker, but in future they may also import limestone. These imported raw materials would provide opportunity for the proposed waterway in NW 9. TCL also uses Cochin Port for exporting its finished products, which could also be diverted to the proposed waterway.

Cochin Port Trust handles approximately 0.7 MMTPA of cement annually, which is shipped as Dry bulk and its packaging is done at the Bagging plants located at Cochin Port. The Port has bagging plants for three cement manufacturers namely, Ambuja Cement, Ultratech Cement & Zuari Cement. The bagged cement is transported to various cities in Kerala & South India via Trucks. However, there is no potential to divert the same via inland waterways because these companies are not willing to use waterway.

4.3.3 Fertilizer

The fertilizer utilisation in the districts in the catchment area is considerable. Approximately 95,000 Metric Tonnes of Fertilizers are used in Alappuzha & Kottayam district every year. Following table describes fertilizer consumption in Kottayam & Alappuzha district in the catchment area.

TABLE 4-15 FERTILIZER CONSUMPTION IN ALAPPUZHA & KOTTAYAM

District	Fertilizer Consumption					
	Urea	SSP	MOP	NPK	DAP	City Compost
Alappuzha	-	-	753	5,060	-	8
Kottayam	38,119	174	22,407	16,422	11,483	102
Total	**38,119**	**174**	**23,160**	**21,482**	**11,483**	**110**

Source: Fertilizer Monitoring System, Govt. of India

There does not exist any fertilizer plant in the catchment area of NW 9. There are many agricultural fields around NW 9 and fertilizers get consumed for agriculture in this region; hence fertilizers allocated in the catchment area would not provide any opportunity for the proposed waterway.

4.3.4 POL

A major petroleum refinery is located at Cochin; i.e. Bharat Petroleum Corporation Ltd. (BPCL). The imported crude oil imported from Cochin Port is sent to the BPCL refinery through 30" via pipeline, having total length of 25 km. After reaching the refinery, the processed petroleum products are sent to their respective destinations by trucks. The crude oil imports are around 10.5 MMTPA and about 3 MMTPA of processed fuel is exported. Rest of the fuel is sent to various destinations via trucks. At present, BPCL's capacity is 9.5 mn T and proposed expansion would be upto 15.5 mn T. POL would not provide any opportunity for NW 9 using IWT as all the raw material and finished product transportation takes place between Ernakulam and Cochin refinery. BPCL does not have any operation in the catchment area of NW 9; hence there would not be any potential for POL transportation through NW 9.

4.3.5 Other bulk & break bulk commodities

In the primary and secondary catchment area of NW 9, there does not exist any iron & steel or thermal power plant. Thereby no scope for other bulk commodities like coal, coke or break bulk commodities like steel etc.

4.4 Originating & Terminating commodities

The below table depicts the commodities, which would provide opportunity to NW 9.

TABLE 4-16 COMMODITIES AND POTENTIAL FOR NW 9 in FY 25

Cargo	Volume (T)	Origin	Destination	Potential for NW 9
Container	3,800 TEU	ICTT (Cochin Port)	KPACT	✓
Container	1,200 TEU	KPACT	ICTT (Cochin Port)	✓
Grey Cement	1,000,000	TCL	Cochin Port	✓
White Cement	60,000	TCL	Cochin Port	✓
Clinker/ Limestone	700,000	Cochin Port	TCL	✓

Source: Consultant's Analysis

4.5 Passenger Traffic

Passenger Ferry Terminal

There exist passenger ferry services in both Alappuzha & Kottayam districts. State Water Transport Department, Government of Kerala operates Passenger services. There exist total 14 stations under State Water Transport Department, out of which 8 fall under Alappuzha district and 2 fall under Kottayam District. Alappuzha- Kottayam boat service is run by state Government and there is no luxury facility. It is a country style boat, which takes about 2.5 hours to reach Kottayam from Alappuzha. In between, the boat stops at 40 points, basically it stops at every village. Kanjiram (7 km away from

Kottayam) is the last stop of this ferry service. Due to construction of bridge at Kottayam, the ferry does not go to Kottayam town jetty.

As per statistics (FY 14-15) of State Water Transport Department, Govt. of Kerala, following Ferry stations fall under both Alappuzha & Kottayam districts.

- **Alappuzha-** Alappuzha, Nedumudy, Kavalam, Pulinkunnoo, Edathua, Vaikom, Mohamma & Panuavally
- **Kottayam-** Kottayam & Changanassery

TABLE 4-17 BOAT SERVICE BETWEEN ALAPPUZHA & KOTTAYAM

To	From	Time	Route
Alappuzha	Kottayam	7.30	Via Chithira - Pattaserry - Vettikadu
		9.35	Via Kuppapuram - Pandissery
		11.30	Via Soman Jetty - Kuppapuram - Pullathussery
		14.30	Via Kuppapuram - Chithira
		17.15	Via Kuppapuram - Pandissery

Source: State Water Transport Department, Govt. of Kerala

4.5.1 Alappuzha Ferry Station

A total of 8 Routes are operational from Alappuzha Ferry Station. Table 4-18 shows the list of routes operational from Alappuzha Station. The below table also shows the travel time for each route.

Table 4-18 Operational ferry route from Alappuzha

Route No.	Route Name	Travel Time (hh:mm)	Average Passengers Handled (Daily)
1	Alappuzha to Nedumudy	1:30	550
2	Alappuzha to Pulinkunnoo	2:30	200
3	Alappuzha to Kavalam (Island)	2:15	650
4	Alappuzha to Kayalapuram	2:15	750
5	Alappuzha to Changanassery	3:00	400
6	Alappuzha to Kottayam	2:30	300
7	Alappuzha to Kainakari	1:00	530
8	Alappuzha to Venattukadu	1:30	750
Total			4,130

Source: State Water Transport Department, Govt. of Kerala

From Kottayam station ferry service goes to Alappuzha only. First ferry starts in the morning at 06:45 am via Chithira – Pattassery and last ferry at 05:15 pm from Kottayam via Pattassery – Chithira.

As per the data of SWTD, approximately 4,130 passengers use the ferry services from Alappuzha station along various routes on daily basis. Table 4-18 shows the average passengers handled daily along various routes from Alappuzha.

4.5.2 Kottayam & Changanassery Ferry Station

The table below shows the list of routes operational in the catchment of Kottayam & Changanassery Station, along with the travel time for each route. As per the data collected from Changanassery ferry station, approximately 444 passengers use ferry services along various routes. The below table shows the average passengers handled daily along various routes in vicinity of Changanassery.

TABLE 4-19: FERRY ROUTES OPERATIONAL FROM KOTTAYAM & CHANGANASSERY STATION

Route No.	Route Name	Travel Time (hh:mm)	No. of average passengers handled (Daily)
1	Changanassery to Alappuzha	3:00	125
2	Alappuzha to Meghailpally	1:30	110
3	Meghailpally to Lissio	1:00	45
4	Lissio to Changanassery	1:30	40
5	Changanassery to Rajapuram	1:30	2
6	Rajapuram to Kidangara	1:00	2
7	Kidangara to Lissio	1:00	40
8	Lissio to Changanassery	1:30	80
9	Kottayam to Alappuzha	2:30	-
Total			444

Source: State Water Transport Department, Govt. of Kerala

Kodimatha ferry station is the newly opened ferry boat station in Kottayam district, which is a popular means of transportation for tourists to commute from one place to another. Ferry services are available from here even when the water level is relatively low. Daily ferry services operate from Kodimatha boat Jetty in Kottayam and take the visitors through the backwaters of Kerala. From this boat jetty, tourists can reach various destinations like Kovalam, Kumarakom, Alappuzha and Nedumudi.

FIGURE 4-10 EXISTING FERRY STATIONS

Passenger ferry services have been operational in the waterway and there are several places of tourist interest enroute, which are listed below in the table.

TABLE 4-20 FAMOUS PLACES ENROUTE KOTTAYAM & ALAPPUZHA FERRY RIDE

Time	From	To	Distance (km)	Fare (INR)	Famous Sights of tourism interest enroute
11.30	Alappuzha	Kottayam	29	17	Finishing Point of World famous Nehru Trophy Boat Race, Round Shaped Lakes, Manorama Church at Kuppappuram, Large Lake Paddy Fields, 'R' Block where Holland scheme Agriculture is done, Villages on either side of the canal, stretching 5 km.
13.00/ 17.15	Kottayam	Alappuzha	29	18	Canal stretching about 5 km, Villages on either side of the canal, Large Lake Fields, Chithira Church on the bank of the lake, 'R' Block where Holland scheme Agriculture is done, Lake Vembanad, Lamp post, Manorama Church, Round Lake, Finishing point of Nehru Trophy Boat Race
15.30	Kottayam	Alappuzha (via. Aryad)	34	19	Canal stretching about 5 km, Villages on either side of the canal, Large Lake Fields, Circum Navigation through three sides of 'R' Block, Lake Vembanad

There already exist ferry services in several locations along the route of the catchment area of NW 9 and passengers are using these ferry services. Hence, there would not be further potential for passenger traffic for IWT at NW 9. In future, when passenger traffic would increase in the existing ferry routes, there may be a need for additional infrastructure to handle the growing number of passengers.

4.6 Tourism Traffic

Kerala is one of the favorite Indian tourist destinations among Indian as well foreign tourists. Tourists from all over the world, especially from UK, USA, France and Australia visit Kerala every year. Apart from scenic beauty and backwaters of Kerala, Ayurveda is another major attraction among foreign tourists. Ayurveda is popular in UK, France, Spain, Italy, Germany and Gulf Countries; however, the largest number of tourists coming to Kerala for Ayurveda is from Germany. In the catchment area of NW 9, there are several tourist spots in Alappuzha & Kottayam districts.

Alappuzha

Alappuzha tourism has grown significantly from past so many years. There are plenty of tourist destinations in Kerala. Backwaters of Alappuzha are famous around the globe. Alappuzha is famous for Houseboat holidays, boat race and marine products. At Alappuzha, 15 houseboat fleets are stationed. Sanchari luxury cruiser runs from Alappuzha and Quilon and has capacity of 40 persons. This cruiser runs every day during peak tourist season. ATDC also owns new luxury cruiser called Safari, which also has 40 persons seating capacity. Alappuzha to Kottayam is recognized as most exotic Backwaters cruise in Kerala. Old heavy cargo carriers used in Kerala are now converted into house boats for back water ride.

Kottayam

Tourism is the major contributing sector to economy of Kottayam district. The major tourist places near NW 9 in Kottayam are Vembanad Lake and Kumarakom Wildlife Park. Located 10 km away from Kottayam and set in the backdrop of Vembanad Lake, Kumarakom is a beautiful tourist spot. Kumarakom Bird Sanctuary is noted for its rare species of birds arriving from Siberia in the winter season.

It is also famous for beautiful mangrove forest. Traditional country boats, crafts and canoes ply on Vembanad Lake. There are resorts in the surroundings of the lake that provide various options to tourists like Ayurvedic massages, Yoga and meditation. Changanassery Temples also attract many tourists every year. Hill station called Wagamon, which is more than 60 km away from the stretch of NW 9, is a famous trekking spot.

TABLE 4-21 TOURIST PLACES IN THE CATCHMENT AREA OF NW 9

Sl. No.	District	Tourist Place	Distance from NW 9 (km)
1	Kottayam	Thazhathangady Juma Masjid	0*
2		St George Knanaya Catholic Forane Church	0*
3		Mozart Art Gallery	1
4		Thaliyil Mahadeva Temple	1
5		Municipal Jublee Park	3
6		Thirunakkara Mahadev Temple	3
7		Ettumanoor Mahadeva Temple	12

Sl. No.	District	Tourist Place	Distance from NW 9 (km)
8		Malliyoor Sri Maha Ganapathi Temple	15
9		Bay Island Driftwood Museum	16
10		Kumarakom Bird Sanctuary	17
11		Changanassery Temples	27
12		Pathiramanal Island	24
13	Alappuzha	Vembanad lake	0*
14		Mullackal Rajarajeshwari Temple	12
15		Kalloorkad St. Mary's Basilica Church	16
16		International Coir museum	21
17		Chakkulathukavu Sree Bhagavathi Temple	28
18		St. Andrew's Basilica	39

(*- On the bank of NW 9)

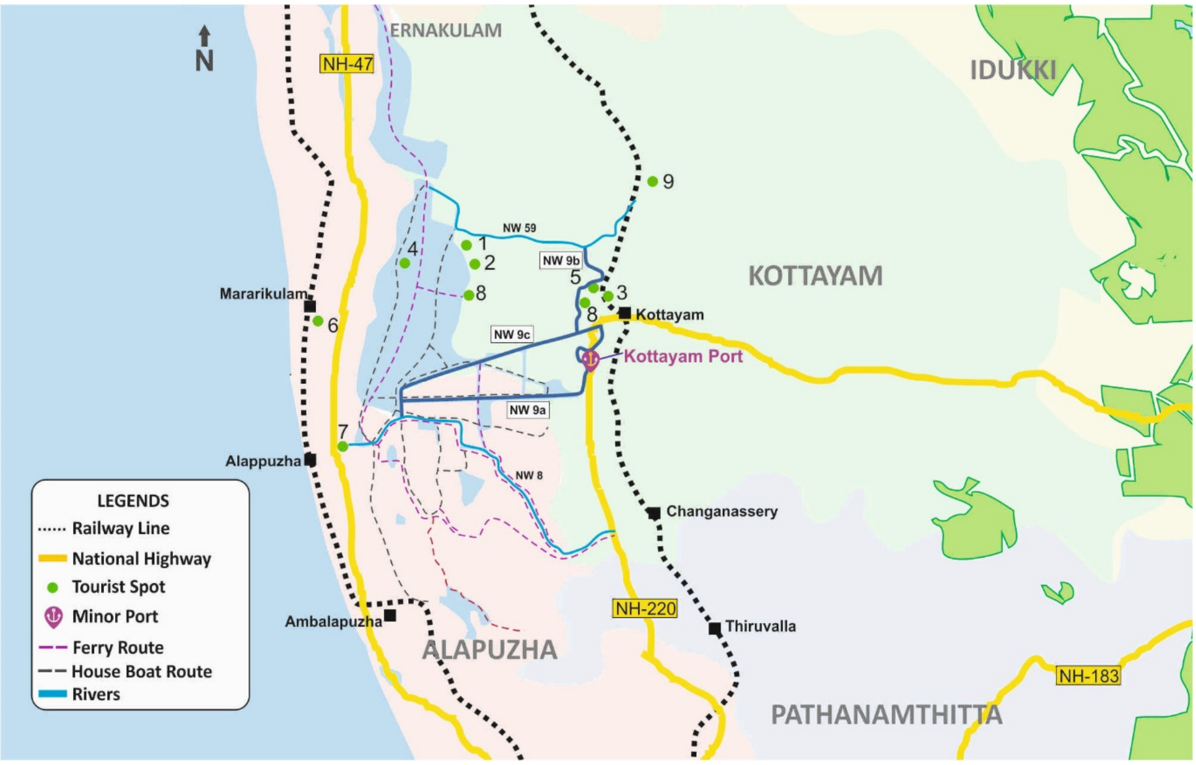


FIGURE 4-11 TOURIST PLACES AROUND NW 9

Index	
Sr. No.	**Tourist Place**
1	Kumarakom Bird Sanctuary
2	Bay Island Driftwood Museum
3	Thazhathangady Juma Masjid
4	Island of Pathiramanal
5	Mozart Art Gallery
6	International Coir Museum
7	Mullackal Rajarajeshwari temple
8	Thaliyil Mahadeva Temple
9	Ettumanoor Mahadeva Temple

The table below shows the tourist arrivals in Alappuzha & Kottayam districts. It is observed that more than 7.5 lakh tourists visited Alappuzha and Kottayam districts in FY 14-15. Some of the tourist locations are located in the catchment of NW 9. The tourist traffic of these places would be considered for tourist projection of NW 9.

TABLE 4-22 HISTORIC TOURIST ARRIVALS IN ALAPPUZHA & KOTTAYAM DISTRICT

District	International Tourist Arrivals					
	2010	2011	2012	2013	2014	2015
Alappuzha	41,977	46,019	50,760	55,364	60,337	63,838
Kottayam	32,561	37,573	40,926	40,932	44,366	49,976
Total	74,538	83,592	91,686	96,296	1,04,703	1,13,814
District	**Domestic Tourist Arrivals**					
	2010	**2011**	**2012**	**2013**	**2014**	**2015**
Alappuzha	1,83,416	1,99,670	2,11,799	2,25,061	2,46,156	2,70,507
Kottayam	3,01,599	3,34,747	3,54,270	3,82,197	4,13,182	4,58,101
Total	4,85,015	5,34,417	5,66,069	6,07,258	6,59,338	7,28,608

Source: Kerala Tourism Statistics, 2015 (Govt. of Kerala)

Tourist places around the proposed waterway would attract tourists. Tourists could also enjoy houseboat ride or ferry boat ride on the waterway to see the surrounding beautiful places in the catchment area.

Though there is potential of tourism growth in the catchment area of proposed NW 9, tourism would not provide any opportunity for the proposed waterway. There already exists ferry service in the backwaters of Alappuzha and Kottayam. Tourists would use the existing ferry service and there is no requirement of additional infrastructure to handle tourist traffic.

4.7 Growth Trend

4.7.1 Cargo Growth for NW 9

Hinterland defined by IWAI, i.e. 25 km from the proposed waterway has some major & medium industries; however, all the industries are not willing to use the waterway. Industries that use Cochin Port or KPACT could use the waterway to move their cargo through NW 9 and further in NW 3.

Travancore Cement Ltd., which has expansion plans, would use the waterway for transporting its exported raw material (Clinker/ limestone) and finished product (Cement) to/from Cochin Port.

Containers that are transported between ICTT Cochin and KPACT would also be diverted to the waterway.

The proposed waterway 9c is directly connected from Kottayam to NW 3 in Alappuzha. Using 9c and NW 3, industries could access KPACT and Cochin Port both. Hence, industries of both the districts would prefer 9c. Industries would not provide opportunity for 9a & 9b as 9c would fulfill the requirement of industries.

Waterway movement is viable and beneficial only for high volume cargo; minerals, agriculture product and fertilizers would not create any opportunity for NW 9 because their volume is less.

4.7.2 Passenger Growth for NW 9

At present, ferries ply between Alappuzha, Kottayam & Changanassery. Locals of the region use these ferries for movement from one place to another. Due to road congestion and long distance via roadways, people prefer waterways to travel between Alappuzha and Kottayam. Passenger traffic has witnessed growth in last few years and it would likely grow in future.

The state government has plans to ply Catamaran boats in the waterways for passengers and tourists. Such existing and upcoming infrastructure and facilities are sufficient to handle the growing number of passengers and tourists in future, limiting scope for IWT proposed terminal.

4.7.3 Tourism Growth for NW 9

It is observed that more than 7.5 lakh tourists visited Alappuzha and Kottayam districts in FY 14-15. There are several places of tourism interest near NW 9. Places like Vembanad Lake, Mozart Art Gallery, Kumarakom Bird Sanctuary, which are located near the catchment area of NW 9, attract the maximum number of tourists in the catchment area, but they would not provide opportunity for NW 9.

Tourists use existing ferry service and houseboats to travel the places near the waterway. As the existing infrastructure is sufficient for handling tourist traffic, at present and in future; there is no need for IWT to develop additional terminal at NW 9.

4.7.4 Comparison of FSR & DPR study

The below table shows an analysis of the commodities, which are considered as potential traffic for NW 9 in FSR and also considered in DPR for the study and analysis. The commodities, which are considered in FSR and are also considered as potential commodity in DPR are listed with suitable reasoning. Those commodities, which are considered in FSR but during DPR stage, it was found that these commodities would not provide any opportunity for NW 9; they are also presented below with proper reasoning. Potential from commodities, tourist and passenger for NW 9 is explained in the below table, with reasoning.

TABLE 4-23 ANALYSIS OF FSR STUDY

Commodity	Source	Considered in DPR	Potential	Reasoning
Container	ICTT (Cochin Port)	✓	✓	Containers are transported between ICTT (Cochin Port) to Kottayam Port and Container Terminal (KPACT). These containers could be moved using NW 3 and NW 9.
Container	KPACT	✓	✓	
Industrial Traffic	Operational in the catchment area	✓	✓	Travancore Cements is willing to use NW 9 and further NW 3 to move its product, i.e. cement to Cochin Port. Other industries would also likely prefer using NW 9 to save travel time and overcome road congestion problem.
ICTT Cochin Traffic	ICTT (Cochin Port)	✓	✓	ICTT would provide opportunity for container traffic. As ICTT is part of Cochin Port; hence the potential from ICTT is added with Cochin Port.
Minerals	Extracted from mines in the catchment area	✓	✗	Less volume of minerals; extraction of lime shell from Vembanad Lake is banned. No opportunity from minerals.
Cement	Travancore Cements	✓	✓	Travancore Cements is willing to use NW 9 and further NW 3 to move its product, i.e. cement to Cochin Port.
Fisheries	Caught in the catchment area	✓	✗	Fish catch is mostly consumed locally, and volume of exported fish is less; hence no opportunity.
Food Grains & Horticulture	Produced in the catchment area	✓	✗	Mostly consumed locally or used by local industries. Jackfruit, which is grown in large volume in the region is consumed locally and exported in processed form. The volume of processed fruit products is not huge that it could be a potential for the waterway. Coconut

Commodity	Source	Considered in DPR	Potential	Reasoning
				is also grown in large volume; however, it is the major raw material for coir industry and food processing units; hence consumed by these industries.
Fertilizer	Allotted in the catchment area	✓	✗	Used in agriculture and consumed in the catchment area.
POL	BPCL, Cochin	✓	✗	POL is transported via pipeline and raw material and finished products are transported between Cochin and Ernakulam. As POL is not transported in NW 9 catchment area; hence no potential from POL.
Passenger	Population of the catchment area	✓	✗	Ferry service is already operational in the catchment area; hence there is no potential for IWT proposed terminal. Passengers would continue to use the existing ferry service.
Tourism	Tourist Spots	✓	✗	Tourist traffic of the region would be handled by existing ferry service; hence no opportunity for IWT.

Source: Consultant's Analysis

4.8 Forecasting & Potential IWT Assumption

The below mentioned factors are considered for forecasting traffic for the proposed waterway.

- ✓ Containers movement between KPACT and ICTT could be diverted to the waterway. Only container movement from KPACT is considered for traffic, as the terminal of KPACT is located on proposed NW 9. The container volume handled by KPACT in Fy 16 is the basis for container traffic projection. In Fy 16, 2,470 TEU Container was sent from ICTT to KPACT and 173 TEU containers is sent from KPACT to ICTT. This container volume of Fy 16 is provided by KPACT. KPACT has told during interaction that due to lack of infrastructure, there is limited container volume at present. Once NW 9 and proper infrastructure is developed at KPACT, then more customers would use KPACT for container movement.
- ✓ Future cargo projection is made based on the present traffic in the region. These would be potential commodity for NW 9 waterway.
- ✓ Travancore Cements Ltd. (TCL) has showed willingness to use the proposed waterway to transport imported clinker/limestone from Cochin Port and move its finished product cement to Cochin Port.
- ✓ The future projection is based on interaction with prospective stakeholders (Kottayam Port & Container Terminal and Travancore Cement Ltd).
- ✓ Traffic Projection for container traffic is based on the capacity expansion plans and business growth possibility of KPACT for Fy 16 to Fy 40.
- ✓ Growth rate has not been considered for projecting the future container traffic at KPACT. Traffic Projection for container traffic is based on the projected traffic provided by KPACT & TCL for Fy 16 to Fy 40. During interaction, KPACT has shared input that at present, container volume at KPACT is limited due to lack of infrastructure. After development of proper infrastructure at KPACT and NW 9, more customers would use KPACT for container movement. TCL has an expansion plan to increase production of grey cement to 10,00,000 tonnes (1 mn T) and white cement to 60,000 tonnes.. The raw material for this plant would be clinker (700,000 tonnes).
- ✓ In the table below, traffic volume of Fy 16 depicts existing cargo volume of the targeted ports and industry.

The future potential volume of TCL is considered based on the interaction with the company. TCL plant was down for a substantial period due to diminished demand of cement. However, the plant has recently resumed its operation. The company and the State Government are trying to revive the plant with expansion plans. The State Govt. has plans to provide funds to set up an Export based cement plant. As domestic demand is limited, hence the new plant would target Export market. Projected Traffic of TCL for NW 9 is justified only if TCL expands its production by setting up a new plant and it produces 60,000 tonnes white cement and 1,000,000 tonnes grey cement and exports raw material, i.e. 700,000 tonnes limestone in Fy 35.

- ✓ According to TCL, the company would produce 1 mn tonnes grey cement and 60,000 tonnes white cement by Fy 20. The volume of clinker and limestone would be 700,000 tonnes by Fy 20. As the volume is very large compared to the existing volume; hence it is very unlikely that the company would produce projected volume by Fy 20. The consultant has assumed that by Fy 25, the company would produce atleast half of the projected volume of grey cement. This means the volume of raw material; clinker and limestone would also be less, i.e. 350,000 tonnes.
- ✓ It is assumed that by Fy 25, TCL would start producing the projected volume of grey cement. After Fy 35, the terminal would attain full capacity utilization and the company has no plan for expansion so far. Hence, the traffic would remain constant after Fy 35.
- ✓ For containers, average container size of 4.25 feet height, 8 feet width and 20 feet length, which is equal to 680 cubic feet is considered. 1 TEU of these containers is equal to 17 tonnes.
- ✓ Passengers and tourism would not provide any opportunity for NW 9; hence they are not included in projection.

TABLE 4-24 PROJECTION OF CARGO TRAFFIC

Commodity	Unit	FY 16	FY 20	FY 25	FY 30	FY 35	FY 40
Container	TEU	2,643	4,500	5,000	5,000	5,000	5,000
Grey Cement	'000 Tonnes	0	0	500	500	1,000	1,000
White Cement		12	30	50	50	60	60
Clinker/ Limestone		12	30	350	350	700	700

Source: Consultant's Analysis

Passengers and tourism would not provide any opportunity for NW 9; hence they are not included in projection.

4.9 Proposed IWT terminal

There already exist 1 private terminal and 1 captive jetty in NW 9. KPACT (Kottayam Port and Container Terminal) has one terminal in NW 9; however, KPACT need one developed terminal. Travancore Cements Ltd. (TCL) has its own captive jetty in NW 9, which could be developed by IWAI. TCL has offered IWAI a parcel of land on its premise for the development of that terminal and additional infrastructure. This development would be based on mutual agreement and revenue profit sharing with IWAI. As per discussion with TCL, the captive jetty can handle third party cargo too.

Source: KPACT site

FIGURE 4-12 PRIVATE TERMINAL OF KPACT

Source: TCL site

FIGURE 4-13 CAPTIVE JETTY OF TRAVANCORE CEMENTS LIMITED

4.10 Terminal wise IWT Traffic analysis

TABLE 4-25 TERMINAL & COMMODITY WISE PROJECTIONS

Sl. No	Name of Cargo	Type of Cargo	Origin	Origin Terminal on NW	Final Destination	Destination Terminal on NW	Co-ordinates	Unit p.a	FY 16	FY 20	FY 25	FY 30	FY 35	FY 40
1	N.A.	Container	ICTT (Cochin Port)	N.A.	KPACT	KPACT	N.A.	TEU	2,470	3,800	3,800	3,800	3,800	3,800
2	N.A.	Container	KPACT	KPACT	ICTT (Cochin Port)	N.A.	N.A.		173	700	1,200	1,200	1,200	1,200
3	Grey Cement	Bulk	TCL	TCL	Cochin Port	N.A.	N.A.	000 Tons	0	0	500	500	1,000	1,000
4	White Cement	Bulk	TCL	TCL	Cochin Port	N.A.	N.A.		12	30	50	50	60	60
5	Clinker/ Limestone	Bulk	Cochin Port	N.A.	TCL	TCL	N.A.		12	30	350	350	700	700

Source: Based on interaction with prospective stakeholders (Kottayam Port & Container Terminal and Travancore Cement Ltd)

In the above table, traffic volume of Fy 16 depicts existing cargo volume of the targeted ports and industries. The projected cargo volume of Fy 20 is based on the interaction with aforementioned ports and industries. It is assumed that after Fy 25, there will be growth based on the infrastructure of industry till Fy 40.

4.11 Logistics Cost Analysis

Once the entire stretch of NW 9a is developed, KPACT and Travancore Cement (TCL) would start transportation of their cargo via waterway. Figure 4-14 depicts time and distance difference between the existing roadway movement and the proposed waterway route using the National Waterways (NW 9a).

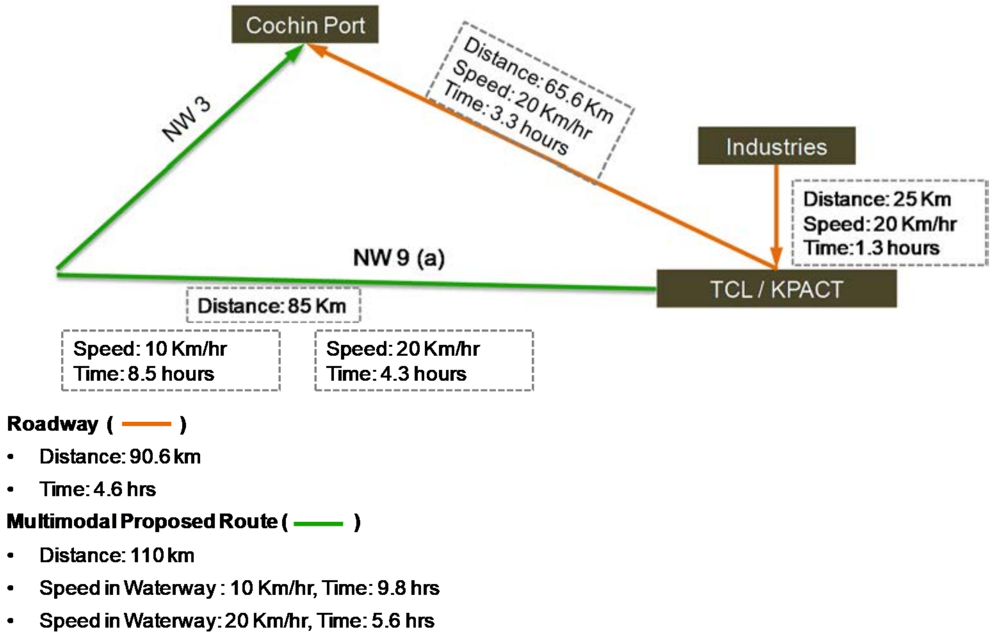


Figure 4-14 Time & Distance Comparison

(Note: All the calculations are done without custom clearance timings)

It is evident from the graphical representation above that time required to cover the distance to reach ICTT/Cochin Port from KPACT/TCL is more in case of multimodal route (combination of IWT & Road), considering speed in waterway is 10 Km/hr. Time and cost involved in multimodal transportation is less compared to roadway when speed in waterway is 20 Km/hr. The below table shows Logistics Cost Comparison in two different cases, under Lo-Lo Cost Dynamics. In Case I, vessel with a cumulative engine power of 839 kW and 20 km/hr speed has been considered. In Case II, vessel with only one engine of 350 kW power and loaded speed of 10 km/h has been considered for cost comparison.

Lo-Lo/Trade Cost Dynamics

Origin	Destination
KPACT (Container)	Cochin Port

Lo-Lo Cost Dynamics (84.5 km.)

Components	Unit	Case I	Case II
Engine	kW	839	350
Engine fuel requirement	l/hr	222	102
Per TEU Tariff	INR/TEU	9,760	9,456
Port-related charges	INR/TEU	233	233
Total Cost	**INR/TEU**	**9,993**	**9,689**

Truck Cost Dynamics (65.6 km.)

Components	Unit	Cost
Fuel	INR	1,125
Toll Charges	INR	1,245
Total Cost	**INR/Truck**	**2,370**

Origin	Destination
TCL (Cement)	Cochin Port

Lo-Lo Cost Dynamics (84.5 km.)

Components	Unit	Case I	Case II
Engine	kW	839	350
Engine fuel requirement	l/hr	222	102
Per Ton Tariff	INR/Ton	488	473
Port-related charges	INR/Ton	8	8
Total Cost	**INR/Ton**	**497**	**481**

Truck Cost Dynamics (65.6 km.)

Components	Unit	Cost
Fuel	INR	1,125
Toll Charges	INR	1,245
Total Cost	**INR/Truck**	**2,370**
	INR/Ton	**113**

Figure 4-15 Logistic Cost Analysis

Two scenarios have been considered to arrive at logistic cost for a possible Lo-Lo service on the proposed IWT route. Logistics Cost Analysis includes nominal fairway charges, charges associated with vessel chartering, the associated fuel cost, and port-related charges (berth hire and port dues). Traffic diversion from road to waterway entails cost saving in relation to truck transportation cost. Primarily, this saving is on fuel cost and toll charges. While, calculating Lo-Lo cost dynamics, these haven't been considered, as these cost heads will never feature in proposed transportation logistics. In case of truck cost dynamics, there are other parameters that influence the total roadway logistics cost. These include Repair & Maintenance cost, driver/crew wages, truck finance cost, profit & other costs. Including these for truck logistics analysis will necessitate inclusion of the same cost heads in case of Lo-Lo cost dynamics. However, these costs will be nullified, as their impact on both the logistics cost dynamics will produce a similar cost escalation, leading to a similar logistics cost difference. It is assumed that IWAI will develop the entire infrastructure (Terminal & Navigation), and hand it over to the operator without looking to recover the development cost. IWAI will also be required not to take Terminal charges, Fairway usage charges, etc.

NW 9 is proposed for handling break-bulk cargo. However, IWT movement on it is financially not viable proposition because of huge logistics cost difference between IWT and existing mode i.e. road. IWT movement is costlier than existing mode of transportation by a significant margin. For development of Lo-Lo Terminal and for it to attract the projected traffic, government needs to subsidize the shift by offering the cost difference or other sops to the transporters. This sole reason of subsidy requirement, on account of the wide logistics cost difference, renders this entire project unattractive. Therefore, NW-9A will be a commercially sound investment prospect with the government support in the form of subsidy or other measures.

Annexure

Abbreviation	**Full Form**
N.H.	National Highway
S.H.	State Highway
N.W.	National Waterway
GDP	Gross domestic product
ICTT	International Container Transshipment Terminal
KPACT	Kottayam Port and Container Terminal
SWTD	State Water Transport Department, Govt. of Kerala
IWAI	Inland Waterways Authority of India
km	Kilometer
Ha	Hectare
FY	Financial Year
Sq. Ft.	Square Feet
Mn TPA	Million Tonne Per Annum
T	Tonne
MT	Metric Tonne
MMT	Million Metric Tonne
NH	National Highway
Pvt. Ltd.	Private Limited
INR	Indian Rupee
CR	Crore
SSP	Single Superphosphate
MOP	Muriate of Potash
NPK	Nitrogen Phosphorus Potassium
DAP	Diammonium Phosphate
Ro-Ro	Roll-on Roll-off

CHAPTER 5 : TERMINALS

5.1 General Review

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

5.2 Identification and Site Location

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

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

The study stretch of NW 9 is greatly depended for discharging water from the paddy polders to the Pallathuruthy River with Agricultural plots on either side of the canal, small markets Pallon, Nattakom, Muppaikad, Kodimatha, Vellor etc., and Large Agricultural Lands, Lake Vembanadu etc.

In the morphological rivers, due to seasonal precipitation there are fluctuations in river flow and the rapid changes in water flow causes shift in the location of the deep channel and also results in erosion of banks and siltation. Accordingly, the basic requirement of an inland terminal is to ensure a permanent access to the navigational channel throughout the year. However, the study stretch of NW 9 is in the Lake area and TWO Captive Terminals are already under operation.

The study stretch is in the Vembanad lake area and the Alappuzha town is on the western side of the lake and Kottyam town is in the eastern side of the lake. N.H. 66 connects Alappuzha with Thiruvananthapuram & Cochin. N.H. 183 and SH 1 traverses through Kottayam. Southern railway runs two parallel lines (Between Kochi and Kollam) one on the western side through Alappuzha and other through Kottayam on the eastern side. The nearest railway station to the captive Terminals is Kottayam at about 6.5 km from Terminal.

IWAI is already having an Inland Water Transport (IWT) Terminal at Alappuzha on NW 3, which is also the originating point for NW 9 and its hinterland has many industries, like Ram Coir mill, Oxide India, D.C. Mills, Alleppey Co-operative Spinning Mills Ltd., Evershine Chemical, Wilton Weavers Pvt. Ltd., Autocast Ltd., Conso Feeds etc.

Travancore Cement Ltd. and Oil Palm India are the nearest industries from the canal, as they are located on the bank of Alappuzha-Kottayam- Maniyaparambu Canal (NW 9). There are several industries in the hinterland; which are located more than 25 km far from NW 9. The industries in Kottayam include Cochin Cements and St. Marys Rubbers Pvt. Ltd. Etc.

The identified Traffic for IWT for this Waterway is of Lo-Lo operation with specific criteria of achieving the operational volumes of about 3800 TEUs p.a (inward) + 1200 TEUs p.a (outward) at KPACT and 7 Lakhs T p.a (inward) + 10.60 Lakhs T p.a (outward) at TCL estimated in 2040.

5.3 Terminal Layout / Master Planning including phases of development

The NW 9 is having two well established captive ports along with the Terminal structure / Infrastructure.

Kottayam Ports and Container Terminal:

The Port is based on 5 Ha. of land. At present, authorized custom clearance and EXIM activity are being carried out. The Port has handled about 4,233 TEU of export & import cargo till present. 300 TEU is getting handled at the port per month. Companies like Malayala Manorama, MRF use this port. The Port has acquired additional 7 acres of land for the 2nd phase expansion; this land is adjacent to the existing facility. MAERSK has commenced an empty container yard, which would help in storing empty containers at the yard, so that exporters could pick their nominated export containers.

KPACT is mainly handling rubber products, automobile spare parts, RMG which gets exported through Cochin port. At present these commodities move via roadways. There already exist 1 private terminal and 1 captive jetty in NW 9. KPACT (Kottayam Port and Container Terminal) has one terminal in NW 9.

At present, the port has a terminal but due to some technical problems, it is not used effectively. KPACT has plan to develop a jetty with berthing facility for barges, measuring 50m X 12m. (Consultant's suggestion is 50 m x 15 m). Barges of 10 TEU capacity are handled at the port.

Domestic cargo movement is 10 times higher than EXIM cargo. Loading platform, hydra cranes, forklifts and covered cargo storage would be developed in the port for smooth operation.

Existing 40,000 sq. ft. Warehouse is used for export, import and hazardous goods. There is planning to construct 20,000 sq. ft. of additional warehouse.

Travancore Cements Limited

The company mainly produces white cement, named Vembanad White cement. Other end products of TCL are Vembanad white putty and Super Shelcem Cement Paint. The licensed capacity of the plant was 50,800 tonnes of Cement per annum. Earlier, the company's grey cement annual production volume was 20,000 tonnes. The plant produces around 1,000 tonnes of white cement per month. Travancore has expansion plan to increase production of grey cement to 10,00,000 tonnes (1 mn T) and white cement to 60,000 tonnes by FY 2035.

The Company used lime shell, White clay, White sand and Gypsum as raw material for producing finished product. The company used Vembanad lake for lime shell extraction which was the major raw material for manufacturing cement; but after ban on extraction from the lake, TCL stopped using Vembanad lake completely. TCL also used to procure limestone from Tirunelveli, Tamil Nadu through roadways, however at present TCL stopped using limestone also as raw material.

At present, the company uses clinker as a substitute raw material because Limestone and lime shell are calcium carbonate and clinker also is made of the same material. The company's expansion plans are also depended on clinker as raw material. TCL imports Clinker from Gulf countries through Cochin Port. TCL has 3 cement mills with clinker grinding capacity of 60 tons per hour and other two has capacity of 50 tons per hour. Three silos are developed in the plant area.

TCL plant was down for a substantial period due to diminished demand of cement. However, the plant has recently resumed its operation. The company and the state government are trying to revive the plant with expansion plans. At present, only white cement is produced. For grey cement production, the company needs expansion, as the current plant's capacity would be exhausted. If expansion of the plant takes place in near future, only then grey cement would provide opportunity for IWT movement through NW 9. As per TCL, both grey cement and white cement would be transported using NW 9.

In order to meet the above combined cargo operation effectively, it is estimated to have 2 Berthing structures of 50 m x 15 m jetty each and the handling infrastructure for both the combined operations 125 Tons output per hour capacity of Cranes – 01 + 05 Tons capacity Fork Lifts – 02 in Nos along with 1 Ambulance have been suggested in this area as an upgradation of the handling infrastructure to meet the estimated cargo for loading and unloading of containers from barges.

5.4 Land Details

KPACT is having 5 Hectares of back up land and other 07 Acres of land is under the proposal for taking over. The approximate Coordinates of the location is Lat 09°33'33.17"N and Long 76°30'22.63"E. It has already been confirmed by KPACT that they are very much interested to share the land / infrastructure on mutually agreed basis for development of IWT in this port area.

Reference is invited to the mail received from M/s TCL (placed at Annexure 5.1) about the provision of 12500 Sq. m of land for construction of jetty structure with 100 m water front land, which will be most suitable for developing the 2 Nos. of Terminal jetties of 50 m x 15 m. The approximate Coordinates of the location is Lat 09°33'37.87"N and Long 76°30'36.18"E of TCL. The sharing of Land / infrastructure would be based on mutual agreement and revenue profit sharing with IWAI. The site plan drawing provisioned is placed at Annexure 5.3.

The image of the Terminal location is placed at Annexure 5.2.

5.5 Geotechnical Investigations

The requirement of geotechnical investigation has not been required at the terminal location. The identified cargo on NW 9 is being originated / destined to Captive Terminals of KPACT and TCC and hence there is no need of development of separate Terminal by IWAI on this National Waterway (NW 9).

5.5.1 Regional Geology

The geology of Kerala is a part of the south Indian Precambrian terrain, which is composed of granulites, gneisses, granites and greenstones. The granulites and associated gneisses belong to the Precambrian in Kerala state. The younger Meso-Cenozoic dykes and pegmatites are found to intrude late Precambrian rocks. The tertiary sedimentary formations belong to Neogene period only (Soman, 2002). The geology map of Kerala state is shown as Figure 5.1.

The Charnockites and charnockitic gneisses are the oldest rock complex units of Kerala state. Charnockitic gneisses, gneisses and the pyroxene-bearing granulites occupy the major parts of the Western Ghats and the midland regions located within Kerala state. The granulitic gneisses are very well spatially connected with lineaments and faults in Kerala state (Soman, 2002). Khondalites are yet another major rock formation of south Kerala and are associated with garnet-biotite gneiss and garnetiferous quartzofeldspathic gneiss.

The presence of intrusives especially, the dykes, have hydrogeological role to find good zones of water bearing fractures. Intrusive formation dykes of Lower-Middle Proterozoic age, pegmatites of Middle Proterozoic age, host of younger granites (Late Precambrian-early Palaeozoic age) and later dolerite dykes, contemporaneous with Cretaceous-Paleocene Deccan Basalt magmatism, are the common elements seen in granulitic terrain of this state.

The western parts of the State consist of sedimentary formations of Neogene period and quaternary period having four distinct beds viz. Alleppey, Vaikom, Quilon and Warkali. In midland regions, the Tertiary and crystalline formations are found as lateritized units which act as good aquifer. Along the coastal regions, alluvial deposits of recent origin are found. The stratigraphic succession of the Kerala is given under Table.

TABLE 5-1: GENERAL STARTIGRAPHIC SUCCESSION OF KERALA

(after Poulose and Narayanaswami 1968)

Recent to Sub Recent	Soils and alluvium Beach sand deposits Lime shell deposits of backwaters Old and red Teri sands of sub recent marine and lacustrine formations Peat beds with semi carbonised woods Calcareous clays with shell Laterite
	------Unconformity------
Warkallai formation (Mio-pliocene)	Current bedded friable variegated sandstone interbedded with plastic & variegated clays Carbonaceous and alum clays with(Mio-Pliocene)Lignite seams Gravel and pebble beds. Base marked by gibbsitic clay
Quilon formation (Middle Miocene)	Fossiliferous shell limestone alternating with thick beds of sandy clays, calcareous clays. Base unknown
	------Unconformity------
Archaean	Crystallaine Rocks

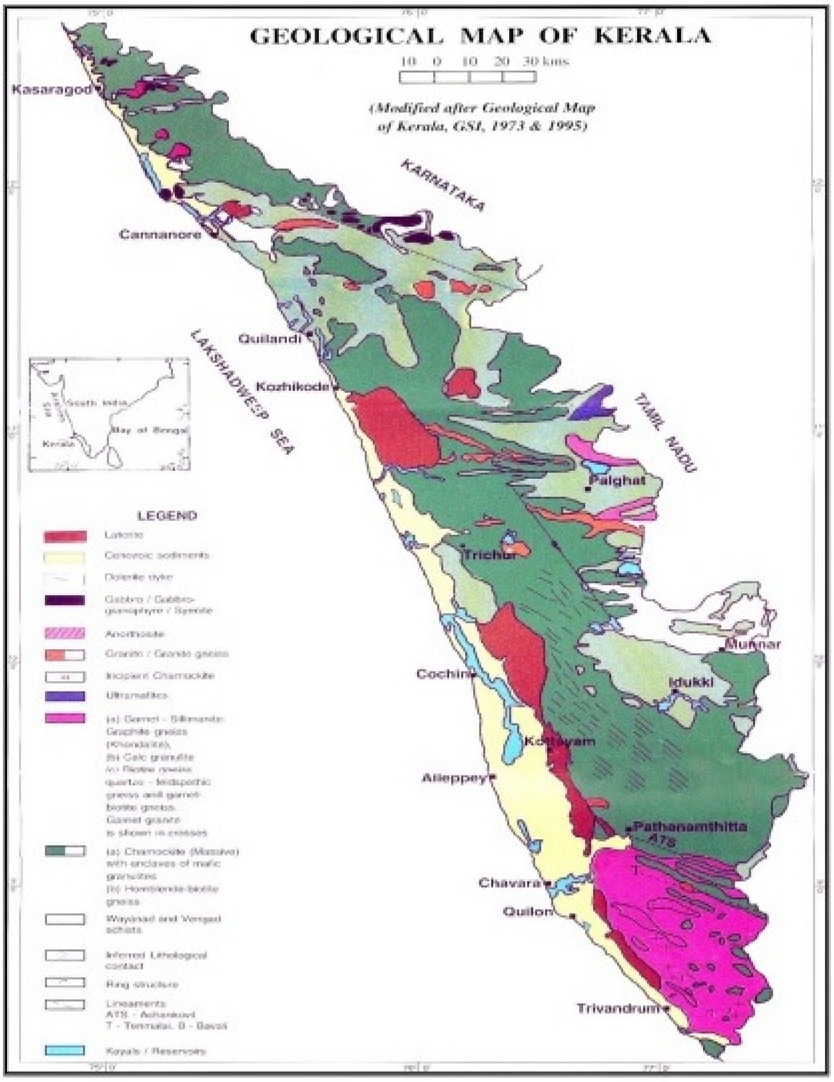


Figure 5-5-1: Geological Map of Kerala

5.5.2 Physical Condition and Drainage

Physiographically, Kottayam district is divided into three well defined physiographical units from west to east viz. (i) western low lying fluvial landscape (coastal plain) followed by (ii) laterite capped midland region with moderate to gently sloping spurs towards east and (iii) the structurally controlled high hills and steep ridges in the east. A major part of the district is undulating peneplain. Because of a thick soil cover cash crops are widely cultivated. The low-lying fluvial landscape which is the flood plain of Muvattupuzha and Pamba rivers has thick fluvial sediments derived from the catchment area of these rivers. This fertile land is ideal for paddy cultivation. The high hills to the east have thin forest soil cover which supports luxuriant growth of plantation crops.

The lowland is the area with an elevation of less than 7.5 m amsl which covers around 398.4 sq km and midland area having an elevation of 7.5 to 75 m amsl covers around 1287.75 sq km and the highland area with an elevation of more than 75 m amsl covers around 508.8 sq km and are mainly found in the eastern part of the district. The low lands are seen along the western portion of Vaikom, Changanassery and Kottayam taluks whereas the Meenachil and Kanjirapally taluks fall in the highlands. Major part of Kottayam, Changanassery and Vaikom taluks fall in the midland region. Around upper Kuttanad (part of Changanassery taluk) particularly Pallom, Ettumanoor and Kaduthuruthy the ground elevation is generally 1 to 1.5 m below mean sea level. The maximum elevation is 1193 m amsl at Kursimudi.

Drainage

The major rivers in the district are the Meenachil River, the Muvathupuzha River and the Manimala River. The Meenachil River flows through Meenachil, Vaikom and Kottayam taluks. The total catchment area of Meenachil River is 1272 sq km and is formed by several streams originating from the Western Ghats in Idukki district. The Poonjar river join at Erratupetta, the Chittar River join at Kondur and the Payapparathodu join at Lalam. Finally, the river confluences with Vembanad Lake. The Muvattupuzha River originates from Idukki district flowing mostly through vaikom taluk and joins with Vembanad Lake. The Manimala river flows through Kanjirapally and Chanaganacherry taluks. The Chittar joins it on its course further down the west as it flows towards Alappuzha district.

A chain of Kayals (backwaters), lying parallel to the coastline is a characteristic feature of Kerala coast. These are mostly interconnected by natural or man-made canals. There are 27 estuaries and 7 lagoons listed in Kerala (Anon, 1974).

The project area/selected site form a part of already operational Alappuzha - Kottayam canal system which has already established operational Terminal. The location of the selected site on Google earth is shown as Figure 5.2 while the enlarged view of the same is shown as Figure 5.3.

Figure 5-2: Google Earth Image showing Project Area

Figure 5-3: Enlarged View of Google Earth Image showing Project Area

5.5.3 Physical Condition and Drainage

This area shows a very interesting correspondence between the major rock classes and their physiographic expression. The east comprises Precambrian metamorphic rocks and forms hilly ground. The central part is a low plateau, where Tertiary sediments containing lignite occur. These are followed by further west by a low plain, which is underlain by Quaternary Formations, fluvial or partly marine. The Charnockite Group dominates in areal distribution with charnockite, charnockite gneiss and diopside gneiss occupying the major part. Pyroxenen granulite (with hornblende granulite), magnetitie quartzite and cordierite gneiss occur as concordant bands within charnockite. The linear bands of quartzite (Khondalite Group) are the oldest rock of the area. Biotite geniss (composite gneiss) representing the Migmatite Complex has a limited areal extent, west of Ettumanur and along the eastern boundary. Three major granite bodies are emplaced in the district, two along the southwest and other in the east. Numerous dolerite and gabbro dykes trending NW-SE traverse the older basement rocks in the central and eastern parts. A prominent gabbro dyke extends from north to south with a NNW-SSE trend. Tertiary sediments comprising sandstone, clay with lignite intercalations are confined to the west and they occur as small patches, especially as capping on hillocks. Both the Archaean and Tertiary rocks are lateritised. Quaternary alluvial deposits occur to the west. They have been classified into various morphostratigraphic units, based on their environment of formation, as Guruvayur Formation (palaeo-marine), Periyar Formation (fluvial) and Viyyam Formation (fluvio-marine). Figure 5.4.

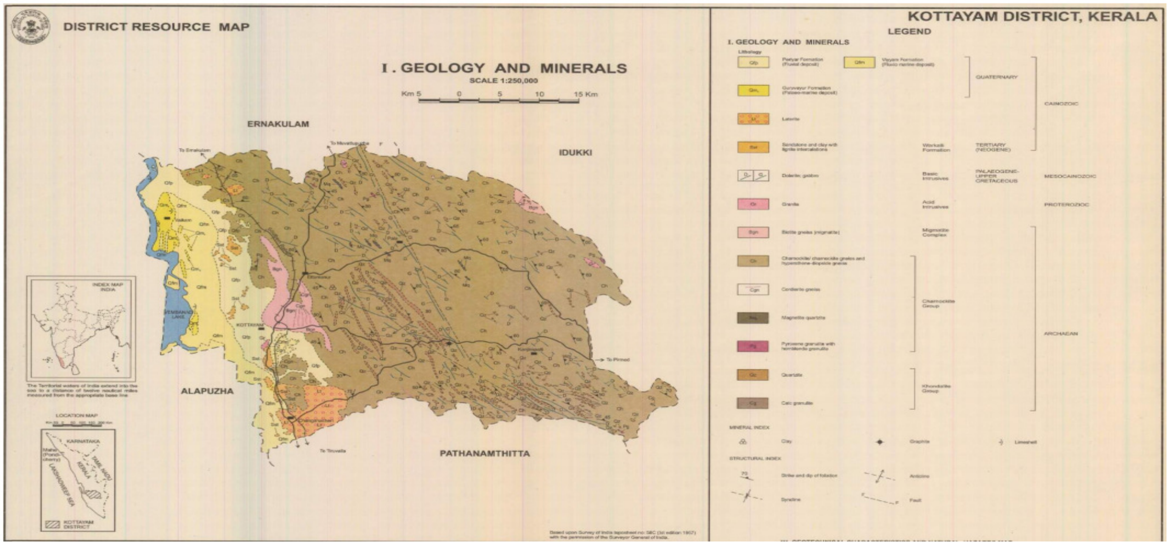


Figure 5-4: Geology and mineral resources of Kottayam

Soil types

The soil types occurring in Kottayam district can be broadly grouped into four types on the basis of their physico-chemical properties and morphological features. They are (a) Lateritic soil. (b) Riverine alluvium, (c) Brown hydromorphic, and (d) Forest loams.

Lateritic soil

The lateritic soil is the pre-dominant soil type, which covers almost the entire midland areas of the Katya district. The surface soil is mostly reddish brown to yellowish red in colour and the texture ranges from gravelly loam to gravelly clay loam. Heavy rainfall and high temperature prevalent in the area are conducive to the process of formation of this soil type. It is well drained and the presence of organic content is low. This soil is poor in nitrogen, phosphorous and potassium. It is acidic in nature with a pH value ranging from 5.0 to 6.2.

Riverine alluvium

The occurrence of these soils is restricted along the river courses and their tributaries. They show wide variation in their physico-chemical properties depending on the nature of the alluvium that is deposited, and the characteristics of the catchments area drained by the river. They are very deep soils with surface textures ranging from sandy loam to clay loam. These soils are characterised by moderate amount of organic matter, nitrogen and potassium. Presence of mica flakes has been observed in the alluvial soils.

Brown hydromorphic soil

These soils are mostly confined to valley bottoms between undulating topography in the midland and in low-lying areas. They have been formed as a result of transportation and sedimentation of material from adjoining hill slopes and also through deposition by local streams. These soils are very deep and brownish in colour and exhibiting wide variation in physico-chemical properties and morphological features. The surface soil texture varies from sandy loam to clay. Their pH value ranges between 5.2 and 6.4 and are acidic in nature.

Forest loam

These soils are the products of weathering of crystalline rocks under forest cover. They are occurring in the eastern hilly areas. These are dark reddish brown to black in colour. The surface texture varies from loam to silt loam. They are characterised by a surface layer very rich in organic matter. Generally, they are acidic, rich in nitrogen and their pH ranging from 5.5 to 6.3.

5.6 Terminal Infrastructure including equipment

KPACT is having 5 Hectares of Back up land and other 7 Acres of land is under the proposal for taking over. The approximate Coordinates of the location is Lat 09°33'33.17"N and Long 76°30'22.63"E.

M/s TCL communicated the provision of 12500 Sq. m of land for construction of jetty structure with 100 m water-front land, which will be most suitable for developing the 2 Nos. of Terminal jetties of 50 m x 15 m. The coordinates of the location is Lat 09°33'37.87"N and Long 76°30'36.18"E of TCL.

The estimated bulk cargo operation as a gross (inward + outward) is working out to 17,60,000 T per annum (1000 + 60 + 700 – '000), which is of 1,47,000 T per month. Considering 20 days of operation in a month, it is 7,350 T per day. M/s TCL is already having the infrastructure with an exclusive jetty, 1/3 rd can be segregated for its operation through the existing handling system available. For 2/3 rd of cargo i.e., 4,900 T handling, suggested 2 jetties, wherein 3 cranes can simultaneously operate. {3 Nos x 125 T output per hour crane x 0.8 (with 80 % efficiency) x 16 Hrs (2 shift operation) can handle up to 4,800 T}. Hence moderately suggested the infrastructure. The 2 Nos. Jetties will be taken up in due consultation with KPACT and TCL i.e., 1 Jetty in the land of KPACT and 1 Jetty in the land of TCL.

KPACT is having arrangement for Ro-Ro operation, which may have to be augmented, on need basis. Hence, the design vessel also could not be concluded, whether it is of TEU handling or Ro-Ro handling.

The cargo requirement estimated is of about 5000 TEUs per annum (3800 + 1200), which is of about 420 TEUs per month. Considering 20 days of operation, the handling requirement will be of 21 TEUs are to be handled per day. It has already been proposed the procurement of 125 T output per hour crane of 01 Nos. and already having 2 + 1 jetties, which can easily handle the estimated volumes. These jetties are proposed for Lo-Lo operation which is having on-board cranes and eventually capable of handling the projected cargo. In such case the material handling equipments are not needed.

In case of situation when a barge or vessel without crane is berthing, it may be considered for having one 125 tonne handling capacity per hour crane either crawler or tyre mounted at the jetty can handle the traffic projected as shown in **Table 4.25** of chapter-4. Beside this 02 numbers of fork-lift is recommended for general cargo on the jetty.

The following caution is to be adopted while commencing the Operation in the above Terminal locations.

Note: The suggested Terminal details are only to the extent of Preliminary Engineering / Design. At this juncture, it is pertinent to mention that the Appropriate provisions and infrastructure are to be catered for "Disposal of Operational waste including the waste oil from vessels berthing at the terminal locations" and the related aspects are to be addressed to / attended to in accordance with the Gazette Notification vide No. 480 dt.

13/07/2016 of Ministry of Shipping {GSR No. 687 (E)} at the stage of Detailed Engineering / Design. In the similar way, the collection and disposal of Pollutants, generated, on board vessel, also to be addressed during the Detailed Engineering / Design.

5.7 Berthing Structure

The berthing structures shall be designed such that they provide safe berthing of barges/vessels without damaging the barges/vessels as well as the structure. These structures shall also cater to the requirements of the various equipments to be used for loading /unloading of the vessels. The requirements of the berth differ depending on the nature of cargo being handled at the berth. The size of the structure shall depend on the largest vessel likely to use the berth and the type of the handling equipment to be used on the deck. The berth shall be designed for all possible loads that are likely to act on the structure as per BS 6349 & IS 4651. The total two number of berths are proposed for the terminal which is fixed based on the nature of cargo, traffic, and water level variation. The proposed berths under study are planned for handling 1 no vessel / barge of 300 T/15 TEUs at a time. The Lo-Lo berth is designed taking into account of availability of crawler crane loading.

Deck Level

As per IS 4651 _IV, the deck level of the berthing structure shall be fixed considering the optimum position of the cargo transfer to cater for two extreme conditions viz the largest vessel in light displacement condition at highest water level and the smallest vessel fully laden at lowest water.

The deck level of Lo-Lo shall be calculated taking a freeboard of 1 m above the highest water level in the Rivers. However, in the Canal stretches of Kerala Waterways, it is preferred as 0.3 m above MHWS (+1.05 m RL). The Maximum Velocity observed is of 2.05 m / sec in this waterway.

Deck Dimensions

The dimensions of the berthing structure shall be decided on the basis of the dimensions of the largest vessel that are likely to use the terminal facilities as well as the function of the terminal. The proposed minimum dimension of the Deck shall be

TABLE 5-2: Salient Features of berth structure

Description	Length (m)	Width (m)
2 Nos Lo-Lo	50	15

5.8 Terminal Costing

5.8.1 Capital Cost

Development of 2 jetties (Lo-Lo Terminals) of 50 m x 15 m is proposed along with handling equipments i.e., Cranes of 01 No. of 125 T handling capacity per hour + 02 Nos. of 05 T Fork Lifts + 1 Ambulance are suggested. The Capital Cost for the Terminals along with equipments is working out to 22.00 Crores.

However, the actual requirement could not be firmed up at this stage, since both KPACT and TCL are interested to have a mutually understandable working arrangement with revenue sharing etc. In view of the above, the same is possible at the stage of implementation of the project.

5.8.2 O&M Cost

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

CHAPTER 6 : PRELIMINARY ENGINEERING DESIGNS

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

River training in Canal stretches is not required, wherein the Bank Protection may be essential in the widening reaches.

6.2 Bank Protection

6.2.1 Typical Revetment

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

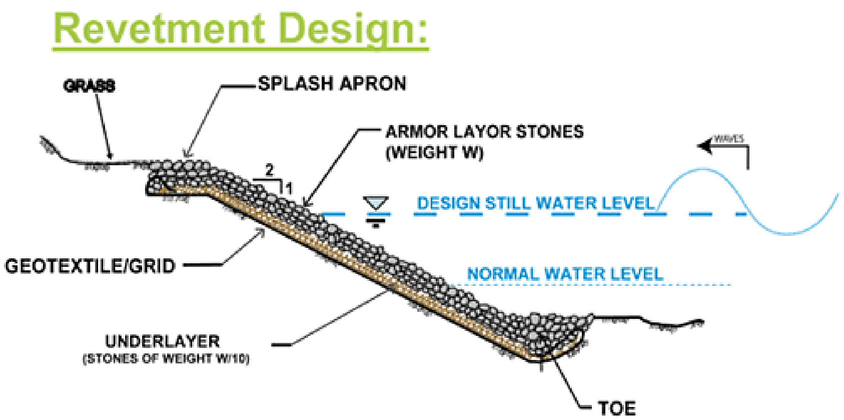


Figure 6-1: Typical detail of revetment

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

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

6.2.2 Typical Pile and Slab

The present study stretch of NW 9 is a canal amenable for Class III Waterway and similar to that of present NW 3 waterway and having connectivity. Further, the NW 9 is traversing through the Kuttanad area and hence the Pile & Slab type of Bank Protection is most suitable. The typical drawing is placed below.

The entire material is of M 40 grade concrete with standard steel components and Geo Filter Membrane.

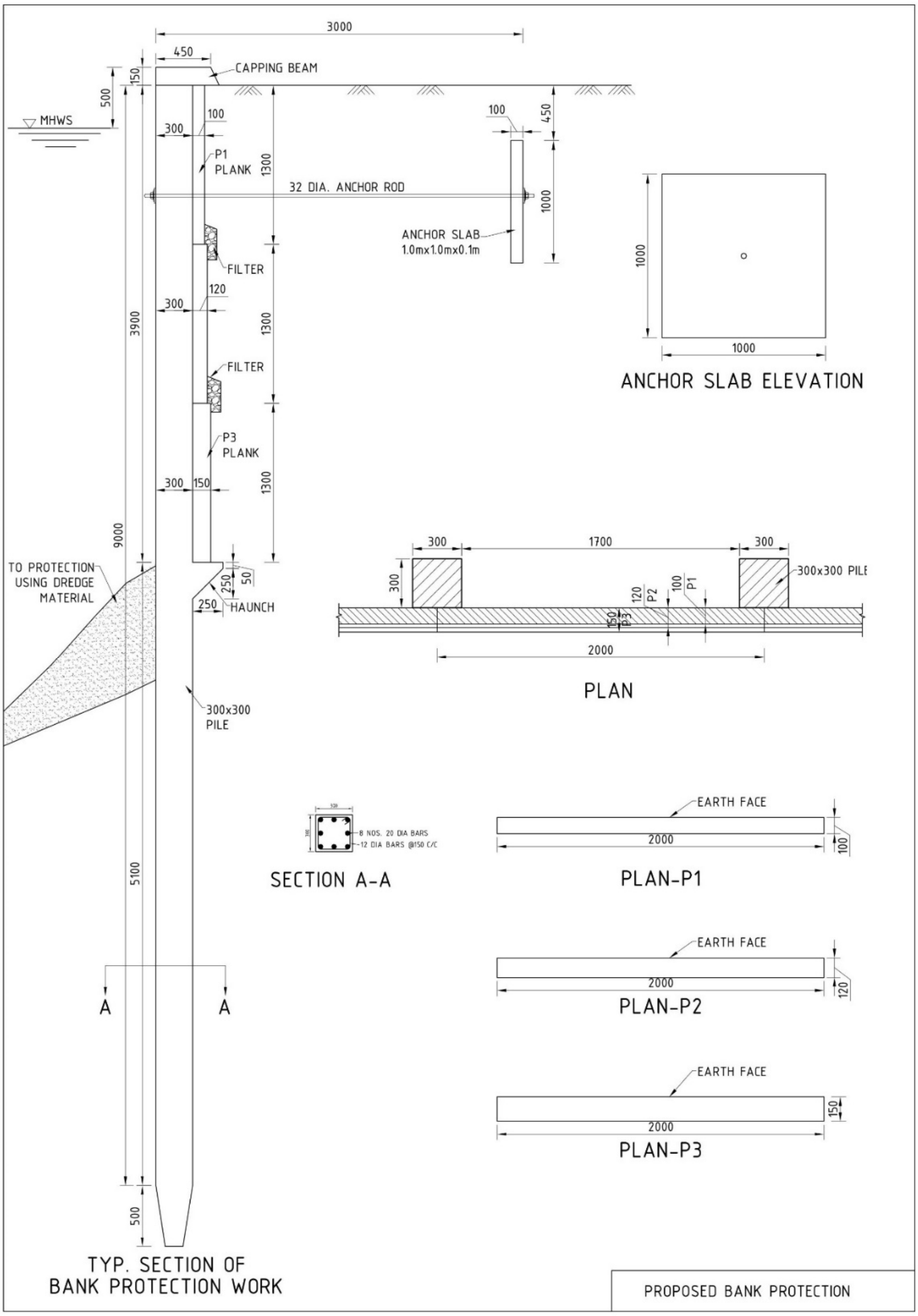


Figure 6-2:Typical section of Bank Protection Work

6.3 Navigation Aids

The detailed Drawing and Specifications are reproduced herewith for consideration.

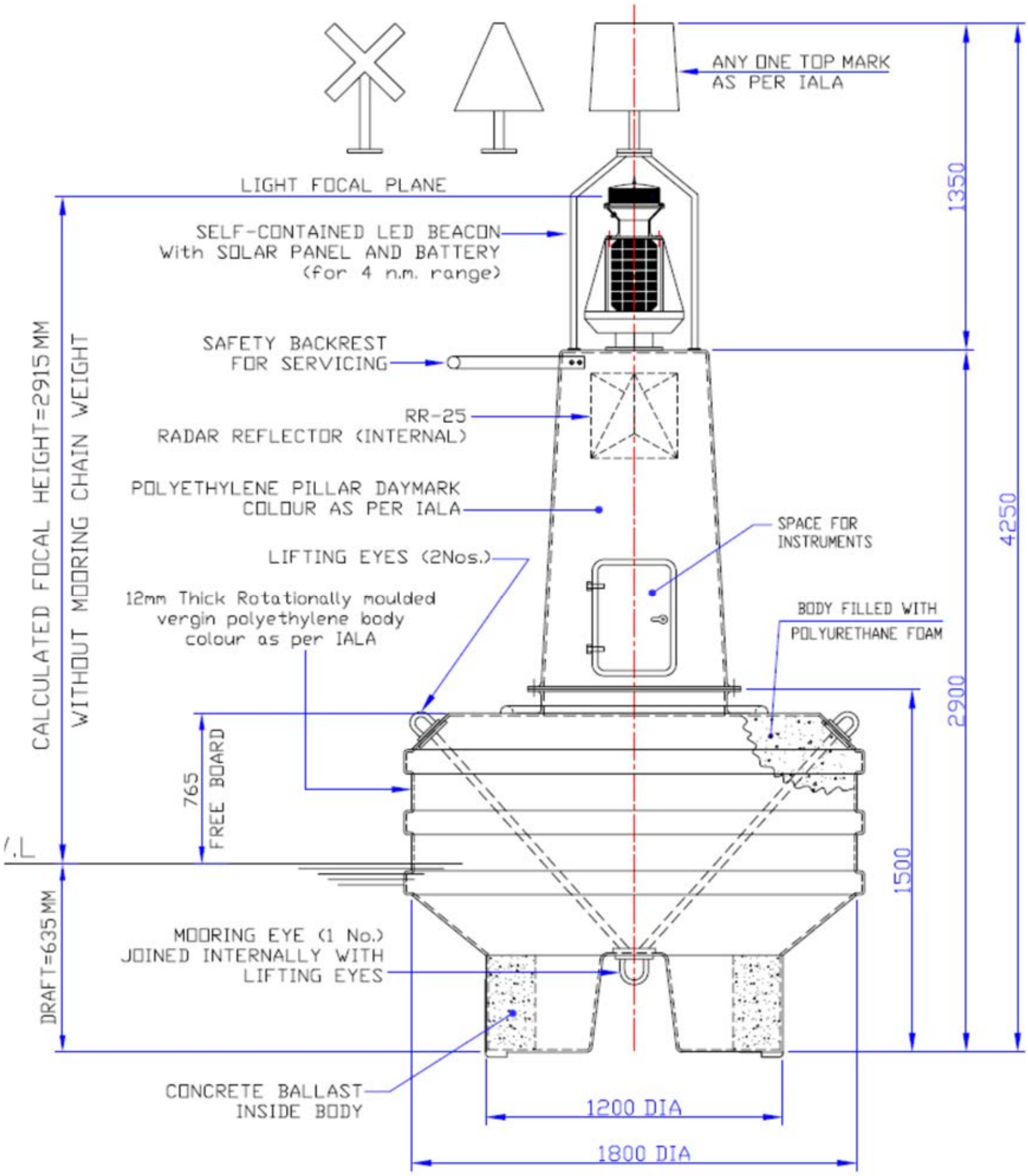


Figure 6-3: Typical section of navigational aid

<u>POLYETHYLELENE CHANNEL MARKING BUOYS: (PORT HAND) 1 No. - PEB/1 800 Polyethylene Buoys, each complete with Day mark, Top Mark and Radar Reflector. Main features are as given below:</u>

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

Daymark : P E Module (as per IALA system) / Radar Reflector : RR - 25 as specified (25M2).

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

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

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

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

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

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

Note: The chains shall be made as per 1S4692, shackles and swivel as per IS 4484 and stockless steel Anchor. The chain shackles and swivel shall carry proof load test certificate witnessed by the IRS. All the above shall be given one coat of coaltar paint.

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

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

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

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

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

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

6.4 Cargo Terminals and River Ports

Design Criteria

All structures shall be designed using limit state design approach. 3-D structural analysis of the structure shall be carried out under all specified loads and load combinations as per Indian Standards as explained in this report using STAAD Pro software. The design shall be done manually using the results of the analysis obtained from STAAD.

Design Life

All permanent structures shall be designed for a design life of 50 years.

Material Properties

Density of reinforced concrete	25.0 kN/m3
Density of Steel	78.5 kN/m3
Density of plain concrete	24.0 kN/m3

Density of Backfill soil 18.0 kN/m3 (May vary based on soil fill proposed during detail design)

Structural Steel

Minimum yield stress: 250 N/mm²

However, higher grade of steel (310/ 355 Mpa) shall be used based on the availability during the detailed design stage and subject to owner's approval.

Reinforcing Steel (Corrosion Resistant)

The grade of steel to be used as reinforcement in the structural concrete members shall comply with IS 1786 and will have minimum strength and elongation as mentioned below.

Yield Strength	500 Mpa
Elongation	14.5%

However, use of higher-grade steel in the detail design is subject to availability of higher grade steel meeting the ductility requirements (as per revised latest code).

Cover to Reinforcement

The clear cover to main reinforcement shall be as follows:

Piles	100 mm
Deck Slab	75 mm
Longitudinal beams:	75 mm
Columns:	75 mm
Cross Beams	75 mm

Concrete Grades

Grade of RCC members	M40 for Piles
	M40 for Beams and Slab
	M40 for all precast elements
Grade of reinforcement	Fe500 confirming to IS 1786

Overall Deflection Criteria

The criteria for deflection shall be so limited that it shall not produce difficulties in serviceability conditions nor shall it cause damage to the structures and its components.

Deflection limits

Pile deflection at the deck level is normally considered as H/350 under extreme condition, where H is the distance from the point of fixity of piles to the top elevation of deck.

Crack Control

The crack width criteria shall comply with the provisions of IS: 4651(Part 4).

However, the assessed surface width of cracks (for service load combinations only) at points nearest to the main reinforcement will be restricted to 0.004 times the cover to the main reinforcement.

Corrosion Protection Painting

All steel surfaces in the splash zone and atmospheric zone shall be painted in accordance with the painting specifications. Areas and joints that are inaccessible for maintenance and thereby susceptible to corrosion shall be suitably sealed by methods such as boxing with plates.

All appurtenances such as walkway bridges shall be painted as per technical specifications of corrosion resistance suitable for the environment.

Classification of Loads

A. General Loading

The Self weight of the structure shall be calculated using the following

Density of reinforced concrete	25.0 kN/m3
Density of Steel	78.5 kN/m3
Density of plain concrete	24.0 kN/m3
Density of Backfill soil	18.0 kN/m^3 (May vary based on soil fill proposed during detail design)

In addition, superimposed dead load and live load shall be considered

The various loads acting on the berthing structure are classified as:

1. Loads from the River Side:

The loads from the river side include the horizontal forces caused by the river currents and the forces caused by berthing and vessel's pull from bollard. The forces caused by the berthing of the vessels are determined from the velocity and angle of approach of the vessels.

2. Loads from Deck

The important loads from the deck are the vertical loads caused by self-weight of the deck and the superimposed loads from handling equipments. Also horizontal loads due to wind and seismic forces are considered.

3. Loads from Shore

Seismic loading

Earthquake loads shall be adopted as applicable for the site as per IS 1893 – 2002. All districts in the state lie in Zone III as per the seismic map of India shown in IS 1893-2002. Design horizontal seismic coefficient shall be evaluated as per procedure detailed in IS 1893-2002.

The horizontal seismic coefficients are as follows:

TABLE 6-1: SEISMIC LOADING

Seismic zone	III
Design horizontal seismic coefficient, Ah	Z I (Sa/g)/ (2R)
Zone Factor Z	0.10
Importance factor, I	1.5
Response Reduction Factor, R	3 (for ordinary RC moment resisting frame)
Average response acceleration coefficient Sa/g	Depending on time period of structure

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

Scour

Scour depth shall be considered while fixing the total length of the pile.

$R = 0.473\ (Q/f\ )^{1/3}$

Where R = depth of scour below HFL

Q = discharge m^3/s

f = silt factor (=1)

Max scour around piers = 2 R.

Loads & Load Combinations

All the structural members shall be designed to sustain safely the effect of the combination of various loads/forces and stresses that can possibly co-exist. The load combinations shall comply with the requirements of Indian reference standards both for limit state of collapse & serviceability.

NW 9 Canal stretch of Kerala Waterways is preferred at 0.3 m above MHWS (+1.05 m RL). The Maximum Velocity observed is of 2.05 m / sec in this waterway.

Structural Design of Berthing Structure

Structural Arrangement

The Lo-Lo berthing structure shall consist of a concrete deck supported on piles. Whereas the super structure shall comprise of the pile caps and concrete deck precast planks supported on longitudinal beams and cross beams. The pile caps span in the transverse direction with the longitudinal beams resting on the pile caps.

The structure shall be designed for its self-weight and also for forces arising due to wind / seismic loads, current forces, vehicular loads etc. as explained below.

For Lo-Lo the deck shall be considered at approx. 1 m above HFL/ MHWS. Expansion loops shall be provided along the stretch at almost 30 m

A staged construction approach is assumed in the design viz:

- Piles,
- Precast pile caps and placement of cross head beams,
- Placement of precast longitudinal beams with precast planks for slab
- Placement of concrete for cast-in-situ ties between beams and deck slab.

The Lo-Lo berthing structures proposed shall have salient features as below:

TABLE 6-2: Salient Features of Ro-Ro and Lo-Lo

Sl. No	Type	Length	Total Width
1	Lo-Lo	50m	10 m

Design Loads on Berthing Structures

a) Dead Load

The dead load comprises of the weight of all components of the structure as well as the weight of all permanent connections.

For Lo-Lo berthing structures, the member load shall be defined directly by STAAD Pro using the self-weight command. The weight of concrete slab & precast panels shall be applied in STAAD Pro software using floor load command.

b) Live Load

The vertical live loads comprise of loads from vehicular traffic of all kinds including trucks/ trailers/track and cranes, and other mechanical handling equipments and also, surcharges due to stored and stacked materials such bulk .The vertical live loads as defined in IS 4651 (III) shall be considered in the analysis and design of the berthing structure.

TABLE 1 TRUCK LOADING AND UNIFORM LOADING

FUNCTION OF BERTH	TRUCK LOADING (IRC CLASS)	UNIFORM VERTICAL LIVE LOADING T/m²
(1)	(2)	(3)
Passenger berth	B	1·0
Bulk unloading and loading berth	A	1 to 1·5
Container berth	A or AA or 70 R	3 to 5
Cargo berth	A or AA or 70 R	2·5 to 3·5
Heavy cargo berth	A or AA or 70 R	5 or more
Small boat berth	B	0·5
Fishing berth	B	1·0

NOTE — The relevant Indian Road Congress (IRC) codes may be referred for axle load. The spacing of the loads may be changed to suit individual design requirements.

For LO LO berthing structure, uniform loading corresponding to container berth of 30 KN/m2 shall be considered in the analysis. However, additional surcharges because of stored and stacking of material shall not be considered.

c) Seismic Forces

The river is in zone III as per IS 1893:2002(part I). Dynamic analysis shall be done to calculate the time period of the structure. The spectral acceleration shall be calculated based on the time period of the structure obtained for its mode as per IS 1893:2002 for rocky soils types.

d) Wind Forces

Wind loads on the structure shall be applied according to IS: 875 (Part 3) -1987

Wind Pressure $P_z = 0.6\ V_z^2$

Where

Pz = Design Wind Pressure in N/m2 at height Z

Vz = Design wind speed at any height in m/s

Vb = Basic wind speed at any height in m/s

K1 = Probability factor (risk coeff)

K2= Terrain height and structure size factor

K3 = Topographic factor

The wind force shall be applied on piers in both X and Z direction in STAAD Pro software.

e) Berthing Load

Berthing forces on the structure shall be applied according to IS 4561 (III). When an approaching vessel impacts on the berth, horizontal forces act on the berth. The magnitude of this force depends on the kinetic energy that can be absorbed by the fender system. When the berthing takes place, the fenders absorb the kinetic energy and convert into strain energy and in that process, passes on the reaction force to the structure, for which the berth shall be designed. The kinetic energy, E, imparted to a fender system by a vessel moving with velocity V is given by E = (Wd x V^2 x Cm x Ce x Cs) / (2x g)

Where,

E = Berthing Energy (Tm)

Wd= Displacement Tonnage of the Vessel (T)

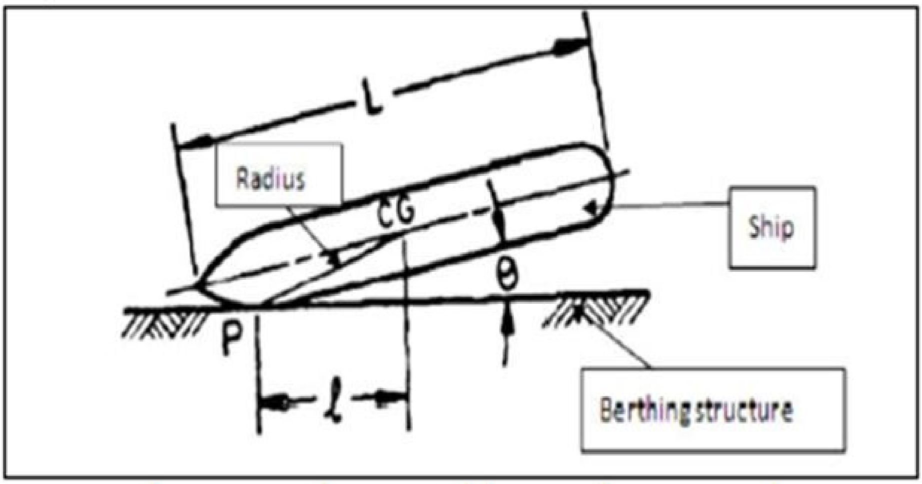
V= Berthing Velocity in m/s

Cm = Mass co –efficient

Ce = Eccentricity co-efficient

Cs = Softness co-efficient

G = Acceleration due to gravity (m/s2)



IS : 4651 (Part III) - 1974

TABLE 2 NORMAL VELOCITIES OF VESSELS

(*Clause* 5.2.1.1)

SL No.	SITE CONDITION	BERTHING CONDITION	BERTHING VELOCITY NORMAL TO BERTH IN m/s			
			Up to 5 000 DT	Up to 10 000 DT	Up to 100 000 DT	More than 100 000 DT
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Strong wind and swells	Difficult	0·75	0·55	0·40	0·20
ii)	Strong wind and swells	Favourable	0·60	0·45	0·30	0·20
iii)	Moderate wind and swells	Moderate	0·45	0·35	0·20	0·15
iv)	Sheltered	Difficult	0·25	0·20	0·15	0·10
v)	Sheltered	Favourable	0·20	0·15	0·10	0·10

f) Mooring Load

The Mooring loads are the lateral loads caused by the mooring lines when the vessel is pulled into or along the deck or hold it against the forces of wind or current. The maximum mooring forces are due to wind force on exposed area, on the port side of the vessel.

IS 4651_III, gives Bollard Pulls of vessel as below

TABLE 4 BOLLARD PULLS

(*Clauses* 5.3.4 *and* 6.1)

DISPLACEMENT (TONS)	LINE PULL (TONNES)
(1)	(2)
2 000	10
10 000	30
20 000	60
50 000	80
100 000	100
200 000	150
Greater than 200 000	200

NOTE 1 — For ships of displacement tonnage 50 000 and over the value of line pulls given above should be increased by 25 percent at quays and berths where there is a strong current.

NOTE 2 — Main bollards at the ends of individual large vessel berths at river structures should be designed for a line pull of 250 tons for ships up to 100 000 tons displacement and for double the values given above for larger ships.

g) Current Forces

As per IS 4651 III, pressure due to current shall be applied to the area of vessel below the water line when fully loaded.

Current force $F = w\, v^2/2g$ per m^2

Where v = velocity

W= 10 kN/m^2

Load Combinations

The load combinations as per IS 4651(IV): General Design Considerations will be considered in design of structure. Suitable partial safety factors as per IS: 4651 - 1989 applied to the loads for limit state design will be considered.

All operational load combinations will be checked to satisfy the serviceability criteria.

TABLE 6-3: Partial Safety Factors for Loads in Limit State Design

Loading	Partial Safety Factor					
	Limit State Serviceability		Limit State of Collapse			
Dead load [4.1(a)]	1.0	1.0	1.5	1.2 (or 0.9)	1.2 (or 0.9)	1.2 (or 0.9)
Vertical live load [4.1(b)]	1.0	1.0	1.5	1.2 (or 0.9)	1.2 (or 0.9)	1.2 (or 0.9)
Earth Pressure [4.1(f)]	1.0	1.0	1.0	1.0	1.0	1.0
Hydrostatic and hydrodynamic forces [4.1(g)]	1.0	1.0	1.0	1.2	1.0	1.0
Berthing and mooring forces [4.1(h) and 4.1(j)]	-	1.0	1.5	-	-	-
Secondary stresses [4.1(m)	1.0	-	-	-	-	-
Wind forces [4.1(k)	-	-	-	-	1.5	-
Seismic forces [4.1(p)	-	-	-	-	-	1.5

NOTE: For the limit states of serviceability, the values given in the table are applicable for short terms effects. While assessing the long term effects due to creep, the dead load and the part of the live load, likely to be permanent, may only be considered.

6.5 Construction Schedule

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

CHAPTER 7 : VESSEL DESIGN

7.1 General Review

The design of a vessel is dependent on various factors viz., Waterway / Fairway structure; Flow pattern in the Fairway for different seasons; Waterway morphological behaviour in different seasons; Cross structures across the fairway; Navigational constraints (Presence of Locks); Cargo volumes to be handled; Type of cargo to be handled; Cargo handling facilities available at Origin and destination; Turnaround time; Capacity of the fairway.

In the above, the predominant factors are Fairway and Cargo i.e., the Fairway availability and Cargo Volumes to be transported. The Fairway details have been discussed in Chapter 03 and the IWT Cargo scenario has been discussed in Chapter 04. Further the present status on the vessels plying in the study stretch also have been collected and placed in subsequent chapters, which will also have bearing in the vessel deployment.

There are not many countries internationally in which IWT is a significant industry, so skills and techniques in IWT vessel research and development are globally scarce. The countries that have significant IWT industries can therefore gain by learning from each other. Vessel design, including vessel loading/unloading methods, is expected to be a fruitful area for USA, EU and China to utilize international experience, particularly in newer, more specialized vessel types.

7.2 Design Basis

The design waterway channel width / depth is usually determined according to the following information: Design Width / depth = f {vessel size, vessel steering characteristics, traffic density, vessel speed, water depth, channel type, flow currents, waves and winds}

Further, the determination of the vessels will be based on traffic / freight projection. The higher the amount of traffic / volumes and lesser the freight cost, the more transport capacity can be foreseen, either in the form of larger vessels or by using more vessels.

7.2.1 Vessel Classification adopted in Indian Inland Waterway

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 tonne Dead Weight Tonnage (DWT) and tug-barge formation in Push Tug + 4 barges units of carrying capacity up to 8000 tonne (Ref: IWAI, Gazette Notification 2006).

The classification criteria of waterways are mentioned in **Table 7.1** for Rivers and in **Table 7.2** for canals.

TABLE 7-1: CLASSIFICATION OF INLAND WATERWAYS FOR RIVERS

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

TABLE 7-2: CLASSIFICATION OF INLAND WATERWAYS FOR RIVERS

Class of Waterways	Canals				
	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	-	-	-	-	-

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

i) Low voltage transmission lines including telephone lines -16.5 metres

ii) High voltage transmission lines, not exceeding 110 kilo volt-19.0 metres

iii) High voltage transmission line, exceeding 110 kilovolt- 19.0metres +1 centimetres extra for each additional kilovolt

The vessel sizes for self-propelled or tug and barge combination for different classes of waterways are described in **Table 7.3**.

TABLE 7-3: 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)

In general, total weight of the vessel considered to be 1.4 X DWT. Refer Figure 7.1 below for proposed dimensions of one way navigation channel.

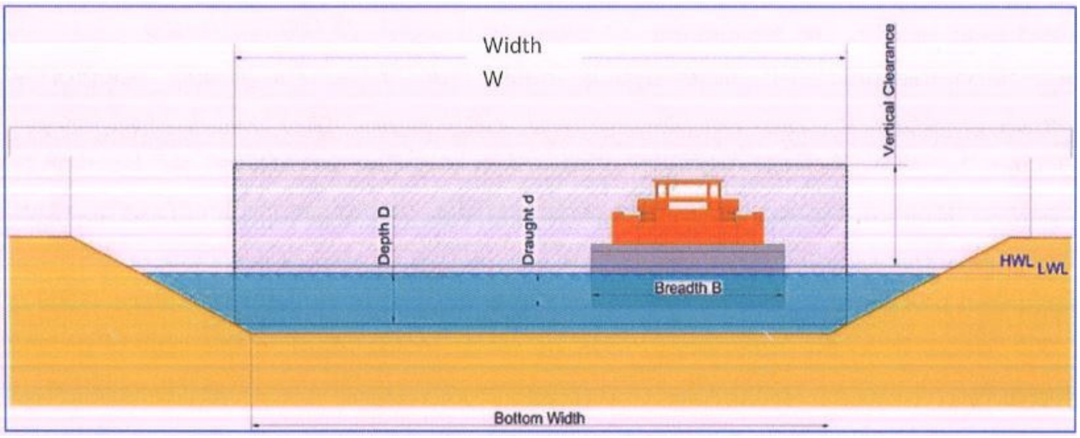
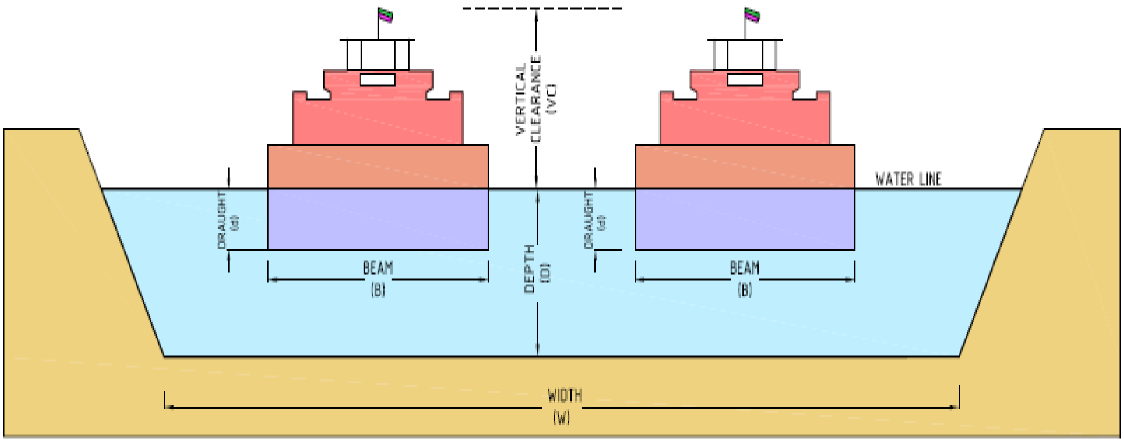


FIGURE 7-7-1: Dimensions – one way navigation Channel

Proposed dimensions of two ways navigation channel has been shown in **Figure 7.2** below.

FIGURE 7-7-2: Dimensions – Two-way navigation Channel



7.2.2 Vessel Classification of USA Inland Waterway

As per American Association of State Highway and Transportation Officials (AASTHO) standards, vessels with following dimensions referred in **Figure 7.3** below is under consideration with the characteristics as given in **Table 7.4** and **Table 7.5**.

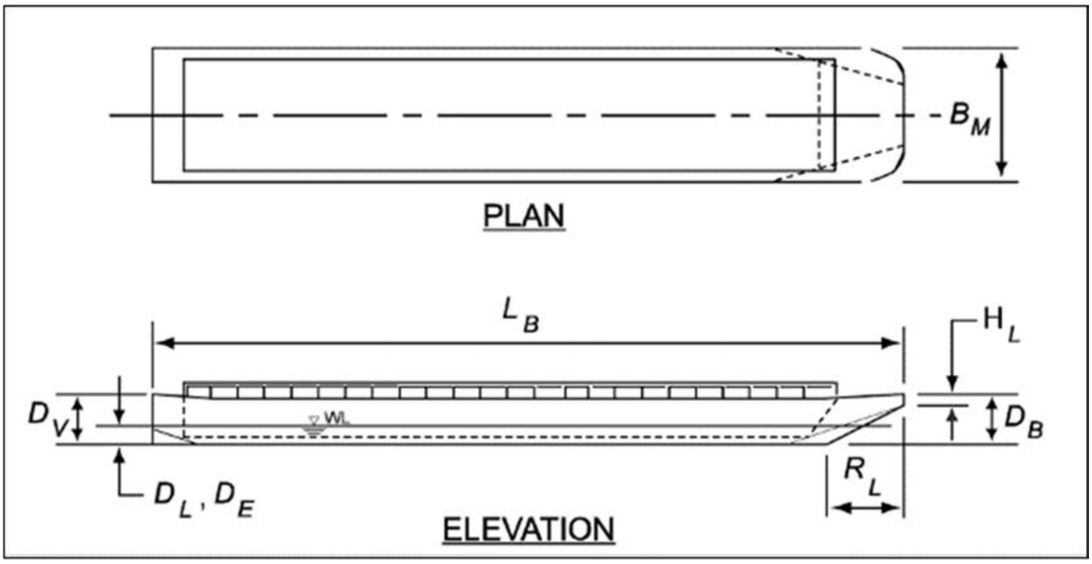


FIGURE 7-3: Plan and Elevation of vessel

TABLE 7-4: TYPICAL BARGE TOW CHARACTERISTICS

Particulars	Symbol	Unit	Jumbo Hopper	Oversize Tank	Special Deck
Width	BM	ft/m	35 / 10.67	53 / 16.15	72 / 21.95
Length	LB	ft/m	195 / 59.44	290 / 88.39	250 / 76.20
Head log Height	HL	ft/m	2-3 / 0.61-0.91	2-3 / 0.61-0.91	3-5 / 0.91-1.52
Depth of Vessel	DV	ft/m	12 / 3.66	12 / 3.66	17 / 5.18
Depth of Bow	DB	ft/m	13 / 3.96	13 / 3.96	18 / 5.49
Bow rake length	RL	ft/m	20 / 6.10	25 / 6.10	30 / 9.14
Loaded Draft	DL	ft/m	8.7 / 2.65	8.7 / 2.65	12.5 / 3.81
Empty (light) draft	DE	ft/m	1.7 / 0.52	1.7 / 0.52	2.5 / 0.76
Cargo Capacity	CC	tons	1700	3700	5000
Empty Displacement	WE	tons	200	600	1300
Loaded Displacement	WL	tons	1900	4300	6300

TABLE 7-5: TYPICAL CHARACTERISTICS OF BARGES ON THE INLAND WATERWAYS SYSTEM

Barge Type	Size	Length (ft/m)	Width (ft/m)	Draft (ft/m)	Capacity (tons)
Open Hopper	Small	120 / 36.58	30 / 9.14	7 / 2.13	630
Open Hopper	Standard	175 / 53.34	26 / 7.92	9 / 2.74	1060
Open Hopper	Jumbo	195 / 59.44	35 / 10.67	9 / 2.74	1700
Open Hopper	Oversize	245 / 74.68	35 / 10.67	10 / 3.05	2400
Covered Hopper	Jumbo	195 / 59.44	35 / 10.67	9 / 2.74	1700
Deck Barge	Small	100/150 ------- 30.48/45.72	26/32 ------- 7.92/9.75	6 / 1.83	350/600
Deck Barge	Jumbo	195 / 59.44	35 / 10.67	9 / 2.74	1700
Deck Barge	Oversize	200 / 60.96	50 / 15.24	9 / 2.74	2050
Tank Barge	Small	135 / 41.15	40 / 12.19	9 / 2.74	1300
Tank Barge	Jumbo	195 / 59.44	35 / 10.67	9 / 2.74	1700
Tank Barge	Oversize	185/290 ------- 56.39/88.39	53 / 16.15	9 / 2.74	2530/3740

7.2.3 Vessel Classification of European Inland Waterway

As per European, CEMT standards vessel dimensions are under consideration as given in below **Table 7.6** (Ref: SMART Rivers 2015-PIANC).

TABLE 7-6: CLASSIFICATION OF EUROPEAN INLAND WATERWAYS-1992

Type of Inland Waterways		Classes of Navigable waterways	Motor Vessels and barges					Pushed Convoys					Minimum Height under Bridges
			Type of Vessels Characteristics					Type of convoys: General Characteristics					
			Designation	Maximum Length	Maximum Beam	Draught	Tonnage		Length	Beam	Draught	Tonnage	
				L (m)	B (m)	d (m)	T (t)		L (m)	B (m)	d (m)	T (t)	H (m)
1		2	3	4	5	6	7	8	9	10	11	12	13
Of Regional Importance	To West of Elbe	I	Barge	38.5	5.05	1.80-2.2	250-400						4.0
		II	Campine barge	50-55	6.6	2.50	400-650						4.0-5.0
		III	Gustav Koeings	67-80	8.2	2.50	650-1000						4.0-5.0
	To East of Elbe	I	Gross Finow	41	4.7	1.40	180						3.0
		II	BM-500	57	7.5-9.0	1.60	500-600						3.0
		III		67-70	8.2-9.0	1.60-2.00	470-700		118-132	8.2-9.0	1.6-2.0	1000-1200	4.0
Of International Importance		IV	Johann Welker	80-85	9.5	2.50	1000-1500		85	9.5	2.5-2.8	1250-1450	5.25 or 7.0
		Va	large Rhine Vessel:	95-110	11.4	2.50-2.80	1500-3000		95-110	11.4	2.5-4.5	1600-3000	5.25 or 7.0 or 9.1
		Vb							172-185	11.4	2.5-4.5	3200-6000	
		VIa							95-110	22.8	2.5-4.5	3200-6000	7.0 or 9.1
		VIb		140	15.0	3.90			185-195	22.8	2.5-4.5	6400-12000	7.0 or 9.1

7.2.4 Vessel Classification of China Inland Waterway

As per European, CEMT standards vessel dimensions are under consideration as given in below **Table 7.7.** (Ref: SMART Rivers 2015-PIANC)

TABLE 7-7: CHARACTERISTICS OF REFERENCE MOTOR CARGO VESSELS- CHINESE CLASSIFICATION

Class	Type of vessel: General Characteristics					Type of convoy : General Characteristics				
		Length	Beam	Draught	Tonnage		Length	Beam	Draught	Tonnage
		m	m	m	T	Push tows	m	m	m	T
II	Barge	75	14	2.6	2000	1) 2P. barge -2 rows *1 columns	180	14	2.6	4000
		65	15.8	2.6-2.9		2) 2P. barge -2 rows *1 columns	160	15.8	2.6-2.9	
	Motor Vessel	90	15.4	2.6		3)1 motor vessel	90	15.4	2.6	2000
		65	13	2.6-2.9		3)1 motor vessel	65	13	2.6-2.9	
III	Barge	65	10.8	1.9-2.2	1000	1) 2 P. barge -2 rows *1 columns	160	10.8	1.9-2.2	2000
		55	10.8	2.5		2) 6 T. barges	357	10.8	2.5	6000
	Motor Vessel	68	10.8	2.6		3) 1 motor vessel	68	10.8	2.6	1000
IV	Barge	42	9.2	1.9	500	1) 2 P. barge -2 rows *1 columns	108	9.2	1.9	1000
		42	8.2	1.9-2.1		2) 7 T. barges	320	8.2	1.9-2.1	3500
	Motor Vessel	52	9.6	2.2		3) 1 motor vessel	52	9.8	2.2	500
V	Barge	30	8	1.8-1.9	300	1) 2 P. barge -2 rows *1 columns	82	8	1.9	600
		35	6.8	1.7-2.0		2) 8 T. barges	303	6.8	1.7-2.0	2400
	Motor Vessel	42	8.2	1.8-2.2		3) 1 motor vessel	42	8.2	1.8-2.2	300

After having elaborate analysis over the important ratios, the following comparison has been found as an apt requirement to arrive at the Channel vessel relationship and the same has been compared with the present Classification of IWT vessels considered by IWAI.

TABLE 7-8: WATERWAY RATIOS OF DIFFERENT COUNTRIES

Relative Waterway Dimensions from Guidelines for different Countries

Location	Ship	Two-lane			One-lane		Driving Quality
	(B x L x D)	F/B	D/d	N	F/B	D/d	category
China Canel	Average (Class III-VII)	4.4	1.3	7	-	-	A-B
China Cannel	Average (Class II-VII)	4.4	1.4	6-7	-	-	A-B
China River	Average (Class I-VII)	4.4	1.2	-	2.3	1.2	A-B
Dutch normal	11.45 x 185 x 3.5	4.0	1.4	8.7	2	1.3	A-B
Dutch narrow	11.45 x 185 x 2.8	3.0	1.3	6.7	-	-	B-C
France	11.45 x 105 x 2.5	3.1	1.4	5.8	-	-	B-C
Germany	11.45 x 185 x 2.8	3.3	1.4	5.6	1.8	1.4	B-C
Russia	16.5 x 135 x 3.5	2.6	1.3	-	1.5	1.3	C
US River	10.7 x 59.5 x 2.7	3.3	1.3	4.9	2.2	1.3	B-C

TABLE 7-9: WATERWAY RATIOS OF INDIAN IWT (RIVERS)

Relative Waterway Dimensions (in Rivers) from Guidelines in vogue in India

Class	SPV			Tug and Barge		SPV L x B x d / Convoy L x B x d
	F/B	D/d	n	F/B	D/d	Waterway F x D
Class I	6.00	1.20	7.20	6.00	1.20	32 x 5 x 1.0 / 80 x 5 x 1.0 30 x 1.2
Class II	5.00	1.17	5.83	5.00	1.17	45 x 8 x 1.2 / 110 x 8 x 1.2 40 x 1.4
Class III	5.56	1.13	6.30	5.56	1.13	58 x 9 x 1.5 / 141 x 9 x 1.5 50 x 1.7
Class IV	4.17	1.11	4.63	4.17	1.11	70 x 12 x 1.8 / 170 x 12 x 1.8 50 x 2.0
Class V	6.67	1.11	7.41	3.33	1.11	70 x 12 x 1.8 / 170 x 24 x 1.8 80 x 2.0
Class VI	5.71	1.10	6.29	5.71	1.10	86 x 14 x 2.5 / 210 x 14 x 2.5 80 x 2.75
Class VII	7.14	1.10	7.86	3.57	1.10	86 x 14 x 2.5 / 210 x 28 x 2.5 100 x 2.75

TABLE 7-10: WATERWAY RATIOS OF INDIAN IWT (CANALS)

Relative Waterway Dimensions (in Canals) from Guidelines in vogue in India

Class	SPV			Tug and Barge		SPV L x B x d / Convoy L x B x d Waterway F x D
	F/B	D/d	n	F/B	D/d	
Class I	4.00	1.50	6.00	4.00	1.50	32 x 5 x 1.0 / 80 x 5 x 1.0 20 x 1.5
Class II	3.75	1.50	5.63	3.75	1.50	45 x 8 x 1.2 / 110 x 8 x 1.2 30 x 1.8
Class III	4.44	1.47	6.52	4.44	1.47	58 x 9 x 1.5 / 141 x 9 x 1.5 40 x 2.2
Class IV	4.17	1.39	5.79	4.17	1.39	70 x 12 x 1.8 / 170 x 12 x 1.8 50 x 2.5
Class V	--	--	--	--	--	70 x 12 x 1.8 / 170 x 24 x 1.8 --
Class VI	4.29	1.40	6.00	4.29	1.40	86 x 14 x 2.5 / 210 x 14 x 2.5 60 x 3.5
Class VII	--	--	--	--	--	86 x 14 x 2.5 / 210 x 28 x 2.5 --

The parameters of Horizontal clearance and Vertical clearance considered in the Indian Waterway classification guidelines are related to the Cross Structures in the particular waterway. These aspects can be modified for the requirement of Vessel / Waterway size, on need basis.

Further, the Bend Radius criterion is related to the terrain, which can be taken care by Cutting / Protection in the curves.

Hence, the basic Vessel design criteria is related to the Cross Section of the Waterway and accordingly, the factors on Breadth (F / B); Depth (D / d) and Cross Section Area (n), which is now being considered for comparison i.e., the Indian IWT classification with the Waterway classifications of other countries, with reference to the Tables above.

The Range variation on the Factors – Width F / B; Depth D / d and N have been tabulated herewith for an overview.

TABLE 7-11: RANGE VARIATION OF THE FACTORS

Factor on Width "F / B"	
Indian classification – Rivers – SPV / Single Channel	4.17 to 7.14
Indian classification – Canals – SPV / Single Channel	3.75 to 4.44
Others – Waterways – SPV / Single Channel	1.50 to 2.30
Indian classification – Rivers – Convoy	3.33 to 6.00
Indian classification – Canals – Convoy	3.75 to 4.44
Others – Waterways – Convoy	2.60 to 4.44
Factor on Depth "D / d"	
Indian classification – Rivers – SPV / Single Channel	1.10 to 1.20
Indian classification – Canals – SPV / Single Channel	1.39 to 1.50
Others – Waterways – SPV / Single Channel	1.20 to 1.40
Indian classification – Rivers – Convoy	1.10 to 1.20
Indian classification – Canals – Convoy	1.39 to 1.50
Others – Waterways – Convoy	1.20 to 1.40

Factor on Cross Section Area “n”	
Indian classification – Waterways – SPV / Single Channel	4.63 to 7.86
Indian classification – Canals – SPV / Single Channel	5.63 to 6.00
Others – Waterways – Convoy	4.90 to 8.70

Note:

Other Waterways, only Chinese waterways are having the segregation available between Rivers and canals. However, the same has not been taken into consideration.

Indian IWT classification has not been provided with “n” value for convoy system, which is essential.

Other Waterways has not been provided with “n” value for SPV / Single Channel.

In the above, the range of Indian IWT Classification on Width factor “F/B” and Cross Section area factor “n” are well within the safer range. Whereas, the Depth factor “D/d” may have to be relooked into and this will have larger implication on the West flowing rivers i.e., the present study stretch areas.

7.3 Type of proposed Vessels

The most suitable river vessel is to be considered based on the following aspects viz., Fairway availability; Availability of Day / Night navigation system; Obstructions enroute like Locks; Navigational clearances free cross structures; Haulage distance; Type and Nature of Cargo; Terminal facilities etc.

Kerala State Inland Navigation Corporation Ltd., (KSINC), Kochi Government of Kerala Undertaking under the Coastal Shipping and Inland Navigation Department is the prime utilizer of the existing NW 3. The vessels being deployed in NW 3 by KSINC are placed below. There is a possibility of plying these vessels on NW 3 (Extension) / NW 8 / NW 9 / NW 59 after its development to equivalent / Class III Canal standards.

If the vessel has to travel in sea for all year second, then vessels to be built as “RSV” as per DG’s order “08 of 2018” dated 04.09.2018 and accordingly the vessel may not be further used in Inland Waters due to height clearances.

KERALA SHIPPING AND INLAND NAVIGATION CORPORATION LIMITED
KOCHI -20, KERALA

DETAILS OF CARGO FLEET OWNED BY KSINC / PLYING ON NW-3

Sl. No.	Name of the vessel	Year Built	Length (LOA) (in m)	Width (in m)	Draft / Depth (in m)	Cargo Capacity (in T)	Engine Make	Engine X HP (No x HP)	Other details, if any
1.	**Archana**	1982	36.45	7.98	1.80 / 2.60	300	Ashok Leyland 370	ALHM, KFEM, 2 x 98 HP	POL barge
2.	**Bhama**	1994	35.37	7.40	1.80 / 2.20	213	Ashok Leyland	AWHM26392, 26454 2 x 160 HP	POL
3.	**Bharatha**	1994	35.25	7.37	1.80 / 2.19	201	Ashok Leyland	22220610431 426, 2x156HP	POL
4.	**Ocean Breeze**	2013 Dec.	53.00	10.00	1.80 / 3.00	498 Gross 175 Net	Cummins India Ltd.	25365721; 25365722 2 x 325 HP	POL - operates only in port area
5.	**Athulya**	2010 March	52.285	10.00	1.80 / 2.80	425	Ashok Leyland	KXHM – 575397 KXHM – 575398 2 x 156HP	Bulk
6.	**Orion**	2017	49.00	9.00	1.80 / 2.75	349	Ashok Leyland 60T19	HFHM 408150; 408151 2 x 220 HP	bulk
7.	**Amla**	1987	34.09	7.45	1.80 / 2.64	276	Ashok Leyland ALMU 402	LKEM 0423801; 042383 2 x 88 HP	Phosphoric Acid

ALL BARGES OPERATE ONLY IN THE UDYOGAMANDAL AND CHAMPAKKARA CANALS OF NW-3

The study stretch of NW 9 is being considered for Lo-Lo operation with Class III canal standard and the suggested vessel size is discussed accordingly. However, the fairway thus developed should be in a position to accommodate the mobility of Ro-Ro vessel also, on need basis.

Vessel Requirement for a waterway can be segregated mainly into two parts i.e., Waterway maintenance vessels and Cargo vessels. There are many vessels required for maintenance of waterway viz., Dredgers; Tugs; Survey vessels; Navigational Equipment maintenance vessels; Patrol Boats; Pilot Boats; Inspection Vessels etc.,. The said abundant types of vessels may not be required for the proposed stretch and neither suggested nor recommended.

With regard to the SPV vessel / Ro-Ro vessel, it is suggested the deployment of 1 No. vessel (Multi purpose) at initial stages on promotional basis and may be considered with augmentation, on observing the Growth.

7.4 Proposed Vessel Size and Specifications

In line with the above derivations, the vessel size and specifications are placed herewith.

With regard to the SPV / Ro-Ro operation, the vessel size proposed for such mobility will be considered at the initial stage with 50 m – 55 m of LOA x 9 m – 12 m Breadth x 1.6 m – 1.8 m Loaded Draft / 2.2 + m, which can carry 300 T – 500 T or 15 Nos. TEU – 21 TEU (Equivalent Ro-Ro). The Propulsion will be 2 Nos of Marine Diesel Engines of 325 Bhp each. Initially the operation will be taken up with ONE vessel deployment and can be augmented with growth observation.

Note: Depth + is an indication for provision of increased depth for the vessel mobility.

1 SPV / Ro-Ro vessel may be required at the initial stages i.e., by 2022.

Other vessel may be required after 10 years, based on the growth trend.

The estimated volumes of operation is subjected to the approval of Government of Kerala for Grey Cement production and also the ultimate mutual understanding of investment / revenue sharing. Further, working of vessel requirement will not have much bearing, since the vessel deployment is the responsibility of Entrepreneurs.

7.5 Turn around Time

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

In the existing study stretch of NW 9, the Origin / Destination may be from ICTT, Kochi / Cochin Port, which may be of about 90km from / to the adjacent captive terminals.

The maximum time to be traversed between ICTT, Kochi and KPACT / TCC is of 4 ½ Hrs, taking the average speed of 20 Kmph. Further working at this stage may not have much implication for any suggestion / recommendation. To ascertain the operational requirements etc., 1 cycle operation is possible in a day.

7.6 Number of Vessels Required

As suggested above,

1 SPV / Ro-Ro vessel may be required at the initial stages i.e., by 2022.

Other vessel may be required after 10 years, based on the growth trend.

7.7 Vessel Repair facilities

Vessel Repair facility in close proximity always will have added advantage for ease and timely operation of IWT Vessels. On board Minor repairs can be considered, while the vessel under mobility, wherein the Major repairs and Dry Dock repairs may have to be attended only in the Ship Yards.

In the NW 9 reach, i.e. in Vembanad Lake area, No repair yard exists to attend the Dock type of Repair repairs of IWT Vessels plying in this region.

The "Cochin Ship Yard" in Kochi is the Ship Yard catered for undertaking the Construction and Repair of the Sea going ships. It may attend the construction of IWT Vessels. However, undertaking the repair of IWT Vessels may not be cost effective for such big Ship Yard. CSY, Kochi is the Public Sector Undertaking under the Ministry of Shipping, Government of India.

KSINC is having a Boat Yard in Perumanoor area of Kochi adjacent to Venduruthy (Rail) Bridge connecting Wellingdon Island, Kochi with main Ernakulam city. KSINC has been constructing passenger boats, speed boats, house boats, tourist boats and small seagoing vessels. It constructs the vessels using wood, steel or FRP as per the requirements of customers. KSINC also has experience in repair (both hull and machinery) of large variety vessels. KSINC has a slipway, where vessels of weight up to 200 MTs can be hauled up and repaired. There are facilities to dock six vessels at a time. Facilities for manufacture, repair and servicing of seagoing and inland navigation vessels are available. This location is about 60 Kms. North of NW 9 study area.

Kerala Water Transport Department is having a Boat Repair Yard at Alappuzha, which attends only the repair and docking of Department / Govt. of Kerala Vessels.

The following are certain repair yards in KOCHI area, attending the repair of IWT Vessels, as ascertained.

Sl.no	Name of company	Address	email id	Phone number
1	J Pee Marine	14/548 Nazreth, Kochi - 682002	jpeemarine@gmail.com	91-9496072700
2	Unotech Marine Engineering and service Pvt Ltd	39/2394 C First floor veejay towers, Salim - Rajan road Gandhinagar, Kochi - 682017	mail@unotechmarine.com	91-484-2206033
3	Cochin Marine Engineering	Door No.7/472 Kochangadi Road, Kochi - 682002	cinmarine@gmail.com	91-9895480901
4	Sea Blue Shipyard Ltd	1/212, VP Road, Azheekal PO, Vypin, Kochi – 682510	josejames@seablueshipyard.com	91-484-4567890
5	Krishna Marine Engineering	40/7818, Anjaly T.D Rd, Ernakulam, Kochi – 682035	appuajay93@gmail.com	91-9388850888
6	Western Marine Engineering	Near St.Lawrence school, P.Box. 915 Edakochi, Kochi - 682010	westernmarine@gmail.com	91-9895186610
7	Walrus Marine And Engineering Co.Pvt.Ltd	Anjikkattu Towers, Near Metro Pillar 363,Koonamthai, Edappally, Kochi - 682024	navneeth@walrusmarine.com	91-9746475712
8	Sea Max Marine Service Pvt Ltd	Thoppil tower, 2nd Floor, Opp.St.Joseph Church, N.F.Gate, Tripunithura, Kochi - 682301	ops@seamax.co.in	91-9947107775
9	4.Square Marine	61/589, Zaabil Building, R. Madhavan Nair Road (Old Thevara Road), Kochi, - 682016	info@4squaremarine.com	91-9496252868

7.8 Vessel Costing

7.8.1 Capital Cost

At the outset, it is to place that the Capital Cost of the vessel may not form part of the Financial / Cost analysis, since the deployment of vessels will be considered by the Vessel Owners, who will deploy the required type of vessel. It has been noted that the Capital Vessel Building Subsidy is under consideration by IWAI / Administrative Ministry of Shipping, which is being recommended herewith to give boost to this sector. Hence, the indicative cost, as ascertained from the Market, is being furnished herewith.

The SPV / Ro-Ro vessel is suggested with 50 m – 55 m of LOA x 9 m – 12 m Breadth x 1.6 m – 1.8 m Loaded Draft / 2.2 + m, which can carry 300 T – 500 T or 15 Nos. TEU – 21 TEU (Equivalent Ro-Ro). The Propulsion by Marine Diesel Engines of 2 x 325 Bhp is costing about **INR 700 Lakhs each.**

7.8.1.1 O&M Cost

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

1 SPV / Ro-Ro Vessel (For 1 Year)

1 Ro-Ro vessel Running cost for 300 days operation with 9 Hrs mobility in a day, cost per annum will be as detailed.

- 300 days x 9 Hrs x {0.1 Liter per hour x 2 Engines x 325 Bhp} x INR 70 per Liter = **INR 122.85 Lakhs Per Annum**.
- 6 Nos. Crew on 1 Ro-Ro vessel @ INR 0.50 Lakhs per month.
- Crew cost for 12 months will be 12 x 6 x 0.5 = **INR 36 Lakhs Per Annum** per Unit.
- Repair Cost is @ 2 % P. A of CAPEX i.e., 0.02 {1 x 700} = **INR 14 Lakhs Per Annum.**
- Depreciation is proposed by considering the life of vessels as 20 Yrs.
- Interest factor is proposed as per the industry norms.
- Insurance factor is proposed as per the industry norms.

CHAPTER 8 NAVIGATION AND COMMUNICATION SYSTEM

8.1 General Requirements

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

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

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

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

8.1.1 VHF / HF

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

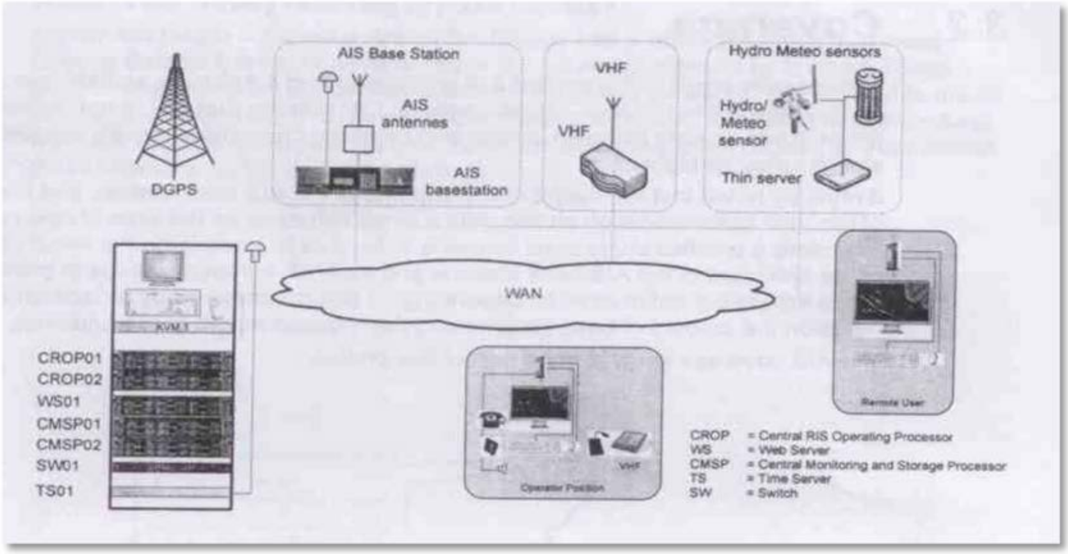
8.1.2 GPS

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

8.1.3 RIS / AIS / Radar / VTMS

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

The general technical solution is depicted in Figure below.



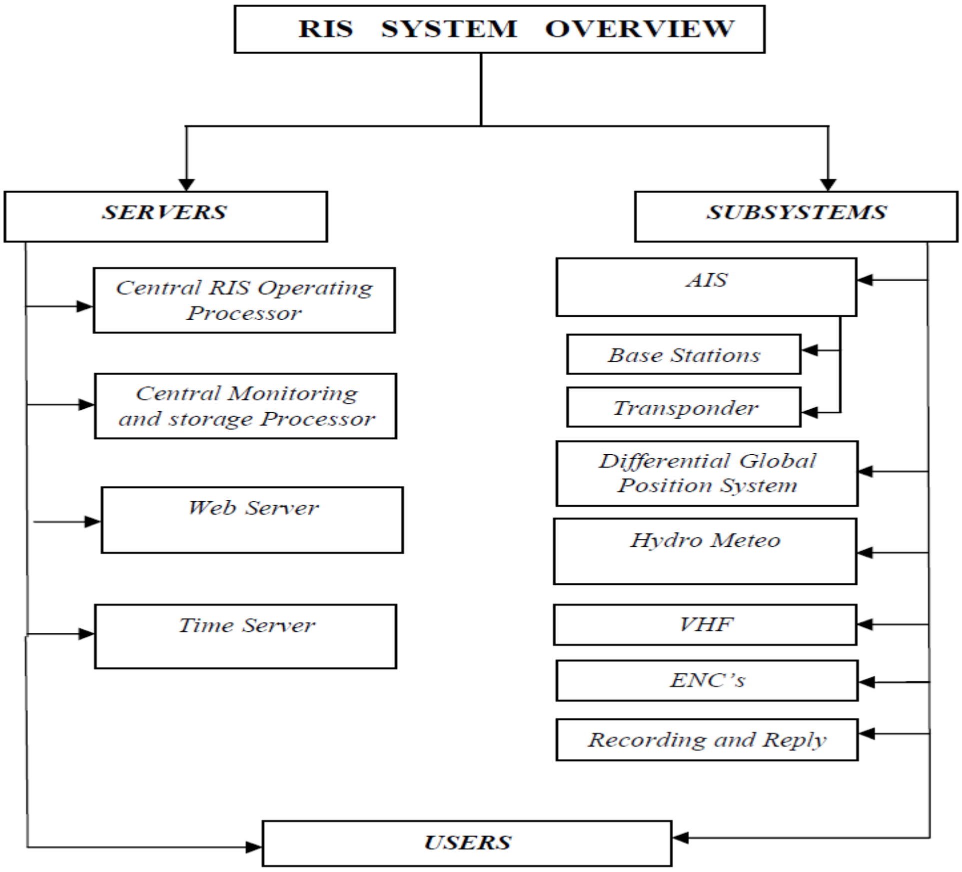


FIGURE 8-1: Main components of the RIS system

River Information Service (RIS) system is one among the latest technology introduced in Inland Water Transport sector, which is in nascent stage in India. It has been ascertained that the system is suitably designed keeping in view the PIANC and IALA guidelines for setting up of RIS.

In the RIS system, a group of base stations is connected by LAN through lease line. Each of the stations is located at 50-60Kms intervals. These base stations will have 30 Kms (approx) radial coverage and two-way communication between vessels plying in their region and management authority. The goal of safe and efficient transportation can be achieved by avoiding navigational risks like ship to ship collision, ship to bridge collisions and vessel groundings. In addition, RIS system provides fairway information, traffic information, calamity abatement support etc. Efficiency of this system gets greatly increased when there are multiple users of the waterway with different type of vessels and different types of cargo.

Components of RIS systems: The River Information Services (RIS) System consists of (a) base stations, (b) control stations and (c) Mobile /user stations.

a) Base station: Deploy series of sensors for exchange of electronic data between the control station and the vessels. Two porta-cabin at each station are equipped with latest version of the sophisticated electronic equipment's transmit the waterway information namely navigable depth in their jurisdiction, channel limits with virtual buoys, terminal facilities, port clearance etc. The AIS and VHF antennae and meteorological sensors are installed on the mono pole tower of 30-meter height at each station to provide update weather information. The basis of height calculation will be considered based on the geographical position including the Antenna height and the vessel Antenna elevation.

The list of equipment's includes

- Automatic Identification Systems (AIS) equipment
- Meteorological equipment.
- VHF equipment's with Tx/Rx installed on 30 mtr mono pole.
- Gen Set 10 KVA with UPS 5 KVA for 2 hours backup.

b) Control station: The control station is responsible for situational awareness of waterway for undertaking coordinated actions to ensure safe passage of vessels through the waterway. The control station has been set up along with any one of the base station suitability near to the Regional Office. As the name indicates, control station carries out all standing orders and collect the data of cargo/vessel movement and keep back up for analysis and further improvement of efficiency. The control centers include 2x control Centers Servers for AIS data record and display, WEB Servers which provide traffic situation presentation via Web interface. This also includes Operator Workstations. Operator have comprehensive tabular information about traffic, wide variety of navigational alarms, traffic management tools like zones, reporting lines, routes, traffic prediction tools, control of AIS base stations. Tools such as Playback are available for each Operator. All above mentioned system components interact between each other via TCP/IP protocol i.e. proposed system is completely IP based. The control station consists of the following computer hardware: -

- Central RIS Operating Processor
- Central Monitoring and Storage Processor
- Web Server & Time Server
- Workstation
- Operator Display 52" LED wide Screen+ with operator display

- RIS software

c) Mobile/user station: The state of art equipment installed on board each vessel for her safe navigation and smooth sailing for 24x7 in clock.

- AIS Transponder Inland Class – A
- VHF Sets with Antenna
- Echo Sounder
- DGPS Receiver
- Short Range Radar
- Laptop (Tough Book) - 14" with 5 KVA UPS
- MFD Multi-Function Display 19" size

d) Manpower: Each of the base stations and control station are manned 24x7 round the clock by 3 operators and 3 security personnel. Accommodation facilities have been provided in the porta cabins. The manpower deployments are covered under Operation and Maintenance of RIS system.

As ascertained, IWAI has already initiated the implementation of RIS system in phased manner.

Observations:

1. AIS receiver is must on board the vessels utilizing the Waterway.
2. Preferred to provide the RADARs installed at selected locations, for easy tracking of vessels.
3. Trained Operators can effectively be utilized for ensuring proper running of RIS system.

8.1.4 Vessel / Hydrographic Survey equipment

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

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

8.2 Existing System

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

8.3 Additional requirement

The communication system technology is rapidly changing with Technology change. Accordingly, within a short gap of time, the existing system is leading to an obsolete scenario. Hence, development of a sustainable system is very difficult. However, an attempt has been made and a workable rather reliable system has been worked out and placed as Annexure 8.1. This is only indicative.

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

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

Regarding the RIS on "NW 9", this stretch is nothing but a canal system and not amenable for provision of RIS. However, the cost details are provisioned for taking up the same, at later date, if the need is judicious.

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

8.4 Specifications of certain equipment's of the system

The following indicative specifications on various equipment's proposed for developing the RIS unit are placed. A system context Diagram is placed at the end.

VHF sets with Antenna

- Channel Capacity minimum - 100
- Frequencies 156.00 - 161.50 Mhz (Marine Universal frequency band)
- Rx @ Rated Audio 2 A max
- Tx @ Rated Audio 14.5 A max
- Power Supply 12 VDC to 24 VDC
- Channel Spacing:- 12.5 kHz/ 25 kHz

- Audio Response: - + 1, -3 dB
- Adjacent Channel Selectivity: - 60 dB @ 12.5 kHz 70 dB @ 25 kHz

Metrological Equipment's (Anemometer, Barometer, Relative Humidity)

Wind Speed

- Range: 0 to 60 m/s
- response time 250 ms
- accuracy: 0 to 35 m/s: ±0.3 m/s or ±3%, whichever is greater
- Output resolution and unit: 0.01m/s
- Protection IP66
- Serial Output:RS232/485

Wind Direction

- Azimuth: 0 to 360°
- Response time: 250 ms
- Accuracy: ±3°
- Output resolution and unit: 1°
- Protection IP66
- Serial Output:RS232/485

Air temperature

- Range: - 50 3 to +60 °C
- Accuracy for sensor at +20 °C: ±0.3 °C
- Output resolution and unit: 0.1 °C

Barometric pressure

- Range: 600 to 1100 hPa
- Temp: -50 to +60 °C
- Accuracy: ±0.5% of analog pressure range, digital accuracy 0.2 hPa (25°C)
- Output resolution: 0.2hPa

Relative humidity

- Range: 0 to 100 %RH
- Accuracy: ±3 %RH within 0 to 90 %RH ± 5 %RH within 90 to 100 %RH

Output resolution and unit: 0.1 % RH

Control Station Servers (CROP / CMSP / WS / TS)

Central RIS Operating Processor (Application cum Data base Server)

- Processor Intel Xeon – 4 core

- RAM 64 GB
- HDD 2TB
- DVD RW (Re Writable)
- Operating System:- Windows Server latest edition
- 52" LED Display. The Operator console should be minimum 21” size.

Central Monitoring and Storage Processor (Web Server / GIS Software)

- Processor Intel Xeon – 4 core
- RAM 64 GB
- HDD 10TB
- DVD RW (Re Writable)
- Operating System :- Windows Server latest edition

Web Server & Time Server (Application cum Data base Server)

- Processor Intel Xeon – 4 core
- RAM 64 GB
- HDD 4TB
- DVD RW (Re Writable)
- Operating System :- Windows Server latest edition
- Concurrent 50 web users

Operator Console

• Processor :-	Intel® Core™ Xeon Processor or Better
• Operating System :-	Latest Windows operating system 64 bit (English)
• Display :-	24. 0" (min)
• Memory :-	16 GB RAM (min)
• Hard Drive :-	2.0 TB SATA Hard Drive (min)
• Optical Drive	DVD +/- RW
• USB Ports	4 Ports minimum
• Memory card	Standard Memory Card Reader slots
• Warranty :-	3 Year Complete Cover Accidental Damage

Operator Display

- 52” LED Display wide Screen

General Features for RIS Software/ Application

1. Provide the situational awareness and Traffic overview of channel to the Traffic Operators in the Control centre.

2. Facilitate planning of the river Channel activities on a 'Time-line' view of the Traffic Display.

    - The GUI (Graphical User Interface) should be capable of displaying the arrival and departure information of vessels entering and exiting the Channel with date and time indicators.

    - List all important activities being undertaken in the Channel

    - Should Display various important activities being undertaken in the Channel, which includes activities of the 'previous Operator Watch', 'current Watch' and the activities being planned for the 'next Watch'.

    - It must be possible to define start and end-point of the time line.

    - It must be possible to choose the waterway for the time-line.

3. Facilitate the Operator to 'Define' the conditions for generating Alerts / Warnings by the system and automatic generation of Alerts / Warnings in the event of any abnormality

4. Facilitate escalation of the alerts / warnings to all important stakeholders using SMS / email.

5. Undertake Incident management during emergencies

6. Receive AIS messages from Base stations and store important AIS messages. Data storage facilities should be able to store data for a period of one year. AIS messages received by multiple stations shall be stored only once.

7. Send out AIS messages broadcast and individual to Vessels in the river channel

8. Disseminate met data on case to case basis to vessels in the system.

9. Facilitate communications between the Traffic operator and captains of the vessels using VHF.

10. Provide the situational awareness and Traffic overview of the river channel to important stakeholders over the web using web access. Web Access shall be planned for minimum 50 stakeholders which shall be scalable at later date.

11. Application should be web based and available on PC, tablet and smartphone (Android and IoS). Application must be available as App for Android Users.

12. BITE facility to provide system status to the Operators to detect any abnormality in the functioning of the sensors integrated with the system.

13. Support integration with other Command and Control systems of security agencies of Police, Navy / Coastguard etc. for building up a collaborative contingency plan in case of emergencies.

14. Should facilitate Storing of important information being received from the sensors such as:-

    - Storing of display scenarios

- AIS messages
- VHF data
- Warning / Alerts

Minimum one-year data shall be stored.

15. Facilitate automatic detection of the abnormal behaviors of Vessels such as over speeding, vessel entering or leaving demarcated non-entry area, Anchor watch etc. This automatic detection shall be done based on AIS data in the system.

16. Should be able to Zoom and navigate to any geographical area in the Channel.

17. Should be possible to switch between ENC and Google Maps presentation.

18. Should have the facility for inserting temporary charts (such as plotting point, lines, circle etc.) on the map.

19. Should be able to search any vessel on the geographical location at the given instant.

20. Should have tools to calculate "Closest Point of Approach, TCPA, Range & Bearing Line, ETA, Distance between 2 Vessels or points" etc. in the Channel.

21. Facilitate geo fencing.

22. Capability to provide Virtual Buoys / Aids to Navigation inputs. This according international standard for ATON via AIS.

Based on the market survey, the cost implications are placed herewith.

8.5 Costing

8.5.1 Capital Cost / O & M Cost

Provision of RIS is not suggested, at this point of time. However, cost implications are placed.

COST FOR RIS SYSTEM ON "NW 9"

Sl. No.	Equipment	Qty	Unit Price (in INR)	Total (in INR)
A.	**CAPITAL COST**			
1	AIS Base Station (Hot standby for 2 locations)	2	30,00,000	60,00,000
2	RADAR	1	50,00,000	50,00,000
3	Meteo Sensor	1	8,00,000	8,00,000
4	ATG	2	11,90,000	23,80,000
5	VHF	2	5,00,000	10,00,000
6	DG Set 10 KVA	1	7,00,000	7,00,000
7	UPS	1	5,00,000	5,00,000
8	RIS Software	1	65,00,000	65,00,000

COST FOR RIS SYSTEM ON "NW 9"

Sl. No.	Equipment	Qty	Unit Price (in INR)	Total (in INR)
9	RIS Hardware	1	120,00,000	1,20,00,000
10	Installation Testing & Commissioning	1	20,00,000	20,00,000
11	Porta cabin	2	12,00,000	24,00,000
12	Trestle Tower	2	10,00,000	20,00,000
13	Land Cost	-	Lump Sum	34,20,000
14	Buildings etc.,	-	Lump Sum	74,00,000
			Total	**5,21,00,000**
B.	**MANPOWER COST**			
	1^{ST} YEAR			
	1 Engineer * 1 NW * 12 months p. a	12	35,000	4,20,000
	3 Operators * 2 Sites * 12 months p. a	72	20,000	14,40,000
	3 Security * 2 Sites * 12 months p. a	72	15,000	10,80,000
	Total for 1^{st} year			**29,40,000**
	Total for 2^{nd} year (10 % on the previous year)			**32,34,000**
	Total for 3^{rd} year (10 % on the previous year)			**35,57,400**
	Total for 4^{th} year (10 % on the previous year)			**39,31,140**
D.	**CAMC for 4 years**			
	1^{st} year			**-Nil-**
	2^{nd} year (10 % on the Capital Cost)			**52,10,000**
	3^{rd} year (+ 10 % on the previous year Cost)			**57,31,000**
	4^{th} year (+ 10 % on the previous year Cost)			**63,04,100**
D.	**LICENSE COST (per annum)**			
	Wireless etc.,			33,00,000
	VHF	2	5,000	10,000
	Other Miscellaneous		Lump Sum	90,000
			Total	**34,00,000**

A. Equipment Cost has been ascertained from the Market, in consultation with IWAI.

B. Manpower Cost has been worked out as per the requirement and only indicative.

C. Cumulative Annual Maintenance Cost is indicative.

D. The Annual License Cost may vary according to the policy of the Licensing Authority.

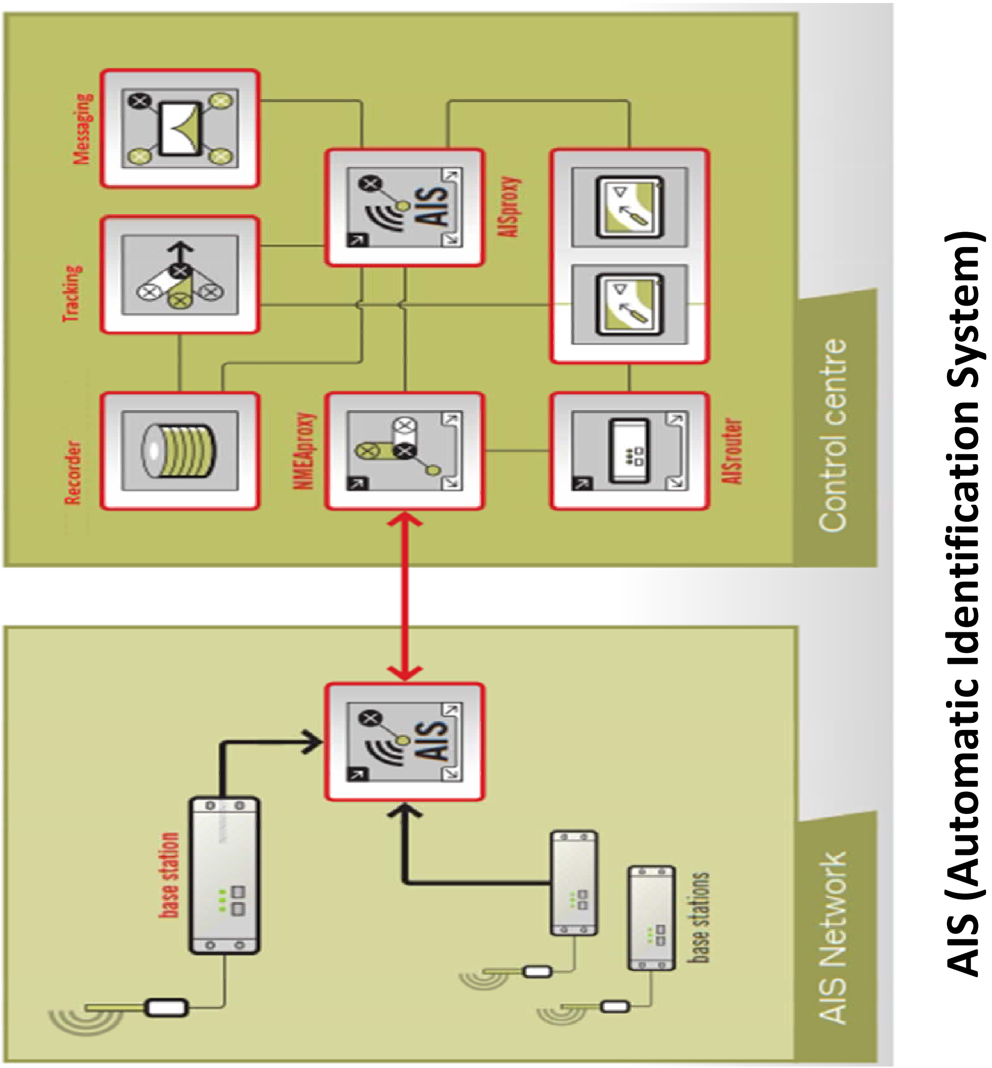
E. The above cost is not being considered for any cost analysis, since it is only optional.

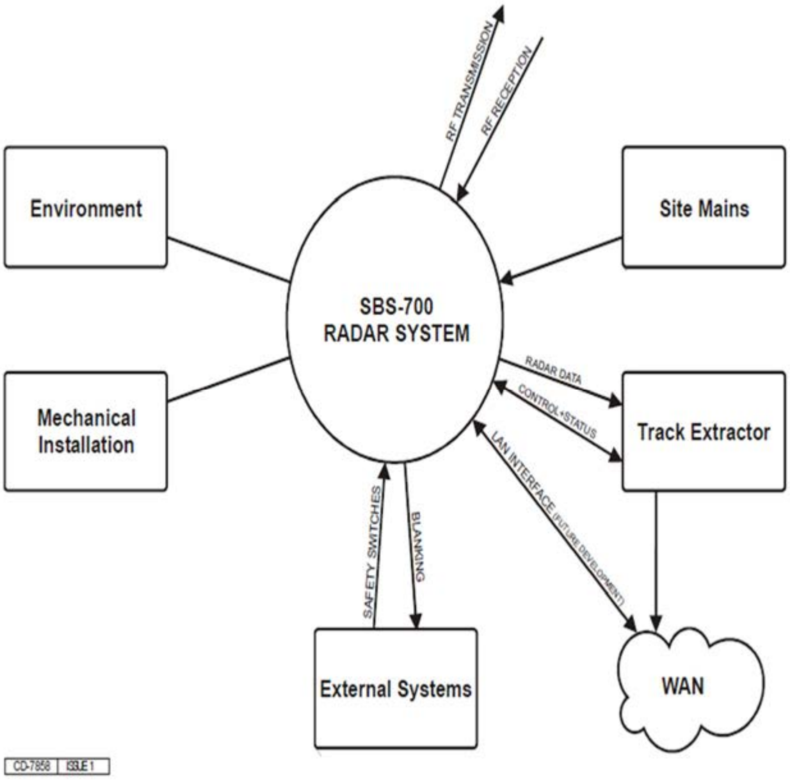
F. If RIS is planned for implementation, additional cost of INR 0.5 Lakhs / Buoy may have to be added.

Further, Typical Automatic Identification System (AIS) and its connectivity to Control Centre and a typical line diagram showing the interface of other systems with the Radar system are placed herewith.

AIS (Automatic Identification System)

Vessels equipped with an AIS transponder broadcast their position, velocity, ships name, call sign and several other data in regular intervals on a VHF channel. The AIS Base Stations installed in VTS will receives ships information and send to data processing for process and display on Display Terminals





The proposed navigation on “NW 9” is on a canal system. The cost details are worked out only for taking up the same at later date, if the need be required. Inland Waterways Authority of India (IWAI) is planning for installation of RIS in NW-3 West Coast Canal System (Kottapuram- Kollam, Udyogmandal & Champakara): 205 km. The system shall enhance swift electronic data transfer between mobile vessels and shore (Base stations) through advance and real-time exchange of information. As RIS ensures safety of vessels in navigation, as per the Inland Vessel Act, all the vessels are to be equipped with RIS compatible equipment. The range of RIS system shall normally be in the range of 100-125 kms surrounding the base station, hence there is no requirement of separate RIS for NW-9 as these waterways shall be covered by RIS system being planned under NW-3. The cost has not been included in the DPR cost.

CHAPTER 9 ENVIRONMENTAL & SOCIAL ASPECTS

9.1 Objective of Environmental and Social Studies

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

9.2 Environmental Setting in the Project Area

The proposed project is designated as national waterway no. 9 (NW-9) under the National Waterways Act 2016 and is located on Alappuzha-Kottayam-Maniyaparambu Canal passing through Alappuzha and Kottayam districts of Kerala State.

NW 9 has been divided into three sub stretches namely 9A, 9B and 9C.

The stretch of the Kainakary to Kottayam, near Kodimatha, which is named as NW 9A, starts from Alappuzha at Lat 9°31'1.31"N, Lon 76°22'44.15"E and ends at Kottayam, near Kodimatha at Lat 9°34'39"N, Lon 76°31'08"E. The total length of this stretch is 22.40 km.

The stretch of the Kainakary North to Kottayam, which is named as NW 9B, starts from Kainakary North at Lat 9°31'37.75"N, Lon 76°24'19.33"E and ends at Kottayam at Lat 9°34'32.96"N, Lon 76°30'53.39"E. The total length of this stretch is 17.823 km.

The stretch of the Kanjiram Junction to Maniyaparambu, which is named as NW 9C, starts from Kanjiram Junction at Lat 9°34'9.06"N, Lon 76°29'21.91"E and ends at Maniyaparambu at Lat 9°38'40.18"N, Lon 76°28'42.71"E. The total length of this stretch is 14.970 km.

The combined length of NW 9A, 9B and 9C is 51.70 km.

The location details of the three sub-stretches of NW 9 are summarized in Table 9-1 below.

TABLE 9-1: LOCATION DETAILS OF SUB-STRETCHES OF NW 9

S. No.	Name / No. of the waterway	Stretch of the waterway	Starting Point and Coordinates	End Point and Coordinates	Length (in km)	Districts through the waterway passes
1.	NW 9A	Kainakary to Kottayam, near Kodimatha	Alappuzha Lat 9°31'1.31"N Lon 76°22'44.15"E	Kottayam, near Kodimatha Lat 9°34'39"N Lon 76°31'08"E	22.40	Alappuzha and Kottayam
2.	NW 9B	Kainakary North to Kottayam	Kainakary North Lat 9°31'37.75"N Lon 76°24'19.33"E	Kottayam Lat 9°34'32.96"N Lon 76°30'53.39"E	17.82	Alappuzha and Kottayam
3.	NW 9C	Kanjiram Junction to Maniyaparambu	Kanjiram Junction Lat 9°34'9.06"N Lon 76°29'21.91"E	Maniyaparambu Lat 9°38'40.18"N Lon 76°28'42.71"E	14.97	Alappuzha and Kottayam

A part of NW-9 is located within the Vembanad Lake in Kerala, which is designated as a Ramsar wetland site. In case of NW 9A, the stretch that falls within the Vembanad lake is 1.24 km in length. In case of NW 9C, the stretch that falls within the Vembanad is 1.38 km in length. In case of NW 9B, no part of the stretch falls within the Vembanad Lake. The Vembanad Lake is fed by 10 rivers flowing into it including the six major rivers of central Kerala namely Achenkovil, Manimala, Meenachil, Muvattupuzha, Pamba and Periyar.

The Vembanad wetland system covers an area of over 2033.02 km² thereby making it the largest wetland system in India. The lake is bordered by Alappuzha, Kottayam and Ernakulam districts. It is separated from the Arabian Sea by a narrow barrier island. A unique characteristic of the lake is the 1,252 metres (4,108 ft) long Thanneermukkom salt water barrier (Barrage) constructed as a part of the Kuttanad Development Scheme to prevent tidal action and intrusion of salt water into the Kuttanad low-lands. It is the largest mud regulator in India and essentially divides the lake into two parts, one with perennial brackish water and the other with fresh water from rivers draining into the lake.

This barrier has helped farmers in Kuttanad by freeing the area of salinity and by allowing them an additional crop in the dry season. The Thanneermukkom barrier is located at one of the narrower parts of the Vembanad Lake.

Presently passenger ferry services are operational in both Alappuzha & Kottayam districts. Passenger services are operated by State Water Transport Department, Government of Kerala. The water transport department has a total of 14 stations under its control, out of which 8 fall under Alappuzha district & 2 falls under Kottayam District.

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

9.2.1 Physiography

Kerala State is situated between 8°8' and 18°48' North latitude and 74°4' to 77°50' East longitude, along the windward side of the Western Ghats of Indian Peninsula. The State is located in the tropical region of Indian Peninsula and extends to an area of about 38863 km^2, which accounts for about 1. 2 per cent of the total geographical area of the country. The State has a total coastline of about 560 km and from sea level it rises to about 2694 m above msl.

The State is bordered by the Arabian Sea on the western side and the Western Ghats on the eastern side. Kerala shares its borders with Karnataka State at the extreme north and with Tamil Nadu in the remaining eastern and southern sides.

Physiographically, the terrain has three natural regions namely: (i) the highlands (600–1800 m high), (ii) the midlands (300–600 m high) and (iii) the lowlands (6–300 m high). These three zones lie parallel to one another in the south-north direction. The broadest part of Kerala is at the middle, which is nearly 130 km wide and towards the north and south, it narrows down to about 30 km.

(i) The Highlands

The mountain terrains of the Western Ghats constitute the highlands. Around 48% of Kerala's land area is taken up by the Western Ghats. The main hill range covers more than 20,000 sq km of land in Kerala. The average height of the Western Ghats in Kerala is 900 m but there are a number of peaks above 1800 m and the highest peak, Anaimudi, has a height of 2694 m. The highlands have dense forest cover and also have large tracts of plantations of cardamom (*Elettaria cardamomum*), tea (*Camellia sinensis*) and coffee (*Coffea arabica*).

(ii) The Midlands

The midlands lying between the highlands and the lowlands form roughly 40% of the land area. The midlands have a topography of undulating hills and valleys. Here natural forests are sparse and most areas are under cultivation of crops such as cashew (*Anacardium occidentale*), coconut (*Cocos nucifera*), areca nut (*Areca catechu*), tapioca (*Manihot esculenta*), banana (*Musa paradisiaca*), rubber (*Hevea brasiliensis*) and different varieties of vegetables.

(iii) The Lowlands

The lowlands comprise the western coastal plains which are made up of 81 lagoons, river deltas, backwaters and the shores of Arabian Sea. Coconut (*Cocos nucifera*) and rice (*Oryza sativa*) are widely cultivated in these areas.

Kerala has 44 perennial rivers, of which three are east flowing and the remaining 41 are emptied into the Lakshadweep Sea, along the western side of the State. Rivers are generally swift flowing having very steep gradients in their higher reaches. Absence of delta formation is characteristic of Kerala rivers. As per national norm (Rao, 1979), there are no major rivers in Kerala. The four medium rivers, namely Chaliyar, Bharathapuzha, Periyar and Pamba have a total drainage area of only 8250 km^2 with length 169 km, 209 km, 244 km and 176 km respectively. The length of rest of the rivers varies from 16 km to 130 km, with an average length of 62 km and total drainage area of 19,485 km^2.

There are two fresh water lakes in the State namely the Pookot and Sasthamkottah. The State is also having a total of 46.13 km^2 of estuaries and backwaters. The important backwaters are Vembanad and Ashtamudi lakes.

Alappuzha district is drained mainly by Pamba River and its tributaries viz. Achankovil and Manimala Rivers. The Pamba River drains an area of 804 sq km of the district and forms a deltaic region skirting the south eastern, southern and south western fringes of Vembanad Lake. The Manimala River enters the Kuttanad area at Thondara and confluences with Pamba River at Neerettupuram. Achancovil enters Kuttanad at Pandalam and joins Pamba River at Veeyapuram. Vembanad Lake, the largest back water in the State, lies on the north eastern part of the district separating Alappuzha from Kottayam district.

The major rivers in Kottayam district are the Meenachil River, the Muvathupuzha River and the Manimala River. The Meenachil River flows through Meenachil, Vaikom and Kottayam taluks. The total catchment area of Meenachil River is 1272 sq km and is formed by several streams originating from the Western Ghats in Idukki district. The Poonjar river joins at Erratupetta, the Chittar River joins at Kondur and the Payapparathodu joins at Lalam. Finally, the river confluences with Vembanad Lake. The Muvattupuzha River originates from Idukki district flowing mostly through Vaikom taluk and joins with Vembanad Lake. The Manimala river flows through Kanjirapally and Chanaganacherry taluks. The Chittar joins it on its course further down the west as it flow towards Alappuzha district.

(Sources:

1. http://www.kerenvis.nic.in/Database/ ENVIRONMENT_821.aspx;

2.http://shodhganga.inflibnet.ac.in/bitstream/10603/87093/9/09_chapter%204.pdf

3. http://dmg.kerala.gov.in/docs/pdf/dsr/dsr_ala.pdf

4. http://dmg.kerala.gov.in/docs/pdf/dsr/dsr_kot.pdf)

9.2.2 Geology and Seismicity

Geologically, Kerala is occupied by four major rock formations namely, crystalline rocks of Precambrian age, sedimentary rocks of Tertiary confined to Neogene period, laterites capping the crystalline and sedimentary rocks and recent and sub recent sediments forming the low-lying areas and river valleys. There are sporadic Paleozoic granites and pegmatite and Meso-Cenozoic dykes intruding these rocks. The oldest rocks so far dated in Kerala are the charnockites, which yielded an age of 2930 ± 50 Ma (Soman, 1997& 2002). The varied rock formations under different geological domains harbour different mineral deposits and the transformed rock strata stockpile copious groundwater resource. (Source: State of Environment Report, Kerala 2007, Volume I, Kerala State Council for Science, Technology and Environment, Government of Kerala)

Khondalite is the oldest rock in the Alappuzha district and it includes quartzites which occur as lenticular bodies and garnet-biotite-sillimanite gneiss with or without graphite. The charnockite group of rocks including acid and intermediate varieties are found in the north eastern parts. Rocks of the migmatite group represented by biotite gneiss (quartzo-feldspathic gneiss) is noticed as small bodies in along the eastern margin of the district. Near Chengannur, a massive granite body representing the acid intrusive occurs. Hills in the southern and western parts are capped by Tertiary sedimentary rocks (Warkalli Formations). Drilling by CGWB indicated that the Tertiary basin is deepest along the coastal plains of the district and is more than 600m deep south of Alappuzha town. The Kuttanad low land covering an area of approximately 100 sq km is reported to have plenty of semi-carbonised and partly decayed wood trunks, roots, branches, leaves etc. buried under a thin veneer of black carbonaceous clay. This region is locally known as Karipadams because of yielding of coal-like (carbonised wood) material from the paddy field. It is believed that this area is submerged forest of Quaternary period. The other Quaternary sediments include strand line/palaeo beach deposit (Guruvayoor Formation), fluvial deposits (Periyar Formation), tidal/mudflat deposit (Viyyam Formation) and beach deposit

(Source: http://dmg.kerala.gov.in/docs/pdf/dsr/dsr_ala.pdf)

Geologically, Kottayam district shows a very interesting correspondence between the major rock classes and their physiographic expression. The east comprises Precambrian metamorphic rocks and forms hilly ground. The central part is a low plateau, where Tertiary sediments containing lignite occur. These are followed by further west by a low plain, which is underlain by Quaternary Formations, fluvial or partly marine.

The Charnockite Group dominates in areal distribution with charnockite, charnockite gneiss and diopside gneiss occupying the major part. Pyroxenen granulite (with hornblende granulite), magnetitie quartzite and cordierite gneiss occur as concordant bands within charnockite.

The linear bands of quartzite (Khondalite Group) are the oldest rock of the area. Biotite geniss (composite gneiss) representing the Migmatite Complex has a limited areal extent, west of Ettumanur and along the eastern boundary. Three major granite bodies are emplaced in the district, two along the southwest and the other in the east. Numerous dolerite and gabbro dykes trending NW-SE traverse the older basement rocks in the central and eastern parts.

A prominent gabbro dyke extends from north to south with a NNW-SSE trend. Tertiary sediments comprising sandstone, clay with lignite intercalations are confined to the west and they occur as small patches, especially as capping on hillocks. Both the Archaean and Tertiary rocks are lateritised. Quaternary alluvial deposits occur to the west. They have been classified into various morphostratigraphic units, based on their environment of formation, as Guruvayur Formation (palaeo-marine), Periyar Formation (fluvial) and Viyyam Formation (fluvio-marine).

(Source: http://dmg.kerala.gov.in/docs/pdf/dsr/dsr_kot.pdf)

As per the seismic zoning map of India, the project area falls under seismic zone III and indicates moderate seismicity. Kerala has experienced occasional mild tremors since historical times. A seismic hazard map with 10% probability of exceedance in 50 years assigns low-level hazard to regions falling in Kerala. However pockets of higher ground acceleration have been identified in central Kerala. In Kerala, several deep seated faults exist, the notable among them are Periyar fault, Idamalayar fault, Muvattupuzha fault, Bhavali fault and Kuthuparamba fault. Besides there are many more minor faults and fractures that can generate minor tremors as a result of crustal readjustment. Minor tremors in Kerala are also explained by hydroseismicity model wherein pressure transients generated due to sudden increase in hydrostatic heads especially after rains results in increased pore pressure and movement along pre-existing faults (Radhakrishnan, 2007). (Source: Kerala State Disaster Management Plan Profile, Kerala State Disaster Management Authority, Government of Kerala as available on http://documents.gov.in/KL/16344.pdf)

9.2.3 Climate

The climate of Kerala is tropical monsoon with seasonally excessive rainfall and hot summer. The Western Ghats plays a major role in the climatic conditions that prevail all along the state.

The year may be divided into four seasons. The period of March to the end of May is the hot season which is the summer month and is uncomfortable due to high temperature and humidity. This is followed by South West Monsoon season that continues till the beginning of October. From October to December is the North East Monsoon season and two months, January and February, are the winter season. The climate is pleasant from September to February. The state is extremely humid due to the existence of Arabian Sea in the west of it.

The annual precipitation varies between 100 cm (around Chinnar) to 500 cm (around Neriyamangalam), with a state average of about 300 cm. March to May is the hottest with maximum temperature reaching more than 32°C and the minimum is attained during December to January. Winds over the state are seasonal; diurnal variation is felt owing to the maritime influence. Annual relative humidity varies between 79 – 80% in the morning and 73 – 77% in the evenings.

(Source:http://www.moef.gov.in/sites/default/files/KERALA%20STATE%20ACTION%20PLAN%20ON%20CLIMATE%20CHANGE.pdf)

Alappuzha district has a tropical humid climate with an oppressive summer and plentiful seasonal rainfall. The period from March to the end of May is the hot season. This is followed by the southwest monsoon season, which continues till the end of September. During October and major part of November southwest monsoon retreats giving place to the northeast monsoon, and the rainfall up to December is associated with northeast monsoon season. The district receives an average annual rainfall of 2965.4 mm. The southwest monsoon season from June to September contributes nearly 60.3% of the annual rainfall. This is followed by the northeast monsoon season from October to December, which contributes about 20.9% of the annual rainfall, and the balance 18.8% is received during the period from January to May months.

(Source: http://dmg.kerala.gov.in/docs/pdf/dsr/dsr_ala.pdf)

Kottayam district has, in general, wet type of climate and four seasons are seen in this district. The hot summer season from March to May, the South West monsoon season from June to September, the North East monsoon season from October to December and cool climate prevails during January and February. The major contribution of rainfall in Kottayam district is during South West monsoon followed by the North East monsoon. The analysis of rainfall data reveals that the distribution of rainfall increases from west to east. The highest rainfall is recorded at Pala while the lowest is recorded at Ettumanur. The annual rainfall ranges from 2435.9 to 3755.2 mm and the average annual rainfall of the district is 3169.28 mm. The South West monsoon contributes nearly 59 % of the total rainfall and while the North East monsoon contributes nearly 21% of the total rainfall in the district.

(Source: http://dmg.kerala.gov.in/docs/pdf/dsr/dsr_kot.pdf)

9.2.4 Soils

Ten broad groups of soils based on morphological features and physico-chemical properties have been identified in Kerala (Anon, 1978). They are red soil, laterite soil, coastal alluvial soil, riverine alluvial soil, grayish Onattukara soil, brown hydromorphic soil, hydromorphic saline soil, acid saline soil, black soil and forest soil. (Source: http://www.kerenvis.nic.in/Database/ENVIRONMENT_821.aspx)

Soils of Alappuzha District

On the basis of morphological and physico-chemical properties, the Soil Survey Division of Department of Agriculture, Govt. of Kerala has classified the soils of Alappuzha district into four types viz. (1) Coastal alluvium (Entisols), (2) Riverine Alluvium (Inceptisols) (3) Brown hydromorphic soil (Alfisols) and (4) Lateritic soil (Oxisols).

Coastal Alluvium (Entisols)

These soils are seen along the western parts of the district all along the coast and have been developed from recent marine and estuarine deposits. The texture is dominated by sand fraction and is extensively drained with very high permeability. These soils have low content of organic matter and of low fertility level.

Riverine alluvium (Inceptisols)

These soils occur mostly in the central pediplains and eastern parts of the area along the banks of Pamba River and its tributaries and show wide variation in their physicochemical properties depending on the nature of alluvium that is deposited and characteristics of the catchment area through which the river flows. They are very deep soils with surface textures ranging from sandy loam to clayey loam and moderately supplied with organic matter like nitrogen and potassium.

Brown hydromorphic soil (Alfisols)

These are mostly confined in the western low-lying areas of the district along the coast. These soils have been formed as a result of transportation and sedimentation of material from the adjoining hill slopes and also through deposition by rivers and exhibit wide variation in their physical and chemical properties. They are moderately supplied with organic matter like nitrogen, potassium and deficient in lime and phosphate.

Lateritic soil (Oxisols)

The lateritic soil is the result of weathering process of Tertiary and Crystalline rocks under tropical humid conditions and is seen in the south-eastern part of the district. Heavy rainfall and temperature prevalent in the area are conducive to the process of formation of this soil type and have been formed by leaching of base and silica from the original parent rock with accumulation of oxides of iron and aluminium. They are poor in nitrogen, phosphorous, potassium and low in bases. The organic content is also low and is generally acidic with pH ranging from 5.0 to 6.0.

(Source: http://dmg.kerala.gov.in/docs/pdf/dsr/dsr_ala.pdf)

Soils of Kottayam District

The soil types occurring in Kottayam district can be broadly grouped into four types on the basis of their physico-chemical properties and morphological features. They are (1) Lateritic soil. (2) Riverine alluvium, (3) Brown hydromorphic, and (4) Forest loams.

Lateritic soil

The lateritic soil is the pre-dominant soil type, which covers almost the entire midland areas of the Kottayam district. The surface soil is mostly reddish brown to yellowish red in colour and the texture ranges from gravelly loam to gravelly clay loam. Heavy rainfall and high temperature prevalent in the area are conducive to the process of formation of this soil type. It is well drained and the presence of organic content is low. This soil is poor in nitrogen, phosphorous and potassium. It is acidic in nature with a pH value ranging from 5.0 to 6.2.

Riverine alluvium

The occurrence of these soils is restricted along the river courses and their tributaries. They show wide variation in their physico-chemical properties depending on the nature of the alluvium that is deposited and the characteristics of the catchments area drained by the river. They are very deep soils with surface textures ranging from sandy loam to clay loam. These soils are characterised by moderate amount of organic matter, nitrogen and potassium. Presence of mica flakes has been observed in the alluvial soils.

Brown hydromorphic soil

These soils are mostly confined to valley bottoms between undulating topography in the midland and in low-lying areas. They have been formed as a result of transportation and sedimentation of material from adjoining hill slopes and also through deposition by local streams. These soils are very deep and brownish in colour and exhibiting wide variation in physico-chemical properties and morphological features. The surface soil texture varies from sandy loam to clay. Their pH value ranges between 5.2 and 6.4 and are acidic in nature.

Forest loam

These soils are the products of weathering of crystalline rocks under forest cover. They are occurring in the eastern hilly areas. These are dark reddish brown to black in colour. The surface texture varies from loam to silt loam. They are characterised by a surface layer very rich in organic matter. Generally they are acidic, rich in nitrogen and their pH ranging from 5.5 to 6.3.

(Source: http://dmg.kerala.gov.in/docs/pdf/dsr/dsr_kot.pdf)

9.2.5 Land Use Pattern

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

Kerala has a diverse land use and cropping pattern. The data on land use pattern of Kerala for the year 2009-10 reveals that out of a total geographical area of Kerala, net sown area is about 56 per cent. Forest occupies around 28 per cent. Agriculture and forest sectors together account for over 84 per cent of the land area. There was an increase in the area under current fallow (9186 ha) and a decrease in the area under fallow other than current fallow (581 ha) during 2009-10 over 2008- 09. The area under cultivable waste increased by 1821 ha. and barren and uncultivated land declined by 7019 ha.

(Source: http://www.moef.gov.in/sites/default/files/KERALA%20STATE%20ACTION%20PLAN%20ON%20CLIMATE%20CHANGE.pdf)

Land Use in Alappuzha District

According to Agricultural Statistics for 2010-11, relating to land use pattern of the district, there is no forest area in the district. Land under non-agricultural use which was 16.74 per cent in 1997-98 has decreased to 14.80 per cent (20881 ha) in 2010-11. The net cropped area has marginally declined from 1032.12 sq km to 874.45 sq km. The fallow other than current fallow has increased from 17.70 sq km in 1997–98 to 39.54 sq km in 2010–11. There is increase in the area under culturable waste during the corresponding period.

TABLE 9-2: CLASSIFICATION OF AREA ON THE BASIS OF LAND UTILIZATION IN ALAPPUZH DISTRICT

S. No.	Type of Land	Area in sq km
1	Total area	1410.11
2	Forest area	0
3	Land put to non-agricultural use	208.81
4	Barren & uncultivable	0.32
5	Permanent pastures and grazing land	0.39
6	Land under miscellaneous tree crops	1.5
7	Cultivable waste	128.29
8	Fallow other than current fallow	39.54
9	Current fallow	31.45
10	Marshy Land	0.33
11	Still water	121.44
12	Waterlogged area	3.26

S. No.	Type of Land	Area in sq km
13	Social forestry	0.33
14	Net sown area	874.45
15	Area sown more than once	210.44
16	Total cropped area	1084.89

(Source: District Census Handbook, Alappuzha District, Series 33, Part XII A, Directorate of Census Operations, Kerala, Census of India, 2011)

Land Use in Kottayam District

Kottayam District has an area of about 2204.42 sq km. It accounts for 5.68 percentage of the total area of the State (38862.87 sq km). According to agricultural statistics for 2010-11, the data on land use pattern of the district reveals that forest occupies around 3.69 per cent. In view of the high density of population, the pressure for non-agricultural use is increasing. Land under non-agricultural use which was 11.86 per cent in 2000-01 has decreased to 11.74 % during 2010-11. The net cropped area decreased from 1734.94 sq km to 1644.51 sq km during the period. There was an increase in the area under current fallows (58.08 sq km) and increase in area for fallows other than current fallows (30.46 sq km).

TABLE 9-3: CLASSIFICATION OF AREA ON THE BASIS OF LAND UTILIZATION IN KOTTAYAM DISTRICT

S. No.	Type of Land	Area in sq km
1	Total area	2204.42
2	Forest area	81.41
3	Land put to non-agricultural use	258.93
4	Barren & uncultivable	14.69
5	Permanent pastures and grazing land	0
6	Land under miscellaneous tree crops	1.33
7	Cultivable waste	48.9
8	Fallow other than current fallow	30.46
9	Current fallow	58.08
10	Still water	63.62
11	Waterlogged area	1.59

S. No.	Type of Land	Area in sq km
12	Social forestry	0.9
13	Net sown area	1644.51
14	Area sown more than once	423.38
15	Total cropped area	2067.89

(Source: District Census Handbook, Kottayam District, Series 33, Part XII A, Directorate of Census Operations, Kerala, **Census** of India, 2011)

The project area is characterized by mixed land use on both banks of the designated stretch of NW-9 comprising residential use, agricultural land, fishing and ferry jetties, temples and churches. The chainage wise details of land use and land cover along the entire NW-9 stretch is provided in the hydrographic survey report prepared as part of the present DPR.

9.2.6 Ambient Air and Noise Quality

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

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

Ambient air is monitored by the Kerala State Pollution Control Board for Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM), Sulphur Dioxide (SO_2) and Oxides of *Nitrogen* (NO_X) from stations located in industrial, residential and sensitive areas. Observations at these stations show that SPM and RSPM regularly exceed allowable limits. SO_2 and NO_X levels are observed to be almost always within the prescribed limits.

Even increasing use of fossil fuel in the transportation and industrial sectors is adversely affecting the air quality in Kerala. These driving *forces* are also responsible for the increase in ambient noise.

The number of vehicles on the roads in *Kerala* has increased more than 20 times since 1975. Vehicular emission and noise from this vehicles are sever in the three major cities of Kerala namely, Thruvananthapuram, Kochi and Kozhicode.

Kerala's industrial growth has been very low when compared to the rest of India. The number of industries, which can be categorized as Large or Medium, is about 640. Most of these units are in the private sector and a majority of *them* are located at Kochi. There are about 2.5 lakh SSI units, which are dispersed in the different districts of the state. Kerala state pollution control board brought nearly 600 large/medium scale industries and about 2500 SSI units under the consent regime of Air (Prevention and Control of Pollution) Act. Majority of the smaller units, comprise of stone crusher.

(Source: http://www.kerenvis.nic.in/Database/Air_Pollution_835.aspx)

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

9.2.7 Ambient Water Quality

As per surface water sample tests carried out as part of the present study, the canal water in the NW-9 stretch is slightly basic in nature with pH value being above 7 for all sample locations. Surface water quality analysis has been done at three sample locations in the project stretch as part of the hydrographic survey carried out for the present DPR study. The sample locations for water quality analysis include Pallam, Kodimatha and Kanjiram. The pH values for the three locations are 7.23, 7.09 and 7.11 respectively, which indicates the alkaline nature of water in all three sub-stretches of NW-9.

Kerala is one of the most thickly populated regions in the world and the population is increasing at a rate of 14% per decade. The rivers of Kerala have been increasingly polluted from the industrial and domestic waste and from the pesticides and fertilizer in agriculture. Industries discharge hazardous pollutants like phosphates, sulphides, ammonia, fluorides, heavy metals and insecticides into the downstream reaches of the river. The river Periyar and Chaliyar are very good examples for the pollution due to industrial effluents. It is estimated that nearly 260 million litres of trade effluents reach the Periyar estuary daily from the Kochi industrial belt.

The major water quality problem associated with rivers of Kerala is bacteriological pollution. The assessment of river such as Chalakudy, Periyar, Muvattupuzha, Meenachil, Pamba and Achenkovil indicates that the major quality problem is due to bacteriological pollution and falls under B or C category of CPCB classification. There are local level quality problems faced by all rivers especially due to dumping of solid waste, bathing and discharge of effluents.

With regard to groundwater, water quality characteristics of wells in Kerala are found to be affected by chemical and biological contaminants. The ground water quality problems in the coastal areas are mainly because of the presence of excess chloride. The chloride concentration >250 mb/l was detected in the well water samples of Azhicode, Kakkathuruthy, Edathinjil, Kadalundi, Chellanum, nallalam, Mankombu and Haripad.

In Alappuzha district, flouride concentration in the pumbing wells was observed to be high. In midland region, with regard to ionic concentration, the concentration of flouride iron and chloride were found to be on the higher side. The flouride content was observed to be beyond the permissible limit of 1 mg/l. Deep wells in Chittur taluk and Knajikod areas of Palakkad district are found to contain flouride concentration greater than 1mg/l.

Open well of Kerala are under threat of bacteriological contamination. In Kerala about 60% of the population relies on ground water for drinking. At the same time studies have shown that faecal contamination is present in 90% of drinking water wells. The open character of the wells, and conventional maintenance habits, and use of buckets and rope to draw water, kitchen wastes and pit latrines with average family load factor of 5 members at a distance of less than 5 meters from wells are some of the factors, which are contributing to the bacteriological contamination.

Ground water contamination due to industrial pollution has been reported from places of Kochi (eastern part of Aluva), Palakkad and some parts of Kollam, Kozhikode and Kannur.

(Source: http://www.kerenvis.nic.in/Database/Waterpollution_834.aspx)

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

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

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

Criteria for Priority I

Monitoring locations exceeding BOD concentration 30 mg/l.

Criteria for Priority II

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

Criteria for Priority III

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

Criteria for Priority IV

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

Criteria for Priority V

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

According to this report, there are 73 monitoring locations on 55 rivers in Kerala out of which 18 locations are exceeding the Water Quality Criteria limit with respect to BOD. These 18 non-complying locations are situated on 13 rivers. The names of the rivers are; Chitrapuzha, Kadambayar, Kallai, Karamana, Keecheri, Kuppam, Manimala, Neeleswaram, Periyar, Pullur, Puzhckal, Thirur and Uppala. These rivers are classified in three priority classes (Class – I, IV and V).

The details of the polluted river stretches in Kerala are provided in Table 9-4.

TABLE 9-4: DETAILS OF POLLUTED RIVER STRETCHES IN KERALA

Sl. No.	River Name	Stretch Identified	Towns Identified	Approx. Length of the Stretch (in km)	BOD Range Max. Value	Priority Class
1.	Chitrapuzha	Irumpanam to Karingachira	Chittethukara	15	8	IV

2.	Kadambyar	Manckakadavu to Brahmapuram	Kakkattikara, Thengumthuruthu	8	4.4-8.0	IV
3.	Kallai	Thekepuram to Arakkinar	Kozhikode, Mananchira	5	6	V
4.	Karamana	Malekkdu to Thiruvallam	Trikkannapuram	4	80	I
5.	Keecheri	Puliyannor to Kechery	Thrissur	6	3.8	V
6.	Kuppam	Thaliparamba to Velichangool	Marathakkad, Kuttiyeri	12	5.4	V
7.	Manimala	Kalloopara to Thondra	Mallappally, Vaipur	10	4.2-4.4	V
8.	Neeleswaram	Nambiarkal Dam to Hosdurg	Puthukai	8	3.3-3.8	V
9.	Periyar	Alwaye-Eloor to Kalamassery	Muttinakam, Edampaadam	5	3.7-6.0	V
10.	Pullur	Ramnagar to Kannoth	Kottapara,	2	3.1	V
11.	Puzhackal	Olarikkara to Puzhackal	Puthurkara, Chettupuzha	3	5.4	V
12.	Thirur	Naduvilangadi to Thalakkadathur	Chembra, Thazhepalam, Mangalam, Thiruthummal	8	4.4	V
13.	Uppala	Poyya to Mulinja	Manjeshwar, Hosabettu	3	3.3	V

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

Parts of the NW-9A and NW-9C stretches traverse through Vembanad Lake. As per information provided in National Wetland Atlas prepared as part of the project on National Wetland inventory and Assessment (NWIA) by Space Application Centre (ISRO), Ahmedabad and Kerala State Remote Sensing & Environment Centre, Thiruvanathapuram and published in February 2010, turbidity of the lake water is low.

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

9.2.8 Susceptibility to Natural Hazards

According to the Kerala State Disaster Management Plan Profile prepared by the Kerala State Disaster Management Authority, Government of Kerala, the State of Kerala is prone to a host of natural hazards such as coastal erosion, flood, drought, lightening, landslide and earthquake. All most all districts of Kerala are multi-hazard prone. In Kerala lightning, landslides (debris flows) and floods are the most commonly occurring natural hazards. Droughts and minor earth tremors also occur occasionally.

Kerala is prone to high incidence of lightning, especially during the months of April, May, October and November. It is estimated that about 70 people die every year due to lightning.

In Kerala, riverine flooding is a recurring event consequent to heavy or continuous rainfall exceeding the absorptive capacity of soil and flow capacity of streams and rivers. About 14.8% of the state is prone to flooding. Kerala has been experiencing seasonal drought conditions every year during summer months. Between 1871-2000, the state experienced 12 moderate drought years.

Apart from floods the mountain regions of the state experience several landslides during the monsoon season. Landslides commonly occur in localised areas of the Western Ghats region where the slope is steep and the soil is over saturated as a result of prolonged rainfall. The landslides in the state include rock falls, rock slips, debris flow and in a few cases rotational types of slides. But the most prevalent recurring and disastrous type of earth or tectonic movement noted in Kerala are the debris flow (urulpottal) characterized by the swift and sudden down slope movement of highly water saturated overburden ranging in size from soil particles to boulders destroying and carrying with it everything that is lying in its path. About 1500 sq km area in the Western Ghats is prone to landslides. A total of 65 fatal landslides occurred between 1961 and 2009 causing the death of 257 individuals.

With a length of 570 km and covering about 15% of state's total area, the coastal zone of Kerala is an important physiographic unit. Hazards in the coastal zone are erosion, monsoon, storm surges, sea level rise etc. More than 300 km of sea shore is erosion prone. Extensive sea wall construction along with gabion-box and groins has failed to arrest the erosion in many cases. The tsunami of 2004 which was experienced along most of the coastal regions of the state has added a new dimension to the disaster scenario of the state.

(Source: Kerala State Disaster Management Plan Profile, Kerala State Disaster Management Authority, Government of Kerala; Website: http://documents.gov.in/KL/16344.pdf)

9.2.9 Estuary and Coastal Zone

The Kerala coast extends from Manjeswaram in north to Pozhiyur in the south. Well-developed sandy beaches are in Chittari, Kappad, Ponnani, Calicut, Cochin, Alleppey and Kovalam. The beach consists of sands of different fractions along with broken molluscan shells. In addition to this, crescent shaped pocket beaches are observed at Ezhimals, Dharmadom, Tellicherry, Kadur point and Ealthur.

Spits are seen at the estuarine of Vambanad, Asthamudi, Shiriys, Bypore and Veli. At some places during the lean season opening of small estuaries got blocked by the growth of the spits.

Cliff and rocky coasts are observed at many places on the Kerala coast. The rocky shores are made up of laterites or Precambrian crystalline such as Khondalites or Charnockites. Some of the prominent rocky coasts are near Bekal, Ezhimala, Azhikode and Kadalur point in the north and Vizhinjam, Varkala and Tangasseri in the south.

The mangrove vegetation in the coastal area of Kerala is very sparse and thin. The Kerala coast has a number of islets or islands. Most of them are populated. Locally the islands are called thuruths. Manmade thuruths are also common. The Vembanad, the Asthamudi, and Kakavvayi estuaries show more islands. The islands in the Vembanad estuary in central Kerala are large in size compared to the islands in the Kavvayi estuary. The major islands are Wellington, Kumbalam, Nettur, Madavana, Cheppanam and Perumbalam. Dharmadom, a large island with mangroves is situated in the northern Kerala. Mudflat occupies 41.61 sq km and Habitation with vegetation occupies 4903.70 sq km.

(Source: Coastal Zones of India, Space Application Centre, ISRO, Ahmedabad, 2012)

The coastal plain of Kerala also constitutes a special ecological mosaic. The Coastal Zone in Kerala is the low land fringing the sea extending over 560 km with a height of less than 8m from the MSL, covers about 15 % of the state's total area of 38,863 sq km. A chain of water bodies, locally known as kayals running parallel/ oblique to the coastline is a characteristic feature of Kerala coast. These are mostly interconnected by natural or man-made canals, facilitating internal navigation almost for the entire length of the coast. Numerous perennial rivers discharge into these kayals. Southern half of the Kerala coast harbours more of larger backwaters. The kayals of the Kerala coast are mostly separated from the sea by elongated sandbars and based on this they can be treated as "coastal lagoons".

(Source: http://kerenvis.nic.in/Database/Coastal_and_Environment_1204.aspx)

The entire National Waterway 9 project area falls in the tidal zone.

9.2.10 Archaeological and Heritage Locations

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

As per the information available on the website of the Department of Cultural Affairs, Government of Kerala, there are 13 State Protected Monuments in Alappuzha District and eight (08) State Protected Monuments in Kottayam District. These monuments have been declared as Protected by the State Archaeological Department, Government of Kerala. The list of the State Protected Monuments in the two districts through which NW-9 passes viz. Alappuzha and Kottayam is provided in Table 9-5 below.

As can be noted from Table 9-5, none of the State Protected Monuments are located close to the project site. The nearest protected monument from the project site, which is Menhir in Kottayam District, is located at a distance of 1.90 km from the project site. Therefore, no clearance requirement is envisaged with respect to protected monuments.

TABLE 9-5: PROTECTED MONUMENTS LOCATED IN ALAPPUZHA AND KOTTAYAM DISTRICTS, KERALA

Sl. No.	Monument	Location (District)
1.	Buddha Image, Karunagappally	Alappuzha
2.	Buddha Image, Mavelikkara	Alappuzha
3.	Sree Kumaramangalam Subramanya Swamy Temple, Muthavazhi	Alappuzha
4.	Buddha Image, Karumadikuttan	Alappuzha
5.	Buddha Image Bharanikavu	Alappuzha
6.	Narasimha Temple, Chathankulangara	Alappuzha
7.	Krishnapuram Palace, Kayamkulam	Alappuzha
8.	Excavated yatch and its surroundings, Kadakkarappally	Alappuzha

Sl. No.	Monument	Location (District)
9.	Sri Karthiyayini Temple, Kuttemperoor	Alappuzha
10.	Varanad Naduvilay Kovilakam	Alappuzha
11.	St. Raphel's Church and Compound	Alappuzha
12.	Sri Itti Achuthan Vaidyar Kuriala, Oushada Sasyakavu	Alappuzha
13.	Trikkuyrutty Mahadeva Temple, Mannar	Alappuzha
14.	Pundareekapuram Devaswam	Kottayam
15.	Thrikkodithanam Sri Mahavishnu Temple	Kottayam
16.	Old Seminary	Kottayam
17.	House of freedom fighter Chembilarayan	Kottayam
18.	St. Mary's Church, St. Augustian's Church & two storied building in which Thoma Kathanar was residing	Kottayam
19.	Menhir, Kottayam	Kottayam
20.	Venniamala Sree Rama Lakshmana Swami Temple, its Pond & Cave	Kottayam
21.	Sree Dharma Sastha Temple, Poonjar	Kottayam

Source: http://www.keralaculture.org/keralaasi-protected-mounments/628

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

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

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

As per the information available on the website of the Department of Cultural Affairs, Government of Kerala, there are a total of 27 Centrally Protected Monuments in the State of Kerala. These are the monuments that have been declared as Protected by the Archaeological Survey of India, Government of India.

As per the list available on the said website (http://keralaculture.org/protected-monuments-asi/627), none of the 27 Centrally Protected Monuments in Kerala are located in the districts of Alappuzha and Kottayam. Therefore, no clearance requirement is envisaged with respect to these structures.

9.2.11 Flora and Fauna

The Western Ghats region, wherein the Keral State is situated, is one of the 35 biodiversity hotspots in the whole world. The state contains more than 4,500 species of flowering plants of which above 1,500 taxa are endemic in nature. There is also equally rich fauna belt in the state. The diversity of lower plants and animal groups, and the marine flora and fauna in particular even though not fully known, is remarkably rich in the state.

(Source: http://www.kerenvis.nic.in/Database/Hotspot_1804.aspx)

Flora of Kerala comprises of a total of 11,840 taxa of plants (SoE, 2007). Among them, angiosperms comprises the dominant group, composed of 4968 taxa, of which about 900 are those endemic to Western Ghats. Among the Western Ghats endemics, 252 taxa are those confined to Kerala State.

The flora comprises of 866 species of algae, 4800 species of fungi, 520 species of lichens, 350 species of bryophytes, 332 species of pteridophytes, 4 species of gymnosperms and 4968 species of angiosperms or flowering plants.

Habitat wise, algal species are mostly confined to aquatic or damp conditions whereas the other plant groups in the State ate mostly terrestrial in habit. Habit or life form-wise, there are herbs, shrubs, trees, lianas, epiphytes, lithophytes, saprophytes, etc. within the plant kingdom. Based on this the habitats are also different for different species.

Table 9-6 below gives the details of the representation of different plant groups in the flora of Kerala.

TABLE 9-6: TOTAL NUMBER OF PLANT TAXA BELONGING TO DIFFERENT GROUPS RECORDED FROM KERALA

S. No.	Plant Groups	No. of Taxa
1	Algae	866
2	Fungi	4800
3	Lichens	520
4	Bryophytes	350
5	Pteridophytes	332
6	Gymnosperms	4
7	Angiosperms	4968
	Total	**11,840**

Apart from this there are hundreds of cultivated species either on plantations or crop levels or as garden plants, ornamentals, etc. There are also 850 species and varieties of cultivars growing the State with their origin in mostly tropical parts of the globe. Due to various reasons, many of them are in various threat categories of IUCN Red List of flora and fauna (2004), prepared at global level.

(Source: http://www.kerenvis.nic.in/Database/Flora-Kerala_1399.aspx)

Medicinal Plants constitute an important component of the plant resource spectrum of Kerala. Recent analysis shows that out of estimated 4600 flowering plants in Kerala, about 900 possess medicinal values. Of these, 540 species are reported to occur in forest ecosystems. Over 150 species of plants that are either indigenous or naturalized in Kerala are used in the Indian system of Medicine like Ayurveda and Sidha. The rural folk and tribal communities make use of about 2,000 species of lesser-known wild plants for various medicinal uses. About 60 to 65% of plants required for Ayurvedic medicine and almost 80% of plants used in Sidha medicine are found in the forests of Kerala. (Source: http://www.forest.kerala.gov.in/index.php/forest/flora)

Fauna

The Western Ghat's encompassing the forests of Kerala is one of the 35 Biodiversity hot spots in the World and Kerala has close to 90 % of its vertebrate fauna. Very high levels of species diversity and endemism provide importance to the faunal wealth of Kerala.

TABLE 9-7: FAUNAL WEALTH OF KERALA

Sl.No	Group	No.of.Species
1	Mammals	145
2	Birds	486
3	Reptiles	164
4	Amphibians	85
5	Freshwater Fishes	196
6	Insects	4027
	TOTAL	**5103**

(Source: http://www.forest.kerala.gov.in/index.php/forest/fauna)

According to one estimate, 285 species of Vertebrate are reported to be endemic to Western Ghats, which include 12 mammals, 16 birds, 89 reptiles, 87 amphibians, and 84 fresh water fishes. Among large mammals, no species is endemic to Kerala. However, birds such as White breasted laughing thrush, Wayanad laughing thrush, White bellied shortwing, Southern treepie, Rufous babbler are possible endemic birds which may slightly overlap state boundaries in the southern Western Ghats. (Source: http://www.forest.kerala.gov.in/index.php/forest/fauna)

TABLE 9-8: FAUNA ENDEMIC TO WESTERN GHATS-FOUND IN KERALA

Group	Nos.
Amphibians	61
Reptiles	57
Birds	16

National Parks, Forests, Wildlife Sanctuaries and Reserves

The geographical area of the state is 38,863 sq km of which 11309.50 sq km (29.10%) is forest area. By legal status, the entire forest area of Kerala is divided into the following three categories:

i) Reserved Forests,

ii) Proposed Reserve Forests and

iii) Vested Forests and ecologically Fragile Lands

The area falling under the above mentioned three categories of forests in Kerala is provide in Table 9-9 below.

TABLE 9-9: FOREST AREAS IN KERALA

Forest Area	
Total Forest Area	11309.5032 sq km
Percentage of forest area to the total area of the state	29.101 %
By Legal Status(Area as per records)	
Reserved Forests	9107.2006 sq km
Proposed Reserve	364.5009 sq km
Vested Forests & Ecologically Fragile Lands	1837.7957 sq km
TOTAL	**11309.5032 sq km**

(Source: http://www.forest.kerala.gov.in/index.php/forest/forest-area).

There are two Biosphere Reserve in Kerala namely Nilgiri Biosphere Reserve and Agasthyamalai Biosphere Reserve. Parts of these biosphere reserves fall in other adjoining States too. The parts of the biosphere reserves falling in Kerala are delineated in Table 9-10 below.

TABLE 9-10: BIOSPHERE RESERVES IN KERALA

Sl. No.	**Name of Biosphere Reserve**	**Extent (sq km)**	**Forest Areas falling in Kerala**
1.	Nilgiri Biosphere Reserve	1455.40	Wayanad Wildlife Sanctuary Silent valley National Park Nilambur South (New Amarambalam, Karimpuzha) Mannarkkad (Attappady) Palakkad (Siruvani Reserved Forests) Nilambur North, (Chakkikuzhy, Kozhipara, Punchakolly, Ex.Karulai Range (Nilambur Kovilakom) Kozhikode (Kuttyadi, Thamarassery, Vested Forests) Wayanad South (Kalpetta)
2.	Agasthyamalai Biosphere Reserve	1828	Neyyar Peppara and Shendurney wildlife sanctuaries Achencoi

			Thenmala Konni Punalur and Thiruvananthapuram territorial divisions and Agasthyavanam Biological Park Range

There are five National Parks, 17 Wildlife Sanctuaries (WLS) and one Community Reserve in the State spread across an area of 3213.24 sq km, out of which, two wildlife sanctuaries have been declared as Tiger Reserves. The wildlife sanctuaries that have been declared as Tiger Reserves are Parambikulam and Periyar wildlife sanctuaries.

(Source: http://www.forest.kerala.gov.in/index.php/wildlife/2015-03-16-09-50-24/introduction)

The proximity of the project alignment / site to the National Parks and Wildlife Sanctuaries in Kerala has been verified on Google Earth and it is found that the project area is not located close to any of these national Parks or Wildlife Sanctuaries. Mangalavanam Bird Sanctuary and Idukki Wildlife Sanctuary are the nearest protected areas from the project site and even these are located at a distance of over 50 km from the project site. Therefore, no Wildlife Clearance is envisaged for the project.

The list of National parks and Wildlife sanctuaries in the State has been provided in Table 9-11 below.

TABLE 9-11: PROTECTED AREAS IN KERALA

Sl. No.	Name of WLS/NPs	G.O. No. & Date	Year of Formation	Total Area (Sq. km)	Approximate Distance from the Project Site (in km) as measured on Google Earth
	National Parks				
1	Eravikulam National Park	G.O.(MS)142/78 dated 19-05-1978	1978	97	84.72
2	Silent Valley National Park	GO-5462/FSA3/82/AD dated 15.11.84	1984	237.52	164.55
3	Anamudi Shola National Park	G.O.12876/F2/2003/F&WLD dated 14-12-2003	2003	7.5	99.29
4	Mathikettan Shola National Park	GO(MS)No.50/2003/F&WLD dated 10-10-2003	2003	12.817	91.45
5	Pambadum Shola National Park	G.O.12875/F2/2003/F&WLD dated 14-12-2003	2003	1.318	100.84
	Wildlife Sanctuaries				
6	Parambikulam Wildlife Sanctuary (Tiger Reserve)	GO(P)39/73/AD dated 12..02..1973 GO(P) No. 443/06/F&WLD dated 31..10..2006	1973	643.66	94.61
7	Periyar Wildlife Sanctuary (Tiger Reserve)	F1-2854/AD dated 11-08-1950 G-11025/34/FRY(PT) dated 29-08-1977	1950	925	79.9

Sl. No.	Name of WLS/NPs	G.O. No. & Date	Year of Formation	Total Area (Sq. km)	Approximate Distance from the Project Site (in km) as measured on Google Earth
8	Neyyar WLS	GO(MS)871/58 dated 06..08..1958	1958	128	131.33
9	Peechi-Vazhani WLS	GO(MS)871/58 dated 06..08..1958	1958	125	101.38
10	Wayanad WLS	GO(MS)182/73/AD dated 30..05..1973	1973	344.44	232.1
11	Idukki WLS	GO.7898/FM3/76/AD dated 09.02.76	1976	70	53.82
12	Peppara WLS	GO(P)379/83/AD dated 21..12..1983	1983	53	122.32
13	Thattekkad B.S	GO.35743/FM3/83/AD dated 27..08..83	1983	25	64.11
14	Shendurney WLS	GO(P)258/84/AD dated 25..08..1984	1984	171	108.27
15	Chinnar WLS	GO(P)229/84/AD dated 04..08..1984	1984	90.44	110.22
16	Chimmony WLS	GO(P)259/84/AD dated 25..08..1984	1984	85	94.47
17	Aralam WLS	GO(P)300/84/AD dated 15..10..1984	1984	55	274.02
18	Mangalavanam Bird Sanctuary	G.O(MS) No.42/04/F&WLD dated 31..08..2004	2004	0.0274	52.67
19	Kurinjimala Sanctuary	G.O.(P)36/2006/F&WLD dated 06-10-2006	2006	32	108.23
20	Choolannur Pea Fowl Sanctuary	G.O.(P) 24/2007/F&WLD dated 15-05-2007	2007	3.42	127.45
21	Malabar Sanctuary	G.O (P) 26/2009 / F&WLD dated 05-06-2009	2009	74.215	227.1
22	Kottiyoor Wildlife Sanctuary	G.O (P) 17/2011 / F&WLD dated 01-03-2011	2011	30.3798	263.33
	Community Reserve				
23	Kadalundi-Vallikunnu Community Reserve	G.O(MS)No.66/2007/F&WL dated 17-10-2007	2007	1.5	187.23
	TOTAL			3213.237	

(Source: http://www.forest.kerala.gov.in/index.php/wildlife/2015-03-16-09-50-24/introduction)

The NW-9 project is not located close to any of the above mentioned protected areas.

9.2.12 Socio-economic Profile

The NW-9 project is located in two districts of Kerala namely Alappuzha and Kottayam.

Alappuzha District

Alappuzha district was carved out of the erstwhile Kottayam and Quilon (Kollam) Districts, on the 17th August 1957, consisting of seven Taluks namely, Sherthalai (Cherthala), Ambalappuzha, Kuttanad, Thiruvalla, Chengannur, Karthikappally and Mavelikkara. The then name of the District i.e., Alleppey, an anglicised form, was changed later on as 'Alappuzha' as per GO (P) No.133/90/RD dated 7.2.90.

As per GO (MS) No.1026/82/RD dated 29.10.1982, another District named Pathanamthitta was constituted taking portions from the then Alleppey, Quilon and Idukki Districts. Thiruvalla Taluk as a whole and parts of Chengannur and Mavelikkara Taluks had been transferred to the newly formed Pathanamthitta District.

The present Alappuzha District comprises six Taluks, namely, Cherthala, Ambalappuzha, Kuttanad, Karthikappally, Chengannur and Mavelikkara.

The two administrative systems prevailing in the District are Revenue and Local Self-Government. Under the Revenue System, the District is divided into Revenue Divisions, Taluks and Villages. Under the Local Administration set up, the District is divided into Statutory Towns and Panchayats. For the implementation of development activities, Panchayats are grouped under Community Development Blocks.

The District with two Revenue Divisions, consists of 6 Taluks and 92 Villages. The two Revenue Divisions are Alappuzha Division comprising of Cherthala, Ambalappuzha and Kuttanad Taluks covering 47 Villages and Chengannur Division, comprising of Karthikappally, Chengannur and Mavelikkara Taluks covering 45 Villages.

Under the Local Self-Government System, the District is divided into 5 Statutory Towns, 12 Development Blocks and 73 Panchayats.

District Highlights 2011 Census: Alappuzha District

- Alappuzha District was formed on the 17th August 1957.
- In terms of area, Alappuzha is the smallest district in the State.
- The District has the fourth highest effective literacy rate (95.72 per cent) and with regard to female literacy rate, it also stands at the 4th in the State.
- Alappuzha is the second densest district (1504) in the state in terms of population per sq. km.
- The District has a higher sex ratio (1100) than the State (1084).
- Alappuzha is the only district in the state where there are no reserved forests.
- Kuttanad Taluk, known as the rice bowl of the state, has a predominant position in the production of rice.
- With 2127789 persons, Alappuzha district ranks 9th among the districts of the state in population.

- In work participation rate (37.81 per cent), the district has the 4th position among the districts.
- Alappuzha District ranks the 3rd in female work participation rate (24.02 per cent).
- In child sex ratio, the district has 13th rank with 951 female children per 1000 male children.
- In the percentage of Scheduled Tribe population to total population, the district has the 13th rank (0.31 per cent) among the districts.
- It stands at the 7th position in the percentage of Scheduled Caste population to total population (9.45 per cent).
- In the district, 74.13 per cent of workers are main workers and 25.87 percent are marginal workers.
- The district stands at the 2nd position in the percentage of workers in household industry (4.46 per cent).

(Source: District Census Handbook: Alappuzha, Series 33, Part XII-B, Directorate of Census Operations, Kerala, Census of India, 2011)

Alappuzha District, known as the Rice Bowl of the State, has a predominant position in the production of rice which is mainly concentrated in Kuttanad Taluk. Since most of the area of the district does not have highlands, plantation crops are cultivated in a limited area in the Eastern portion of the district.

Paddy (*Oryza sativa*) is cultivated in three seasons of the year mainly Viruppu associated with autumn, Mundakan associated with winter and Punja associated with summer. Kuttanad Tract in Kuttanad Taluk and Onattukara Tract comprising of Karthikappally Taluk and portion of Mavelikkara Taluk are the two important paddy growing areas of the district.

Coconut (*Cocos* nucifera) is also a predominant crop cultivated on a large scale in all the Taluks. More yields are obtained from the deltaic region of the district. Other important crops grown in the district are tapioca (*Manihot esculenta*), rubber (*Hevea brasiliensis*) and Mango (*Mangifera indical*).

Though the District is normally favoured with heavy rainfall, there are major and minor irrigation projects which help the agricultural development of this district. Pamba Irrigation Project is the major irrigation project utilising the tailrace water of Sabarigiri Hydro Electric Project, irrigating land in Chengannur, Mavelikkara and Karthikappally Taluks. Kuttanad Development Scheme is the other major scheme under which the Salt Water Barrier at Thanneermukkam and the Spillway at Thottappally to control salinity of water and to bring down the floodwater were constructed.

The District is poor in cattle wealth because of the scarcity of green grass, as most of the area is waterlogged. Straw is the main cattle feed and so production of milk is very low as compared to most of the other districts.

The district with the Arabian Sea in the West has 82 km long coastal area stretched between Pallithode in the North and Valiyazheekal in the South. The District has the benefit of immense wealth of marine and inland fishing. The Vembanad and Kayamkulam Backwaters and the network of rivers and canals enrich the inland fishing. Both brackish water fish farming and fresh water fish farming are done in the district. Oil Sardines, Prawns, Mackerel, Anchoviella, Other Sardines, etc., are the major species of economic importance and Lobsters, Elarmobranches, Scienids, Catfishes, Pomfrets, Leiognathus, etc., are the other kinds of fish landing in the coast.

Though the district is industrially backward, industries based on coir and coir products, marine products, handloom, different types of handicrafts, toddy tapping, etc. are a part of the local tradition. The district is known as the traditional home of coir industry in Kerala.

There are 15466 Small-Scale Industrial Units in Alappuzha District in 2011. Of these, 500 units are promoted by Scheduled Castes/Scheduled Tribes, 4756 units by women, 14966 units by others and 85984 persons are employed in these factories. There are three Industrial Estates at Aroor, Maithara and Kollakadavu and 6 Mini Estates at Mannanchery, Mararikkulam, Mannar, Nooranad, Pathiyoor and Thamarakkulam functioning in the District. Industrial area is earmarked at Aroor and Kollakadavu. Industrial development plots are marked at Punnapra, Mundankavu and Cherthala. There are 339 Industrial Co-operative Societies and 26 Handloom Societies in the district.

Alappuzha District is most favoured by the natural link of rivers, canals and backwaters. Most of the early trade and traffic of Alappuzha District was by means of waterways as the area is extensively connected by rivers and backwater systems. Now the district is well connected by a good network of roads, waterways and railways.

All the major towns of the district have been connected through rail network. The coastal railway line functions parallel to the already existing railway line through Kottayam.

The Vembanad Lake is the main artery of the Inland Navigation System. It forms the most important part of the West Coast Canal System which starts from Hosdurg in the North and ends in Thiruvananthapuram. A network of rivers and canals connects the places of commercial importance like Kochi, Kottayam, Changanassery and Chengannur. Alappuzha Town is connected with Changanassery by Alappuzha-Changanassery Canal passing through Kuttanad area. The Wadai and Commercial Canals take off from the Vembanad Lake and run parallel through the heart of the Town. Some of the inland canals falling in the District are Alappuzha-Ambalappuzha, Alappuzha-Changanassery, Alappuzha Commercial Canal, Alappuzha-Kottayam, Alappuzha-Wadai, Alappuzha-Thalavady, Alappuzha-West junction, Kakkazham-Kayamkulam Salt Shell, Muhamma-Puchakkal Canal, etc. There are ferry services in almost all the water-logged areas.

In the District, the three predominant religions are Hindus, Muslims and Christians. Other religious communities such as Sikhs, Buddhists and Jains are insignificant as their percentage to the total population is very negligible. Hindus, Muslims and Christians constitute about 99.63 per cent of the total population.68.6 per cent population of the District are Hindus. Muslims (10.55 per cent) and Christians (20.44 per cent) together account for 31 per cent of the total population.

The population of the Scheduled Tribes in the District in 2011 was 6,574 with 3,175 males and 3,399 females. They accounted for 1.4 per cent of total Scheduled Tribe population in the State. As per 2011 Census, the population of the Scheduled Castes in the district was 201,211 with 97,183 males and 104,028 females. The proportion of Scheduled Caste population in the District is 9.5 per cent with 11.4 per cent in rural and 7.8 per cent in urban.

(Source: District Census Handbook: Alappuzha, Series 33, Part XII-A, Directorate of Census operations, Kerala, Census of India, 2011)

Kottayam District

The present Kottayam District was previously a part of the erstwhile Princely State of Travancore. Then the Travancore State consisted of two Revenue Divisions, viz., the Southern and Northern Divisions under the administrative control of 'Diwan Peshkar' for each Division. Thereafter in 1868, two more Divisions – Quilon and Kottayam were constituted. Though the fifth division – Devicolam came next, in course of time, it was added to Kottayam.

At the time of the integration of the State of Travancore and Cochin in 1949, these Revenue Divisions were renamed as Districts and Diwan Peshkars gave way to District Collectors and that marked the birth of the District of Kottayam.

There are two systems of administrative set up in the District – Revenue and Local Self Government. Under the Revenue System, the District is divided into two Revenue Divisions, five Taluks and 95 Villages. The two Revenue Divisions are Palai, comprising Meenachil and Vaikom Taluks with 42 Villages and Kottayam, comprising Kottayam, Kanjirappally and Changanassery Taluks with 53 Villages.

Under the Local Self Government System, the District is divided into four Statutory Towns and 14 Development Blocks, consisting of 75 Panchayats.

District Highlights -2011 Census: Kottayam District

- Kottayam district was formed on the 1st July 1949 at the time of the integration of the States of Travancore and Cochin.
- Kottayam district was formed on the 1st July 1949 at the time of the integration of the States of Travancore and Cochin.
- Kumarakam is a beautiful tourist spot, 10 Kms away from Kottayam on the beaches of the Vembanad Lake. Kumarakom Bird Sanctuary is noted for its rare species of birds arriving from Siberia in the winter season.
- The district with 2206 sq km of area ranks the 10th among the districts.
- Kottayam district is devoid of Coastal line.
- The district stands first in rubber production in the state.
- In Literacy rate, Kottayam district has the 1st position in 2011 Census also with the highest female literacy (96.48 per cent) among the districts.
- The important rivers of the district are the Meenachil River, The Muvattupuzha river, and the Manimala river. The Vembanad lake, the largest backwater in the state forms the Western boundary of Kottayam district.

- With 19,74,551 persons, Kottayam district ranks the 10th in population among the districts.
- The district ranks the 8th in total density (895) and 6th in urban density (2066).
- In sex ratio, the district ranks the 11th with 1039 females per 1000 males.
- The district has the 8th rank in Child Sex ratio with 964 female children per 1000 male children.
- In the percentage of Scheduled Caste population to total population, the district ranks the 9th with 7.8 per cent.
- It ranks the 6th in the percentage of Scheduled Tribes Population to total population (1.1 per cent).
- The total work participation rate of the district is 37.3 per cent and has the 6th position among the Districts.
- In the District, 82.2 per cent of the workers are main workers and 17.8 per cent are marginal workers.
- Kottayam district ranks the 6th position in Female Work Participation rate with 20.4 per cent.

(Source: District Census Handbook: Kottayam, Series 33, Part XII-B, Directorate of Census operations, Kerala, Census of India, 2011)

Agriculture is a predominant sector of the District economy. Food crops as well as cash crops are cultivated here. Paddy and Tapioca are the main food crops while rubber, coconut and pepper are the main cash crops. Annual crops like plantain and pineapple, seasonal crops like ginger, tubers, vegetables and a wide range of perennial crops like jack, mango, etc. are also grown.

Paddy is the most important food crop. Kayal land cultivation is a peculiarity of the District and the neighbouring District of Alappuzha. Kayal lands are below mean sea level.

Rubber is the major cash crop in the District. The District has the credit of largest content of area under this crop. Meenachil Taluk has maximum area under rubber cultivation. Indian Rubber Board has its Headquarters at Kottayam.

Meenachil Irrigation Project is the major irrigation project. This project was started in 1980. Besides this, lift irrigation projects and other minor irrigation projects help to irrigate the cultivable area in the District.

The main species of livestock in the District are cows, buffaloes, goats and pigs. The majority of cattle found in the District is Rangayam, Hallikyr and cross breeds of Jersey, Sindhi and Swiss Brown. There are fairly large number of cross breed Jersey and Swiss Brown animals in the District. The two other breeds found here are Murrah and Surabhi.

The District is deprived of sea coast. But it has abundant lakes and rivers which are the base of inland fishing. The main sources of fish in the District are the Vembanad Lake and the Muvattupuzha and Meenachil Rivers.

Industrially, Kottayam District is not highly advanced.

The main modes of transport in the district are by roads and railways. The inland water transport is negligible. In the District, there is only one National Highway, which is NH-220 i.e., Kottayam–Kumily passing through Manarcad, Pampady, Kanjirappally, Mundakayam, etc. SH-1 popularly known as MC Road passes through Changanassery, Kottayam and Meenachil Taluks. It enters the District from the South in Changanassery Taluk. The main roads branching from MC Road are; Changanassery – Alappuzha, Changanassery – Kumily, Ettumanoor – Palai – Erattupetta – Thekkedy (i.e., SH-14) and Ettumanoor – Kuruppumthara – Kaduthuruthy – Thalayolaparambu (i.e., SH – 15).

A part of the traffic and cargo is borne by the Vembanad Lake and the rivers flowing into it. There are also a few navigable canals in Changanassery, Kottayam and Vaikom Taluks. Kottayam Town is connected by a canal to the Vembanad Lake.

The District with 5.7 per cent of the total geographical area of the State accommodates 5.9 per cent of the total population of the State.

In the District, the three predominant religious groups are Hindus, Christians and Muslims. Other religious communities such as Sikhs, Buddhists and Jains etc. are insignificant as their percentage to the total population is very negligible. Hindus, Muslims and Christians constitute about 99.7 per cent of the total population. 49.81 per cent of the populations are Hindus, closely followed by Christians (43.48 per cent). Muslim population accounts for only 6.41 per cent.

According to 2011 Census, the population of the Scheduled Castes in the District is 153,909 with 75,503 males and 78,406 females. They accounted for 5.06 per cent of the total Scheduled Castes in the State.

The population of the Scheduled Tribes in the District in 2011 was 21,972 with a break-up of 10,974 males and 10,998 females. They formed 4.53 per cent of the total Scheduled Tribe population in the State.

(Source: District Census Handbook: Kottayam, Series 33, Part XII-A, Directorate of Census operations, Kerala, Census of India, 2011)

9.3 Potential Environmental and Social Impacts of the Project

The stretch of NW 9 connects IWAI Terminal at Alappuzha and two captive terminals at Kottayam. The two captive terminals are: 1. Kottayam Port & Container Terminal (KPACT) and 2. The Travancore Cements Limited TCL). Both are adjacent at Nattakom. Cargo mobility is already in existence and both the locations are well connected to Road / Highway. Both the Captive Terminals are presently existing and operational. Hence, the existing Terminals are to be utilized for cargo operation and no new terminals are envisaged to be constructed as part of NW-9 development.

Development of NW-9A, which shall be for a stretch of 22.4 km, shall involve dredging of 0.93 Lakhs Cu. M of general soil material. 600 m Bank protection works are envisaged under the project.

Thus, the development of NW-9 envisages the following major construction activities:

- Construction of access roads leading to the existing terminals.
- Bank protection works – Nil.
- Dredging of the river for development of fairway.

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

As has been mentioned above, no terminal is proposed to be constructed for operation of NW-9.

No significant adverse impact on account of land use change is anticipated due to the project. No dislocation of population is envisaged due to the project.

Development of NW-9 envisages dredging for creation of a navigable channel. All the dredged material is proposed to be disposed of within the flood banks of the river, since this will help to fill the low lying area. As such there is no impact on the land environment due to disposal of dredged material. Impacts on aquatic ecology due to dredging and disposal of the dredged material need to be established as part of the EIA study to be carried out separately for the project by IWAI.

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

Impacts on air and noise, arising out of vehicular movement and fugitive dust emission, will be largely limited to the construction period.

Potential impacts on water quality of the river can be suitably mitigated by constructing the labour camps away from the river banks and by not allowing any debris to be thrown into the river during the construction and operation phases.

The positive impacts on the project will include improved waterway facilities and other allied infrastructure facilities the local population. It will also generate some employment and small business opportunities for the local population.

9.4 EMP and Mitigation of Environmental Effects

As already stated most of the potential impacts will be limited to the construction period.

The management measures required to mitigate the potential impacts of the project on the ambient air quality during construction period include suppression of fugitive dust by water sprinkling, transportation of construction debris in covered vehicles, maintaining the specified stack height of DG sets under use and ensuring that the vehicles and equipment used during the construction period are in well maintained condition. To ensure that the ambient air quality remains within the prescribed standards by the Central Pollution Control Board (CPCB), periodic monitoring of ambient air quality should be undertaken through an accredited laboratory. Suitable corrective measures should be implemented if the ambient air quality is found to exceed the prescribed limits.

The measures to ensure that there is no adverse impact on the water quality on account of the project during the construction period would include setting up of labour camps at a safe distance from the river banks. In addition, no construction debris should be allowed to flow or be thrown into the river. The batching pants and concrete mixing plants should be located away from the river banks and these should be set up and operated strictly in accordance with the conditions stipulated by the SPCB.

To mitigate land, air and water contamination by the construction workers, adequate fuel, water and sanitation facilities should be provided to the construction workers. Hunting or poaching of wildlife should be strictly prohibited by any of the construction workers or employees. Also, it should be ensured that no unauthorized tree / forest cutting is undertaken by anyone engaged on the project.

Minimum required land should be acquired for the project. The private land owners, if any, whose land is to be acquired for the project, should be compensated adequately in accordance with law.

The project should take care that the traditional fishing rights of the local population are not impacted adversely in any manner. Adequate consultation with the local population should be undertaken as required.

The project authorities should ensure that the Contractors engaged on the project have an approved environment management plan in place and that this management plan forms a part of the Contract document so as to ensure its effective implementation by the Contractors.

9.5 Applicable Legal and Regulatory Framework

The Kerala State Pollution Control Board (KSPCB) acts as the nodal agency for environmental management, prevention & control of pollution and for the enforcement of following important acts & rules:

- Water (Prevention & Control of Pollution) Act, 1974
- Water (Prevention & Control of Pollution) Cess Act, 1977
- Air (Prevention & Control of Pollution) Act, 1981
- Environment (Protection) Act, 1986
- Notifications issued under Environment (Protection) Act, 1986
- Noise Pollution (Regulation & Control) Rules, 2000

Key legal and regulatory provisions as applicable to the project are described below.

Consent to Establish and Consent to Operate

The project will require obtaining the Consent to Establish from the SPCB under the Air and Water Acts prior to commencement of construction. Prior to commencement of operation, it shall require obtaining the Consent to Operate from the SPCB under the same Acts.

CRZ Clearance

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

The CRZ Notification 1991 was later amended and a new Notification was issued in 2011 namely CRZ Notification 2011.

The CRZ Notification, 2011 declares the following areas as CRZ:

i. the land area from High Tide Line (HTL) to 500 mts on the landward side along the sea front.

ii. the land area between HTL to 100 mts or width of the creek whichever is less on the landward side along the tidal influenced water bodies that are connected to the sea and the distance up to which development along such tidal influenced water bodies is to be regulated shall be governed by the distance up to which the tidal effects are experienced which shall be determined based on salinity concentration of 5 parts per thousand (ppt) measured during the driest period of the year and distance up to which tidal effects are experienced shall be clearly identified and demarcated accordingly in the Coastal Zone Management Plans (hereinafter referred to as the CZMPs).

   Explanation - For the purposes of this sub-paragraph the expression tidal influenced water bodies means the water bodies influenced by tidal effects from sea, in the bays, estuaries, rivers, creeks, backwaters, lagoons, ponds connected to the sea or creeks and the like.

iii. the land area falling between the hazard line and 500mts from HTL on the landward side, in case of seafront and between the hazard line and 100mts line in case of tidal influenced water body the word 'hazard line' denotes the line demarcated by Ministry of Environment and Forests (MoEF) through the Survey of India (SoI) taking into account tides, waves, sea level rise and shoreline changes.

iv. the land area between HTL and Low Tide Line (LTL) which will be termed as the intertidal zone.

v. the water and the bed area between the LTL to the territorial water limit (12 Nm) in case of sea and the water and the bed area between LTL at the bank to the LTL on the opposite side of the bank, of tidal influenced water bodies.

The coastal zone is categorized for the purposes of regulation in the following categories:

i. CRZ-I,–

   A. The areas that are ecologically sensitive and the geomorphological features which play a role in the maintaining the integrity of the coast,

      (a) Mangroves, in case mangrove area is more than 1000 sq mts, a buffer of 50 meters along the mangroves shall be provided;

      (b) Corals and coral reefs and associated biodiversity;

      (c) Sand Dunes;

      (d) Mudflats which are biologically active;

(e) National parks, marine parks, sanctuaries, reserve forests, wildlife habitats and other protected areas under the provisions of Wild Life (Protection) Act, 1972 (53 of 1972), the Forest (Conservation) Act, 1980 (69 of 1980) or Environment (Protection) Act, 1986 (29 of 1986); including Biosphere Reserves;

(f) Salt Marshes;

(g) Turtle nesting grounds;

(h) Horse shoe crabs habitats;

(i) Sea grass beds;

(j) Nesting grounds of birds;

(k) Areas or structures of archaeological importance and heritage sites.

B. The area between Low Tide Line and High Tide Line;

ii. CRZ-II,-

The areas that have been developed up to or close to the shoreline.

Explanation.- For the purposes of the expression "developed area" is referred to as that area within the existing municipal limits or in other existing legally designated urban areas which are substantially built-up and has been provided with drainage and approach roads and other infrastructural facilities, such as water supply and sewerage mains;

iii. CRZ-III,-

Areas that are relatively undisturbed and those do not belong to either CRZ-I or II which include coastal zone in the rural areas (developed and undeveloped) and also areas within municipal limits or in other legally designated urban areas, which are not substantially built up.

iv. CRZ-IV,-

A. the water area from the Low Tide Line to twelve nautical miles on the seaward side;

B. shall include the water area of the tidal influenced water body from the mouth of the water body at the sea upto the influence of tide which is measured as five parts per thousand during the driest season of the year.

v. **Areas requiring special consideration** for the purpose of protecting the critical coastal environment and difficulties faced by local communities -

A. (i) CRZ area falling within municipal limits of Greater Mumbai;

(ii) the CRZ areas of Kerala including the backwaters and backwater islands;

(iii) CRZ areas of Goa.

B. Critically Vulnerable Coastal Areas (CVCA) such as Sunderbans region of West Bengal and other ecologically sensitive areas identified as under Environment (Protection) Act, 1986 and managed with the involvement of coastal communities including fisherfolk.

The development or construction activities in different categories of CRZ are regulated by the concerned Coastal Zone Management Authority (CZMA) in accordance with the norms as defined under the CRZ Notification 2011.

The entire NW-9 project area falls in tidal zone. As such the project shall require clearance under the CRZ Notification 2011.

Forest Clearance

The project does not involve diversion of forest land. Therefore, no Forest Clearance from the MoEF is required for development of the project.

9.5.1 Need for Environmental Clearance

Inland waterways are not listed as an activity that requires prior environmental clearance under the EIA Notification 2006. The Notification, as amended in 2009, includes 'Dredging' as an activity for which prior environmental clearance is required.

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

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

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

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

The project area is not located close to any Protected Areas. Therefore, the project shall not require Wildlife Clearance from the MoEF, Government of India.

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

A summary of major clearances / approvals / permits and their applicability to the project is provided in Table 9-12 below

TABLE 9-12: MAJOR CLEARANCES / APPROVALS / PERMITS AND THEIR APPLICABILITY TO THE PROJECT

Sl. No.	Clearance / Approval	Applicability to the Project	Applicable Legislation	Remarks
1.	Environmental Clearance	No	EIA Notification 2006	Exempted by MoEFCC vide its letter dated 21 December 2017.
2.	Forest Clearance	No	Forest Conservation Act, 1980	The project does not involve diversion of forest land.
3.	Wildlife Clearance	No	Wildlife Protection Act, 1972	No part of the project falls within the boundary of any of the protected areas or within their eco-sensitive zones.
4.	CRZ Clearance	Yes	CRZ Notification 2011	The entire project falls in tidal zone.
5.	Consent to Establish (CTE) and Consent to Operate (CTO) from SPCB	Yes	Water (Prevention and Control of Pollution) Act, 1974 and Air (Prevention and Control of Pollution) Act, 1981	CTE is to be obtained prior to commencement of construction and CTO is to be obtained prior to commencement of operation.

9.6 Cost Implications

As per the scope of services for further environmental and social impact assessment (EIA & SIA) studies and requirement of obtaining all mandatory statutory clearances for the project approximately 1 to 1.5 year is adequate period for consultancy services (1 year for non-CRZ and 1.5 year for CRZ waterways) related to EIA & SIA studies. In this regard, the project authority may engage to QCI/NABET accredited EIA consultant for Category – A projects, who shall conduct rapid EIA & SIA studies and shall prepare a stand-alone EMMP (EMP & EMoP) for inclusion in the contractor bid documents. The generation of environmental baseline data at pre-construction stage along with environmental monitoring during construction and operation stages shall be carried out by the NABL/MoEF&CC approved laboratory to assess the project performance during entire project cycle.

The estimated cost for conducting EIA-EMP & SIA studies along with obtaining all mandatory statutory clearances at pre-construction stage and timely and effective implementation of EMMP (EMP & EMoP) during construction and operation stages have been described in the following sections.

9.6.1 Estimated Cost at Pre-Construction Stage

The statutory fee shall be paid by the project authority for obtaining all mandatory statutory clearances. The estimated environmental and social budget for EIA-EMP & SIA studies have been summarized below:

TABLE 9-13: SUMMARIZED ESTIMATED COST FOR CONSULTANCY SERVICES

Sl. No.	**Particulars of Estimated Budget**	**Amount (in Rs. Lakh)**	**Remark (if any)**
1.	Salary of 12 Professionals/Domain Experts on intermittent based input (as per QCI/NABET scheme)	40	Lump-sum cost on intermittent basis
2.	Cost of one Time Baseline Data Generation at Pre-Construction Stage	5.60	To be done for one season **(Table – 9-14).**
3.	Public Consultation Meeting (PCM)	4	Lump-sum cost
4.	Reports / Document Printing	1	Lump-sum cost without break-up
5.	Travelling Cost for Site Visits (Bus, Taxi, Boat *etc.*)	5	Lump-sum cost
6.	Lodging & Boarding Cost	5	Lump-sum cost
7.	Cost for collection of metrological data and other information like Maps *etc.*	5	Lump-sum cost
	Grand Total (Rs)	**65.60**	
	In words: *Rs. Sixty Five Lakhs Sixty Thousand only*		

Note: No. of Key Experts: 12 as per QCI/NABET Scheme on intermittent basis. Which may increase or decrease by the project proponent as per actual scope of work.

(i) Above consultancy Fee is without Service Tax.

(ii) The breakup of Sl. No. 2 is given in Tables 9-14.

TABLE 9-14: ESTIMATED SUB-COST FOR ONE TIME BASELINE DATA GENERATION AT PRE-CONSTRUCTION STAGE

Sl. No.	Environmental Attributes	Parameters	Monitoring Frequency	Unit	No. of Tentative Locations	Unit Rate (Rs)	Amount (Rs)
1.	Ambient Air Quality	PM 2.5, PM10, CO, SO2, NO2 etc.	24 Hourly sampling (Day & Night time) to be done at each location.	Per Sample with various parameters	7	20,000	140,000
2.	Water Quality monitoring	***Physical Properties:*** pH, Temp., DO, Conductivity, ***Chemical Properties:*** TSS, Alkalinity, Hardness, BOD, COD, NO3, PO4, Cl, SO4, Na, K, Ca, Mg, Silica, Oil & grease, Phenolic compounds, Residual Sodium Carbonate. ***Bacteriological Properties:*** Total Coliform.	Surface and ground water to be monitored separately	Per Sample with various parameters	7	15,000	105,000
3.	Noise Quality monitoring	Day & Time monitoring to be done at each location	24 Hourly sampling (Day & Night time) to be done	Per Sample with various parameters	7	10,000	70,000
4.	Soil	Bulk Density, Colour, Texture, Soil Type, pH, Electrical Conductivity, N, P, K *etc.*	Composite sample shall be prepared based on at least 3 replicates from each location.	Per Sample with various parameters	7	10,000	70,000
5.	Aquatic Ecology	Trophic Status, Primary Productivity, Species diversity & densities of Phytoplankton, Zooplankton, Benthic Organism (Benthos, Macro-benthos), Fish and Macrophytes, Shanon Weiner Diversity Index.	One time study at this stage.	-	7	25,000	175,000
	Sub-Total (Baseline Environmental Data Generation Cost)						**560,000**
	In Words: *Rs. Five Lakh Sixty Thousand only*						

Note: 1 monitoring station @ 7 Km/station = tentatively 7 locations shall be monitored.

9.6.2 Estimated Cost at Construction Stage

The civil work contractor during construction stage shall depute a well experience environmental & safety Officer (ESO), who shall conduct Environmental Monitoring at Construction Stage as per stipulated conditions in the contractor documents. He shall also prepare environmental monitoring report that to be submitted timely to the project proponent and statutory authorities as per project requirement.

TABLE 9-15: ESTIMATED COST FOR ENVIRONMENT MANAGEMENT DURING CONSTRUCTION

Sl. No.	Particulars of Estimated Budget	Cost (Rs. Lakhs)	Remark (if any)
1.	Environmental Monitoring Cost at Construction Stage once in a year for three years	16.80	Shall be carried on yearly basis for entire construction period (**Table 9-16)**
2.	Greenbelt Development nearby terminal Premises by Contractor	6	Lump-sum cost
3.	Solid Waste Management	6	Lump-sum cost
4.	Sanitary facilities at labour camps	6	Lump-sum cost
5.	Disaster Management Plan	5	Lump-sum cost
6.	Any other/miscellaneous	2	Lump-sum cost
	Total (Lakhs)	**41.80**	
	In Words: *Rs. Forty One Lakh Eighty Thousand only*		

TABLE 9-16: ENVIRONMENTAL MONITORING COST FOR CONSTRUCTION STAGE

Sl. No.	Env. Attributes	Parameters	Monitoring Frequency	Unit	No. of Tentative Locations (for 3 Years)	Unit Rate (Rs)	Amount (Rs)
1.	Ambient Air Quality	PM 2.5, PM10, CO, SO2, NO2 etc.	24 Hourly sampling (Day & Night time) to be done at each location.	Per sample with various param eters	7X3 = 21	20,000	420,000
2.	Water Quality monitoring	***Physical Properties:*** pH, Temp., DO, Conductivity ,	Surface and ground water to be monitored separately	Per sample with various param eters	7X3 = 21	15,000	315,000

Sl. No.	Env. Attributes	Parameters	Monitoring Frequency	Unit	No. of Tentative Locations (for 3 Years)	Unit Rate (Rs)	Amount (Rs)
		Chemical Properties: TSS, Alkalinity, Hardness, BOD, COD, NO3, PO4, Cl, SO4, Na, K, Ca, Mg, Silica, Oil & grease, Phenolic compounds, Residual Sodium Carbonate. ***Bacteriological Properties:*** Total Coliform.					
3.	Noise Quality monitoring	Day & Time monitoring to be done at each location	24 Hourly sampling (Day & Night time) to be done	Per sample location with various parameters	7X3 = 21	10,000	210,000
4.	Soil	Bulk Density, Colour, Texture, Soil Type, pH, Electrical Conductivity, N, P, K *etc.*	Composite sample shall be prepared based on at least 3 replicates from each location.	Per sample with various parameters	7X3 = 21	10,000	210,000
5.	Aquatic Ecology	Trophic Status, Primary Productivity, Species diversity & densities of Phytoplankton, Zooplankton, Benthic Organism (Benthos, Macro-benthos), Fish and Macrophytes, Shanon	One time study at this stage.		7X3 = 21	25,000	525,000

Sl. No.	Env. Attributes	Parameters	Monitoring Frequency	Unit	No. of Tentative Locations (for 3 Years)	Unit Rate (Rs)	Amount (Rs)
		Weiner Diversity Index.					
Total (Rs)							**1,680,000**
		In Words: *Rs. Sixteen Lakh Eighty Thousand only*					

9.6.3 Estimated Cost at Operation Stage

Like pre-construction stage, the environmental monitoring and supervision to be done by the project proponent.

TABLE 9-17: ESTIMATED ENVIRONMENT MANAGEMENT COST DURING OPERATION

Sl. No.	Particulars of Estimated Budget	Cost (Rs. Lakhs)	Remark (if any)
1.	Environmental Monitoring Cost at Operational Stage once in a year.	5.60	Shall be carried for one season as per Table 9-14 given above for pre-construction stage.
2.	Maintenance & Supervision of Greenbelt Developed during construction stage	2	Lump-sum cost
3.	Solid Waste Management	2	Lump-sum cost
4.	Sanitary facilities nearby terminals	2	Lump-sum cost
5.	Disaster Management Plan (if applicable)	2	Lump-sum cost
6.	Any other/miscellaneous	2	Lump-sum cost
	Total (Lakhs)	**15.60**	Per Year
	In Words: *Rs. Fifteen Lakh Sixty Thousand only*		

9.6.4 Summary of Estimated Environmental & Social Budget

This covers the consultancy fee at pre-construction stage along with implementation of EMMP (EMP & EMoP) during construction and operational stages of the project. The statutory fee along with the cost of private and government land acquisition shall be borne by the project proponent. This has been summarized in Table 9-18 given below:

TABLE 9-18: SUMMARY OF ESTIMATED ENVIRONMENTAL & SOCIAL COSTS FOR VARIOUS STAGES

Sl. No.	Project Stages	Cost (Rs.)	Remark
1.	Pre-Construction Stage	65.60	Lump-sum
2.	Construction Stage	41.80	
3.	Operational Stage	15.60	
Total Estimated Budget (Except Statutory Fee & Land Acquisition & R&R Costs)		123.00	
In Words: *Rs. One Crore Twenty Three Lakh only*			

Provision has already been catered in the proposed estimates appropriately.

CHAPTER 10 INSTITUTIONAL REQUIREMENTS

10.1 Organizational Set up / Establishment

The Inland Waterways Authority of India (IWAI) has been carved out duly taking over the responsibilities etc., of the erstwhile Inland Water Transport (IWT) directorate under Ministry of Surface Transport / Ministry of Shipping with a vision of more thrust on the IWT sector along with more Autonomy, by an Act of Parliament (IWAI Act 82 of 1985). Accordingly, IWAI is vested with the functions / duties and responsibilities connected to the safe navigation in the National Waterways and in the interconnected waterways, where IWT is considered for development. The Para 14 of IWAI ACT 82 of 1985 is provisioned with the Functions and Powers of authority, as detailed, which is self-explanatory.

Functions and Powers of the authority:

14. (1) The Authority may-

(a) carry out surveys and investigations for the development, maintenance *and better utilization of the national waterways and the appurtenant land for shipping and navigation and prepare schemes in this behalf;*

(b) provide or permit setting up of infrastructural facilities for national waterways;

(c) carry out conservancy measures and training works and do all other acts necessary for the safety and convenience of shipping and navigation and improvement of the national water-ways;

(d) control activities such as throwing rubbish, dumping or removal of material, in or from the bed of the national waterways and appurtenant land, in so far as they may affect safe and efficient, shipping and navigation, maintenance of navigable channels, river training and conservancy measures;

(e) remove or alter any obstruction or impediment in the national waterways and the appurtenant land which may impede the safe navigation or endanger safety of infrastructural facilities or conservancy measures where such obstruction or impediment has been lawfully made or has become lawful by reason of long continuance of such obstruction or impediment or otherwise, after making compensation to person suffering damage by such removal or alteration;

(f) provide for the regulation of navigation and traffic (including the rule of the road) on national waterways;

(g) regulate the construction or alteration of structures on across or under the national waterways;

(h) disseminate navigational meteorological information about national waterways;

(i) ensure co-ordination of inland water transport on national waterways with other modes of transport; and

(j) establish and maintain pilotage on national waterways;

(k) enter into joint ventures concerning inland shipping by way of equity participation.

14. (2) The Authority may also-

(a) advise the Central Government on matters relating to inland water transport;

(b) study the transport requirement with a view to co-coordinating inland water transport with other modes of transport;

(c) carry out hydrographic surveys and publish river charts;

(d) assist, on such terms and conditions as may be mutually agreed upon, any State Government in formulation and implementation of scheme for inland water transport development;

(e) develop consultancy services and provide such services, on such terms and conditions as may be mutually agreed upon, in India and abroad in relation to planning and development of waterways for shipping and navigation or any facility thereat;

(f) conduct research in matters relating to inland water transport including development of craft design mechanization of country crafts, technique of towage, landing and terminal facilities, port installations and survey techniques;

(g) lay down standards for classification of inland waterways;

(h) Arrange programme of technical training for inland water transport personnel within and outside the country; and

(i) Perform such other functions as may be necessary to carry out the provisions of this Act.

14. (3) Any dispute arising out of or concerning the compensation referred to in clause(e) of subsection (1) shall be determined according to the law relating to like disputes in the case of land required for public purposes.

14. (4) Every scheme, prepared by the Authority to carry out functions under sub-sections (1) and (2), involving capital expenditure exceeding the amount as may be prescribed, shall be submitted to the Central Government for approval.

14. (5) The Central Government may either approve the scheme submitted to it under sub-section (4) without modification or with such modifications as it may consider necessary or reject the scheme with directions to the Authority to prepare a fresh scheme according to such directions.

In order to consider a planned and systematic implementation with the assigned functions of the authority, a strong Institutional mechanism is required.

If we keenly observe the Institutional systems of similar administrations / establishment globally and the parallel administrations / establishments nationally, the key factor emerging out of the same is only the Policy and procedure of implementation of the assigned responsibilities. It is yet a debatable aspect i.e., whether to have a full pledged organization so as to undertake the works through contractual agencies or to have a mechanism of Out-Sourcing the work along with supervision to different contractual agencies (Out-Sourcing the work to an agency and the Project Management to other agency).

10.2 Man Power Requirement

It is suggested that the Outsourcing the work to a contractual agency is the best alternative for the subject study and accordingly, the Manpower requirement is under consideration

As ascertained, IWAI is having an Institution Mechanism consisting of a Board along with Functional Manpower having the inverted conical organization pattern. The major functional aspects have already been segregated as Project; Planning; Survey; Marine; Traffic; Finance and Administration. Hence, dislocation of the existing system is not suggested. The present requirement within the study stretch should be unique, which should be amenable to the existing system in the office of Policy making with Control.

Accordingly, the Controlling office (at NOIDA) has been depicted in the pictorial form and will have 1 Chief Engineer to look after the Central part of the country (Hyderabad) to deal with the Waterways / National Waterways in the states of Maharashtra; Goa; Karnataka; Orissa; Telangana; Andhra Pradesh; Tamilnadu & Kerala (including NW 3). Refer the Annexure 10.1.

The present study stretches of Cluster 6 having 03 National Waterways in the state of Kerala will be looked after by the existing Directorate of IWAI at kochi within its geographical zone, for a better control on the project implementation. No additional organizational requirement has been envisaged.

10.3 Training Requirement / Capacity Building

IWAI is having various disciplines within the organization viz., Civil Engineering; Mech. Marine Engineering; Hydrographic Survey; Traffic; Administration / Establishment; Finance etc.

It is suggested and recommended to have an intra-discipline and inter discipline training for all the employees of the IWAI at entry level i.e., at Technical Assistant / Assistant Director; Junior Hydrographic Surveyor / Assistant Hydrographic Surveyor; Junior Accounts Officer / Accounts Officer; Section Officer / Assistant Secretary etc.,. The National Inland Navigation Institute (NINI) of IWAI at Patna premises can be used for such training. It is preferred to have such Trainings as onsite training, while the works are under progress.

10.4 Infrastructure

The Infrastructure for the Institution will not have much implication, except the Land for the Office premises, if at all to have the own building of IWAI. However, the infrastructure for functional aspects may be essential within the accessibility of the site controlling office viz., the office of the Director.

The functional requirement can be identified as Survey Vessels; Survey Instruments in order to carry out the mandatory periodical Survey works on the National Waterways. Likewise, to maintain the Night Navigation system, there should be a powerful Tug – cum – Buoy maintenance vessel should be available within the bounds of the office. Further, to have quick inspections and also to have periodical visits, Speed Boats are to be available as an Infrastructure within the controlling office.

Accordingly, 2 Nos. of Survey Vessels; 02 units of Survey Instruments with Software; 02 Nos. of Tug – cum – Buoy maintenance vessel; 02 Nos. of Speed Boats are suggested / Recommended for each Directorate office to look after approximately 6 Nos. of the National Waterways within its jurisdiction.

10.4.1 Immovable

The immovable asset, Land is not suggested at this point of time. In the Long run, even if identified the need of having own office, this will be considered at one of the Terminal Locations, amenable with ease approach. Hence there is no suggestion / recommendation of Land / immovable asset under Institution.

10.4.2 Movable

As discussed above, the asset requirement for attending the functions and responsibilities catered will be considered for procurement. The details have been tabulated directly as a financial Implication with segregation of Capital Cost Implication and Monthly Cost Implication, including the Manpower monthly implication in the forth coming Paras. Keeping in view the Organization requirement, as derived, the implication has been worked out duly taking into consideration of the 7th Pay commission Pay system, so as to have an implementable approach.

10.5 Cost Implications

The cost implication for the apportioned project has been worked out and placed herewith.

TABLE 10-1: MANPOWER FINANCIAL IMPLICATION PER MONTH

Sl. No.	Name of the Post	Nos. of the Post	Basic Pay (INR)	Implication per month @ 95 % extra (INR)	Remarks
1.	Director	1	78800	153,660	Annexure 10.2 may be referred.
2.	Asst. Director Civil / Mechanical	3	56100	328,185	
3.	Asst. Hy. Surveyor	1	56100	109,395	25 % extra for statutory allowances and 20 % extra for perks have been taken into consideration.
4.	Junior Hy. Surveyor	1	47600	92,820	
5.	Junior Accounts Officer	1	47600	92,820	
6.	Supervisor	3	35400	207,090	
7.	Steno / P. A	1	35400	69,030	
8.	Upper Divisional Clerk	1	25500	49,725	
9.	Data Entry Operator	6	21700	253,890	
10.	Driver	1	21700	42, 315	
11.	Attendant	6	21700	253,890	
	Total	25		1,652,820	
	Chief Engineer's Office Component				

Sl. No.	Name of the Post	Nos. of the Post	Basic Pay (INR)	Implication per month @ 95 % extra (INR)	Remarks
1.	Deputy Director	1	67600	131,820	
2.	Technical Assistant	1	47600	92,820	
3.	Data Entry Operator	1	21700	42,315	
	Total	3		266,955	
	Grand Total	28		1,919,775	

TABLE 10-2: FINANCIAL IMPLICATION – CAPITAL AND MAINTENANCE

Sl No	Name of the Item	Capital Cost (INR)	Financial Implication per month (INR)	Remarks
1.	Office premises	*	75,000	* In the initial stages, office will function on rented premises only
2.	Furniture etc.,	1,000,000	--	L. S.
3.	Pay and Allowances for 28 Nos.	--	1,919,775	As per the Table 10.1
4.	Vehicle 1 No.	500,000	--	
5.	Running & Maintenance of the Vehicle	--	50,000	
6.	Computer Systems including UPS etc., 6 Nos. @ 1 lakh each	600,000	60,000	
7.	Printers 4 Nos. @ 0.5 lakhs each	200,000	*	* Taken into General Office maintenance
8.	Laptops 6 Nos. @ 1 lakh each	600,000	*	* Taken into General Office maintenance
9.	Drawing Printer 1 No. @ 5 lakhs each	500,000	*	* Taken into General Office maintenance
10.	High Speed Printer 1 No. @ 3 lakhs each	300,000	*	* Taken into General Office maintenance
11.	Alternate Uninterrupted Power Supply with D. G set 1 No @ 10 Lakhs per no.	1,000,000	50,000	
12.	2 Nos. Survey Vessels (2 engines of 175 Bhp each) @ 350 lakhs each	70,000,000	1,000,000	Inclusive of Staff charges, on board.
13.	2 Units of Survey Instruments (9.5 lakhs each) + Software (6.5 lakhs each) + Laptop (1 lakh each) etc.,	3,400,000	200,000	Maintenance is inclusive of Survey Stationery and Consumables.
14.	2 Nos. Tug – cum – Buoy Maintenance vessel (2 engines of 375 Bhp) @ 750 lakhs each	150,000,000	1,200,000	Inclusive of Staff charges, on board.
15.	2 Nos. Speed Boats (2 engines of 75 Bhp) @ 75 Lakhs each	15,000,000	150,000	Inclusive of Staff charges, on board.

Sl No	Name of the Item	Capital Cost (INR)	Financial Implication per month (INR)	Remarks
16.	Other General Office maintenance including stationery, consumables etc.,	--	500,000	
	Total	**243,100,000**	**5,204,775**	

+ The Cost implications for segregated functions like Fairway Development Cost; Terminal Development Cost; Vessel maintenance Cost; Navigation and Communication system implementation cost etc., have been taken into consideration at the appropriate heads, whereas the item Nos. 12 to 15 above are being provisioned for undertaking the requisite functions under the Institution requirements.

+ Here, in Cluster 6, the West Coast Canal has been taken as equal to 2 Modules of 6 Waterways, wherein, Kabini Dam area will be segregated as separate one by not bringing into the overall system due to its far proximity of other 6 Waterways of Cluster 6.

+ Since the NW 9 A is of 22.4 Kms, and within the existing NW 3 jurisdiction, it is not suggested / recommended with any expenditure on Infrastructure and suggested a nominal one-time provision of INR 40 Lakhs for NW 9. No maintenance is required.

+ However, the limited Manpower requirement of 1 AD + 1 Supr + 1 JAO + 1 DEO + 1 Attendant can be taken as skeleton staff and the same is suggested for the initial stages duly meeting the cost from the suggested provisions. It can be reviewed from time to time based on the volume of the work requirement.

CHAPTER 11 : PROJECT COSTING

11.1 General and Financial assumptions

Project Costing is an important aspect, which is to be worked out rationally to assess the apt requirement of the project with a reasonable costing structure so as to ascertain the end result of returns and also will play a vital role in decision making on the implementation of various project components.

It is also essential to define certain financial requirements, in terms of assumptions for the project, which are to be rational i.e., not to be irrational.

In this context, certain parameters, as defined, by IWAI have been analyzed and considered in the cost working and Return working. The circulated data has been placed at **Annexure 11.1**. However, the same may not suffice the requirements in working out the cost / returns and hence some more assumptions have been considered appropriately, wherever required.

11.2 Basis of Costing

In general, the costing used to be worked out based on the quantity requirements along with rate per unit quantity. The quantities for the subject project have been arrived at based on the actual item wise requirements. The estimated costs have been worked out based on CPWD Schedule of Rates (SoR) published in Dec-2018 and updated with WPI till March-2020 as new SOR has not been published. Rates for the non-schedule items have been proposed based on the Market Rates or based on the realistic budgetary quotations, to the extent possible. A five percent escalation in the cost has been applicable per annum.

11.3 Development Cost

The NW 9 canal stretch is having IWT mobility by KSWTD's passenger vessels, as on date, on regular basis. M/s TCL used the different routes of NW 9 till recently for transporting the Dredged material to its premises and also for transshipment of Cement. KPACT had trial barging and considered the barging operations to establish the mobility through NW 9.

11.4 Capital Expenditure

As explained above, the Fairway related development cost has been worked out and placed herewith herewith in two conditions. There were some observations received from Minstry of Coastal Shipping & Inland Navigation (A) Dept., Govt. of Kerala vide their letter no. A2/224/2018/CSIND dated 07.03.2020. The letter described the requirement of modification of existing structures as well as requirement of new structures. Modification of structures have already been considered in the DPR however in light of suggestion received from Govt. of Kerala and its financial impact has been incorporated in the DPR. There are two situations and may be referred as Option-1 and Option-2. These are referred as below:

1. **Option-1** -The project cost doesnot include the financial impact as suggested vide Coastal Shipping & Inland Navigation (A) Dept., Govt. of Kerala vide their letter no. A2/224/2018/CSIND dated 07.03.2020.
2. **Option-2** -The project cost includes the financial impact as suggested vide Coastal Shipping & Inland Navigation (A) Dept., Govt. of Kerala vide their letter no. A2/224/2018/CSIND dated 07.03.2020.

11.4.1 Option-1

The cost computation and the abstract of cost under option-1 in as below:

TABLE 11-1: ABSTRACT OF COST FOR NW 9 FAIRWAY DEVELOPMENT FOR CAPTIVE TERMINAL OPERATIONS-OPTION-1

		9 (A)	9 (B)	9 (C)	
Sl.No.	**Item Description**	**Amount (in Lakh Rs)**	**Amount (in Lakh Rs)**	**Amount (in Lakh Rs)**	**Schedule/ Reference**
A	**Fairway**				
1	Dredging				
(i)	General Soil	886.66	2913.30	3018.40	Annexure 11.3
(ii)	Hard Soil	0.00	0.00	0.00	
2	Low Cost River Structures				
(i)	Bandaling				
(ii)	Bottom Paneling				
3	River Training Works				
(i)	Spurs				
(ii)	Bank Protection Works for river	86.10	4305.00	861.00	Annexure 11.4
(iii)	Porcupine				
4	Night Navigation				
(i)	Channel Marking Buoy, Mooring Gear & Lighting Equipments	176.53	144.76	141.23	Annexure 11.5

		9 (A)	9 (B)	9 (C)	
Sl.No.	**Item Description**	**Amount (in Lakh Rs)**	**Amount (in Lakh Rs)**	**Amount (in Lakh Rs)**	**Schedule/ Reference**
(ii)	Shore Marking with Lattice Bridge & Lighting Equipments				
5	Land Acquisition	143.75	4024.94	814.57	Annexure 11.6
	Sub-total (A)	**1293.03**	**11387.99**	**4835.20**	
B	**Modification of Structures**				
(i)	Bridges	0.00	330.00	0.00	Annexure 11.10
(ii)	Cables	12.50	26.00	7.00	
(iii)	Dams	0.00			
(iv)	Barrages	0.00			
(v)	Locks	0.00			
(vi)	Others	0.00			
	Sub-total (B)	**12.50**	**356.00**	**7.00**	
C	**Communication System**				
(i)	RIS Centre	0.00			
(ii)	AIS Base Station	0.00			
(iii)	Vessels - Survey vessel & Other Vessel	0.00			
(iv)	Buoys	0.00			
	Sub-total (C)	**0.00**			
D	**Institutional Requirement**				
(i)	Office Development Cost	40.00	40.00	40.00	
	Sub-total (D)	**40.00**	**40.00**	**40.00**	
	Sub-total (A)+(B)+(C)+(D)	**1345.53**	**11783.99**	**4882.20**	
E	Environmental Management Plan as per Chapter-9 of the DPR	101.94	101.94	101.94	
F	Project Management & consultancy Charges @3% of Prime cost	40.37	353.52	146.47	
G	Contingencies and Unforeseen Items of Works@3% of Prime cost	40.37	353.52	146.47	
	Project total Hard Cost	**1528.20**	**12592.97**	**5277.07**	
		15.28	125.92	52.77	Crores

TABLE 11-2: ABSTRACT OF COST FOR NW 9 Lo-Lo FACILITY

Sl.No.	Item Description	Amount (in Lakh Rs.)
A	**Terminals**	
	Terminal	
(i)	Land	0.00
(ii)	Riverine Components	0.00
(iii)	Infrastructure Components including internal roads	0.00
(iv)	Approach Road (External) Cost	0.00
(v)	Bank Protection Works for terminal	0.00
(v)	**2 Nos Lo-Lo berthing Jetty of 50 m by 15 m have been considered**	494.96
	Sub-total (A)	**494.96**
B	**Vessels**	
(i)	Vessel Size	
(ii)	Vessel Capacity	
	Sub-total (B)	
C	**Equipments for Both Terminals**	
(i)	Ambulance - 1 no.	18.00
(ii)	Dumper Trucks 16 T Capacity - Nil.	0.00
(iii)	Cranes with 125 T Handling Capacity per Hour - 01 No..	1398.40
(iv)	Fork lift -05 T Capacity - 02 nos.	95.50
	Sub-total (C)	**1511.94**
	Sub-total (A)+(B)+(C)	**2006.89**
D	Environmental Management Plan as per Chapter-9 of the DPR	73.63
E	Project Management & consultancy Charges @ 3% of Prime cost	60.21
F	Contingencies and Unforeseen Items of Works@3% of Prime cost	60.21
	Project total Hard Cost	**2200.94**
		22.00 Crores

The additional Infra requirement in KPACT Land and TCL Land for meeting the handling requirement have been projected and placed herewith.

TABLE 11-3: TOTAL COST (OPTION-1)

Sl No.	Parameter	9 A INR (In Cr.)	9 A INR (In Cr.)	9 A INR (In Cr.)
1	Fairway	15.28	125.93	52.77
2	Ro-Ro Terminal	22.00	22.00	22.00
3	Financial Impact of Govt. of Kerala Letter dated 07.03.2030 (Not considered in Option-1)	0.00	0.00	0.00
	Total	**37.28**	**147.93**	**74.77**

11.4.2 Option-2

The cost computation and the abstract of cost under option-2 in as below. As explained, option -2 has ben considered taking the financial inpact of the suggestion of Govt. of Kerala vide theit letter Coastal Shipping & Inland Navigation (A) Dept., Govt. of Kerala vide their letter no. A2/224/2018/CSIND dated 07.03.2020. So, this will entail the development cost as computed in the option-1 & considering the financial impact of the suggested measures by the govt. of Kerala.

TABLE 11-4: FINANCIAL IMPACT AS SUGGESTED BY GOVT. OF KERALA (OPTION-2)

Sl No.	Name of Structure	Type & Owner of Structure	Waterway (NW-9) Nos. of Structure			Cost Per Structure	Approximate Amount of Reconstruction (In Crores)		
			9-A	9-B	9-C		9-A	9-B	9-C
1)	Bridge	Cross Structure Under PWD	1	8	1	0	0	0	0
2)	Foot Bridges	Cross Structure Under PWD		2	0	1.2	0	2.4	0
2)	Foot Bridge	Cross Structure Under LSGD		9	0	1.2	0	10.8	0
3)	HT Lines	Kerala State Electricity Board	0	0	0	0.3	0	0	0
3)	LT Lines	Kerala State Electricity Board	25	52	14	0.01	0.25	0.52	0.14
4)	Regulator Cum Bridge & Navigation Lock	Irrigation Dept. & Navigation Dept.	0	0	0	0	0	0	0

Sl No.	Name of Structure	Type & Owner of Structure	Waterway (NW-9) Nos. of Structure			Cost Per Structure	Approximate Amount of Reconstruction (In Crores)		
			9-A	9-B	9-C		9-A	9-B	9-C
5)	Water Pipe - line	Kerala water Authority	0	0	0	0	0	0	0
	Total						**0.25**	**13.72**	**0.14**

Therefore, the total cost as per the Option-2 shall be as detailed in the below table.

TABLE 11-5: TOTAL COST (OPTION-2)

Sl No.	Parameter	9 A INR (In Cr.)	9 B INR (In Cr.)	9 C INR (In Cr.)	Remarks
1	Fairway	15.28	125.93	52.77	Similar to as Per Option-1
2	Ro-Ro Terminal	22.00	22.00	22.00	Similar to as Per Option-1
3	Financial Impact of Govt. of Kerala Letter dated 07.03.2020	0..25	13.72	0.14	As detailed in table above
	Total	**37.53**	**161.65**	**74.91**	

11.5 Operational and Maintenance Expenditure

The operation & Maintenance expenditure has been considered as at Annexure 11.1 and as per the industrial standards.

11.6 Phasing of Expenditure

Development of fairway and construction of 2 Jetties along with procurement of handling equipments is being suggested in 3 years from FY 2021.

CHAPTER 12 : IMPLEMENTATION SCHEDULE

12.1 Time Frame

The present utility of Alappuzha – Kottayam – Maniyapparambu Canal NW – 9 is already being used for Passenger ferry mobility of KSWTD's Passenger vessels, as on date, on regular basis. M/s TCL used the different routes of NW 9 till recently for transporting the Dredged material to its premises and also for transshipment of Cement. KPACT had trial barging and considered the barging operations to establish the mobility through NW 9.

The development of NW 9, Fairway and jetty construction are to be commenced from FY 2021 with a scheduled time frame of 3 years.

However, the achieving the estimated cargo volumes is dependent on the future planning of TCL, especially on the commencement of the Grey Cement production.

The estimated IWT Traffic mobility to the extent of 5000 TEUs and 17.60 Lakhs T is a considerable volume especially in the state of Kerala, where lot of problems are being faced in the Land availability for Acquisition for Road development. Besides Kerala is facing lot of problems with the Road accidents and this suggested IWT mobility will become a boon once established, though economically is not viable without support system, as worked out.

12.2 Phasing

The development of Fairway and Jetties with handling equipments are suggested for development from FY 2021 with the time frame of 3 years.

The Vessel requirement will be taken care by Entrepreneurs i.e., 1 vessel may be required at the initial stages and other vessel requirement can be considered for deployment on need basis.

12.3 Suggested Implementation Mechanism

The implementation will be considered through the Project Management Consultancy, as provisioned. However, it is suggested that the overall supervision will be under the control of the IWAI supervision mechanism.

CHAPTER 13 ECONOMIC AND FINANCIAL ANALYSIS

Development of Alappuzha-Kottayam-Maniyarambu Canal (NW 9) has been discussed in one development module. This is depicted in the following Tables 13-1:

Table 13-1 Development of NW 9

	Sub-sector	FY21	FY22	FY23	FY30	FY41
Development	Fairway	Development				
			Operational			
	Lo-Lo	Construction				
			Operational			

Source: Tractebel; Consultant

NW 9 development has been planned with prospects for cargo handling along the whole stretch. The infrastructure has been planned considering optimistic conditions. The fairway and 2 Lo-Lo terminals are envisaged to divert trucks plying on nearby national and state highways that are destined or originating from Cochin Port. The infrastructures for these Lo-Lo terminals have been proposed at TCL and KPACT for containers and break-bulk handling respectively.

The proposed NW 9 comprise three stretches i.e 9a, 9b and 9c of 22.4km, 14.7km and 11.5km length respectively. Entire NW9 serves as an access from Alappuzha and Kottayam district to existing NW 3, further this NW 3 enhances the connectivity of NW 9 to districts of Cochin & Kollam through IWT.

Trucks moving between TCL – Cochin Port and KPACT – ICTT, Cochin using road could be diverted to waterways.

Amongst all 3 stretches of NW 9, it is advisable to consider NW 9a, which connects to NW 3 at Vembanad Lake, for development and traffic diversion. As compared to NW 9b and NW 9c, NW 9a is the shortest way to reach Cochin and also involves very less investment to get operational. Traffic moving from KPACT & TCL to Cochin would be utilizing NW 9a and later on connect to NW3 at Vembanad lake to reach till final destination. As NW3 is already operational and well developed for waterway movement, construction and development required to start the IWT operation will be done only for NW 9a. Construction period for NW 9a has been assumed to be for 3 years i.e FY21, FY22 and FY23. The waterway could be operationalized in FY-23 and continue till FY40.

The end-to-end logistics cost using multimodal route of NW 9a has to be cheaper compared to existing mode for shift to waterways. IWAI prescribed terminal and fairway tariffs (notified in 2011) has been assumed for the Logistics Cost calculations in below figure. Terminal handling charges at origin and destination of proposed route (NW 9a + NW3) have been considered as per the rates provided by IWAI. IWAI tariff is very old and low compared to other ports in the vicinity. The fairway and Lo-Lo terminal is unlikely to gain any financial or economic returns on investment. Hence, consultants have made financials assuming Cochin Port Trust (CPT) tariff for comparison. The table below shows the scale rates of IWAI and CPT.

Table 13-2 Terminal handling Rates of IWAI and CPT

Sr. No	Contents	As per IWAI (for TCL/KPACT & CPT)	Actual rates @CPT
1	Cargo Related Charges - Berthing	INR 1,000 per Vessel	INR 0.253 GRT/Hr
2	Container Related Charges	INR 50 TEU	INR 410.6 TEU
3	Dry bulk Vessel Container	INR 1 Ton	INR 52.5 Tons
4	Fairway Usage Charges	INR 0.02 GRT-Km	INR 1 GRT-Km (Assumed)

Source: IWAI and Scale rate of Cochin Port Trust

Proposed IWT route involves multiple handling, this adds to the total logistic cost involved in transportation. This leads to rise in total time and cost involved in multimodal transportation on NW 9a compared to roadway. An elaboration on the impact on overall logistics cost difference is depicted in the logistics cost comparison chart of road and NW 9a is in the following Figure 13-1.

Lo-Lo/Trade Cost Dynamics

Origin	Destination
KPACT (Container)	Cochin Port

Lo-Lo Cost Dynamics (84.5 km.)

Components	Unit	Case I	Case II
Engine	kW	839	350
Engine fuel requirement	l/hr	222	102
Per TEU Tariff	INR/TEU	9,760	9,456
Port-related charges	INR/TEU	233	233
Total Cost	**INR/TEU**	**9,993**	**9,689**

Truck Cost Dynamics (65.6 km.)

Components	Unit	Cost
Fuel	INR	1,125
Toll Charges	INR	1,245
Total Cost	**INR/Truck**	**2,370**

Origin	Destination
TCL (Cement)	Cochin Port

Lo-Lo Cost Dynamics (84.5 km.)

Components	Unit	Case I	Case II
Engine	kW	839	350
Engine fuel requirement	l/hr	222	102
Per Ton Tariff	INR/Ton	488	473
Port-related charges	INR/Ton	8	8
Total Cost	**INR/Ton**	**497**	**481**

Truck Cost Dynamics (65.6 km.)

Components	Unit	Cost
Fuel	INR	1,125
Toll Charges	INR	1,245
Total Cost	**INR/Truck**	**2,370**
	INR/Ton	**113**

Figure 13-1 Logistic cost comparison

*Note: Assumptions for Logistic Cost Analysis.

For the above Logistics Cost calculations, terminal handling charges at both the side of proposed route (NW9a + NW3) i.e. TCL/KPACT (Origin) and Cochin Port Trust (Destination) are considered as per the rates provided by IWAI, However the current actual scale rate floated by Cochin Port Trust (CPT) for terminal handling is far more higher than IWAI rates. It is assumed that IWAI will negotiate with CPT to handle inland barges as per the IWAI rates i.e. lower than CPT's current rate.

It is evident that costs involved in multimodal transportation using Lo-Lo are higher when compared to roadways. This cost difference favours the roadway. Analysis for 2 cases has been carried out for end to end logistics cost comparison. Both the cases involve different types of vessels. Case I has higher power engine. Hence, it takes shorter time to travel. However, logistics cost of case I is higher on account of higher fuel requirement.

Case I logistics cost is INR 7,623/TEU and INR 384/Ton higher for waterway compared to road. The Cost of transporting every ton or TEU on the waterway would be nearly two times as expensive as roadway. In Case II, the cost using waterway is higher by around INR 7,319/TEU and INR 386/Ton compared to road. In case of just Lo-Lo cost comparison, Case II is marginally cheaper than Case I. This cost comparison highlights the subsidy amount required per Ton or TEU i.e cost difference for waterways and roadways, to influence the industries divert cargo to IWT. In addition to subsidy, other measures would be needed to package and promote IWT as a better option over other modes, despite the increased transportation time and distance in the former's case.

13.1 INPUT SHEET

The following table lists all the assumptions and input values used in the financial modeling of NW 9a. This includes financial analysis for the navigation infrastructure (fairways), and 2 terminal operations (Lo-Lo):

Table 13.13 Input Sheet for NW 9a project

Description	Unit	Fairway	Lo-Lo
Loan Tenure	Years	10	10
Moratorium Period (Years Construction)	Years	3	3
Rate of Interest	Annual	11%	11%
Corporate Tax	Annual	30%	30%
Annual Lease Rental Increase	Annual	Land belongs to TCL, and it has been assured by TCL that land would be provided by them to IWAI for terminal development.	
Cargo Revenue Escalation	Annual	6%	6%
Other Revenue Escalation	Annual		6%
Administrative Cost	of Revenue	3%	2%
Manpower Cost Escalation	Annual	5%	5%
Cargo Costs Escalation	Annual	5%	
Other Costs Escalation	Annual		6%

Description	Unit	Fairway	Lo-Lo
Fairway Chainage (NW 9a)	km	22.4	
Chainage (Lo-Lo to Cochin)	km		22.4 + 62.1
Tariff for Revenue Calculation			
Various Revenue Sources	**Unit**	**Fairway**	**Lo-Lo**
Revenue prospects from Ancillary Activity			
Truck Parking Charges	Per Day		50
Weigh Bridge Charges	Per Day		75
Leasing Space Coffee Shops	Per Day		500
Lease space for Rest/Retiring	Rs/Day/Truck		30
Operation & Maintenance			
Description	**Unit**	**Fairway**	**Lo-Lo**
Civil Infrastructure	Cost		1%
Dredging		10%	
Utilities		5%	5%
Machinery Infrastructure			5%
Insurance Cost	Of Capex Mechanical	2%	2%
Traffic Handling Cost			
Description	**Unit**	**Fairway**	**Lo-Lo**
Break-bulk Handling Cost			
Crane Operating Cost at Jetty	INR/Tonne		25
Trailer Hire Rate	INR/Tonne		15
Crane Hire to Load for Evacuation	INR/Tonne		15
Container Crane Cost			
Container Crane	Per/Hr		1,100
Assumptions for EIRR			
Parameters	**Unit**	**Value**	**Reference**
Economic loss due to Road Accidents	of GDP	3%	Tractebel
GDP of India@ Current Prices	Rs Lakhs Crores	125.41	

Description	Unit	Fairway	Lo-Lo
Value of economic loss due to road accidents	Rs Lakhs Crores	3.762	
Total Road network in India	Lakh KM	0.49	
Safety Index (IWT as base)	Times safer than road	50	
	Times safer than rail	5	
Accidental Loss			
Road	Rs Lakhs/KM	7.73	Tractebel
IWT	Rs Lakhs/KM	0.15	
Fuel Cost (1 liter of fuel moves)			
Road	t-km	24.00	Tractebel
IWT	t-km	105.00	
Total Distance	KM	Fairway – 2 X (22.4+62.1); Lo-Lo – 2 X 22.4	
Fuel price	Rs/Litre	60.00	
Vehicular Operating Cost (VOC)			
Road	Rs/t-km	2.58	Tractebel
IWT	Rs/t-km	1.06	
Direct Employment Creation			
Road	Per Million t-km	20	Tractebel
IWT	Per Million t-km	0.5	
Employment cost	Rs Lakhs per Annum	2.5	
Emission Reduction			
Road	g CO_2/t-km	60	Tractebel
IWT	g CO_2/t-km	6	
Shadow Factor			
CAPEX/O&M Cost- To convert financial cost to economic cost		0.85	Tractebel
O&M Cost escalation	p.a.	6%	

Description	Unit	Fairway	Lo-Lo
Carbon Credits Factors			
Carbon Shadow price	$/Tonne	20	Tractebel
Exchange rate	Rs/USD	67	

Source: Consultant, Market standards

All the necessary assumptions for financial modeling are either market driven or provided by IWAI. Fairway and terminal tariff have been taken from IWAI. The vessel parcel size is estimated at 90% of the rated DWT. In Lo-Lo terminal sub-section, chainage of 22.4 km is considered which is a total length of NW9a. While in fairway sub-section; 84.5km is considered as chainage i.e entire stretch from terminal location to Cochin port using NW9a. In case of fairway and Lo-Lo revenue calculations, only one-way trip across the chainage is considered. In EIRR, round-trip distance is considered in each of the sub-sector's economic viability evaluation.

Sensitivity analysis for the development of NW 9 is prepared in 4 scenarios. These scenarios are as follows

- Scenario I :- Project Cost Option 1 and IWAI Tariff
- Scenario II :- Project Cost Option 1 and CPT Tariff
- Scenario III :- Project Cost Option 2 and IWAI Tariff
- Scenario IV :- Project Cost Option 2 and CPT Tariff

Two different project costs are considered i.e. Option 1 and Option 2 (Option 1 + Additional Structural modification suggested by Kerala Government i.e. 25 Lakhs for NW-9a). While for Revenue generation, two different Tariff structures are taken i.e. IWAI (circulated as on 2011) and CPT, these tariff rates are already mentioned above. As listed above, four different scenarios are derived from the combination of aforementioned project cost and tariff rates. For Scenario I entire financial analysis is represented in this report, while for Scenario II, III and IV only final outcome i.e. FIRR and EIRR in conclusion section.

13.2 REVENUE

Revenue for the cumulative stretch of Alappuzha-Kottayam will be generated from the core operations, which include utilization of the fairways by the potential users located nearby, and operation at the Lo-Lo terminal. Secondary revenues sources, labeled "Ancillary Revenue", will be generated from sources like truck parking, weighbridge, land leasing for commercial operations (tea-stall, coffee shops, inn, etc.), and leased resting area for truck operators. The revenue break-up and total revenue for IWAI on Alappuzha-Kottayam canal are presented in the table below:

Table 13.2-1 Revenue for NW 9a (INR Lakhs)

Particulars	FY21	FY23	FY25	FY30	FY35	FY40
Fairway						
Fairway Usage	-	0.6	4.7	6.2	15.6	20.9
Total	**-**	**0.6**	**4.7**	**6.2**	**15.6**	**20.9**
Lo-Lo Terminal						
Bulk Cargo Handling	-	3.2	53.5	71.5	187.2	250.5

Particulars	FY21	FY23	FY25	FY30	FY35	FY40
Container Handling	-	2.5	3.2	4.2	5.7	7.6
Ancillary Revenue	3.7	8.1	63.7	71.6	177.6	234.1
Total	**3.7**	**13.8**	**120.3**	**147.4**	**370.4**	**492.1**
Total	**3.7**	**14.4**	**125**	**153.6**	**386**	**513**

Source: Consultant

13.3 COSTS

This section presents the total project cost, and equity-debt distribution in phased manner. The following table shows these cost-heads for both the core business operations:

Table 13.3 Project Cost for NW 9

Description	Total Investment Cost (INR Lakhs)			
	Total	1st Year	2nd Year	3rd Year
Lo-Lo Terminal on NW 9				
Terminal	495.0	198.0	148.5	148.5
Cargo Handling Equipment	1,511.9	604.8	453.6	453.6
Environmental Management Plan Cost as per chapter-9 of the DPR	73.6	29.5	22.1	22.1
Project Management & consultancy Charges @ 3% of Prime cost	60.2	24.1	18.1	18.1
Contingencies and Unforeseen Items of Works @ 3% of Prime cost	60.2	24.1	18.1	18.1
Total Project Cost	**2,200.9**	**880.4**	**660.3**	**660.3**
Fairway - NW 9a				
Fairway	1,293.0	517.2	387.9	387.9
Structure Modification	12.5	5.0	3.8	3.8
Institutional Requirement	40.0	16.0	12.0	12.0
Environmental Management Plan Cost as per chapter-9 of the DPR	101.9	40.8	30.6	30.6
Project Management & consultancy Charges @ 3% of Prime cost	40.4	16.1	12.1	12.1
Contingencies and Unforeseen Items of Works@ 3% of Prime cost	40.4	16.1	12.1	12.1
Total Project Cost	**1,528.2**	**611.3**	**458.5**	**458.5**
Fairway - NW 9b				
Fairway	11,388.0	4,555.2	3,416.4	3,416.4

Description	Total Investment Cost (INR Lakhs)			
	Total	1st Year	2nd Year	3rd Year
Structure Modification	356.0	142.4	106.8	106.8
Institutional Requirement	40.0	16.0	12.0	12.0
Environmental Management Plan Cost as per chapter-9 of the DPR	101.9	40.8	30.6	30.6
Project Management & consultancy Charges @ 3% of Prime cost	353.5	141.4	106.1	106.1
Contingencies and Unforeseen Items of Works@ 3% of Prime cost	353.5	141.4	106.1	106.1
Total Project Cost	**12,593.0**	**5,037.2**	**3,777.9**	**3,777.9**
Fairway - NW 9c				
Fairway	4,835.2	1,934.1	1,450.6	1,450.6
Structure Modification	7.0	2.8	2.1	2.1
Institutional Requirement	40.0	16.0	12.0	12.0
Environmental Management Plan Cost as per chapter-9 of the DPR	101.9	40.8	30.6	30.6
Project Management & consultancy Charges @ 3% of Prime cost	146.5	58.6	43.9	43.9
Contingencies and Unforeseen Items of Works@ 3% of Prime cost	146.5	58.6	43.9	43.9
Total Project Cost	**5,277.1**	**2,110.8**	**1,583.1**	**1,583.1**

Source: Consultant

Cost for dredging activity and bank protection works will be incurred only during the period. For Lo-Lo operations, initially 1 vessel will be required to cater the estimated Lo-Lo traffic on the canal till 2030 and thereafter requirement of 1 additional vessel due to rise in traffic. It is assumed that both the types of traffic i.e. Container and Cement would be transported in a single vessel together. The onus of these vessel acquisitions is with the private operator and not IWAI. Hence, these costs will not be factored in to develop model for the Lo-Lo Terminal. Capital and O&M costs associated with these vessel acquisitions and operations are indicated in the table below:

Table 13.36 Cost associated with vessel acquisition and operation

Parameters	Unit	1 Lo-Lo
Vessel Cost	Lakhs	700
Running Cost	Lakh/annum	189
Crew	No.	8

Parameters	Unit	1 Lo-Lo
Crew Wages	Lakh/annum	6
Crew Cost	Lakh/annum	48
Repair Cost (@2% Capex)	Lakh/annum	14

Source: Tractebel

13.4 FINANCIAL ANALYSIS / FIRR

The financial indicators dictating FIRR for individual ventures, viz. fairways development and terminal operations have been presented in following table. These indicators help measure the financial return on investment, which will enable IWAI in taking an informed decision in regard to implementing the project. However, before presenting FIRR for the project, some major components such as Salary, Depreciation, Project Cash flow, and P&L statement are provided in the following four tables, respectively:

Table 13.47 Employment schedule and salary expenditure – NW 9a (INR Lakh)

Parameter	No.	CTC p.a. / person (INR Lakh)	FY21	FY22	FY25	FY30	FY35	FY41
Fairway								
Manpower Expenditure								
Fibre Boat for Inspection	2	2	-	4.4	5.1	6.5	8.3	10.6
Hydrographer	1	8	-	26.5	30.6	39.1	49.9	63.7
Executives	2	3	-	19.8	23.0	29.3	37.4	47.8
Engineer	1	4	-	13.2	15.3	19.5	24.9	31.8
Total Salary (INR Lakh)	**6**	**17**	**-**	**63.9**	**74.0**	**94.5**	**120.6**	**153.9**
Lo-Lo Terminal								
Manpower Expenditure								
Manager Cargo Handling	1	6.0	-	39.7	45.9	58.6	74.8	95.5
Security Guards (Jetty x 2)	2	1.8	-	11.9	13.8	17.6	22.5	28.7
Executives for billing and commercial	1	3.0	-	9.9	11.5	14.7	18.7	23.9

Parameter	No.	CTC p.a. / person (INR Lakh)	FY21	FY22	FY25	FY30	FY35	FY41
Total Salary (INR Lakh)	**4**	**10.8**	**-**	**61.5**	**71.2**	**90.9**	**116.0**	**148.1**

Source: Consultant

Manpower cost has been considered in Total Project Cost under "Institutional Requirement". However, this investment component toward manpower will accommodate expenses only for the initial years, covering construction period. Manpower expenses in case of the Lo-Lo terminal isn't necessarily directed towards IWAI. It will be borne by whosoever operates the terminal. IWAI can either own and operate the infrastructure or lease it to a private third party on a suitable PPP model.

Table 13.48 Depreciation (Using SLM Method) (INR Lakh)

Depreciation & Amortization	FY21	FY22	FY25	FY30	FY35	FY41
Fairway						
Gross Block	611.3	1,528.2	1,528.2	1,528.2	1,528.2	1,528.2
Depreciation & Amortization	-	121.1	121.1	84.5	84.5	1.9
Cumulative Depreciation & Amortization	-	205.8	448.0	918.2	1,340.9	1,523.7
Net Block	611.3	1,322.4	1,080.2	610.0	187.3	4.5
Lo-Lo Terminal						
Gross Block	880.4	2,200.9	2,200.9	2,200.9	2,200.9	2,200.9
Depreciation & Amortization	-	113.9	113.9	113.9	113.9	75.1
Cumulative Depreciation & Amortization	-	193.7	421.5	991.2	1,560.8	2,032.0
Net Block	880.4	2,007.3	1,779.4	1,209.8	640.1	169.0

Source: Consultant

Depreciation has been calculated using the Straight-Line Method (SLM). Under this method, cost of asset is evenly distributed across its useful life. Gross Block in each case is sum of total hard cost and pre-operative expenses, which includes environmental management plan @ 5% of the Capex.

Table 13.49 O&M Cost (INR Lakh)

Parameter	FY21	FY22	FY25	FY30	FY35	FY41
Fairway						
Operating & Other Cost	7.8	92.4	99.9	122.2	150.7	187.0
Maintenance Cost	51.7	142.6	157.2	200.6	256.0	326.7
Total O&M	**59.6**	**234.9**	**257.1**	**322.8**	**406.7**	**513.7**

Parameter	FY21	FY22	FY25	FY30	FY35	FY41
Lo-Lo Terminal						
Direct Operating Cost	31.7	34.9	90.8	462.7	585.6	1302.9
Maintenance Cost	32.2	88.8	97.9	125.0	159.5	203.5
Other Cost	13.3	94.9	109.2	195.4	245.7	413.7
Total O&M	**77.20**	**218.70**	**297.9**	**783.00**	**990.80**	**1920.1**

Table 13.410 P&L Statement (INR Lakh)

Parameter	FY21	FY22	FY25	FY30	FY35	FY41
Fairway						
PBDIT	**-**	**0.6**	**4.7**	**6.2**	**15.6**	**20.9**
Depreciation	**59.6**	**234.9**	**257.1**	**322.8**	**406.7**	**513.7**
Interest	**- 59.6**	**- 234.3**	**- 252.4**	**- 316.5**	**- 391.1**	**- 492.8**
PBT	-	121.1	121.1	84.5	84.5	1.9
Tax	43.7	109.3	81.3	11.4	-	-
PAT	**- 103.3**	**- 464.7**	**- 454.8**	**- 412.4**	**- 475.7**	**- 494.7**
Lo-Lo Terminal						
Revenue	**3.7**	**13.8**	**120.3**	**147.4**	**370.4**	**492.1**
O&M	**77.2**	**218.7**	**297.9**	**783.0**	**990.8**	**1,920.1**
PBDIT	**- 73.6**	**- 204.8**	**- 177.5**	**- 635.7**	**- 620.4**	**- 1,428.0**
Depreciation	-	113.9	113.9	113.9	113.9	75.1
Interest	62.9	157.4	117.1	16.4	-	-
PBT	**- 136.5**	**- 476.1**	**- 408.5**	**- 766.0**	**- 734.3**	**- 1,503.0**
Tax	-	-	-	-	-	-
PAT	**- 136.5**	**- 476.1**	**- 408.5**	**- 766.0**	**- 734.3**	**- 1,503.0**

Source: Consultant

The Fairway and Lo-Lo both do not turn profit in the projected duration of operation up to FY40. Low tariffs, low traffic potential, and higher development costs are the major factors impacting these infrastructures' commercial prospects.

The following table is the ultimate assessment of the viability of the individual projects planned under the development of the NW 9a:

Table 13.411 FIRR for NW 9a (INR Lakh)

Parameter	FY21	FY22	FY25	FY30	FY35	FY41
Fairway						
Project Cashflow (Pre-tax)	- 670.8	- 692.8	- 252.4	- 316.5	- 391.1	- 492.8
Project IRR(Pre-tax)	**Non-existent**					
Project Cashflow(Post-tax)	- 670.8	- 692.8	- 252.4	- 316.5	- 391.1	- 492.8
Project IRR(Post-tax)	**Non-existent**					
Lo-Lo Terminal						
Project Cashflow(Pre-tax)	- 953.9	- 865.1	- 177.5	- 635.7	- 620.4	- 1,428.0
Project IRR(Pre-tax)	**Non-existent**					
Project Cashflow(Post-tax)	- 953.9	- 865.1	- 177.5	- 635.7	- 620.4	- 1,428.0
Project IRR(Post-tax)	**Non-existent**					

Source: Consultant

Non-existent returns for Lo-Lo Terminal and Fairway indicates lack of commercial viability of the project. In contrast to the above project component-wise FIRR, the following table provides FIRR for the project as a whole:

Table 13.412 FIRR for NW 9 (INR Lakh)

Parameter	FY21	FY22	FY25	FY30	FY35	FY41
With IWAI Tariff						
Project Cashflow (Pre-tax)	-1,624.7	-1,549.0	-420.2	-939.7	- 995.5	-1,684.0
Project IRR (Pre-tax)	**Non-existent**					
Project Cashflow (Post-tax)	-1,624.7	-1,549.0	-420.2	-939.7	- 995.5	-1,684.0

Parameter	FY21	FY22	FY25	FY30	FY35	FY41
Project IRR (Post-tax)	**Non-existent**					
			With CPT Tariff			
Project Cashflow (Pre-tax)	-1,624.8	-1,477.7	392.8	148.9	1,797.5	1,838.3
Project IRR(Pre-tax)	**6.50%**					
Project Cashflow (Post-tax)	-1,624.8	-1,477.7	392.8	148.9	1,797.5	1,838.3
Project IRR (Post-tax)	**4.50%**					

13.5 ECONOMIC ANALYSIS / EIRR

Economic Internal Rate of Return (EIRR) includes all the financial benefits of a project as well as the non-financial benefits of that project. Non-financial benefits would include reduction in CO2 emission, decreased health care interventions, reduced traffic, and other quantified benefits that a project can have on a region considered for a project. The EIRR looks at any investment decision from the perspective of improving the welfare of the society in general. The table below shows the estimated EIRR for each of these sub-sectors is presented in the table below:

Table 13.513 Project EIRR (INR Crores)

Parameters	FY21	FY22	FY25	FY30	FY35	FY41
			Fairway			
Economic Cash Outflow	-1.5	6.4	43.0	42.9	78.7	77.6
Net Cash Flow to Project	-7.7	1.8	43.0	42.9	78.7	77.6
Project EIRR	**75.5%**					
			Lo-Lo Terminal			
Economic Cash Outflow	-2.0	-3.0	6.8	-0.9	7.4	-8.2
Net Cash Flow to Project	-10.8	-9.6	6.8	-0.9	7.4	-8.2
Project EIRR	**Non-existent**					

Source: Consultant

Fairway shows some positive while Lo-Lo sector exhibit no impact on the local economy, and invariably, the economy of the state and the nation. Based on the EIRR for these sectors, Viability Gap Funding (VGF) can be sought to get these projects off the ground. Similar to calculating FIRR of the whole project, the following table shows the EIRR of the whole project:

Table 13.5 Project EIRR – Whole Project (INR Crores)

Parameters	FY21	FY22	FY25	FY30	FY35	FY41
With IWAI Tariff						
Economic Cash Outflow	2.5	- 4.6	14.5	6.3	22.7	9.8
Net Cash Flow to Project	-12.4	-15.8	14.5	6.3	22.7	9.8
Project EIRR	**12.4%**					
With CPT Tariff						
Economic Cash Outflow	2.5	- 4.0	22.3	16.7	44.9	36.0
Net Cash Flow to Project	-12.4	-15.2	22.3	16.7	44.9	36.0
Project EIRR	**26.6%**					

Source: Consultant

13.6 SENSITIVITY ANALYSIS

Variations in tariff rates and project cost have been applied to measure the overall impact these could have on the project's earnings and profitability. Sensitivity Analysis for each of the sub-sectors done in four different scenarios is shown in the table below.

Table 13.615 Sensitivity Analysis – Scenario II

Particulars	FY21	FY22	FY25	FY30	FY35	FY41
Financial IRR (in Lakhs)						
Fairway						
Revenue	-	29.6	233.4	312.3	780.9	1,045.0
PAT	- 103.3	- 436.5	- 233.0	- 115.5	186.7	349.1
Project IRR (Pre tax)	**-0.6%**					
Project IRR (Post tax)	**-1.5%**					
Lo-Lo Terminal						
Revenue	3.7	67.5	739.8	976.4	2,501.0	3,343.4
PAT	- 136.5	- 424.1	134.7	26.7	932.7	883.8

Project IRR (Pre tax)	**9.9%**					
Project IRR (Post tax)	**7.7%**					
Economic IRR (in Crore)						
Fairway						
Economic Cash Outflow	-1.5	6.7	45.2	45.8	85.1	85.8
Net Cash Flow to Project	-7.7	2.1	45.2	45.8	85.1	85.8
Project EIRR	**77.7%**					
Lo-Lo Terminal						
Economic Cash Outflow	-2.0	-2.4	12.0	6.8	23.5	15.0
Net Cash Flow to Project	-10.8	-9.1	12.0	6.8	23.5	15.0
Project EIRR	**17.8%**					

Source: Consultant

Table 13.6 Sensitivity Analysis – Scenario III

Particulars	FY21	FY22	FY25	FY30	FY35	FY41
Financial IRR (in Lakhs)						
Fairway						
Revenue	-	0.6	4.7	6.2	15.6	20.9
PAT	- 104.1	- 468.4	- 458.1	- 414.6	- 477.6	- 495.1
Project IRR (Pre tax)	**Non-existent**					
Project IRR (Post tax)	**Non-existent**					
Lo-Lo Terminal						
Revenue	3.7	13.8	120.3	147.4	370.4	492.1
PAT	- 136.5	- 476.1	- 408.5	- 766.0	- 734.3	- 1,503.0
Project IRR (Pre tax)	**Non-existent**					
Project IRR (Post tax)	**Non-existent**					
Economic IRR (in Crore)						

Particulars	FY21	FY22	FY25	FY30	FY35	FY41
Fairway						
Economic Cash Outflow	-1.5	6.4	43.0	42.9	78.7	77.6
Net Cash Flow to Project	-7.8	1.7	43.0	42.9	78.7	77.6
Project EIRR	**74.8%**					
Lo-Lo Terminal						
Economic Cash Outflow	-2.0	-3.0	6.8	-0.9	7.4	-8.2
Net Cash Flow to Project	-10.8	-9.6	6.8	-0.9	7.4	-8.2
Project EIRR	**Non-existent**					

Source: Consultant

Table 13.6 Sensitivity Analysis – Scenario IV

Particulars	FY21	FY22	FY25	FY30	FY35	FY41
Financial IRR (in Lakhs)						
Fairway						
Revenue	-	29.6	233.4	312.3	780.9	1,045.0
PAT	- 104.1	- 440.3	- 236.2	- 117.7	185.3	348.8
Project IRR (Pre tax)	**0.5%**					
Project IRR (Post tax)	**-1.6%**					
Lo-Lo Terminal						
Revenue	3.7	67.5	739.8	976.4	2,501.0	3,343.4
PAT	- 136.5	- 424.1	134.7	26.7	932.7	883.8
Project IRR (Pre tax)	**9.9%**					
Project IRR (Post tax)	**7.7%**					
Economic IRR (in Crore)						
Fairway						
Economic Cash Outflow	-1.5	6.6	45.2	45.8	85.1	85.8

Particulars	FY21	FY22	FY25	FY30	FY35	FY41
Net Cash Flow to Project	-7.8	2.0	45.2	45.8	85.1	85.8
Project EIRR	**77.0%**					
			Lo-Lo Terminal			
Economic Cash Outflow	-2.0	-2.4	12.0	6.8	23.5	15.0
Net Cash Flow to Project	-10.8	-9.1	12.0	6.8	23.5	15.0
Project EIRR	**17.8%**					

Source: Consultant

Scenario I & III and Scenario II & IV are similar in case of Lo-Lo Terminal; this is because of no change in project cost. Difference between Project Cost Option 1 & 2 is just that, Option 2 includes additional INR 25 lakhs of structural re-modifications in Fairway. While Lo-Lo Terminal project cost remains same in both the options.

13.7 RISK FACTORS & MITIGATION

The project has not been found commercially viable in this scenario. The financial analysis undertaken for the project shows non-existent IRR. Hence, there is no need to develop this project.

13.8 NECESSITY OF GOVT. SUPPORT (VGF / PPP)

Difficulty in securing funds aside, some projects are not even considered to be financially viable, although they might be economically justified and indispensable. To take care of such projects and to carry them towards their successful completion, the government has designed Viability Gap Funding (VGF). Viability Gap Funding is the grant provided by the government towards financing projects that are termed financially unviable but are economically justified. The scheme and the projects are monitored by the Ministry of Finance and amount is allocated through annual budget. The usual grant given by the government is 20% of the total capital cost of the project, which can be supplemented by the state government through an additional 20% grant.

Lo-Lo Terminal and fairway both the projects are commercially unviable while only economically viable. However, with significant financial support from the government at 40% grant, both the projects i.e Lo-Lo Terminal and Fairway do not produce the desired positive returns commercially.

13.9 CONCLUSION

The following table gives a snapshot of the project cost and viability indicators for all the sub-sector developments for NW 9a under different Scenarios:

Table 13.98 Critical indicators for the NW 9a

No	Factors	Section	Unit	Scenarios			
				I	II	III	IV
1	Project Cost	Fairway	Cr.	15.28	15.28	15.53	15.53
		Lo-Lo Terminal	Cr.	22.01	22.01	22.01	22.01
2	Tariff	Vessel Berthing	INR Vessel/Day	1,000.0	1,275.1	1,000.0	1,275.1
		Cargo Unloading	INR Per Ton	1.0	52.5	1.0	52.5
		Container Handling	INR Per TEU	50.0	410.6	50.0	410.6
		Fairway Usage	INR GRT-Km	0.02	1.0	0.02	1.0
2	Traffic	Break-Bulk	Million Tonnes	FY 23 - 0.06 and FY 40 - 1.76			
		Container	TEU	FY 23 - 4,500 and FY 40 - 5,000			
3	Revenue	Fairway (FY40)	Cr.	0.21	10.45	0.21	10.45
		Lo-Lo (FY40)	Cr.	4.92	33.43	4.92	33.43
4	FIRR	Fairway	-	Non-Existent	-1.5%	Non-Existent	-1.6%
		Lo-Lo Terminal	-	Non-Existent	7.7%	Non-Existent	7.7%
5	EIRR	Fairway	-	75.5%	77.7%	55.2%	77.0%
		Lo-Lo Terminal	-	Non-Existent	17.8%	Non-Existent	17.8%

Source: Consultant

Above table clearly depicts that developing fairway and Lo-Lo terminal on NW9a is un-viable under Scenario I & III. This entirely is because of high project cost and tariff charged to the users, as IWAI tariff is very low. Under these scenarios where IWAI tariff rates are considered, fairway and terminals are not able to generate sufficient income that could meet the least operating cost. While Scenario II & IV, even after assuming CPT tariff rates i.e far higher than IWAI, giver positive IRR only in Lo-Lo sector. Also, in future, if industries located nearby the terminal don't show marked increase in traffic volume, then the decision to set up a Lo-Lo Terminal on NW9a becomes irrelevant.

The cost difference between roadways and waterways will remain the same or widen even further. Even when the government is willing to compensate the cost difference, the Lo-Lo Terminal is unsure to generate profits in the long run. A combination of increased costs, time, and distance will weigh on the overall appeal and benefits of waterway movement, deterring potential customers.

Logistics cost comparison in both the cases of waterway movement is be costlier than existing mode of transportation using roadways by a significant margin. For development of Lo-Lo Terminal and for it to attract the projected traffic, government needs to subsidize the shift by offering the cost difference to the transporters. The subsidy amount will compensate for high logistics cost, but additional incentives need to be offered to make up for the increase in time and distance. IWAI should bear costs associated with maintenance of the Terminal (repairs and maintenance) and the navigation infrastructure (dredging, night navigation, buoys, etc.). A combination of subsidy and incentives is needed to induce shift of traffic from existing roadways to waterway. The following chart depicts the annual subsidy cost government will have to incur if it were to go ahead with cargo movement on NW9a:

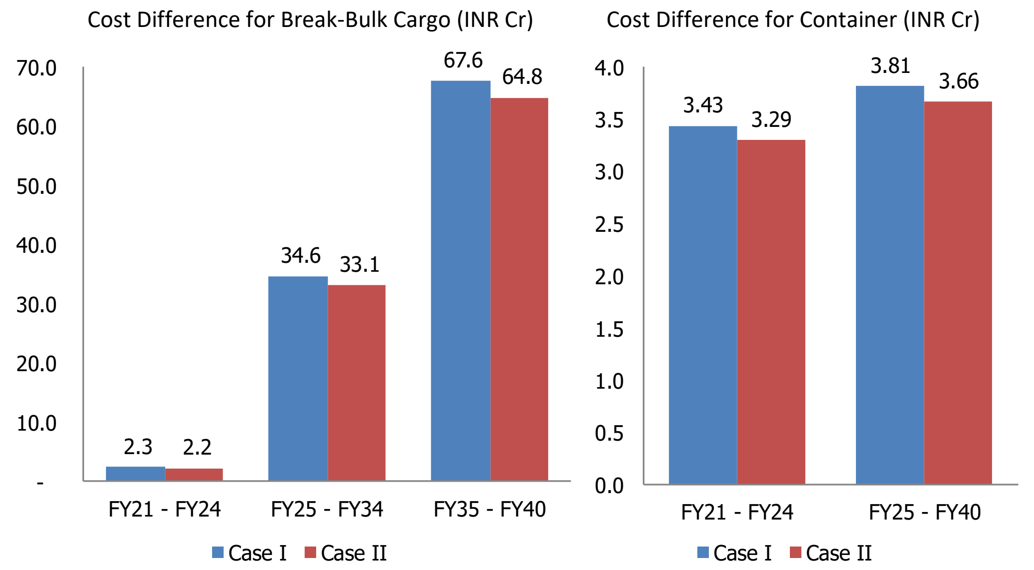


Figure 13.2 Annual Subsidy Expense (INR Cr.)

Source: Consultant

Even the lowest combined subsidy expense is more than the combined cost of fairway investment and the Lo-Lo Terminal. At no stage does the combined revenue generated from fairway and Lo-Lo Terminal comes even half as close to breakeven with subsidy cost. This sole reason of steep subsidy requirement, on account of the wide logistics cost difference, renders this entire project unattractive.

The development of NW-9a can be taken up & recommended for about 22.4 Kms to meet the estimated IWT cargo growth with Class III Canal system of the NW standards, in order to meet the estimated cargo volumes of the existing 2 captive Terminals of KPACT and TCL, keeping in view the heavy road density of Kerala.

There are various large companies located on the banks of waterway needing NW 9 A for cargo transportation to/from Cochin Port via NW-3. NW-9 is acting as a feeder for cargo movement on NW 3. Container, Bulk Cement and Clinkers are prominent commodities on this waterway. Development of NW 9-A would ease out congestion on the narrow roads connecting to Cochin Port. KPACT has a terminal on the river. They are waiting for operationalization of this canal based waterway. The development of this NW-9A shall trigger capacity expansion of existing companies in the post development phase. These would lead to holistic development of region and transportation mode. Therefore the development is recommended.

Also the cumulative returns from both the terminals and fairway comes negative in case where IWAI tariff rates are considered. Tariff structure floated by IWAI is considerably low and thus enough revenue is not being generated. While, considering the CPT tariff structure project gives tangible return i.e. FIRR 4.5% and EIRR 26.6%. The option of considering a higher tariff can be exercised by IWAI to make the project commercially attractive which appears rational and in line with CPT.

CHAPTER 14 : CONCLUSIONS AND RECOMMENDATIONS

The Alappuzha-Kottayam-Maniyapparambu Canal or National Waterway No. 9 is a total of 51.70 km stretch of inland navigational route located in Kerala, India and runs from Alappuzha / Kainakary to Kodimatha as 9 A of 22.45 kms + Kanjiram Junction to Maniyapparambu as 9 B of 17.82 km + Kainakary North to Kottayam as 9 C of 15.14 km proposed to undertake the two stage DPR. There is an overlap of this canal, while undertaking the study, which has been carried out as per the Terms of Reference (ToR) and the details of the study are given in the preceding chapters.

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

- Detailed Hydrographic Survey has been carried out and based on the Survey carried out / Site data collected / subsequent to the Morphological analysis etc., the required developments in the Fairway along with interrelated activities have been identified. The study stretch is in the “Vembanad Lake” area in Kerala, which is one of the identified sites under Ramsar Convention of wet land. Since it is in the Lake area, as such there is no major Regime disturbance in the study stretch.

- The National Waterway 9 (NW 9) has been studied with Three different routes 9 A; 9 B and 9 C, wherein the stretch 9 A has been observed with more depth / less Dredging facilitated the selection of stretch without much iteration for larger analysis by which the development of 9 B and 9 C have been ruled out for any development. NW 9 has been considered for Class III waterway in line with the requirement of connectivity for mobility through existing NW 3.

- NW 9 is having connectivity to Cochin Port; ICTT, Kochi through NW 3 towards north and to Kollam towards south and hence it is most preferred to develop the fairway with Class III waterway, so as to have the compatibility of mobility in this region. Further, NW 9 is connected to 2 Nos. of Captive Terminals viz., Kottyam Port and Container Terminal (KPACT) and Travancore Cements Ltd., (TCL), where presently the operations are on with the developed infrastructure by these two Captive Terminals.

- Passenger mobility is also being carried out by Kerala State Water Transport Department (KSWTD) {HQ: Alappuzha} by deploying Passenger Boats.

- The estimated / identified IWT Traffic volumes for this Waterway is of Lo-Lo operation with specific criteria of achieving the operational volumes of about 3800 TEUs p.a (inward) + 1200 TEUs p.a (outward) at KPACT and 7 Lakhs T p.a (inward) + 10.60 Lakhs T p.a (outward) at TCL estimated in 2040.

- Accordingly, the possibility of vessel mobility has been considered with Class III standard of Waterway with 32 m Bottom Width of fairway in narrow reaches and 38 m Bottom Width of fairway in wider reaches however with 2.2 m Depth of fairway in both the reaches with a vessel requirement for Class III as 50 m – 55 m LOA x 9 m – 12 m Breadth x 1.6 m – 1.8 m Loaded Draft / 2.2 + m, which can carry either 300 T – 500 T of Bulk / Break Bulk Cargo / 15 Nos. – 21 Nos. TEU. The Propulsion will be 3 Nos of Marine Diesel Engines of 375 Bhp each.

- As a part of development, in order to provide a class III safe navigable fairway, Dredging of 3.61 Lakhs Cu. M in Soils has been suggested along with the provision of 600 m Bank Protection (Pile & Slab type). Further provision of 50 Nos of Buoy / Light; Land Acquisition and Maintenance of Power cables also have been suggested / recommended.

- NW 9 is having two well established captive ports along with the Terminal structure / Infrastructure. One is Kottayam Ports and Container Terminal (KPACT) having Back up Land / having 1 Private Terminal & 1 Captive Jetty handling Rubber Products, Automobile products and RMG. Already having 40,000 Sq. ft of Warehouse and other 20,000 Sq. ft is under construction. Other is Travancore Cements Limited (TCL), which has already been confirmed provision of 100 m waterfront land with 12,500 Sq. m of back up land for development of infrastructure on mutually agreed basis and on revenue sharing basis.
- KPACT is having 5 Hectares of Back up land and other 7 Acres of land is under the proposal for taking over. M/s TCL conveyed its willingness about the provision of land, on mutually agreed terms and conditions.
- Development of 2 jetties (Lo-Lo Terminals) of 50 m x 15 m is proposed along with handling equipments i.e., Cranes - 01 Number of 125 T handling capacity per hour + 2 Nos. of 05 T Fork Lifts + 1 Ambulance are suggested.
- The cost estimates have been worked out for development of Fairway with a capital cost of 15.28 Cr and Terminal with a capital cost of 22.00 Cr. Implementation of the above is suggested in 3 years from 2021.
- The FIRR and EIRR have been worked out both for Option-1 & Option-2 and the critical indicators are placed.

NW-9A				
Scenario	**Project Components**	**Cost In Lakhs (Rs.)**	**Financial Internal Rate of Return (FIRR)**	**Economical Internal Rate of Return (EIRR)**
Scenario I :- Project Cost Option 1 and IWAI Tariff	Fairway Cost	1528.20	Non-Existent	75.50%
	Lo-Lo Cost	2200.94	Non-Existent	Non-Existent
Scenario II :- Project Cost Option 1 and CPT Tariff	Fairway Cost	1528.20	-1.50%	77.70%
	Lo-Lo Cost	2200.94	7.70%	17.80%
Scenario III :- Project Cost Option 2 and IWAI Tariff	Fairway Cost	1553.20	Non-Existent	55.20%
	Lo-Lo Cost	2200.94	Non-Existent	Non-Existent
Scenario IV :- Project Cost Option 2 and CPT Tariff	Fairway Cost	1553.20	-1.60%	77.00%
	Lo-Lo Cost	2200.94	7.70%	17.80%

- Recommended the development of NW 9 A for about 22.4 Kms to meet the estimated IWT cargo growth with Class III Canal system of the NW standards, keeping in view the existing cargo mobility and also keeping in view the heavy road density of Kerala.

CHAPTER 15 : TEMPLATES

15.1 Environmental & Social Screening Template

Screening Question	Yes	No	Details / Remarks
1. Is the project located in whole or part in / near any of the following Environmentally Sensitive Area? If yes, please provide the name and distance from the project site			
a) National Park		✓	
b) Wildlife/ Bird Sanctuary		✓	
c) Tiger or Elephant Reserve		✓	
d) Biosphere Reserve		✓	
e) Reserved / Protected Forest		✓	
f) Wetland	✓		Part of the project is located in Vembanad Lake which is a Ramsar Wetland Site.
g) Important Bird Areas		✓	
h) Mangroves Areas		✓	
i) Estuary with Mangroves		✓	
j) Areas used by protected, important or sensitive species of fauna for breeding, nesting, foraging, resting, over wintering, migration		✓	
k) World Heritage Sites		✓	
l) Archaeological monuments/ sites (under ASI"s Central / State list)		✓	
2. Is the project located in whole or part in / near any Critically Polluted Areas identified by CPCB?		✓	
3. Is, there any defence installations near the project site?		✓	
4. Whether there is any Government Order/ Policy relevant / relating to the site?	✓		EIA Notification 2006 Wildlife Protection Act, 1972 Water Act, 1974 Air Act 1981 CRZ Notification 2011 Wetland Rules, 2010

Screening Question	Yes	No	Details / Remarks
			Details are discussed in Section 9.5 of the DPR.
5. Is the project involved clearance of existing land, vegetation and buildings?		✓	
6. Is the project involved dredging?	✓		Details are discussed in Section 9.5 of the DPR.
7. Is the project area susceptible to natural hazard (earthquakes, subsidence, erosion, flooding, cyclone or extreme or adverse climatic conditions)		✓	
8. Is the project located in whole or part within the Coastal Regulation Zone?	✓		
9. Is the project involved any demolition of existing structure?		✓	
10. Is the project activity require acquisition of private land?		✓	
11. Is the proposed project activity result in loss of direct livelihood / employment?		✓	No dislocation is anticipated on account of the project.
12. Is the proposed project activity affect schedule tribe/ caste communities?		✓	

S. N.	Result of Screening Exercise	(Yes / No)
1.	Environment Impact Assessment is Required	Yes
2.	CRZ Clearance is Required	Yes
3.	Environmental Clearance is Required	No
4.	Forest Clearance is required	No
5.	Wildlife Clearance is required	No
6.	NOC from SPCB is required	Yes
7.	Social Impact Assessment is Required	Only as part of EIA study
8.	Abbreviated RAP is required	No
9.	Full RAP is required	No
10.	Any other clearance is required	Other clearances required include those that are to be obtained by the Contractors during the construction period such as the Certificate of Registration under Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996, licenses / permits under other applicable labour laws, permission from SPCB for setting up of batching plants and for use of DG sets etc.

15.2 Traffic Template

15.2.1 Catchment Baseline

- Local Economic Geography– The study stretch of NW 9 (Alappuzha-Kottayam-Maniyaparambu Canal) has been divided into 3 sub-parts, namely, NW 9a (from Alappuzha to Kottayam near Kodimatha), NW 9b (from Kanjiram Junction to Maniyaparambu) and NW 9c (from Kainakary North to Kottayam). NW 9a and NW 9c fall in the catchment of Kottayam & Alappuzha district and NW 9b stretch falls in Kottayam district.

- Catchment Area – Alappuzha and Kottayam district come in the catchment area of NW 9.

- Population – As per census 2011, total population of Alappuzha is 15,97,052 and of Kottayam is 19,74,551.

- Economic Activities- Alappuzha's economy is based on tourism and exports specifically spices, coconut oil, coir, sugar etc. Paddy, coconut, tapioca, jackfruit, mango and plantain are the major crops cultivated in Alappuzha district. Alappuzha has both marine & inland fish catch. There are several fish landing centers in the catchment area. Limeshell, silica sand, laterite are major minerals found in Alappuzha.

  Rubber industry and spice exports are major contributors to Kottayam economy. The important crops cultivated in Kottayam are rubber, pepper and paddy. Inland fishing is active in Kottayam. Kottayam district has rich mineral deposits of lime shell and graphite. There is significant growth in Tourism in both Kottayam and Alappuzha.

- Major Industries –

  ✓ Alappuzha- Garment cluster in Alappuzha, Coir cluster in S.L.Puram, Paddy cluster in Kuttanad and Crabgrass Cluster in Cherthala. Major industries in Alappuzha are The Alleppey Company Ltd., Kanti Floor Furnishers, VKL Seasoning, Plam Fibre, Petrogas, Babu Coir Works, Detilish Rugs

  ✓ Kottayam- There are 3 industrial clusters, Ethnic Food Cluster in Pala, Screw Pine Products in Vaikom and Rubber Products in Changanassery. Major industries in Kottayam are Travencore Cements, MRF, Oil Palm India, Midas Precured Tread, Ceyenar Chemicals, Hi-Tech Cast Iron Industry, TJP Rubber Industries etc.

- Connectivity

  ✓ Major roads – NH 66, NH 183, NH 47, SH 11, SH 15, SH 42 are the major highways.

  ✓ Major railway – The Southern Railway network of Indian Railways serves Alappuzha & Kottayam districts. The Thiruvananthapuram division of Southern Railways connects the catchment of NW 9. In Kottayam district, Chingavanam, Kottayam, Kumarnallor are the railway stations, which are closer to NW 9. There is no major freight loading station on the railway line. Only Kottayam railway station has facility for goods shed. In Alappuzha district, Chengannur, Kayamkulam, Mavelikkara railway stations are used for transporting goods. These are the main stations from where goods are loaded and dispatched to other regions.

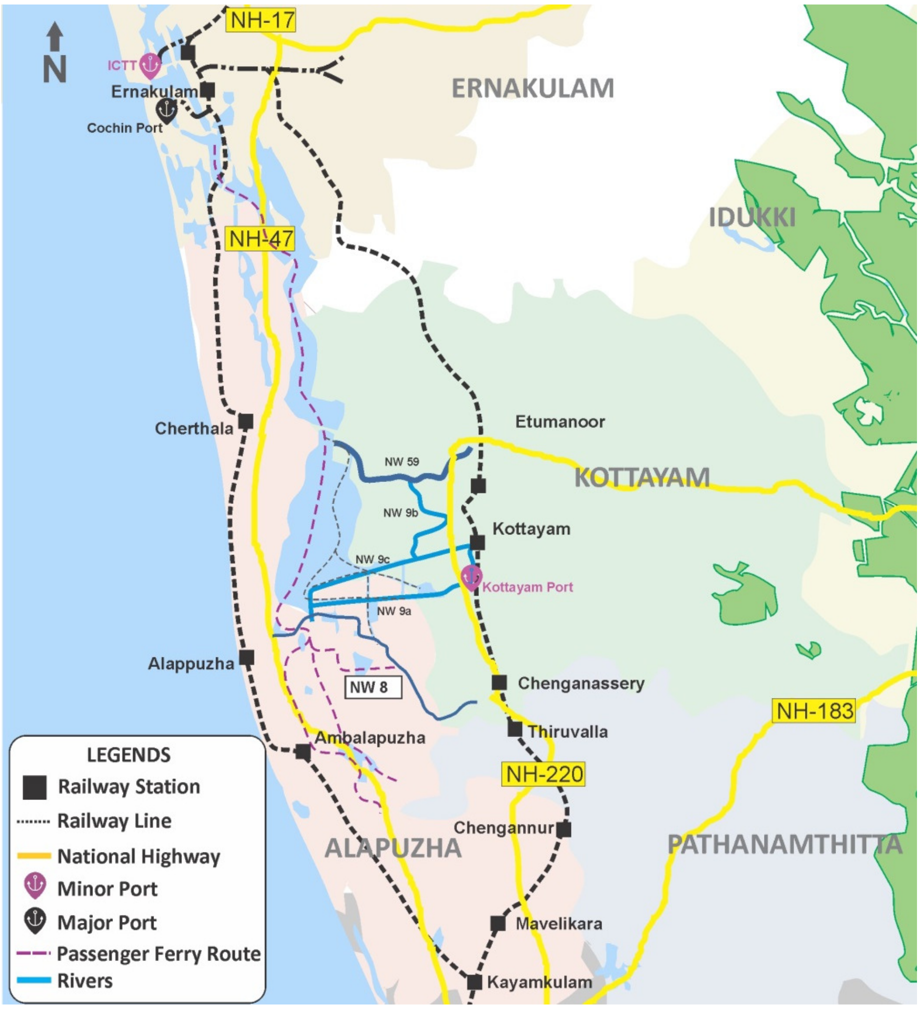
- Specific Developments

  ✓ Five sites, namely Kootickal, Cheruvally Estate, Laha Estate, Malayalapuzha- Kumbazha Estate and Kalleli are shortlisted in Kottayam and Pathanamthitta district for developing Greenfield International Airport at a project cost of INR 2,500 Crore. These locations are more than 35 km away from the identified stretch of NW 9.

  ✓ The Government of Kerala has already decided to develop five minor ports through PPP mode, namely Azheekal, Beypore, Ponnani, Alappuzha and Kollam. Apart from these ports, a major port, Vizhinjam Deepwater International Container Trans-shipment Terminal is going to be developed.

  ✓ At the beginning of FY 17, Kerala Government has started Solar ferry service, which runs between Vaikom to Tavanakkadavu (near Vembanad Lake) ferry route distance is about 2.5 km.

- Catchment area Map



15.2.2 Navigation Baseline

- Existing Waterway Usage
  - ✓ NW 9a provides direct connectivity to Kottayam Port & Container Terminal and Travancore Cements at Nattakom.
  - ✓ The stretch of NW 9c mostly is surrounded by agricultural fields. No major industries or settlements are located along the waterway.
  - ✓ There is one non-major port in the catchment area of NW 9, i.e. Kottayam Port & Container Terminal. There does not exist any major port in the catchment area. Cochin port is located more than 75 km from Kottayam Port by road. At present, cargo from Kottayam Port goes to Cochin Port via roadway.
  - ✓ Travancore cement has its own jetty in Kadoor river, which is a part of NW 9. In future also, this jetty would be used for transporting raw material and finished product of TCL to/from Cochin Port.
  - ✓ At present, passenger ferry services are operational in both Alappuzha & Kottayam districts. Passenger services are operated by State Water Transport Department, Government of Kerala. The water transport department has a total of 14 stations under its control, out of which 8 fall under Alappuzha district and 2 fall under Kottayam district. The existing ferry service is used by both passengers and tourists.

15.2.3 Market Baseline

- Potential Market
  - ✓ Containers
  - ✓ Bulk commodities – Cement, Limestone/Clinker

Commodity	Source	Reasoning
Containers	ICTT (Cochin Port), KPACT	Containers are transported between ICTT (Cochin Port) to Kottayam Port and Container Terminal (KPACT). These containers could be moved, using NW 3 and NW 9.
Cement	Travancore Cements	Travancore Cements is willing to use NW 9 and further NW 3 to move its product, i.e. cement to Cochin Port.
Clinker/ Limestone	Cochin Port	Travancore uses Chennai Port for importing raw material, like clinker & limestone. Raw material transportation could be shifted to waterway.
Industries	Operational in the catchment area	TCL is willing to use NW 9 and further NW 3 to move its product, i.e. cement to Cochin Port. Other industries are not willing to use NW 9. However, if transportation cost using IWT would be cheaper than existing mode then industries might use NW 9 in future to overcome road congestion problem.

15.2.4 Forecasting Years

- IWT Share
  - ✓ Container movement between KPACT and ICTT can be diverted to waterways.
  - ✓ Cargo transportation clinker/limestone from Cochin Port to TCL's (Travancore Cements Ltd.) plant could be 100% diverted to the waterway.
  - ✓ Finished product of TCL, i.e. Grey cement and white cement that would move to Cochin Port could be shifted to the waterway. IWT's share from this diversion is 100%.

15.2.5 Presentation of Forecast

Sr. No	Name of Cargo	Type of Cargo	Origin	Origin Terminal on NW	Final Destination	Destination Terminal on NW	Co-ordinates	Unit p.a.	FY 16	FY 20	FY 25	FY 30	FY 35	FY 40	Terminal Land Area in Sq. Mtr
Existing Terminals on NW 9 (Terminal Present on the canal)															
1	N.A	Container	ICTT (Cochin Port)	N.A	KPACT	KPACT	N.A.	TEU	2,470	3,800	3,800	3,800	3,800	3,800	
2	N.A	Container	KPACT	KPACT	ICTT (Cochin Port)	N.A.	N.A.		173	700	1,200	1,200	1,200	1,200	
3	Grey Cement	Bulk	TCL	TCL	Cochin Port	N.A.	N.A.	000 Tons	-	-	500	500	1,000	1,000	
4	White Cement	Bulk	TCL	TCL	Cochin Port	N.A.	N.A.		12	30	50	50	60	60	
5	Clinker/ Limestone	Bulk	Cochin Port	N.A	TCL	TCL	N.A.		12	30	350	350	700	700	

Source: Based on interaction with prospective stakeholders (Kottayam Port & Container Terminal and Travancore Cement Ltd)

15.2.6 Market Success Factors

The Market success factor for development of NW 9 is the Geographical location with its connectivity with the existing NW 3 i.e., to ICTT, Kochi and the presence of 2 Captive Ports KPACT and TCL already considering the movement of goods through Inland Water Transport (Waterway).

15.2.7 Forecasting Methodology

- Container movement between KPACT and ICTT could be diverted to waterways. Only container movement from KPACT is considered for traffic, as the terminal of KPACT is located on proposed NW 9. The container volume handled by KPACT in Fy 16 is the basis for container traffic projection. In Fy 16, 2,470 TEU Container was sent from ICTT to KPACT and 173 TEU containers is sent from KPACT to ICTT. This container volume of Fy 16 is provided by KPACT. KPACT has told during interaction that due to lack of infrastructure, there is limited container volume at present. Once NW 9 and proper infrastructure is developed at KPACT, then more customers would use KPACT for container movement.
- Future cargo projection is made based on the present traffic in the region. These would be potential commodity for NW 9 waterway.
- Travancore Cements Ltd. (TCL) has showed willingness to use the proposed waterway in NW 9 to transport imported clinker/limestone from Cochin Port and move its finished product cement to Cochin Port.
- The future projection is based on interaction with prospective stakeholders (Kottayam Port & Container Terminal and Travancore Cement Ltd).
- For containers, average container size of 4.25 feet height, 8 feet width and 20 feet length, which is equal to 680 cubic feet is considered. 1 TEU of these containers is equal to 17 tonnes.

15.3 Project Costing Template

Cost type	Cost categories	Components to be itemized
Capital costs	Waterway Infrastructure	□ Land, compensation and resettlement: 1.43 Cr and the Acquisition as per the Govt. Norms. □ Capital dredging: 3.61 lakhs cu.m Ordinary soil – 8.86 cr □ River training/bank protection: 0.86 cr □ Locks: No □ Barrages: No □ Channel markings: No □ Day / Night navigation: 1.76 cr

Cost type	Cost categories	Components to be itemized
		□ Other: Communication system – No
Terminal Infrastructure		Ro-Ro facility □ Fixed infrastructure: berths, moorings, hard-standing etc. (itemized) □ Loading/uploading and other equipment (itemized) □ Buildings : Considered in infrastructure □ Other : -- Considered
Operation and maintenance (O & M) costs	Waterways	□ Maintenance dredging □ Markings and nav.-aids □ Bank maintenance □ Other Considered as per standard
	Terminals	□ Terminal operations □ Terminal maintenance □ Other Considered as per standard
	Vessel: (NB vessel operating costs/tons-km fall sharply with larger capacity vessel, when there is sufficient traffic to utilize them)	□ Crew □ Fuel □ Maintenance □ Registration & insurance □ Fees and charges □ Vessel capital amortization (or leasing cost equivalent) □ Total costs Considered as per standard □ (Cost/tons-km for use in evaluation)
Recurrent costs		Periodic major capital costs that may occur over life of assets: Considered as per standard
Price levels		All costs to be expressed in mid-2014 price levels. Costs derived from other years to be indexed to 2014 price levels : Considered accordingly

Cost type	Cost categories	Components to be itemized
Value engineering		Not all investments will be necessary in all projects. Value engineering should be applied to project scoping and specification to avoid "gold-plating" of costs and undermining viability of project: --
Cost verification		Costs that are estimated on a "bottom-up" basis should be verified or tested for reasonableness against actual costs for such activities evidenced in the marketplace: Considered as per standard

15.4 Economic Evaluation Template

Item	Requirements
Objective	To assess economic internal rates of return (EIRR) on a consistent basis between different river projects.
Economic evaluation approach	Economic evaluation of each river upgrading project may include: **Capital Cost:** (a) Navigation infrastructure (FY21-FY41) – INR 15.28 crore (b) Terminal Lo-Lo Cost – INR 22.00 crore **O & M costs:** (a) Navigation infrastructure (FY21-FY41) – INR 5.14 crore (b) Terminal Lo-Lo Cost - INR 19.20 crore Savings in transport resource costs between IWT and rail and/or road transport **Saving on Fuel:** (a) Navigation infrastructure (FY21-FY41) – INR 33.8 crore (b) Terminal Lo-Lo Cost - INR 9.0 crore **Saving on Vehicle Operating Cost:** (a) Navigation infrastructure (FY21-FY41) – INR – 7.2 crore (b) Terminal Lo-Lo Cost - INR -1.9 crore **Savings in road/rail accident costs:** (a) Navigation infrastructure (FY21-FY41) – INR 6.3 crore (b) Terminal Lo-Lo Cost - INR 1.7 crore

	Saving in carbon emissions: (a) Navigation infrastructure (FY21-FY41) – INR 0.3 crore (b) Terminal Lo-Lo Cost - INR 0.3 crore
Standard values	To ensure consistency between evaluations of different waterways the following has been used: Vehicle operating Cost Road : INR 3.11/tons-km IWT: INR.5.69/tons-km Road accident Loss: INR 7.73 Lakhs/km Rail accident Loss: INR 0.77 Lakhs/km Carbon shadow price : 20 dollars/tons
Other benefits	Other significant economic benefits such as direct employment creation has also been considered in the evaluation. Employment cost has been taken as INR 2.5 Lakhs per annum.
Cash flows in real terms	Economic cost has been considered as 85% of actual values without any escalation.
Resource cost adjustments	Market prices has been taken on 2020 price level as equivalent to resource costs for the purposes of the economic evaluation.
Evaluation period	Initial construction period has been adopted as 3 years for Navigation infrastructure & Lo-Lo terminal. Both the sector will be developed in single phase only. Construction will be from FY21 to FY23. A total 18 years for operation period has been taken into account entire operation.
EIRR	At present, industries located in catchment area are using roadways to reach Cochin port. Development of Alappuzha-Kottayam-Maniyarambu Canal as an alternate mode for transportation for containers and break-bulk is likely to generate employment. The waterway would decongest the roads by traffic diversion and likely to save fuel used in road transportation along with reduction in environment pollution. The reduction of vehicular operating cost due to use of Alappuzha-Kottayam-Maniyarambu Canal is also likely to generate overall benefits to the project. Economic IRR of Navigational Structure & Lo-Lo terminal projects are 75.5% and Non-existent
Checking and Replicability	Systematic checks of spreadsheets and logic trail have been done keeping in mind the input data, assumptions and calculations.

15.5 Financial Evaluation Template

Consultants shall adhere to the following standard approaches in estimating financial internal rate of return (FIRR) and payback period.	
Item	**Requirements**
Objective	To assess financial internal rates of return and financial payback periods of Alappuzha-Kottayam-Maniyarambu Canal
Financial evaluation approach	Financial evaluation of each river upgrading project should estimate and present actual cash flows (cost and revenues) at market prices within the inland waterway sector consisting of the two sub-segments: (a) navigation infrastructure; (b) terminal operation. **Returns for Navigation infrastructure are:** Total Revenue: INR 0.21 cr. in FY41 O&M Cost: INR 5.14 cr. in FY41 Tax: Nil in FY40 (@ 30% on EBITDA) EBIDA: INR -4.93 cr. In FY40 Project Capital Cost (with escalation): INR 15.28 cr. Net Cash Flow: INR -4.93 cr. In FY40 **Returns for Lo-Lo Terminal operations are:** Total Revenue: INR 4.92 cr. in FY40. O&M Cost: INR 19.20 cr. in FY40 Tax: Nil in FY40 (@ 30% on EBITDA) EBIDA: INR -14.28 cr. In FY40 Project Capital Cost: INR 22.00 cr. Net Cash Flow: INR -14.28 cr. In FY40
Disaggregation	Cash flow streams and FIRRs have been attached as annexures in Financial Evaluation chapter-13 for Navigation Structure and terminals separately. It is not considered as a whole. Payback is also considered separately for all 2 facilities. **Returns for Navigation infrastructure are:** Total Revenue: INR 0.21 cr. in FY40 O&M Cost: INR 5.14 cr. in FY41 Tax: Nil in FY41 (@ 30% on EBITDA) EBIDA: INR -4.93 cr. In FY41 Project Capital Cost: INR 15.28 cr. Net Cash Flow: INR -4.93 cr. In FY40 **Returns for Lo-Lo Terminal operations are:** Total Revenue: INR 4.92 cr. in FY40 O&M Cost: INR 19.20 cr. in FY40. Tax: Nil in FY40 (@ 30% on EBITDA) EBIDA: INR -14.28 cr. In FY40. Project Capital Cost (with escalation): INR 22.00 cr. Net Cash Flow: INR -14.28 cr. In FY40.
Evaluation period	Construction period has been adopted as 3 years i.e from FY21 to FY23, for all the sub-segment projects. For fairway & terminal, a total 18 years for

	operation period has been taken into account for the entire operation (FY23 – FY40).
FIRR and payback period	Estimate both FIRR (sector and sub-sectors) and overall sector payback period, the latter being the year in which the cumulative sector each flows becomes positive. Described in financial evaluation
Ramp-up period	Unless good reasons otherwise, assume 4 years ramp-up period from first operational year to long-term trend" levels of traffic: 5 years ramp up period considered
Commentary on FIRR	Explain overall sector FIRR results and distribution between sub-sectors. Identify main drivers of the results and sensitivity to assumptions: The project for development of Alappuzha-Kottayam-Maniyarambu Canal does not exhibit any potential for positive rate of return on investment (FIRR). Factors influencing healthy financial returns of the project are: • Potential revenue likely to be generated across the board is not high enough, mainly because of low traffic potential and high development cost for fairway. • Indicatively, total logistics cost is higher as compared to existing mode of transportation. This will keep the industries from diverting to waterways. • The tariff rates supplied by IWAI are too low, which further impacts revenue potential, and eventually, viability of the project within the projected period up till FY40.
Risks to financial out-turn	Identify main risks to the estimated project out-turn or viability and their underlying causes e.g. market risks (traffic, tariffs, and competition), hydrology risks, engineering risks, operational risks etc.: • Future traffic is uncertain, especially for the cargo that have been proposed for the IWAI terminals. Traffic for private operators should generate decent revenue to eventually recover costs of fairway development in the long run. Industries are very much concerned about the time & cost factor. There are high chances of rejecting the utilization of waterways if overall logistics cost including tariff charged for usage of terminal & fairway is higher than existing mode of transportation for them.
Checking and Replicability	Systematic checks of spreadsheets and logic trail have been done keeping in mind the input data, assumptions and calculations.

ANNEXURES

ANNEXURE 1.1 – TOR OF THE AGREEMENT

SECTION-6 TERMS OF REFERENCE

1.0 OBJECTIVE OF THE STUDY:

Government of India intends to explore the potential of additional waterways across the country for year round commercial navigation, for this it is planned to conduct a Feasibility Study and recommending thereafter the possibility of Composite and Integrated development of proposed waterways to achieve navigation and to develop water transport facilities across India. After carrying out the feasibility study if there is scope for navigation and potential to develop waterway transport facility, a Detailed Project Report needs to be prepared for those waterways which would include detailed hydrographic surveys and investigation, traffic survey, proposed location for terminals and cost assessment etc.

The study would consist of 2 stages:

1. **Stage-1**
2. **Stage-2**

1.1 STAGE-1

Stage-I is only for feasibility of the waterway for navigation, which may have the potential for year round navigation or at least for a few months in a year.

Stage-1 would consist of the following activities:

1A. Reconnaissance Survey

1B. Collection and review of available data

1C. Feasibility Report

1.1.1 Reconnaissance Survey

The detailed field reconnaissance survey may be taken up immediately after the analysis of available data. The primary tasks to be accomplished during the reconnaissance surveys include:

i- Single line longitudinal survey (Bathymetric survey or Topographic survey) in the deepest depths or lowest height lands, with the help of DGPS using Automatic Hydrographic Survey System. Bathymetric surveys in the proposed waterways are to be carried out in the deepest route. Deepest route can be accessed by taking two or three longitudinal line soundings at equal interval. Topographic survey, if required, is to be taken up at lowest ground levels, which can be decided on visual assessment.

ii- Details (horizontal and vertical clearances above High Flood Level of bridges, aqueducts, electric lines, telephone lines, pipe lines, cables en-route are to be collected and indicated on the chart and also included in the report along with their co-ordinates and location. Details about Barrages, Dams, Locks enroute are also to be collected. horizontal and vertical clearance is to be given as approximate on visual assessment. Photographs are required to be submitted in the report.

iii- Topographical features of the proposed Inland Waterways.

iv- Typical physical features along the alignment i.e. land use pattern:

v- Preliminary identification of stretches having year round flow and critical depth for navigational purpose.

vi- Preliminary Traffic identification on the proposed Inland Waterways.

vii- Inventory of major aspects including proposed Inland Waterway width, Terrain, Bridges and structures across the proposed Inland Waterways (Type, size and location), urban areas (location extent). Geologically sensitive areas environmental features. Hydrological features

viii- Critical areas requiring detailed investigations and

ix- Requirements for carrying out supplementary investigations

x- Soil (textural classifications) (only visual inspection at every 10km) and drainage conditions.

xi- Type and extent of existing utility services along the alignment.

xii- Identification of various agencies of the govt. from whom the concerned project clearances for implementation are to be sought.

The data derived from the reconnaissance surveys may be utilized for planning and programming the detailed surveys and investigations. All field studies including the traffic surveys should be taken up on the basis of information derived from the reconnaissance surveys. For the critical locations, River cross sections survey needs to be carried out.

1.1.2 Collection and Review of Available Data

A review has to be done based on the existing data available with the State Agencies and Central Water Commission for the proposed Inland Waterways for determining the nature, extent, adequacy, validity of the available data and identifying the data gaps. Consultant has to collect available data for the proposed Inland Waterways from the State Agencies and Central Water Commission. An introductory letter will be issued by IWAI for collecting information from State / Central Government.

An inception report has to be prepared which would consist of the findings based on the analysis of the existing data and reconnaissance surveys.

1.1.3 Feasibility Report

The Consultant has to prepare Feasibility Report for the proposed waterways based on the available data and reconnaissance survey. It must include the following prospects:

1. **Introductory considerations:**
   The Consultant shall provide an introduction, describing the scope of the assignment, its methodology in fulfilling the assignment and the expected outcome of the assignment.

2. **Analysis of present state of affairs:**
   The Consultant shall provide a quantitative and qualitative description of the current utilization of proposed inland waterways. In addition, the Consultant shall describe the status of goods transport, including utilization of road and transport, as well as river facilities.

3. **Market Analysis:**
   The consultant shall analyze the market and potential usage of proposed Inland Waterways. This analysis shall examine both the existing market and the potential future market. Contractor has to collect the details of available Industries along the waterway, type of production in these industries, ferry services, type of crop along the waterway, previous history of movement of cargo in the waterway etc. Above is to be collected after discussion with local village people while conducting reconnaissance survey etc. and also after interaction with State Govt. Officials, Irrigation / Water Resources departments.

4. **Reconnaissance Survey:**
   Analysis of the data collected in the reconnaissance survey should reflect the possibility of year round flow in the proposed Inland Waterways to achieve the commercial navigation. It should also consist the map of proposed Inland Waterways indicating existing cross structures viz. bridges, dams etc. Navigability of the waterway (for the periods) is to correlate with CWC/Irrigation water level data.

The Consultant has to submit the Feasibility Report for proposed Inland Waterways. Consultant also has to emphasize that which stretches of proposed inland waterways has potential of possible navigation. Only for those stretches of proposed inland waterways, which have potential of possible navigation, Stage 2 has to be carried out.

After obtaining approval from IWAI for identified stretches, Consultant may proceed for Stage - 2. Based on the feasibility report, IWAI will accord the approval for Stage-II, and stretch for DPR will be based on feasibility study.

1.2 STAGE-2

For Stage-2, Consultant has to carry out detailed hydrographic survey, topographic survey, traffic survey and selection of terminal locations.

Stage-2 would consist of the following activities:

1A. Hydrographic Survey & hydro-morphological survey

1B. Traffic Survey & Techno economic feasibility

1C. Preparation of Detailed Project Report

1.2.1 HYDROGRAPHIC SURVEY & HYDROMORPHOLOGICAL SURVEY

Based on the recommendation after reconnaissance survey of proposed Inland Waterways, Hydrographic survey may be carried out as per the International Standards including the following for finding the potential of proposed Inland Waterways for inland navigation:-

(i) The detailed hydrographic survey is to be carried out in WGS'84 datum.

(ii) The horizontal control is to be made using DGPS with minimum 24 hours observations at some platform/base.

The vertical control is to be established with respect to the chart datum / sounding datum from the following methods:-

i. Chart datum/ sounding datum already established by Port Authorities (Chart Datum), Central Water Commission (Average of last six years minimum Water Level) / State Irrigation Department (Full Supply Level (FSL)) and at their gauge stations along the river/canal. Secrecy undertaking forms etc. will be provided by IWAI for collection of CWC data. Introductory letter will be issued to the successful Consultant for collection of other required information from State Departments.

ii. Standard method shall be adopted for transfer of datum in rivers/canals. For tidal reaches standard transfer of datum as per Admiralty Manual shall be adopted.

iii. **By erection of tide gauges – at every 10km interval and also at upstream and downstream of Locks, Sluice gates, Barrages, Dams etc.**

Other Terms of Reference for the survey work shall be as given below: -

1.2.1.1 BENCH MARK PILLARS

a. Construct Bench Mark Pillars of dimension 0.3m x 0.3m x 1.5m (0.6m above GL) RCC pillar with 6mm thick 50mm dia GI pipe inserted (as per construction drawing of Survey Pillar in the tender document), at every 10km interval. Detailed description of the bench mark along with its position and value to be given in the report for future recovery.

1.2.1.2 WATER LEVEL GAUGES

i. Water level gauges are to be erected at every 10 km interval along the canal/river **and also at upstream and downstream of Locks, Sluice gates, Barrages, Dams etc. simultaneously.** Readings are to be taken at 1 hr interval for 12 hours (6 AM to 6 PM) or for the entire period of survey. The gauges are to be connected to a nearest Bench Mark by leveling and its datum value shall be established w.r.to MSL & CD. Water level gauges are to be installed temporarily during the survey period.

ii. At least 2 gauges (one U/s and one D/s at 10 Km apart) shall be read simultaneously and soundings to be carried out within the gauge stations. Soundings are to be reduced for datum of a gauge for 5km length of the canal/river on both side of a gauge.

1.2.1.3 BATHYMETRIC AND TOPOGRAPHICAL SURVEY

Sl. No.	Name of the River / Canal	Description of Inland Waterway
CLUSTER-2		
1	DHANSIRI / CHATHE	110 km length of the river from Bridge near Morongi T.E. village Lat 26°24'40.65"N, Lon 93°53'46.75"E to Numaligarh Lat 26°42'1.20"N, Lon 93°35'15.42"E
2	LOHIT RIVER	100 km length of the river from Parasuram Kund Lat 27°52'40.06"N, Lon 96°21'39.70"E to Saikhowa Ghat, Sadiya Lat 27°47'49.14"N, Lon 95°38'13.84"E

3	SUBANSIRI RIVER	111 km length of the river from Gerukamukh Lat 27°27'3.14"N, Lon 94°15'16.12"E to Brahmaputra confluence at Lat 26°52'24.93"N, Lon 93°54'31.26"E
4	TIZU and ZUNGKI RIVERS	42 km length of the river from Longmatra at Lat 25°46'11.98"N, Lon 94°44'35.04"E to Avanghku at Myanmar border Lat 25°35'2.94"N, Lon 94°53'6.12"E and in Zungki river from bridge at Lat 25°48'26.10"N, Lon 94°46'35.96"E to confluence of Zungki and Tizu rivers at Lat 25°46'58.03"N, Lon 94°45'20.51"E
	CLUSTER-3	
1	BIDYA RIVER	55 km length of the river from Lot No. 124 at Lat 21°54'42.88"N, Lon 88°41'8.48"E to near Uttar Danga at Lat 22°11'47.93"N, Lon 88°51'54.93"E
2	CHHOTA KALAGACHI (CHHOTO KALERGACHI) RIVER	15 km length of the river from near Rajani ferry ghat Lat 22°19'57.49"N, Lon 88°54'21.40"E to near Nazat at Lat 22°26'5.40"N, Lon 88°50'11.69"E
3	DVC CANAL	130 km length of the canal from Durgapur Barrage Lat 23°28'47.36"N, Lon 87°18'19.04"E to Confluence point of DVC canal with Hooghly river near Tribeni Lat 23° 0'30.95"N, Lon 88°24'54.72"E
4	GOMAR RIVER	7 km length of the river from near Ramkrishnapur Lat 22°11'53.35"N, Lon 88°44'41.97"E to near Gosaba Kheya ghat at Lat 22°10'5.44"N, Lon 88°47'37.17"E
5	HARIBHANGA RIVER	16 km length of the river from Bangladesh Border Lat 21°53'18.81"N, Lon 89° 1'23.61"E to confluence with Jhila river at Lat 21°58'17.66"N, Lon 88°55'8.38"E
6	HOGLA (HOGAL)-PATHANKHALI RIVER	37 km length of the river from near Parandar Lat 22°12'22.05"N, Lon 88°40'42.77"E to near Sandeshkhai Ferry Ghat at Lat 22°21'12.26"N, Lon 88°52'47.99"E
7	KALINDI (KALANDI) RIVER	8 km length of the river from Bangladesh Border at Hingalganj Lat 22°28'8.48"N, Lon 88°59'46.19"E to Bangladesh Border near Khosbash at Lat 22°24'41.40"N, Lon 88°58'20.68"E
8	KATAKHALI RIVER	23 km length of the river from Bangladesh Border near Barunhat Lat 22°30'31.44"N, Lon 88°58'24.53"E to Lebukhali ferry at Lat 22°21'45.36"N, Lon 88°57'30.27"E
9	MATLA RIVER	98 km length of the river from Bay of Bengal at Lat 21°33'4.13"N, Lon 88°38'25.65"E to Canning ferry ghat at Lat 22°18'38.87"N, Lon 88°40'42.65"E
10	MURI GANGA (BARATALA) RIVER	27 km length of the river from Bay of Bengal near Bisalakshmipur Lat 21°37'51.94"N, Lon 88°10'0.24"E to near Kakdwip at Lat 21°52'17.39"N, Lon 88° 9'7.52"E
11	RAIMANGAL RIVER	52 km length of the river from Hemnagar at Lat 22°11'40.58"N, Lon 88°58'1.08"E to Rajnagar at Lat 22°33'56.95"N, Lon 88°56'16.64"E
12	SAHIBKHALI (SAHEBKHALI) RIVER	14 km length of the river from near Ramapur Lat 22°17'52.04"N, Lon 88°56'34.78"E to Bangladesh Border near Khosbash at Lat 22°24'41.40"N, Lon 88°58'20.68"E
13	SAPTAMUKHI RIVER	37 km length of the river from Bay of Bengal at Henry Island Lat 21°34'57.35"N, Lon 88°19'8.47"E to near Chintamanipur at Lat 21°51'14.01"N, Lon 88°18'40.50"E
14	THAKURRAN RIVER	64 km length of the river from Bay of Bengal at Lat 21°33'31.95"N, Lon 88°27'45.40"E to Madhabpur at Lat 22° 2'52.19"N, Lon 88°33'27.96"E
	CLUSTER-4	
1	BAITARNI RIVER:	49 kms length of the river from Dattapur village at Lat 20°51'44.61"N, Long 86°33'30.45"E to confluence with Dhamra river near Laxmiprasad Dia at Lat 20°45'13.32"N, Long 86°49'15.36"E

2	BIRUPA / BADI GENGUTI / BRAHMANI RIVER SYSTEM:	102 kms length of the river from Birupa Barrage at Choudwar at Lat 20°30'49.00"N, Long 85°55'20.17"E to confluence of Birupa & Brahmani rivers near Upperkai Pada village at Lat 20°37'36.25"N, Long 86°24'19.13"E including alternative route of 25 kms from Samaspur village at Lat 20°35'40.59"N, Long 86° 6'31.50"E to near Kharagpur village at Lat 20°38'27.77"N, Long 86°17'31.81"E and additional 54 kms length of Brahmani river from confluence of Birupa & Brahmani rivers near Upperkai Pada village at Lat 20°37'36.25"N, Long 86°24'19.13"E to Brahmani river at Katana Lat 20°39'26.28"N, Long 86°44'52.86"E
3	BUDHA BALANGA:	56 kms length of the river from Barrage (approx 300m from Patalipura village) at Lat 21°38'12.96"N, Long 86°50'53.17"E to confluence of Budha Balanga river with Bay of Bengal at Chandipur Fishing Port Lat 21°28'12.14"N, Long 87° 4'11.60"E
4	MAHANADI RIVER:	425 kms length of the river from Sambalpur Barrage at Lat 21°27'34.33"N, Long 83°57'49.80"E to Paradip at Lat 20°19'38.12"N, Long 86°40'16.96"E
CLUSTER-5		
1	PENNAR RIVER:	29 kms length of the river from Penna Barrage, Pothireddypalem at Lat 14°28'8.38"N, Long 79°59'9.31"E to confluence with Bay of Bengal near Kudithipalem at Lat 14°35'36.75"N, Long 80°11'30.61"E
2	KAVERI / KOLLIDAM RIVER:	364 kms length of the river from Uratchikottai Barrage at Lat 11°29'3.09"N, Long 77°42'13.68"E to confluence with Bay of Bengal at Pazhaiyar Lat 11°21'37.97"N, Long 79°49'53.23"E
3	PALAR RIVER:	141 kms length of the river from rail bridge at Virudampattu, Vellore Lat 12°56'14.07"N, Long 79° 7'29.70"E to confluence with Bay of Bengal at Sadurangapattinam Lat 12°27'52.16"N, Long 80° 9'13.47"E
4	PAZHYAR RIVER:	20 kms length of the river from Bridge near Veeranarayana Mangalam village at Lat 8°13'48.97"N, Long 77°26'27.34"E to confluence with Arabian Sea at Manakudi at Lat 8° 5'15.01"N, Long 77°29'7.61"E
5	PONNIYAR RIVER	125 km length of the river from Sathanur Dam at Lat 12°11'0.06"N, Lon 78°51'1.25"E to Cuddalore at confluence of Bay of Bengal at Lat 11°46'21.76"N, Lon 79°47'41.70"E
6	TAMARAPARANI RIVER:	64 kms length of the river from Sulochana Mudalir bridge, Tirunelveli at Lat 8°43'43.17"N, Long 77°42'53.94"E to confluence with Bay of Bengal near Punnaikayal at Lat 8°38'24.90"N, Long 78° 7'37.85"E
CLUSTER-6		
1	West Coast Canal	160 kms length of the canal as extension of NW-3 towards north of Kottapuram - from Kottapuram at Lat 10°11'38.32"N, Long 76°12'4.39"E to Kozhikode at Lat 11°13'38.83"N, Long 75°46'43.90"E
2	ALAPPUZHA-CHANGANASSERY CANAL	28 km from Boat jetty, Alappuzha at Lat 9°30'2.85"N, Lon 76°20'37.05"E to Changanassery Jetty at Lat 9°26'41.61"N, Lon 76°31'41.76"E
3	ALAPPUZHA- KOTTAYAM – ATHIRAMPUZHA CANAL	38 km from Boat jetty, Alappuzha at Lat 9°30'2.85"N, Lon 76°20'37.05"E to Athirampuzha market Lat 9°40'04"N, Lon 76°31'54"E
4	KOTTAYAM-VAIKOM CANAL	28 km from Kottayam, near Kodimatha at Lat 9°34'38.67"N, Lon 76°31'7.67"E to Vechoor joining National Waterway no. 3 at Lat 9°40'0.19"N, Lon 76°24'10.65"E
5	GURUPUR RIVER	10 km length of the river from confluence of Netravathi river at Lat 12°50'44.04"N, Lon 74°49'44.51"E to confluence of Mangalore Port Bridge at Lat 12°55'34.81"N, Lon 74°49'37.34"E

6	KABINI RIVER	23 km length of the river from Kabini Dam Lat 11°58'24.52"N, Lon 76°21'9.69"E to Beeramballi at Lat 11°56'9.55"N, Lon 76°14'17.58"E
7	KALI RIVER	54 km length of the river from Kodasalli Dam Lat 14°55'8.24"N, Lon 74°32'6.90"E to confluence of Kali river with Arabian Sea near Sadashivgad bridge at Lat 14°50'30.95"N, Lon 74° 7'21.32"E
8	NETRAVATHI RIVER	78 km length of the river from Netravathi Dam, Dharmsthala Lat 12°57'55.23"N, Lon 75°22'10.19"E to confluence with Arabian sea at Bengre Lat 12°50'42.73"N, Lon 74°49'28.86"E
9	PANCHAGANGAVALI (PANCHAGANGOLI) RIVER	23 km length of the river from Gangoli Port at Lat 13°38'1.30"N, Lon 74°40'8.43"E to Bridge at Badakere at Lat 13°44'50.01"N, Lon 74°39'15.13"E
10	SHARAVATI RIVER	29 km length of the river from Honnavar Port Sea Mouth at Lat 14°17'56.23"N, Lon 74°25'27.04"E to link at highway at Gersoppa Lat 14°14'14.73"N, Lon 74°39'6.15"E
11	UDAYAVARA RIVER	16 km length of the river from Arabian Sea Mouth at Malpe Lat 13°20'57.24"N, Lon 74°41'28.22"E to Bridge near Manipura Lat 13°17'32.70"N, Lon 74°46'25.56"E
	CLUSTER-7	
1	CHAPORA RIVER	33 kms length of the river from Bridge at State highway # 124 (1Km from Maneri village) Lat 15°42'47.31"N, Long 73°57'23.38"E to Confluence of Chapora river with Arabian Sea at Morjim Lat 15°36'33.27"N, Long 73°44'0.93"E
2	MAPUSA / MOIDE RIVER	27 kms length of the river (including Moide river) from bridge on NH17 at Mapusa Lat 15°35'20.79"N, Long 73°49'17.20"E to confluence point of Mapuca & Mandovi rivers at Porvorim Lat 15°30'20.01"N, Long 73°50'42.09"E
3	SAL RIVER	14 kms length of the river from Orlim Deusa Bridge at Lat 15°13'11.41"N, Long 73°57'29.77"E to confluence with Arabian Sea at Mobor Lat 15° 8'31.93"N, Long 73°56'59.89"E
4	AMBA RIVER	45 kms length of the river from Arabian Sea, Dharamtaar creek near village Revas at Lat 18°50'15.14"N, Long 72°56'31.22"E to a Bridge near Nagothane ST Stand at Lat 18°32'19.82"N, Long 73° 8'0.29"E
5	DABHOL CREEK/VASHISHTI RIVER	45 km length of the river from Arabian Sea at Dabhol Lat 17°34'51.33"N, Lon 73° 9'17.83"E to bridge at Pedhe Lat 17°32'39.45"N, Lon 73°30'35.56"E
6	KALYAN-THANE-MUMBAI WATERWAY, VASAI CREEK AND ULHAS RIVER	145 km length of the waterway from Arabian Sea at Navi Mumbai Lat 18°55'49.78"N, Lon 72°53'21.67"E via Ulhas river to bridge on State Highway No.76 near Malegaon T. Waredi Lat 19° 2'38.20"N, Lon 73°19'53.79"E Bridge on Kalyan-Badlapur road near Kalyan railway yard at Kalyan Lat 19°14'6.39"N, Lon 73° 8'49.13"E to Kalyan Lat 19°15'35.03"N, Lon 73° 9'27.77"E Vasai Creek from Lat 19°18'53.50"N to Lon 72°47'30.18"E to Kasheli at Lat 19°13'22.84"N, Lon 73° 0'21.44"E
7	RAJPURI CREEK	31 km length of the river from Arabian Sea at Rajpuri Lat 18°18'3.15"N, Lon 72°56'42.94"E to Mhasala at Lat 18° 8'15.37"N, Lon 73° 6'45.35"E
8	REVADANDA CREEK / KUNDALIKA RIVER	31 km length of the river from Arabian Sea at Revadanda Lat 18°32'19.85"N, Lon 72°55'32.80"E to bridge on Roha-Astami Road near Roha Nagar Lat 18°26'31.50"N, Lon 73° 7'10.74"E
9	SAVITRI RIVER (BANKOT CREEK)	44 kms length of the river from Bridge near Sape at Lat 18° 5'54.11"N, Long 73°20'8.81"E to Arabian Sea at Harihareswar Lat 17°58'47.10"N, Long 73° 2'15.01"E
10	SHASTRI RIVER / JAIGAD CREEK	52 kms length of the river from Sangmeshwar at Lat 17°11'15.83"N, Long 73°33'2.57"E to confluence with Arabian Sea at Jaigad Lat 17°19'11.92"N, Long 73°12'39.30"E

CLUSTER-8		
1	MAHI RIVER:	248 kms length of the river from Kadana Dam at Lat 23°18'22.35"N, Long 73°49'37.45"E to confluence with Gulf of Khambhat near Kavi railway station at Lat 22°10'34.71"N, Long 72°30'36.31"E
2	NARMADA RIVER	227 km length of the river from Pandhariya at Lat 21°57'10.37"N, Lon 74° 8'27.46"E to confluence of Narmada with Arabian Sea at Gulf of Khambhat Lat 21°38'26.81"N, Lon 72°33'28.24"E
3	SABARMATI RIVER:	212 kms length of the river from Barrage near Sadoliya at Lat 23°26'49.66"N, Long 72°48'34.85"E to confluence with Gulf of Khambhat near Khambhat at Lat 22° 9'17.99"N, Long 72°27'27.81"E
4	TAPI RIVER:	436 kms length of the river from Hatnur Dam near Mangalwadi at Lat 21° 4'21.99"N, Long 75°56'44.88"E to confluence with Gulf of Khambhat (Arabian Sea) at Lat 21° 2'15.51"N, Long 72°39'29.63"E

#	River/Canal	State	Length (km)	Spacing (m)	Ave. width (m)
CLUSTER-2					
1	Dhansiri / Chathe	Assam	110	150	150
2	Lohit	Assam & Arunachal Pradesh	100	200	1000
3	Subansiri	Assam	111	200	1000
4	Tizu and Zungki	Nagaland	42	50	100
			363		
CLUSTER-3					
1	BIDYA RIVER	West Bengal	55	200	1500
2	CHHOTA KALAGACHI (CHHOTO KALERGACHI) RIVER	West Bengal	15	200	500
3	DVC CANAL	West Bengal	130	100	100
4	GOMAR RIVER	West Bengal	7	200	400
5	HARIBHANGA RIVER	West Bengal	16	200	2000
6	HOGLA (HOGAL)-PATHANKHALI RIVER	West Bengal	37	200	300
7	KALINDI (KALANDI) RIVER	West Bengal	8	200	500
8	KATAKHALI RIVER	West Bengal	23	200	200
9	MATLA RIVER	West Bengal	98	200	2000
10	MURI GANGA (BARATALA) RIVER	West Bengal	27	200	3000
11	RAIMANGAL RIVER	West Bengal	52	200	800
12	SAHIBKHALI (SAHEBKHALI) RIVER	West Bengal	14	200	300
13	SAPTAMUKHI RIVER	West Bengal	37	200	700
14	THAKURRAN RIVER	West Bengal	64	200	1000
			583		
CLUSTER-4					
1	Baitarni	Odisha	49	100	100
2	Birupa / Badi Genguti / Brahmani	Odisha	156	100	200
3	Budha Balanga	Odisha	56	100	100
4	Mahanadi	Odisha	425	200	500
			686		

CLUSTER-5					
1	Pennar	Andhra Pradesh	29	100	400
2	Kaveri / Kollidam	Tamil Nadu	364	200	400
3	Palar	Tamil Nadu	141	200	500
4	Pazhyar	Tamil Nadu	20	50	100
5	PONNIYAR	Tamil Nadu	125	200	300
6	Tamaraparani	Tamil Nadu	64	150	300
			743		
CLUSTER-6					
1	West Coast Canal	Kerala	160	50	100
2	ALAPPUZHA- CHANGANASSERY CANAL	Kerala	28	50	100
3	ALAPPUZHA- KOTTAYAM – ATHIRAMPUZHA CANAL	Kerala	38	50	100
4	KOTTAYAM-VAIKOM CANAL	Kerala	28	50	100
5	GURUPUR RIVER	Karnataka	10	100	400
6	KABINI RIVER	Karnataka	23	200	500
7	Kali	Karnataka	54	150	450
8	Netravathi	Karnataka	78	100	300
9	PANCHAGANGAVALI (PANCHAGANGOLI) RIVER	Karnataka	23	150	600
10	SHARAVATI RIVER	Karnataka	29	150	400
11	UDAYAVARA RIVER	Karnataka	16	100	250
			487		
CLUSTER-7					
1	CHAPORA RIVER	Goa	33	100	250
2	MAPUSA / MOIDE RIVER	Goa	27	50	100
3	SAL RIVER	Goa	14	50	100
4	AMBA RIVER	Maharashtra	45	150	300
5	DABHOL CREEK/VASHISHTI RIVER	Maharashtra	45	150	400
6	KALYAN-THANE-MUMBAI WATERWAY, VASAI CREEK AND ULHAS RIVER	Maharashtra	145	150	350
7	RAJPURI CREEK	Maharashtra	31	150	1000
8	REVADANDA CREEK / KUNDALIKA RIVER	Maharashtra	31	150	400
9	SAVITRI RIVER (BANKOT CREEK)	Maharashtra	46	150	400
10	SHASTRI RIVER / JAIGAD CREEK	Maharashtra	52	150	300
			469		
CLUSTER-8					
1	MAHI RIVER	Gujarat	248	200	400
2	NARMADA RIVER	Maharashtra & Gujarat	227	200	500
3	SABARMATI RIVER	Gujarat	212	200	150
4	TAPI RIVER	Maharashtra & Gujarat	436	200	350
			1123		

Note:- Bathymetric and Topographical survey of specified Waterways is to be conducted for average width specified in above table. Average width of the Waterways is the average of narrow and wider portions of the river. For reservoir / ponding areas, only bathymetric survey of maximum 500m width in the deepest channel is to be carried out. Minimum 100m wide corridor is to be surveyed (only for rivers / canals having less than

60m water width). 100m wide corridor includes width of proposed Waterways. Bathymetric and topographic survey is to be carried out for 50m width on both side from the centre line of the channel.

a. Bathymetric and Topographical survey of proposed Inland Waterways is to be conducted for width specified in above table. Minimum 100m wide corridor is to be surveyed to assess the extent of land acquisition required for 100m wide corridor (100m wide corridor includes width of proposed Inland Waterways).
b. Cross-section sounding lines / leveling are to be run from bank to bank at spacing specified in above table, to identify the navigable channel.
c. Continuous soundings are to be taken by running the sounding boat at constant speed on the cross-section so as to get smooth contours. Intermediate line is to be run at bends, if the line spacing is more than the specified above.
d. For cross-sectional bathymetric survey more than 60m in proposed Inland Waterways, spot levels at line spacing x 20m length grid, on both banks should be taken. If Island or sandchur exist in the middle of the waterway, spot levels on the same spacing should also be taken and indicated in the charts along the same cross-section line.
e. If bathymetry cross-section is limited up to 60 mts width in waterway, then Consultant has to cover 100m corridor including spot levels in line spacing x 20m length grid on both banks.
f. If bathymetry cross-sectional is limited up to 20 mts width in waterway, then Consultant has to run three (03) nos. longitudinal lines. One in centre and one each at equal interval (near the edges of water).
g. If bathymetry cross-sectional is limited up to 10 mts width in waterway, then Consultant has to run one (01) no. longitudinal line at centre only.
h. If Island or sandchur exist in the middle of the river, spot levels on the same spacing should also be taken and indicated in the charts along the same cross-section line.
i. Surveys in non-approachable areas are to be informed by the Consultant and joint inspection (Consultant's representative & Engineer-In-Charge or his representative) will be held to confirm the non-approachable areas.
j. The survey area may consist of canal sections, rivers, sea openings of different dimensions. Hence, Consultant has to inspect the area to be surveyed and satisfy themselves with respect to site conditions before submission of bid. However, variation in quantity will be considered only for length of the river/canal (longitudinal length).
k. The soundings are to be reduced to the chart datum/ sounding datum established at every gauge stations.

1.2.1.4 CURRENT VELOCITY AND DISCHARGE MEASUREMENT

a. The current velocity and discharge at every 10 km interval shall be observed once in a day during the survey period. Current velocity and discharge at every 10 km interval are to be measured only once at different depths while carrying out survey in that region.
b. Current meter measurement should be taken at 1m below water surface or 0.5d (if depth is less than 1m), where d is measured depth of water & values indicated in the report along with position.
c. Measurements at different depths may be taken by single equipment over three different time spans.
d. Measurement of current velocity at different depth is to be measured for at least 15

minutes or as per listed calibration period of the equipment, under use for this project.

e. Current velocity and discharge can also be measured with the help of ADCP during survey, at every 10km interval. Discharge can be measured either by ADCP or standard formulas.

1.2.1.5 <u>WATER AND BOTTOM SAMPLES</u>

a. Water and bottom samples are to be collected from the deepest route at every 10 km interval and are to be tested and the results/characteristics of the soil and the water are to be incorporated in the report. Soil sample can be collected by a grab and water sample at 0.5d (d-measured depth of water) by any approved systems. The following tests are to be carried out for Bottom samples:-

i) Grain size distribution
ii) Specific gravity,
iii) PH value
iv) Cu, Cc
v) Clay silt%
and Sediment concentration for Water Samples.

1.2.1.5 <u>COLLECTION OF TOPOGRAPHICAL FEATURES</u>

a. Photographs of the prominent features are to be taken and included in the report along with its position.
b. Permanent structures located within this corridor are also required to be indicated on the report & charts.
c. All prominent shore features (locks, bridges, aqueducts, survey pillars if available etc) and other conspicuous objects are to be fixed and indicated on the chart and included in the report.
d. Identify cross structures which are obstructing navigation.
e. Details (horizontal and vertical clearances above High Flood Level in non-tidal area and High Tide Level in tidal area) of bridges, aqueducts, electric lines, telephone lines, pipe lines, cables en-route are to be collected and indicated on the chart and also included in the report along with their co-ordinates and location.
f. Details of water intake/ structures are to be collected and shown on the charts and include in the report.
g. Availability of berthing place, existing jetty, ferry ghats, approach roads etc. are to be indicated on the charts and include in the report.
h. During the survey, conditions of the banks are also required to be collected. It is to be noted that banks are pitched (protected) or not protected. Estimate the length of bank protection, where banks erosion is taking place.
i. Positions and levels of corners of permanent structures within the corridor are to be physically surveyed and marked on survey charts.
j. Approachable roads / rails / places outside the corridor may be incorporated from Toposheets/Google Map/Google Earth.

1.2.1.6 <u>SURVEY CHART PREPARATION</u>

a. The survey chart is to be prepared on a scale of 1:1,000 for Waterways width less than 100m. On a scale of 1:2,000 for Waterways width between 100m to 300m. On a scale of 1:5,000 for Waterways width between 300m to 500m and On a scale of 1:10,000 for Waterways width more than 500m.

b. Contours of 0m, 1m, 2m, 3 m, 5m and 10 m are to be indicated on the charts with respect to Chart Datum / Sounding Datum.
c. Reduced spot levels w.r.to MSL to be indicted on the charts. Spot level values are to be given w.r.t. Mean Sea Level (MSL) & Soundings w.r.t. Chart Datum / Sounding Datum. A separate file (xyz) (soft copy only) is also to be created for spot levels w.r.t. Chart Datum / Sounding Datum for dredging calculation purpose.
d. On completion of the cross-sections, dredge channel is to be identified/ established by linking deepest soundings on the cross-sections. Dredging quantity is to be estimated for developing a navigational channel of
   i. dimension of 32m x 1.8m, with side slope of 1:5, w.r.t. chart datum/sounding datum (if channel width is less than or equal to 100m).
   ii. dimension of 45m x 2.0m, with side slope of 1:5, w.r.t. chart datum/sounding datum (if channel width is more than 100m).
e. Dredging quantity is to be indicated in the report for per km length of the waterway.
f. Minimum & maximum reduced depth and length of shoal for per km length of the waterway is also to be indicated in the report.
g. Current meter measurement values shall be indicated in the report along with position.
h. The results/characteristics of the soil and the water are to be incorporated in the report.
i. Shallow patches /shoal and submerged sand-chur having less than 1.0 m depth, rocky outcrops, rapids and other navigational impediments are to be indicated on the charts.
j. A brief write up on condition of the locks, Sluice gates, Barrages, Dams etc. (if available) are also to be included in the report. Brief write up based on visual observation, photographs and information from State Irrigation Deptt. and local sources.
k. The chart shall also be suitably updated with prominent land features from the Topo-sheets/site. Available Survey of India (SOI) Topographic sheet will be shared with successful Consultant on receipt of Undertaking. Satellite imageries are not available with IWAI for the designated area. Route map and survey plan will be provided by IWAI to the successful Consultant.
l. All raw data and processed data of Automatic Hydrographic Survey System are required to be submitted. Standard procedure is to be adopted for data processing. All RAW, EDIT, SORT and field data are required to be submitted by the Contractor.
m. All surveyed field data including leveling data (csv file) are required to be submitted.
n. All position data of ground features, waterway structures are to be submitted in both hard copies and soft copies.

1.2.2 TRAFFIC SURVEY & TECHNO ECONOMIC FEASIBILITY

This is a detailed study to make a forecast of the traffic prospects to facilitate the projection of the most promising route for waterway transport and to assess the quantum of traffic of vessels/cargo on that route. This survey is to be under-taken in conjunction with Reconnaissance and Hydrographic surveys so that the Techno Economic feasibility and costs of the alternative proposals can be taken into account while formulating the recommendations.

Modality of conducting traffic survey shall be based on industrial surveys and a traffic projection for a horizon period (say 5, 10, 15 and 20 years) has to be forecasted based on standard methods. Divertible traffic to IWT is also to be assessed.

1.2.3 DETAILED PROJECT REPORT

The scope of works is as follows:

a. Assessment of the morphological, hydrological, hydrographical conditions, and operation and maintenance requirements of the proposed waterways to identify works in sufficient details that are required in respect of:
   - River conservancy including river training, bank protection, dredging etc. needed for shipping and navigation.
   - Navigational aids and communication facilities.
   - Improvements with reference to horizontal and vertical clearances required on the existing or proposed cross structures such as bridges, power cables, locks etc.

b. Geo-tech investigation will be carried out by the consultant as per standard guidelines of Geological Survey of India, Government of India.

c. To conduct necessary investigations for the preliminary design, to ensure a coordinated development to cover waterways engineering works and structures, waterway crossing, navigational structures, riverine ports and terminals, land and rail access.

d. Prepare preliminary engineering designs, drawings and estimates for the optimum structure of river training and bank protection measures and navigational aids to develop and maintain a navigable channel for the waterway system in an EPC mode.

e. For preliminary engineering designs, the data about soil characteristics shall be collected from the local sources based on the structures constructed nearby. In case of critical structures, consultant can suggest that detailed soil investigation including borehole tests etc.

f. River training/bank protection works particularly for those stretches where either the channel is narrow and needs to be widened by dredging or where it is anticipated that the bank can erode due to continuous movement of barges.

g. Identify the location and carry out preliminary designs of cargo terminals and river ports to handle the anticipated cargo as duly updated.

h. Prepare a realistic construction schedule for the whole project indicating the priority of different components of the project. The phasing of expenditure is also to be worked. Also suggest phased programs of construction including riverine terminals and ports which shall be fully integrated with the existing and planned irrigation and hydropower facilities.

i. Prepare cost estimate for various possible alternatives for the entire proposed infrastructure, handling, and other allied facilities. While comparing the different alternatives, the cost and economy factors shall also be evaluated. The most suitable alternative recommended shall have detailed costing for all the components of the project. The Consultant is to propose the River conservancy including river training, bank protection, dredging etc. needed for shipping and navigation. Alternate possible methods for water augmentation are also to be suggested in detail. FIRR, EIRR, NPV and SWOT analysis are also to be carried out by the Consultant.

j. Assess the environmental impacts due to these development works and suggest suitable environmental management plan (EMP) to mitigate the adverse impacts, if any, including its cost. Flood Plain specialist will be responsible to assess the Environmental Impact and preparation of EMP. Consultant has to identify the Authorities who will give the clearances for EIA/EMP. Consultant will not be required to take clearances from these identified Authorities.

k. Suggest horizontal and vertical clearances to be provided on cross structure such as bridges, power cables, locks etc. for commercial viable navigation in present as well as in future. For this, IWAI guidelines Section-IV, may also be referred to.

2.0 PERIOD OF SERVICES

Consultant may associate with sub Consultant(s) to enhance their expertise. The applicant shall submit a Memorandum of Understanding (MOU) with the Sub Consultant regarding the role and responsibilities of the Associate Company along with the proposal.

2.1 TIME SCHEDULE/SUBMISSION OF REPORTS:

(a) The time of completion of various sub-stages of the assignment will be as given below:

	Sl. No	Activity	Cluster -2	Cluster -3	Cluster -4	Cluster -5	Cluster -6	Cluster -7	Cluster -8
			Time in weeks**						
Stage-I	a)	Mobilization of the Team and submission of Inception Report (2 copies)	6	9	10	11	8	8	15
	b)	Submission of Draft Feasibility Report (3 copies)	9	12	13	14	11	11	18
	c)	Comments from IWAI	11	14	15	16	13	13	20
	d)	Presentation and Submission of Final Pre-feasibility Report (3 copies)	13	16	17	18	15	15	22
Stage-II	a)	Acceptance of Stage-I report and go ahead for Stage-II by IWAI	15	18	19	20	17	17	24
	b)	Submission of Hydrographic Survey Charts and report (3 copies)	23	30	29	31	24	26	38
	c)	Submission of Draft Detailed Project Report (3 copies)	31	38	37	39	32	34	46
	d)	Receipt of comments of IWAI on Draft DPR.	33	40	39	41	34	36	48
	e)	Submission of Final Detailed Project Report (10 copies) after incorporating final comments of IWAI.	39	46	45	47	40	42	54
****reckoned from the date of signing of Contract or 15 days from the date of issuance of work order, whichever is earlier.**									

NOTE: - The consultants are required to submit the following outputs in Stage-II for all the clusters in the enclosed standard templates:-

vi) Traffic Template: at Annex-IV
vii) Project Costing Template: at Annex-V
viii) Financial Evaluation Template: at Annex-VI
ix) Economic Evaluation Template: at Annex-VII
x) Environmental & Social Screening Template: at Annex-VIII

3.0 Minimum Qualification of Key Professionals

Sl. No	Key Professionals	Qualification Criteria
1.	**Waterway Expert (Team Leader)**	**Educational Qualification:** • Should be Graduate in Civil Engineering. Higher professional qualification in Port and Harbor Engineering/Structural Engineering/Geo-technical Engineering will be preferred. **Professional Qualification:** • Minimum 15 years" experience in planning, design, construction, preparing Feasibility Report/Detailed Project Report for various waterway/port/river front development/river training works, terminals, trade facilitations and other infrastructures in different natural and operational conditions with at least 5 years in a reputed firm of consultants.
2.	**Port planning & Infrastructure Specialist**	**Educational Qualification:** • Should be Graduate in Civil Engineering. Postgraduate training/ studies in Port & Harbor Engineering will be preferred. **Professional Qualification:** • Minimum 10 years" experience in Port planning, Port infrastructure Planning and development of physical facilities for port operations. Should be well conversant with different types of port structures and other physical facilities required for the provision of various port services efficiently. Should preferably have experience/ exposure of constructing several modern ports.
3.	**Remote Sensing/GIS Expert**	**Educational Qualification:** • Should be Graduate in Engineering/Geology. Higher professional qualification in Remote Sensing/ Geoinformatics will be preferred. **Professional Qualification:** • Minimum 10 years" experience in waterway/port/river mapping and a demonstrated proficiency in using the GIS software. Working knowledge of spatial data formats and related metadata issues. Working knowledge of web mapping applications, such as Google Earth/Bhuvan.
4.	**Floodplain Specialist**	**Educational Qualification:** • Should be Graduate in Civil/Environmental Engineering. Higher professional qualification in Floodplain Management/ Hydrology/Water Resource Engineering will be preferred. **Professional Qualification:** • Minimum 10 years" experience in Floodplain Management. Working

Sl. No	Key Professionals	Qualification Criteria
		knowledge of water and/or wastewater modeling is desirable.
5.	**Hydrographic Expert**	**Educational Qualification:** • Should be ITI in Survey/Diploma in Civil Engineering. Higher qualification in relevant field will be preferred. **Professional Qualification:** • Minimum 8 years‟ experience in conducting hydrographic surveys, investigations and measurements, bathymetric surveys/Topographic Survey in a variety of geographical locations and natural.
6.	**Soil Engineer/ Foundation Engineer**	**Educational Qualification:** • Should be Graduate in Civil/Environmental Engineering. Higher qualification in Marine Structure/Geotechnical Engineering will be preferred. **Professional Qualification:** • Minimum 10 years‟ experience in related field. He should have experience of the soil investigation, reclamation work, soil improvement and will be associated in foundation design. He will also be responsible for preparation of cost estimates/BOQ.
7.	**Traffic Surveyor**	**Educational Qualification:** • Should be Graduate in Engineering. Higher qualification in relevant field will be preferred. **Professional Qualification:** • Minimum 10 years‟ experience in related field. He should have experience of traffic survey of waterways/river/canal or similar facilities.
8.	**Transport Economist**	**Educational Qualification:** • Should be Graduate in transport planning management, transport economics, transport/road/rail/Civil engineering/MBA or equivalent qualifications. Higher qualification in relevant field will be preferred. **Professional Qualification:** • Minimum 10 years‟ experience in related field. He should have experience of estimating transport investments and implementing transport programs.

NOTE 1:- If the Key Personnel proposed in the CV does not fulfill the minimum academic qualification, the overall score of his CV will be evaluated as zero. All such Key Personnel (whose CV scores less than 75% or who does not fulfill the minimum qualification) will have to be replaced by the firm. H-1 firm will be intimated for replacement of such personnel and work will be awarded after receipt of CV‟s fulfilling the tender criteria.

Note 2:- IWAI may call each key personnel of the preferred Consultant at the time of award of work, at the cost of Consultant.

Note 3: - In case during interaction with the key personnel, it is found that the key personnel proposed is un-suitable for the assignment position, his replacement by equivalent or better shall be provided by the consultant. The key personnel with such un-suitable CV shall not be considered in any future bids for that position for two years. No deduction for such replacement, who are not found suitable during interaction shall be made.

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

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

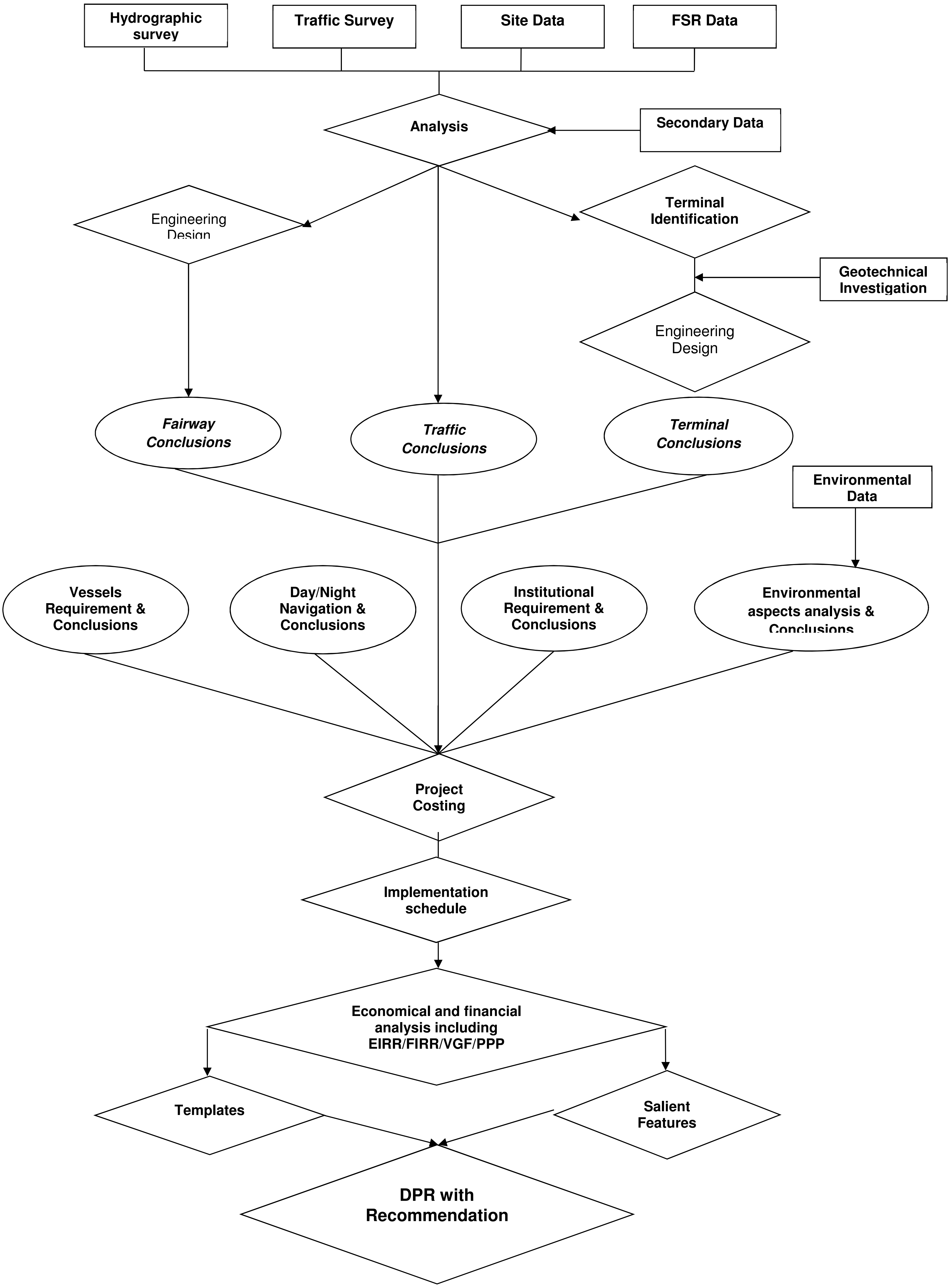
ANNEXURE 1.2 – COMPLIANCE ON TOR OF THE AGREEMENT

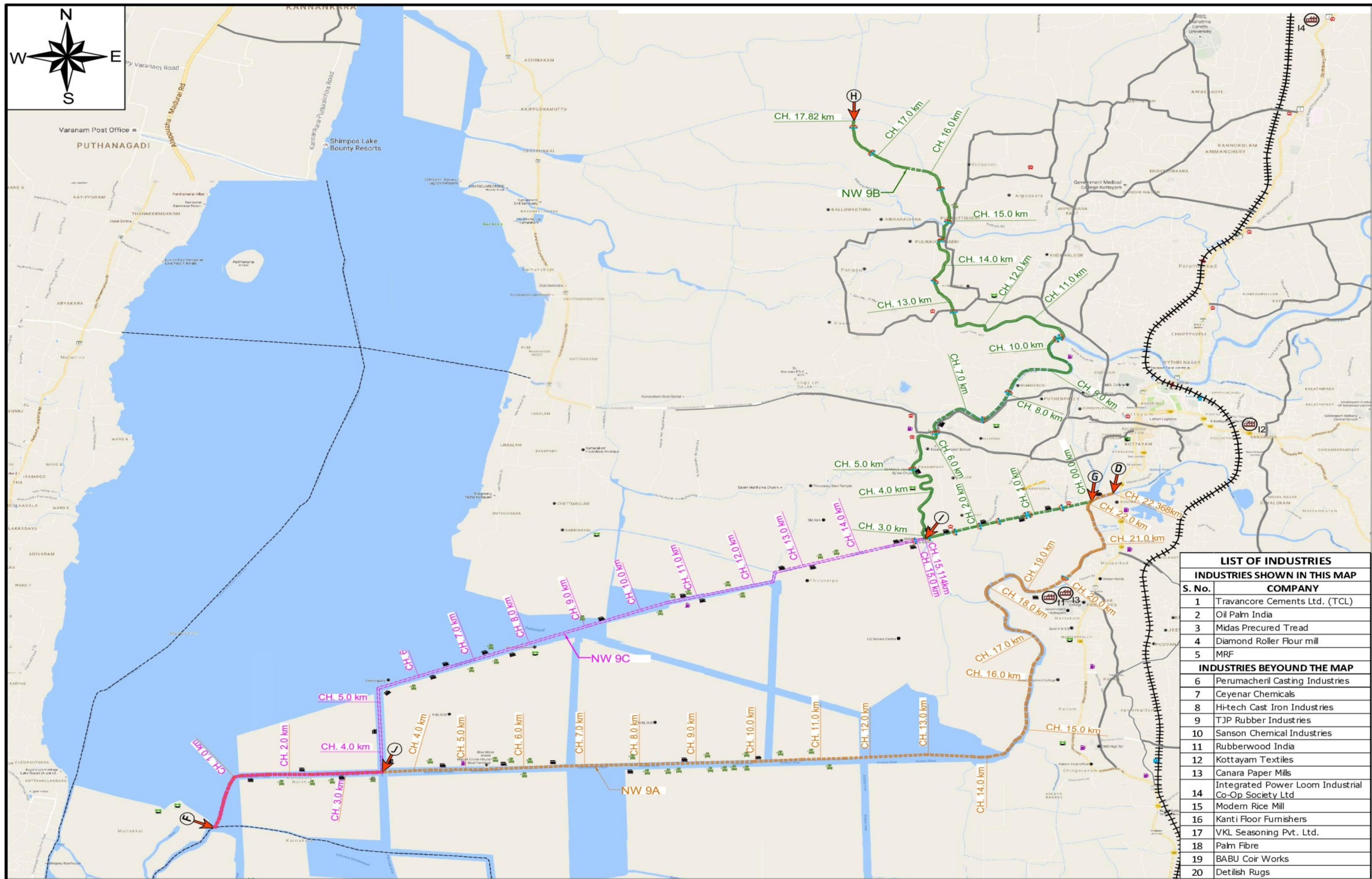
COMPLIANCE ON THE TERMS OF REFERENCE

ALAPPUZHA / KAINAKARY – KOTTAYAM / KODIMATHA AND KANJIRAM – MANIYAPARAMBU CANAL (51.70KM) NW – 9

Brief of ToR	Compliance
1.0 OBJECTIVE OF THE STUDY: The study would consist of 2 stages: Stage-1 &Stage-2	
1.1 STAGE-1 1.1.1 Reconnaissance Survey – i) to xii) 1.1.2 Collection and Review of Available Data 1.1.3 Feasibility Report 1. Introductory considerations: 2. Analysis of present state of affairs: 3. Market Analysis: 4. Reconnaissance Survey:	Stage I has been completed and based on the same, Stage II Work Order was provided by IWAI.
1.2 STAGE-2 1.2.1 HYDROGRAPHIC SURVEY & HYDROMORPHOLOGICAL SURVEY (i) The detailed hydrographic survey is to be carried out in WGS"84 datum. (ii) The horizontal control is to be made using DGPS with minimum 24 hours observations at some platform/base. The vertical control is to be established with respect to the chart datum / sounding datum	Detailed Hydrographic Survey was completed and the data compiled / analysed (including the Charts) have been submitted under Volume III of the report. Further, the analysed data have been taken into Volume I and Volume II of the Report appropriately.
1.2.1.1 <u>BENCH MARK PILLARS – a)</u>	-do-
1.2.1.2 <u>WATER LEVEL GAUGES i) & ii)</u>	-do-
1.2.1.3 <u>BATHYMETRIC AND TOPOGRAPHICAL SURVEY – a) to k)</u>	-do-
1.2.1.4 <u>CURRENT VELOCITY AND DISCHARGE MEASUREMENT – a) to e)</u>	-do-
1.2.1.5 <u>WATER AND BOTTOM SAMPLES – a) – i) to vi)</u>	-do-
<u>COLLECTION OF TOPOGRAPHICAL FEATURES – a) to j)</u>	-do-
1.2.1.6 <u>SURVEY CHART PREPARATION – a) to n)</u>	-do-
1.2.2 TRAFFIC SURVEY & TECHNO ECONOMIC FEASIBILITY	Submitted in Chapter 4 and in the inter related chapters
1.2.3 DETAILED PROJECT REPORT The scope of works is as follows: in paras a) to k)	Submitted the Volume I of the DPR.
2.0 PERIOD OF SERVICES	
2.1 TIME SCHEDULE/SUBMISSION OF REPORTS:	Delay observed, as narrated from time to time.
NOTE: - The consultants are required to submit the following outputs in Stage-II i) Traffic Template: at Annex-IV ii) Project Costing Template: at Annex-V iii) Financial Evaluation Template: at Annex-VI iv) Economic Evaluation Template: at Annex-VII v) Environmental & Social Screening Template: at Annex-VIII	Submitted at Chapter 15 – Templates in the DPR Volume I.

ANNEXURE 1.3 – SEQUENTIAL APPROACH TO THE PROJECT IN SCHEMATIC FORM





MAP 4.1

LEGEND	
	INDUSTRY
	PLACE NAME
	JETTY
	RAILWAY STATION
	NATIONAL/STATE HIGHWAY (Hwy)
	ROAD
	EXISTING WATERWAY/FERRY LINE
	ROUTE PROVIDED BY IWAI
	PUMP HOUSE
	RAILWAY LINE
	RESORT
	FUEL STATION/PUMP
	BUS STOP
	RAILWAY STATION
	ALIGNMENT FOR PROPOSED WATERWAY (ABOUT 40m WIDE)
	BRIDGE
	N.W.-9 DETAILS
F	START POINT FROM ALAPPUZHA AT LAT. 9°31'1.31" N LON. 76°22'44.15" E
D	END POINT KOTTAYAM, NEAR KODIMATHA AT LAT. 9°34'39" N LON. 76°31'08" E
I	START POINT FROM KANJIRAM JUNCTION NORTH, AT LAT. 9°34'9.06" N LON. 76°29'21.91" E
H	END POINT MANIAPARAMBU AT LAT. 9°38'40.18" N LON. 76°28'42.71" E
J	START POINT FROM KAINAKARY NORTH, AT LAT. 9°31'37.75" N LON. 76°24'19.33" E
G	END POINT KOTTAYAM AT LAT. 9°34'32.96" N LON. 76°30'53.39" E

LIST OF INDUSTRIES

S. No.	COMPANY
	INDUSTRIES SHOWN IN THIS MAP
1	Travancore Cements Ltd. (TCL)
2	Oil Palm India
3	Midas Precured Tread
4	Diamond Roller Flour mill
5	MRF
	INDUSTRIES BEYOUND THE MAP
6	Perumacheril Casting Industries
7	Ceyenar Chemicals
8	Hi-tech Cast Iron Industries
9	TJP Rubber Industries
10	Sanson Chemical Industries
11	Rubberwood India
12	Kottayam Textiles
13	Canara Paper Mills
14	Integrated Power Loom Industrial Co-Op Society Ltd
15	Modern Rice Mill
16	Kanti Floor Furnishers
17	VKL Seasoning Pvt. Ltd.
18	Palm Fibre
19	BABU Coir Works
20	Detilish Rugs

LIST OF JETTIES

SL.	DESCRIPTION	JETTY NO.S
1	ALAPPUZHA TO KOTTAYAM, NEAR KODIMATHA	12
2	KANJIRAM JUNCTION TO MANIAPARAMBU	3
3	KAINAKARY NORTH TO KOTTAYAM	19

TRACTEBEL
ENGIE

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Intec House, 37
Institutional Area, Sector 44
122002 Gurgaon-INDIA

CLIENT: INLAND WATERWASYS AUTHORITY OF INDIA
MINISTRY OF SHIPPING

CONTRACTOR:

PROJECT NAME: CONSULTANCY SERVICES FOR PREPARATION OF SECOND STAGE DPR OF CLUSTER -6 KERALA OF NATIONAL WATERWAYS

TITLE: LAYOUT MAP SHOWING EXISTING JETTIES & INDUSTRIES IN VICINITY OF N.W.-9 (MAP 4.1)

STATUS OF DRAWING:- ISSUED FOR DPR

DRAWING NO:- | REV. A | SHEET 1 OF 1

SCALE NTS | SIZE A3

Rev.	Y M D	Modifications	Status	Drawn	Checked	Approved	Validated
A	2018-05-18	FIRST SUBMISSION	DPR	HDR	SRI	NSR	BCJ
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-

ANNEXURE 4.2 – SUMMARY OF INTERVIEWS

Sr. No.	Name of Port/Industries	Designation
1	Cochin Port	Deputy Traffic Manager / Sr. Asst. Traffic Manager
2	Kottayam Port & Container Terminal	Chief Executive Officer
3	State Water Transport Department	Director
4	Travancore Cements Ltd.	Deputy Manager
5	MRF	Sr. Manager
6	Petrogas India	Plant Manager
7	Diamond Roller Flour Mill	General Manager

Name of Company: Cochin Port

Contact Person: Mr. Girish Thomas / Mr. D Anil Kumar

Designation: Deputy Traffic Manager / Sr. Asst. Traffic Manager

Coal handling at Cochin Port has reduced to 44,000 T. Coal from Cochin Port is transported to Malabar Cement and Hindustan Newsprint Ltd. in Kottayam. There is some scope to transport cement to Kozhikode but due to some unknown reasons, industries are not using waterways for cement transport. Electronics, Garments, Tiles & Timber are the major goods for container movement. It can also be transported through waterways if industries demand it.

Name of Company: Kottayam Port & Container Terminal

Contact Person: Mr. Cherian K. Varghese

Designation: Chief Executive Officer

As per discussion with the Chief Executive Officer of KPACT, Mr. Cherian K. Varghese, KPACT needs IWAI to develop certain facilities, which includes a jetty, cranes for handling cargo and smooth navigation in the proposed waterway.

Name of Company: State Water Transport Department

Contact Person: Mr. Shaji V Nair

Designation: Director

Mr. Nair shared his inputs regarding the existing ferry services in Alappuzha, Kottayam & Changanassery. SWTD has witnessed increasing growth in the demand of ferries for passengers/tourists. SWTD has a plan to move Catamaran boat for passengers and tourists. When asked about the potential of Ro-Ro in the existing ferry routes, Mr. Nair shows optimism for Ro-Ro; however he showed concern about less draft problem in some places in the waterway. He said that if the problem of less draft is solved then there is good potential for Ro-Ro in the waterway.

Name of Company: Travancore Cements Ltd.

Contact Person: Mr. P. Ashok Kumar / Mr. Kanan

Designation: Deputy Manager (Marketing)/ Deputy Manager (Maintenance & Internal Projects)

Date: 2017

As per Mr. Kanan, at present the company does not use Vembanad Lake for lime shell, which was the major raw material for manufacturing cement. Earlier, TCL used to procure limestone from Tirunelveli, Tamil Nadu through roadways, however at present TCL stopped using lime shell and limestone as raw materials. TCL now uses clinker as substitute because Limestone and lime shell are calcium carbonate and clinker also is made of the same material. TCL imports clinker from Gulf countries through Cochin Port and the company's expansion plans are also depended on clinker as raw material. According to Mr. Kanan, the plant of TCL is shut down now; however it would start operation form June 2017. The plant produces around 2,000-2,500 tonnes of white cement per month.

TCL has shared some concerns about using IWT Waterway, they are listed below.

- According to Mr. Kanan, the draft of the existing NW in some places is less, i.e. 2 mtrs. only, which is very less for even medium size vessels.
- Mr. Kanan also shared his concern about Thanneermukkom Bund, which is a gate type structure in Vembanad lake and used as salt water barrier. This barrier essentially divides the lake into two parts. This barrier opens when any ship or vessel crosses; however the breadth of the barrier is very less and is not enough for bigger vessels. TCL plans to transport 500-1,000 metric tonne clinkers in one go through vessels in waterway. This means the size of their vessel would be bigger and the opening structure would not be sufficient for the vessel to cross. If IWAI solves this problem, then TCL would like to use waterway extensively in future for its plant.
- The proposed waterway would stretch till Kollam in South; however TCL is interested to use waterway further ahead in South, if IWAI develops waterway in South.
- TCL has an expansion plan to increase production of grey cement to 10,00,000 tonnes (1 mn T) and white cement to 60,000 tonnes.. The raw material for this plant would be clinker.
- However, in future the company may consider using limestone also. The expansion plan is at DPR stage now.
- TCL has offered IWAI a parcel of land on its premise for the development of a terminal and additional infrastructure. This development would be based on mutual agreement and revenue profit sharing with IWAI.

Date: 2018

- According to Mr. Kanan, the plant of TCL is operational now. At present, the plant consumes 1000 tonnes clinker per month for manufacturing white cement. It produces 1000 tonnes of white cement per month. It is expected that the production of white cement would increase to 1200 – 1500 tonnes per month.
- The production of grey cement depends on future market demand. Therefore, as of now, it is not certain.

Name of Company: MRF, Kottayam

Contact Person: Eapen George

Designation: Sr. Manager

Mr. George shared that the annual capacity of MRF, Kottayam plant is 56,000 tonnes. The plant produces around 160 tonnes per day and they have 350 working days in a year. The plant uses Cochin Port for EXIM trade. Synthetic rubber is used as raw material and is imported from Russia, Japan & USA. Natural rubber is imported from Malaysia. The company also uses Cochin Port for export to different countries. At present, MRF is using roadways to transport cargo to/from Cochin Port. The company faces road congestion problems on highways on a daily basis.

As per Mr. George if the waterway is developed by IWAI and the transportation cost by waterways is cheaper, then definitely they would prefer waterway for their cargo transportation.

Name of Company: Oil Palm India

Contact Person: V.M. Jaisar

As per the discussion with Mr. Jaisar, the company produces 20 tonnes per hour palm oil. The company's annual production is around 0.17 million tonnes/annum. The finished product, refined oil is distributed in different states of India through roadways, using lorries. The company does not export its products to different countries. Oil Palm India is not willing to use waterways for transportation of its cargo.

Name of Company: Petrogas India

Contact Person: Mr. A.V. Varghese

Designation: Plant Manager

Petrogas India doesn't import anything. However, the company exports its products to different countries. For export, Cochin Port is used. The company also distributes its products in domestic market through roadways. Export quantity varies according to order; on an average the company exports 30 tonnes product per month.

Name of Company: Diamond Roller Flour Mill

Contact Person: Mr. E.K. Shajahan

Designation: General Manager

As per discussion with Mr. Shajahan, the company is involved in EXIM trade. The annual capacity of the plant is 66,000 MT. The plant procures raw material from Rajasthan, Gujarat, MP, UP and sometimes imports from other countries too through Cochin Port. The plant distributes the finished product to Kerala and Tamil Nadu; it also exports to other countries. Rail & Coastal Shipment is used for raw material movement, whereas road is used for transporting finished products.

As per discussion with the company representative, the major hurdle of present mode of transportation cargo is that Rail transportation in full rake load entails demurrage. The company is willing to use waterway if it is cost effective. Mr. Shajahan was concerned that multiple handling may add to transportation cost.

ANNEXURE 5.1 – Mail communication from M/s TCL

MAIL RECEIVED ON 25/06/2018

Sir,

Ref: (1) Our letter no. 2662 dated 26/02/2018 addressed to Inland Water Ways Authority of India

(2) Letter from Shri. N. Sivaraman, Sr. Consultant- Waterways

Please refer to the above. We would like to inform that 100mtr water front land of 12500 Sq.m is available for development of RO-RO jetty on the banks of Kodoor river and this can be allocated at mutually agreed terms and conditions. The barges and boats available with TCL is in the process of disposal / sale on discontinuation of lime shell dredging from Vembanad lake. However, TCL have two Cutter Suction Dredgers which are presently idling at factory now. The specifications of the dredgers are detailed below.

DREDGER- RUDINGER

Dredger	-	Mechanically operated Cutter Suction Dredger
Main Engine	-	680 ALM Leyland Engine
Main Pump	-	Morris
Suction line	-	12 inches dia
Delivery line	-	10 inches dia
Dredge capacity	-	3000 gallons/minute
Cutting Depth	-	45 feet

DREDGER – LOKANATHAN

Dredger	-	Hydraulic operated Cutter Suction Dredger
Main Engine	-	350 HP Caterpillar
Main Pump	-	AMSCO (USA) make
Suction line	-	12 inches dia
Delivery line	-	10 inches dia
Dredge capacity	-	5000 gallons/minute
Cutting Depth	-	50 feet

The site plan of the plot is attached herewith.

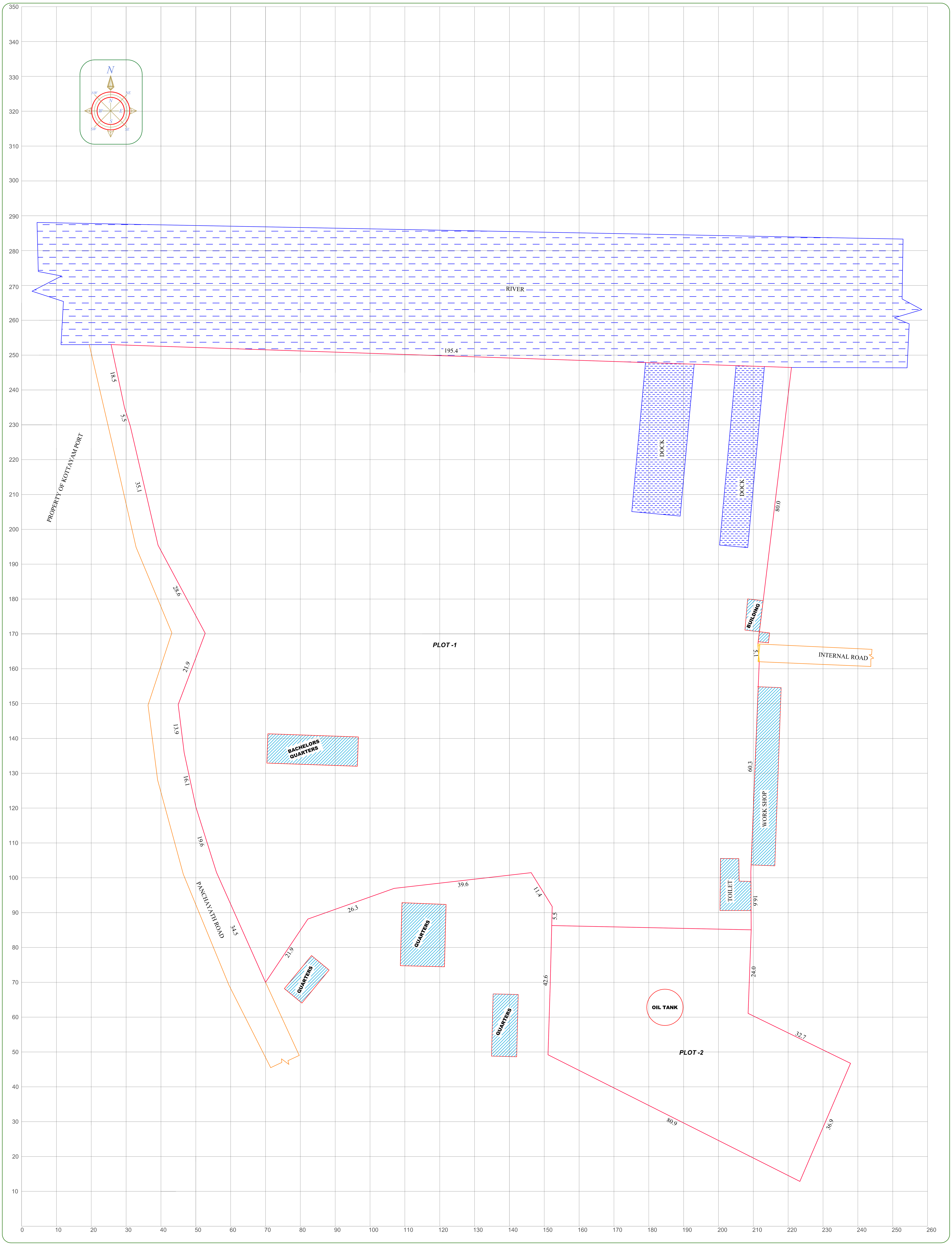
Thanking you,

For The Travancore Cements Ltd.

ANILKUMAR B
Senior Manager (P&O)
THE TRAVANCORE CEMENTS LIMITED
An ISO 9001:2008 Company)(A Govt. of Kerala Undertaking)
Nattakom PO, Kottayam, Kerala, India - 686 013.
GSTIN: 32AAACT7593C1ZG, TIN No: 32050212265, CIN No: U26941KL1946SGC001213
Web: www.travcement.com, Fax: 0481-2362354
Manufacturer of " VEMBANAD®" brand WHITE CEMENT and WALL PUTTY)

ANNEXURE 5.2 – LAND IMAGE OF M/S TCL AREA

ANNEXURE 5.3 – SITE PLAN OF M/S TCL AREA



Drawing Tittle:

PROPOSED SITE FOR GRAY CEMENT FACTORY AT TRAVANCORE CEMENT

Job no: AXS/AS/3999/17	Date: 18/05/17	Scale: 1:500	Revision :

Remarks:

All Dimensions are in meters

Legend

- PLOT BOUNDARY
- ROAD BOUNDARY
- WELL/DRAIN
- ELECTRIC POST

Area Details:

Sl no:	Description	Cents	Are
1	**PLOT -1**	669.813	271.07
2	PLOT -2	94.342	38.18
TOTAL SITE AREA		**764.155**	**309.25**

Surveyed by:

AXIS surveyors

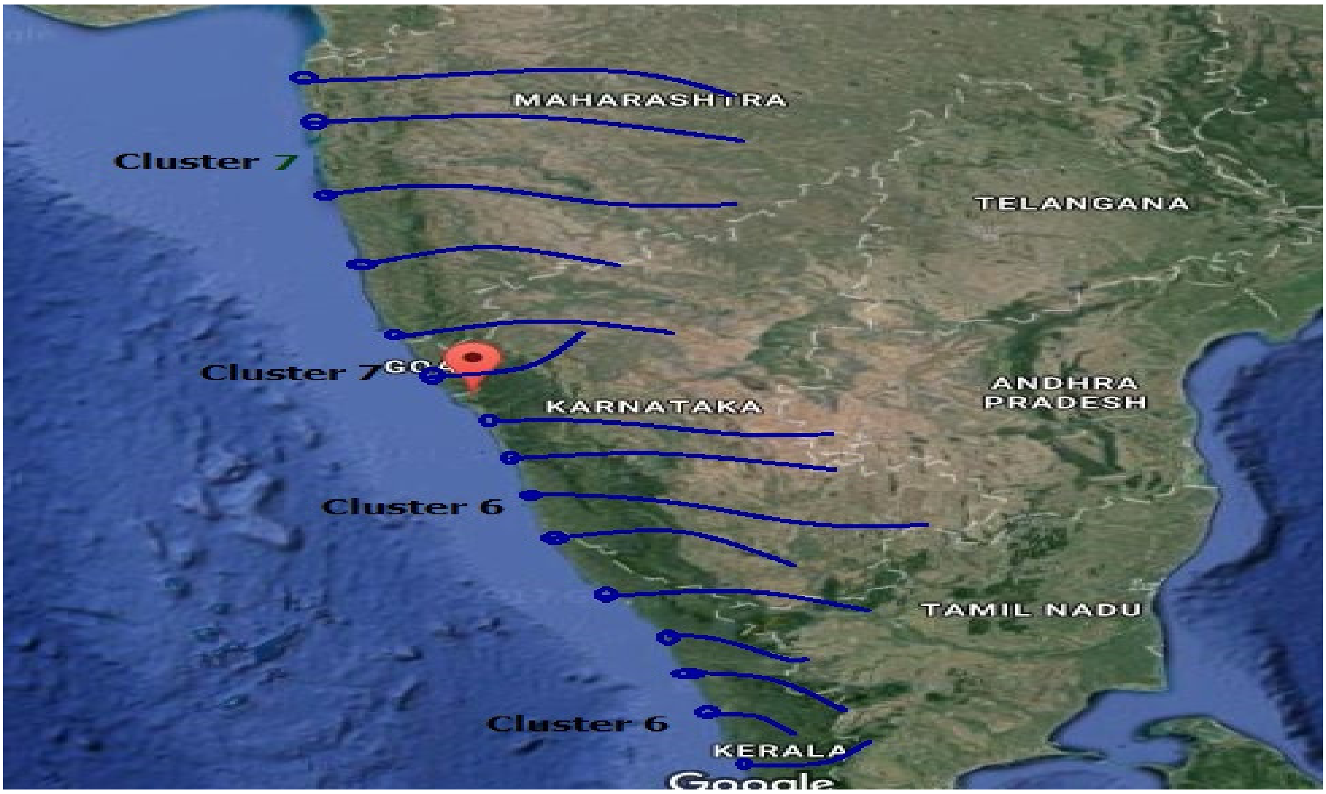
Digital land survey&consultancy

C-112 ,KRS Building, Opposite Muncipal Childrens Park,
Collectrate P.O, Kottayam-02
Email : axisurveyors@gmail.com
Mob:9446 200 979 , 9446 500 979

ANNEXURE 8.1 RIVER VESSEL TRACKING INFORMATION SYSTEM

RIVER VESSEL TRACKING INFORMATION SYSTEM

- RIS Objective
- Proposed AIS Base Station
- RIS Key Technologies
  - (a) Vessel Tracking & Tracking
  - (b) Onshore Facilities
- AIS Base Station Set up
- AIS Station Tower Design
- AIS Station VHF Range
- AIS Onboard Device
- Onboard ECDIS Interface
- RIS Centre
- Communication Segments
- Bill of Material



Services for skippers

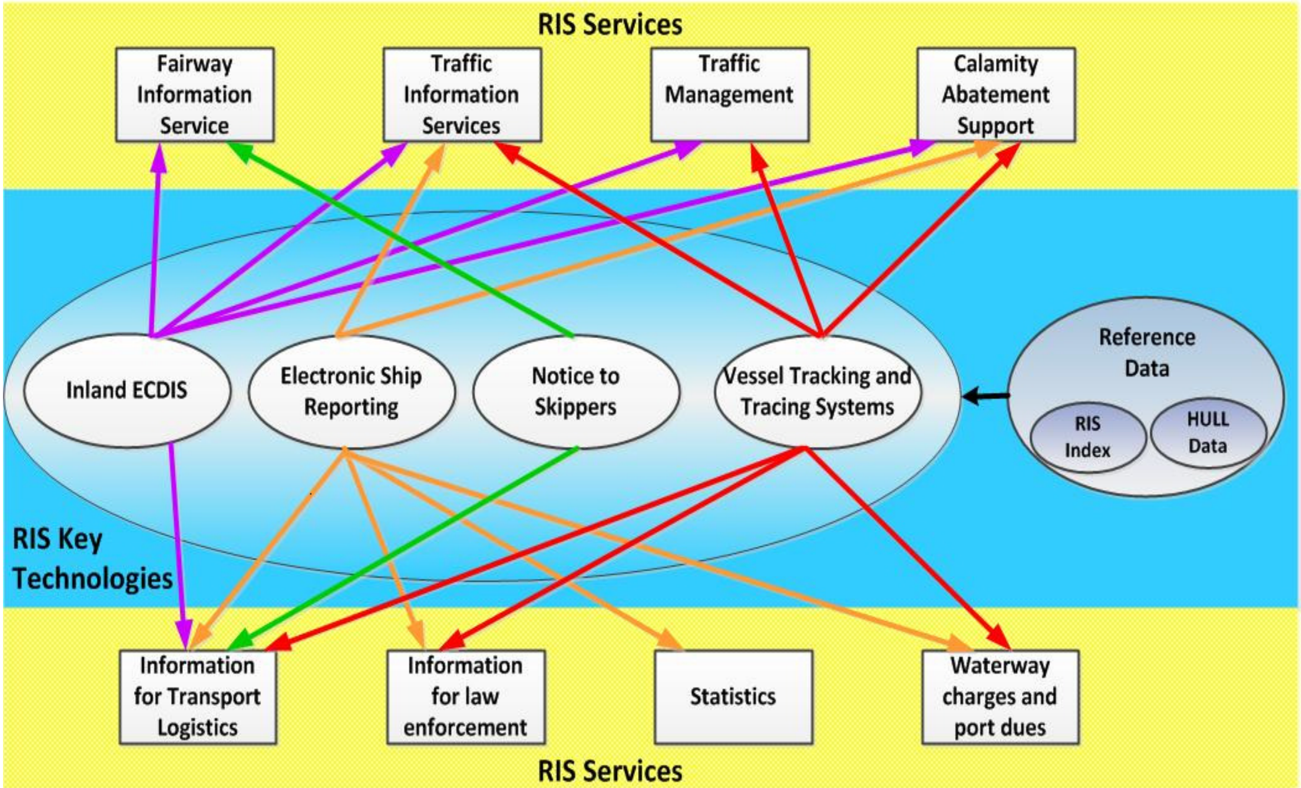
- Electronic Navigational Charts / Inland ECDIS
- Information on nautical conditions (fairway, obstructions, water level, etc.)
- Real time traffic information
- Electronic reporting of cargo and voyage
- Electronic pre-announcement at locks and harbours

Services for authorities

- Real time traffic monitoring (tracking and tracing)
- Analysis of accidents
- Exchange of safety related messages
- Electronic vessel register
- Electronic lock management
- Reception of electronic cargo reports
- Border surveillance

Services for logistic users

- Electronic cargo documents
- Data for fleet management
- Data for voyage planning
- Fairway conditions
- Water level forecast
- Availability of locks
- Calculations of arrival times

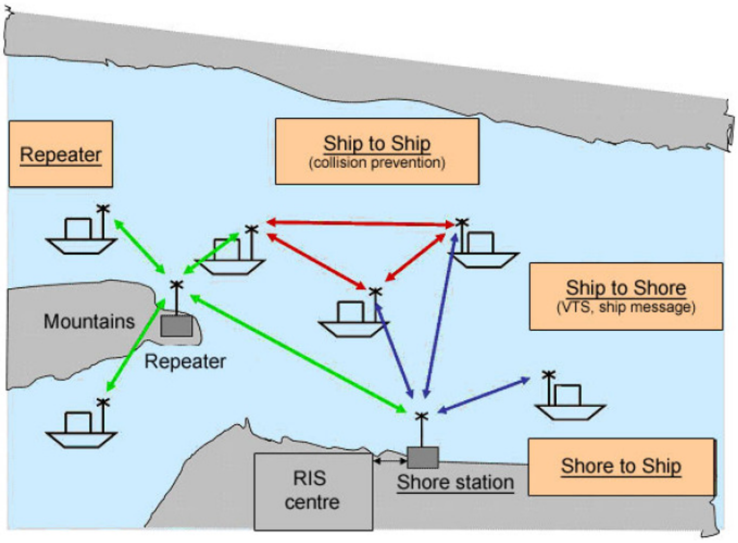


The key technologies of RIS are

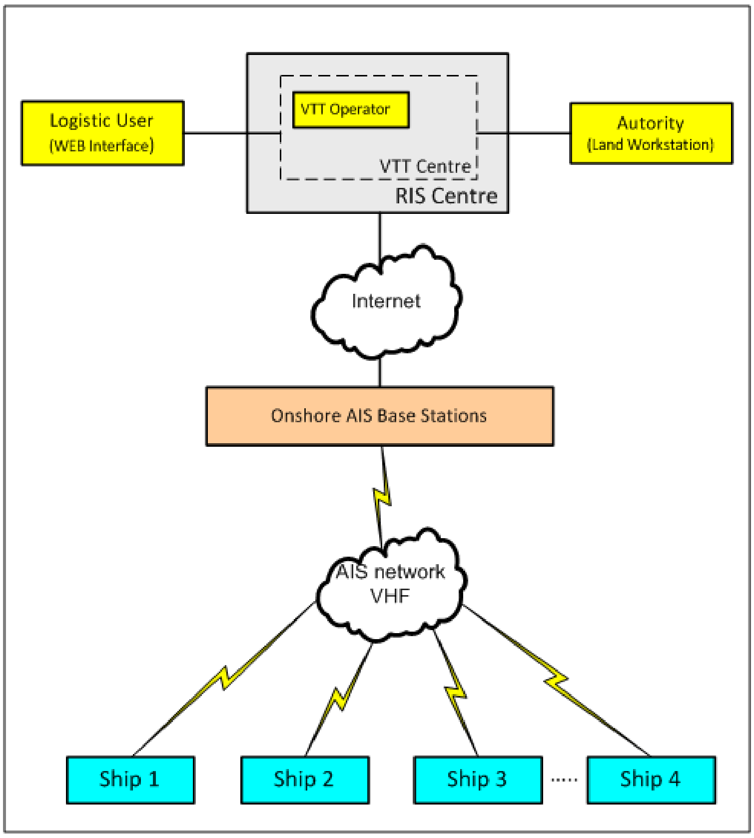
- VTT (Vessels Tracking and Tracing)
- ECDIS (Electronic Charts)
- NtS (Notice To Skippers)
- ERI (Electronic Reporting International)
- HULL Database
- LMS (Lock Management System)

Some technologies needs to be adapted to the local laws and operating procedures.

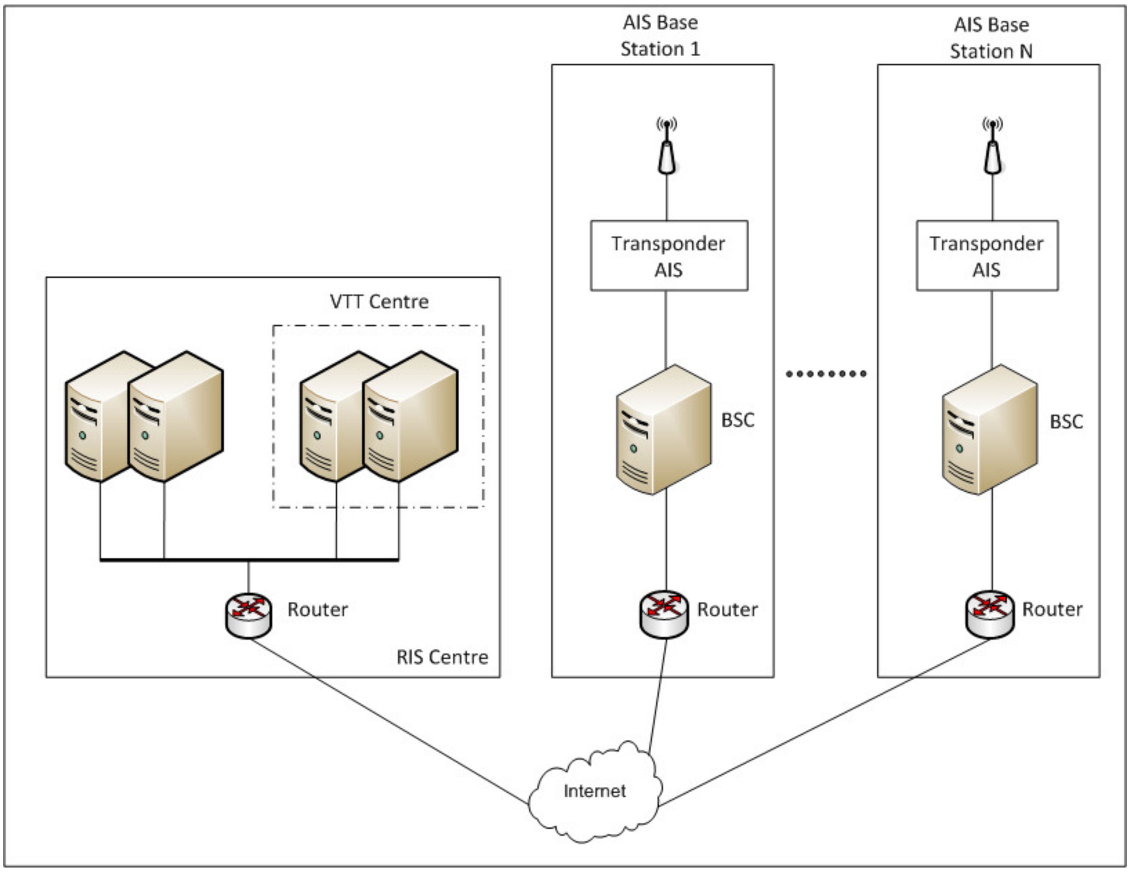
System to get a Strategic and Tactical Traffic Image using AIS technology with INLAND extension



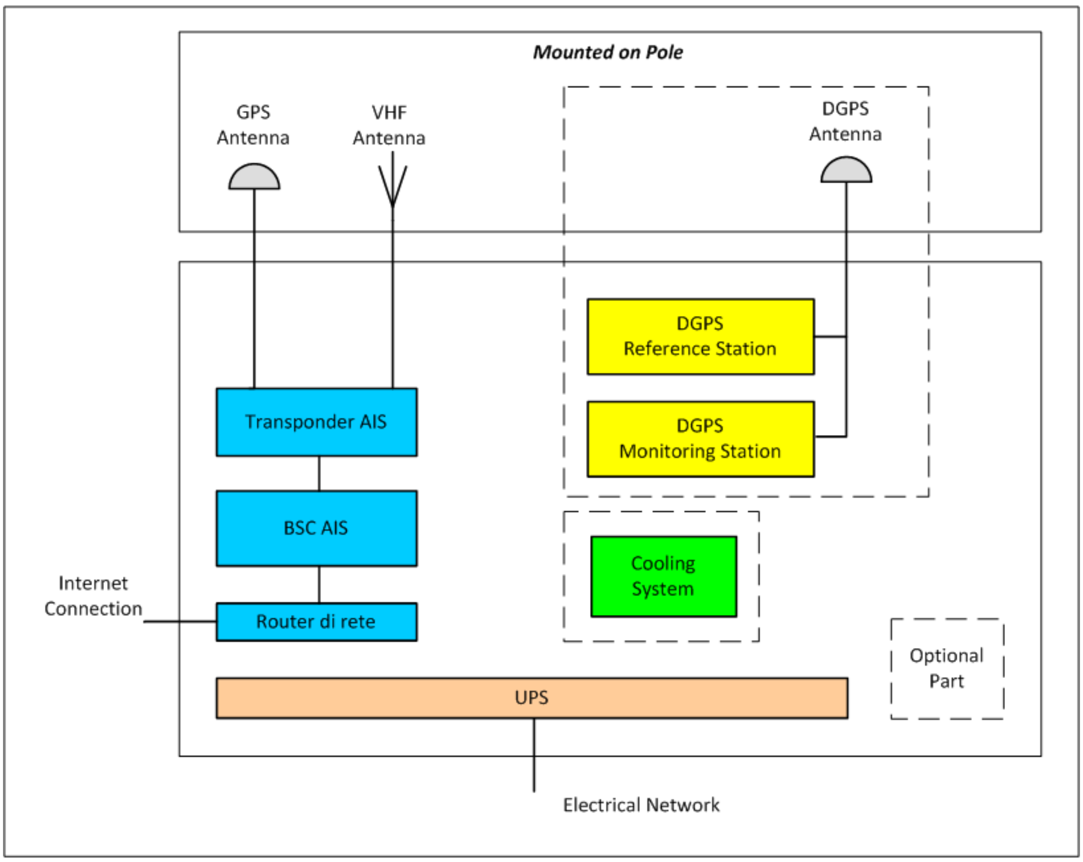
Onboard AIS devices transmit the identity of the vessel, its position and other data at regular intervals. By receiving these transmissions, AIS shore stations or ships fitted with AIS can automatically recognize, identify and track vessels equipped with AIS on a suitable screen, such as an inland ECDIS display. AIS systems are meant to boost the safety of navigation by use from vessel-to-vessel alongside onshore Vessel Traffic Services (VTS) to trace and track vessels and to assist in calamity abatement.



AIS BASE STATION & RIS CENTRE ONSHORE FACILITIES

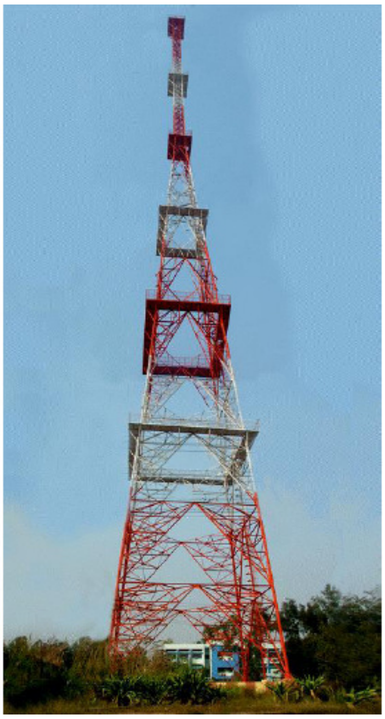


AIS BASE STATION



AIS STATION TOWER DESIGN

The type of tower depends upon the environment & also capable to carry Radar. Some of the examples are shown in the pictures

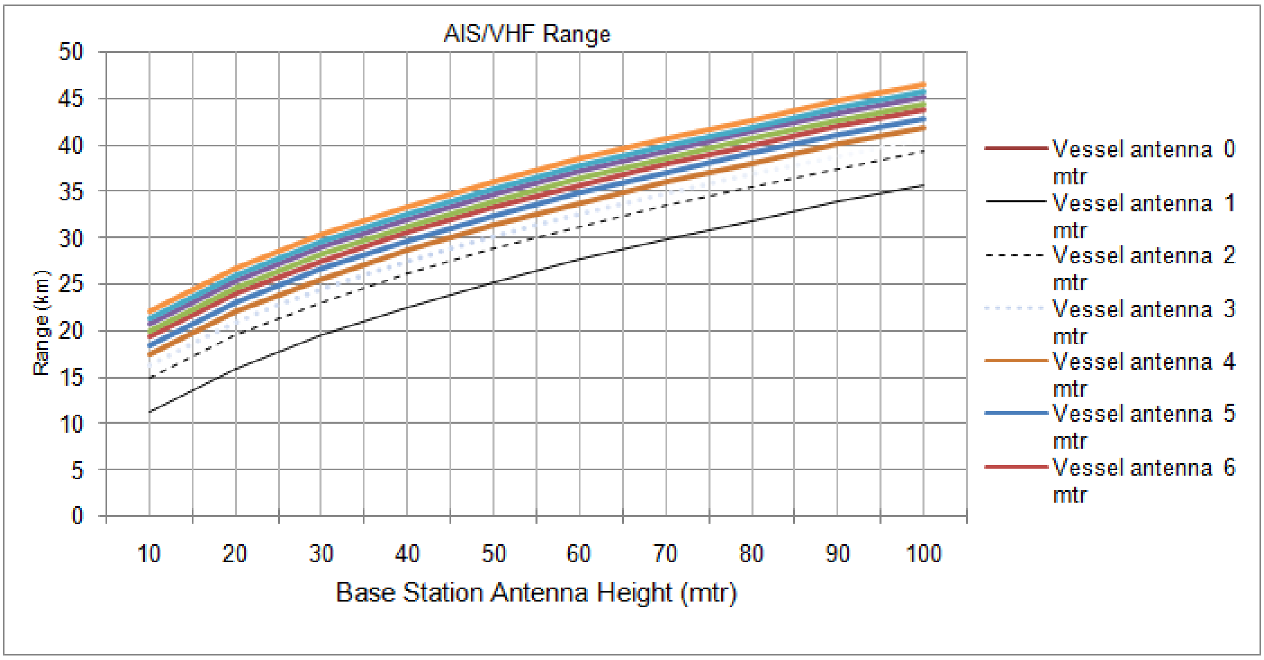


AIS STATION VHF RANGE

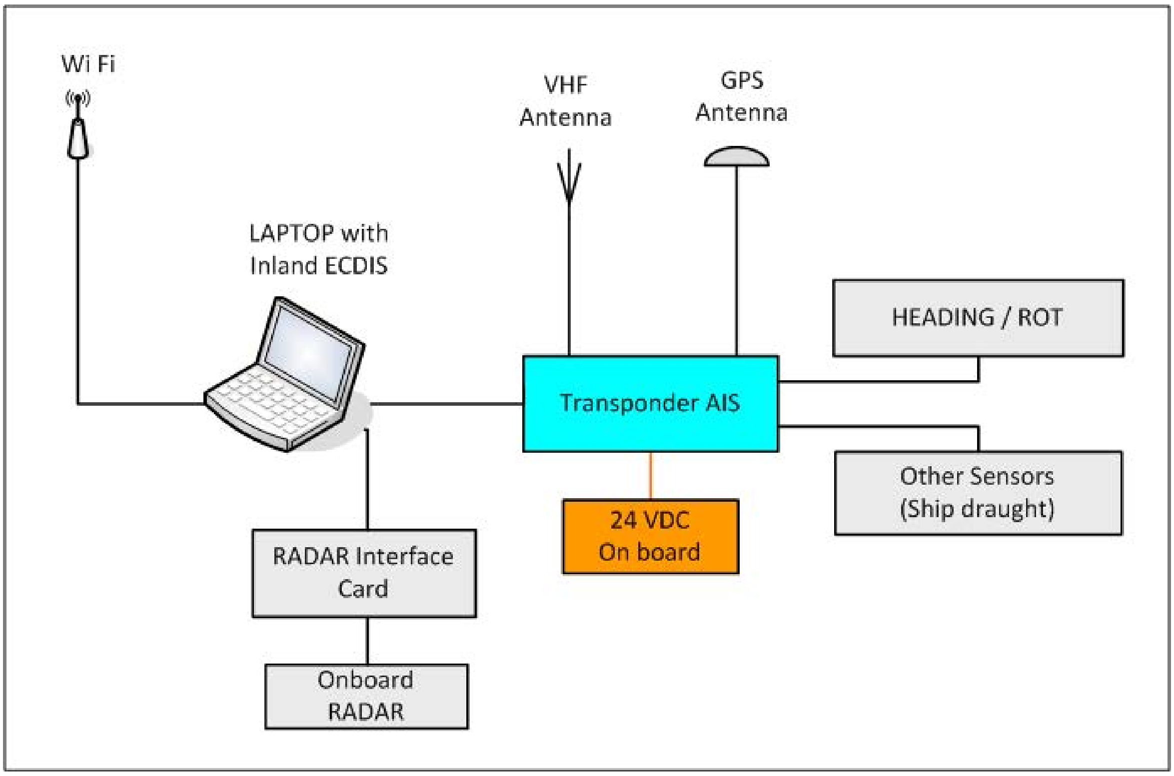
AIS/VHF Range

Base Station antenna Height (mtr.)	Vessel Antenna Height	0	1	2	3	4	5	6	7	8	9	10
10		11.3	14.9	16.3	17.5	18.4	19.3	20	20.7	21.4	22	22.6
20		16	19.5	21	22.1	23.1	23.9	24.7	25.4	26.1	26.7	27.3
30		19.6	23.1	24.6	25.7	26.7	27.5	28.3	29	29.7	30.3	30.8
40		22.6	26.1	27.6	28.8	29.7	30.6	31.3	32	32.7	33.3	33.9
50	Range (km)	25.2	28.8	30.3	31.4	32.4	33.2	34	34.7	35.3	36	36.5
60		27.7	31.2	32.7	33.8	34.8	35.6	36.4	37.1	37.8	38.4	38.9
70		29.9	33.4	34.9	36.1	37	37.9	38.6	39.3	40	40.6	41.2
80		31.9	35.5	37	38.1	39.1	39.9	40.7	41.4	42	42.6	43.2
90		33.9	37.4	38.9	40.1	41	41.9	42.6	43.3	44	44.6	45.2
100		35.7	39.3	40.8	41.9	42.8	43.7	44.4	45.1	45.8	46.4	47

AIS STATION VHF RANGE

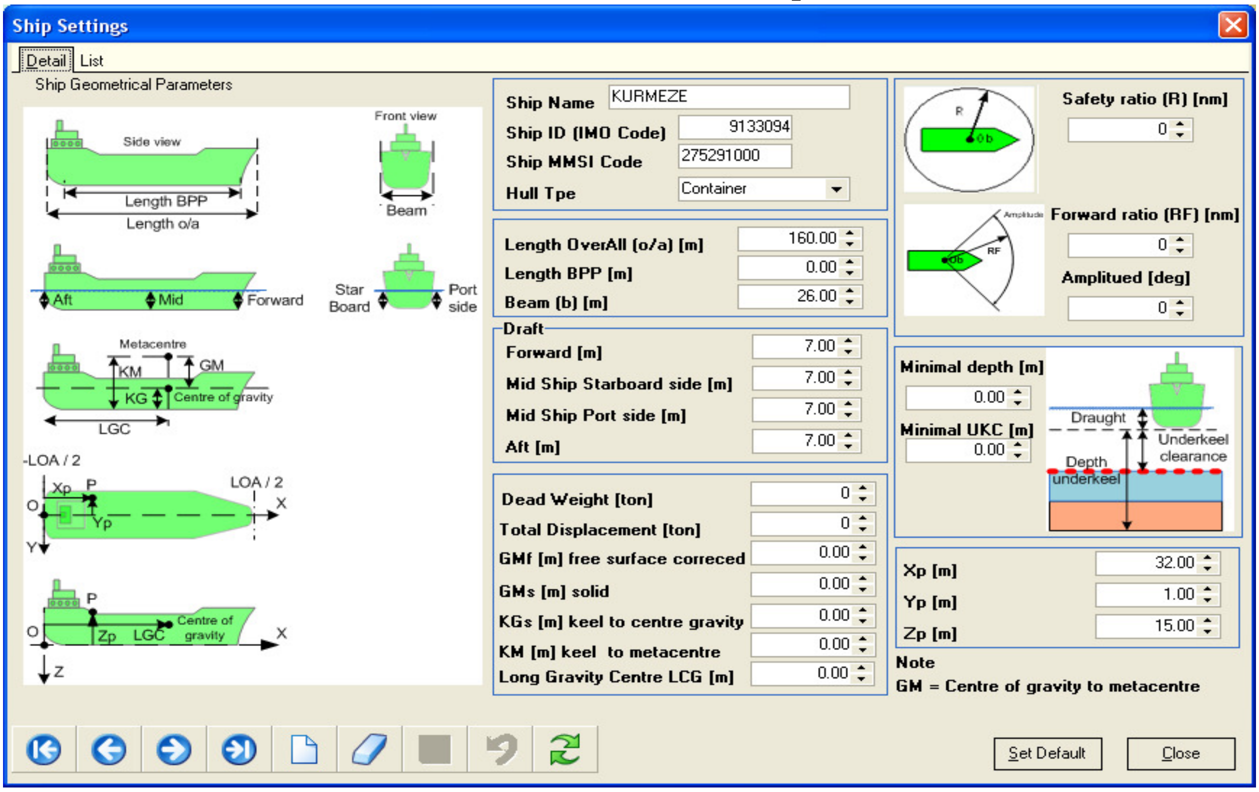


AIS ON BOARD DEVICE



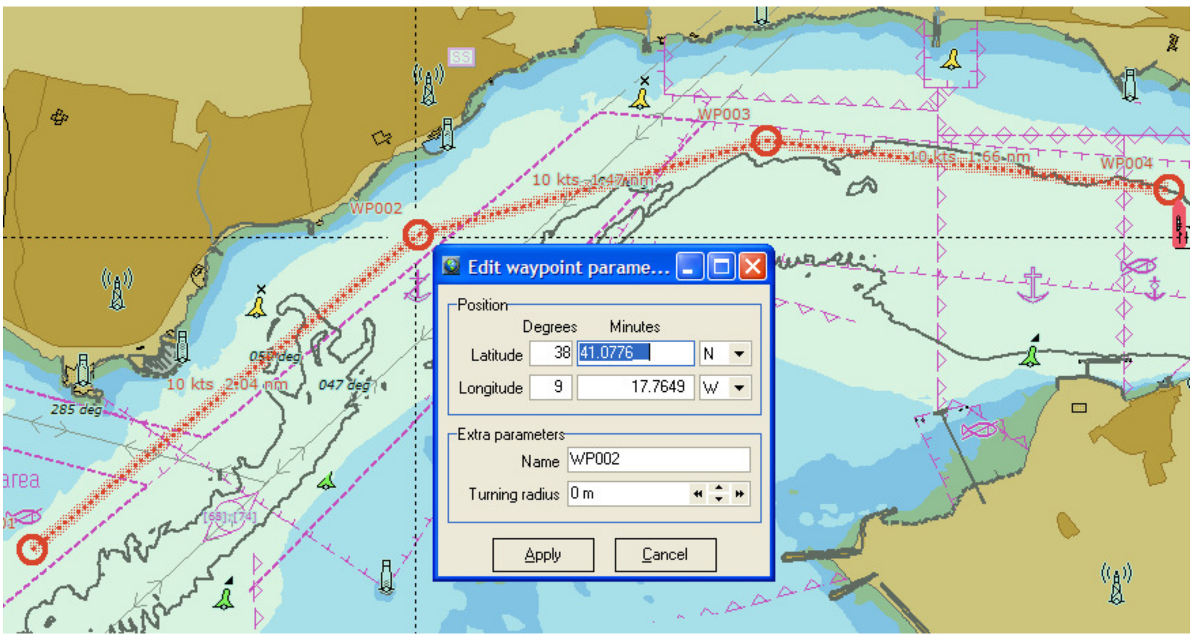
ONBOARD ECDIS INTERFACE

Interface to insert ship data

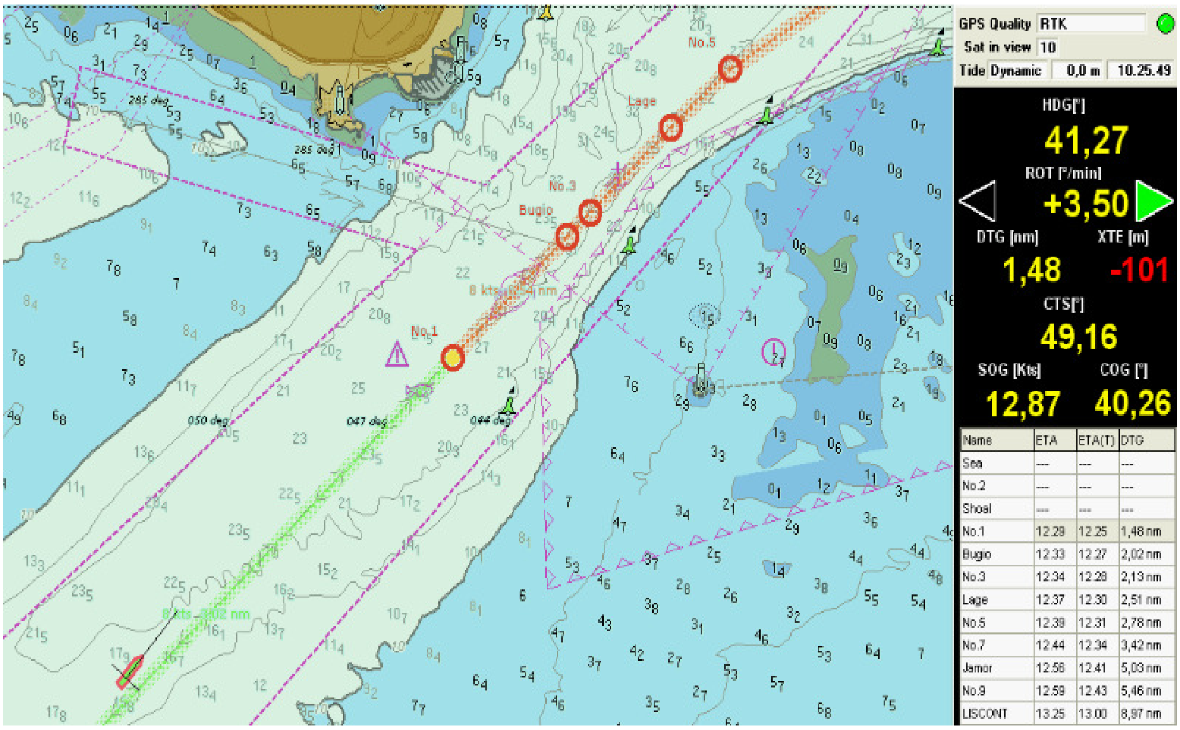


ONBOARD INTERFACE

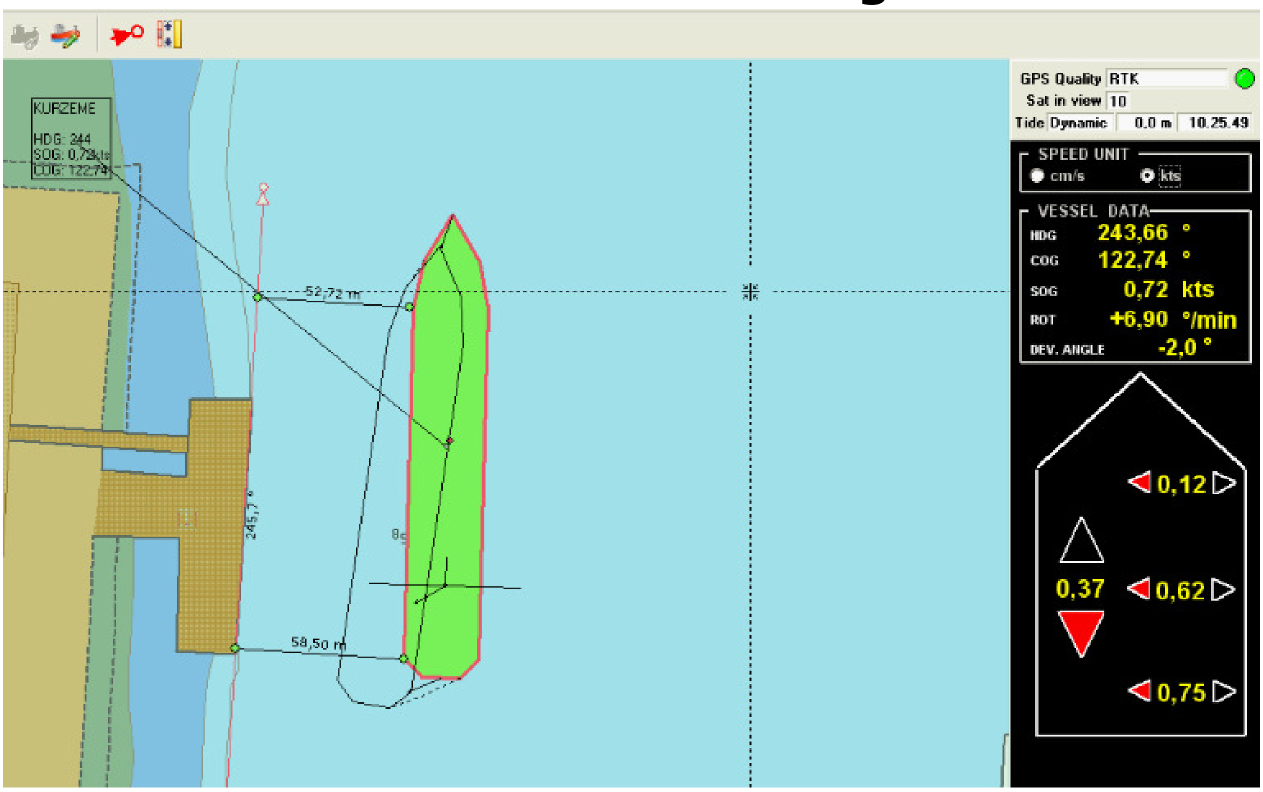
Interface to for voyage planning



Interface in navigation mode

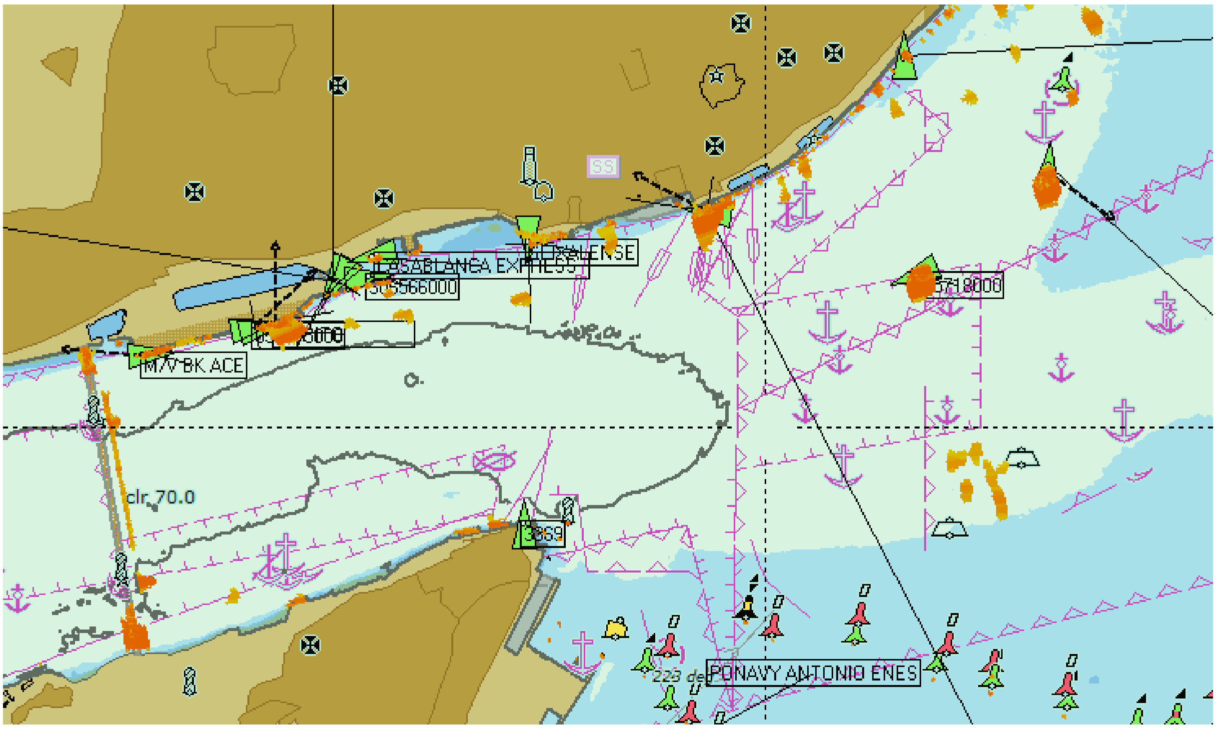


Interface for docking

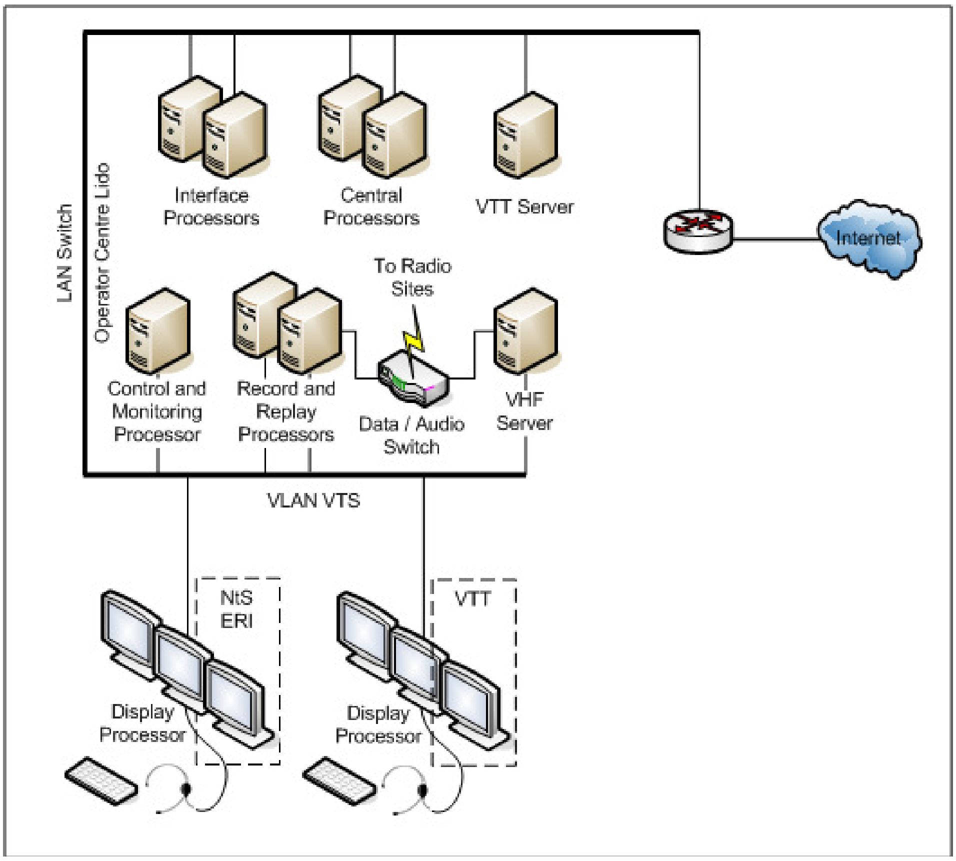


ONBOARD INTERFACE

Tactical Traffic Image + RADAR

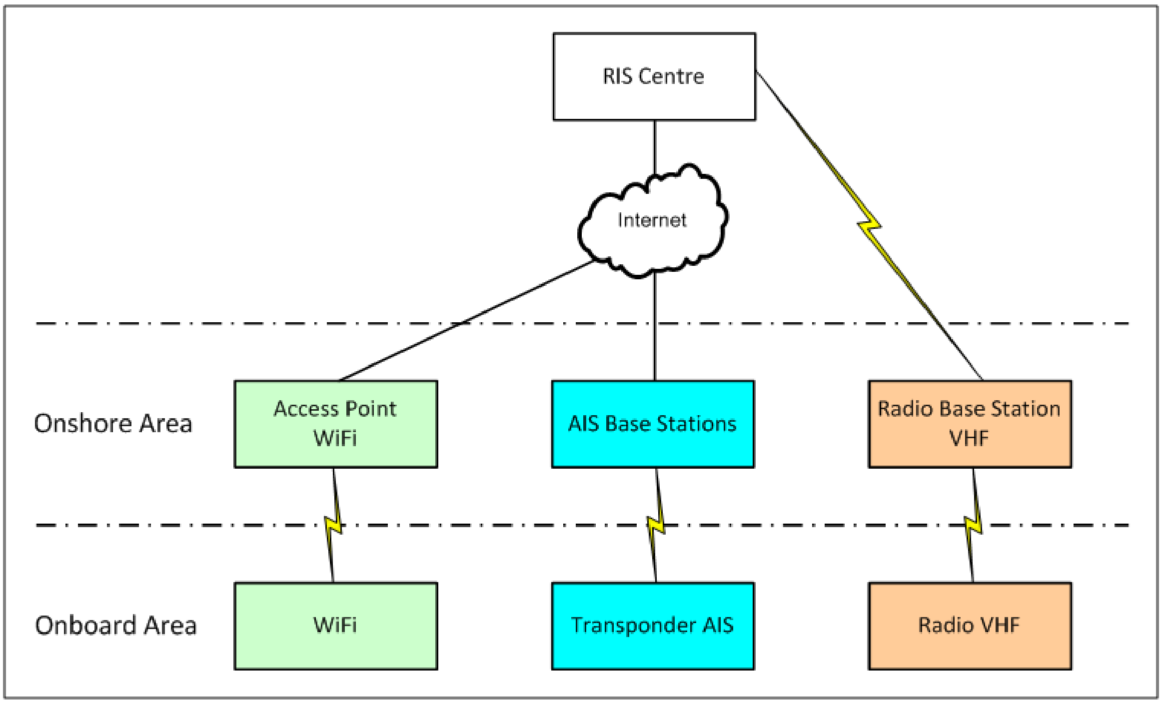


RIS CENTRE



COMMUNICATION SEGMENTS

- **Voice**
- **AIS**
- **WiFi for Charts Update and WEB Interface**



MAIN ACTIVITIES

- VHF/WiFi Coverage Study of the Inland Area
- Identification of Location for WiFi Access Point
- Identification of Location of VHF voice base stations
- Detailed definition of Main VTT Functionalities
- Notice To Skipper for River Levels
- Instrumentation with Inland AIS class A of each ship
- Creation of Inland ECDIS-S57 Chart
- DGPG integration in AIS Base Stations for 10cm precision in ships location (RTCM via AIS Msg. 17)
- Integration with Local Level and Meteo Monitoring Systems ?
- Lock/Bridge/Terminal Management ?

BILL OF MATERIAL

Onboard Vessel composed of
- AIS Transponder+ VHF

Onshore Area composed of
- AIS Base Stations + Controller + radio base VHF (voice)

1 RIS Centre Composed of
- Workstations with Data management software

ANNEXURE 9.1 – LETTER OF MoEFCC

No. F.No.14-9/2016-IA-III
Government of India
Ministry of Environment, Forest and Climate Change
(Impact Assessment Division)

Indira Paryavaran Bhawan
Jor Bagh Road, Aliganj
New Delhi-110003

Dated: 21st December, 2017.

OFFICE MEMORANDUM

Subject: Non-requirement of environment clearance for maintenance dredging in rivers for the purpose of navigation - regarding.

This has reference to your Office Memorandum IWT-11011/89/2016-IWT-(Vol.II) dated 7th December 2017 on the above mentioned subject.

2. The minutes of the meeting held under chairmanship of Hon'ble Minister, Road Transport & Highways, Shipping and Water Resources, River Development & Ganga Rejuvenation held on 24.10.2017 concluded that as per the extant legal position, no prior EC is required for maintenance dredging for navigational channel for Inland Waterways.

3. In view of the above the Ministry of Shipping may like to go ahead with the decision taken during the meeting held under chairmanship of Hon'ble Minister, Road Transport & Highways, Shipping held on 24.10.2017 subject to the implementation of the environmental safety measures as enclosed as annexure.

4. This issues with the approval of the competent authority.

21/12/17

Sharath Kumar Pallerla
Director

To

The Secretary,
Ministry of Shipping,
Parivahan Bhavan, 1, Parliament Street,
New Delhi - 110 001

ANNEXURE

Environmental safety measures to be implemented

i. 'Consent to Establish' and 'Consent to Operate' shall be obtained from State Pollution Control Board under the Air (Prevention and Control of Pollution) Act, 1981 and the Water (Prevention and Control of Pollution) Act, 1974.

ii. The project authority shall ensure that no rivers or tributaries are blocked due to any activities at the project site and free flow of water is maintained.

iii. Shoreline shall not be disturbed due to dumping. Periodical study on shore line changes shall be conducted and mitigation carried out, if necessary.

iv. Dredging shall not be carried out during the fish/turtle breeding seasons.

v. All vessels used in the river will be fitted with noise control and animal exclusion devices so that aquatic life is not unduly disturbed.

vi. Spillage of fuel / engine oil and lubricants from the construction site are a source of organic pollution which impacts aquatic life, particularly benthos. This shall be prevented by suitable precautions and also by providing necessary mechanisms to trap the spillage.

vii. Construction waste including debris shall be disposed safely in the designated areas and in no case shall be disposed in the aquatic environment.

viii. Vessels shall not discharge oil or oily water such as oily bilge water containing more than 15 ppm of oil

ix. The project authority shall ensure that water traffic does not impact the aquatic wildlife sanctuaries that fall along the stretch of the river.

x. All vessels will also have to comply with 'zero discharge' standards to prevent solid or liquid waste from flowing into the river and affecting its biodiversity.

xi. The dredging shall be carried by integrated and systematic planning by selective grid method by allowing migratory movement of Benthic fauna.

xii. All required Noise and vibration control measures are to be adopted in Dredgers. Cutter section Dredgers should be avoided as much as possible which produces more noise and vibration. No Drilling and Blasting is to be carried out.

xiii. Pre geo-tectonic studies has to be completed and the strata to be dredged is predetermined with complete data pertaining to hardness, compressive and tensile strengths.

xiv. Dredger type and other strata loosening methods shall be preconceived.

xv. Staggered dredging shall be carried based on turbidity monitoring to minimise the impact of turbidity.

xvi. Threshold level of turbidity, which has a minimal effect on fauna, has to be predetermined and Dredging planned accordingly.

xvii. Further silt screens needs to be used for minimising the spread of Turbidity.

xviii. Disposal places of Dredged sediments needs to be predetermined, along the shore by assessment of suitability, which will not affect the shoreline (erosion) and also causing impacts during monsoon and flooding.

xix. As much as possible, it shall not be disposed off in the river itself, and the site should be such that the dispersion is quicker by undertaking modelling studies.

xx. Ballast water control and management measures shall be implemented.

xxi. Waste and waste water reception facilities in Jetty shall be implemented.

xxii. The Risk and Disaster management plan has been prepared in consonance with the manual of terminals and harbours issued by the Ministry of Environment and Forests dated 5th May 2010.

xxiii. Standard Operating Procedures (SOP) and Emergency Response Plan (ERP) for onsite and offsite emergencies shall be prepared and implemented based on Hazard Identification and Risk Assessment to handle, process, store and transport of hazardous substances.

xxiv. Oil spill contingency plan shall be prepared and part of DMP to tackle emergencies. The equipment and recovery of oil from a spill shall be assessed. Guidelines given in MARPOL and Shipping Acts for oil spill management shall be followed.

xxv. No diversion of the natural course of the river shall be made without prior permission from the Ministry of Water resources.

xxvi. All the erosion control measures shall be taken at water front facilities.

xxvii. Necessary Air Pollution Control measures shall be taken during loading, unloading, handling, transport of the material at the berthing and water front facilities.

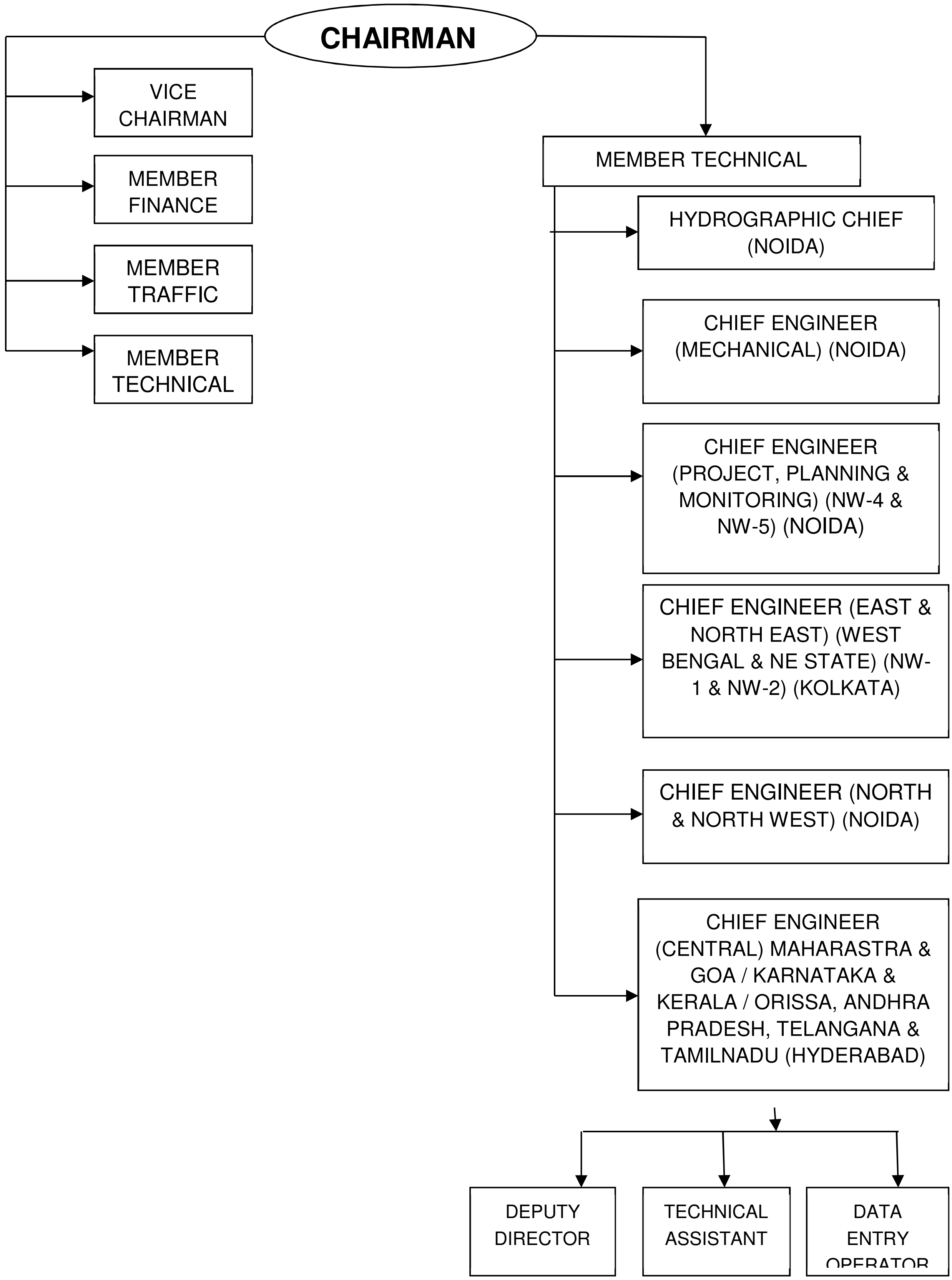
xxviii. The Vessels shall comply the emission norms prescribed from time to time.

xxix. All safety measures are to be implemented in coordination with the respective state government departments such as State Forest Department, Public Works Department, State Pollution Control Board etc.

21/12/17

Sharath Kumar Pallerla
Director

ANNEXURE 10.1– INSTITUTIONAL REQUIREMENT HEAD OFFICE COMPONENTS



ANNEXURE 11.1 – COSTING/FINANCIAL ASSUMPTIONS

FINANCIAL ANALYSIS

Broad Assumptions

Based on Financial Analysis as per DPR of NW5

Abstract

Broadly identified assumptions in order to facilitate financial analysis of Category II shortlisted waterways development

Inland Waterways Authority of India

FINANCIAL ANALYSIS BROAD ASSUMPTIONS[1]:

Capital Expenditure:

Elements to be covered (based on planned infrastructure requirement for respective rivers)

Suitable assumptions with relevant justification shall be made for any missing items.

CAPEX HEAD	TOTAL COST (INR CRORE)
Land Acquisition	Cost initially to be considered for acquisition of land for land side development of floating jetty
Dredging	**Normal Condition** Standard dredging rate of Rs. 200/cum to be considered. Suitable adjustments shall be made (with proper justification) for change in quality of dredge material/any special requirement for disposal of dredge material
Barrages with Navigational Locks	Based on requirement standard charges as per Planned Infrastructure of respective rivers.
Raising Banks	
Protection Measures	
Environmental Monitoring	
Navigational Aids	
Bridges	
Cross Drainage Works	
Facilities to Local People	
Terminals	Initially while calculating CAPEX terminal cost shall include cost for development of required numbers of floating jetty along respective waterways, cost of equipment, manpower required for terminal operation
Total Capital Expenditure	**Sum of all parameters mentioned above**
DC, PMC, IE Services, Loan Fees	10% of Total CAPEX
Overall Contingency	3% of Total CAPEX
Escalation	1.5% of Total CAPEX
Total Hard Capex	
Interest During Construction	
Total Project Cost	

Operations & Maintenance Expenditure:

(Pick up the cost items relevant to your study and planned infrastructure components)

Suitable assumptions with relevant justification shall be made for any missing items.

Annual Escalation shall be assumed @ 5.0%.

---

[1] These assumptions are to facilitate consultants in giving a sense of direction in which they shall move to make the reporting of final outcome consistent. Any missing information shall be assumed suitably (with valid justification) by the consultants in order to provide desired end result.

Cost Items	% of CAPEX
Dredging	5%
Cross Drainage	2%
Locks	2%
Bridges	1%
Terminals	2%
Navigation Aids	2%
Protection Measures	2%
Raising Banks	2%
Facility to Local People for Ferry Services	2%
Environmental Monitoring	2%
Cost of Barrages with Navigation Locks	2%
Total Waterway O&M Costs	

Revenue Estimation:

For estimating the revenue, the tariff structure proposed by IWAI (Levy & Collection of fees and charges) Regulations, 2011 shall be used as a reference.

Existing Tariff Structure & Charges by IWAI (Shall be verified from the latest published Tariffs)

Suitable assumptions with relevant justification shall be made for any missing items.

Tariff Heads	Charge unit	Charges (INR)
(A) Usage Charges		
Movement of Vessels	GRT/km	0.02
(B) Vessel related charges		
Berthing charges	Vessel	1000.00
Towage	Vessel/hour	600.00
Pilotage	Day	750.00
(C) Cargo related charges		
(i) Terminal Charges		
Dry Cargo	Ton (or part thereof)	1.00
Liquid Cargo	Ton (or part thereof)	1.00
Containerised Cargo	TEU	50.00
(ii) Transit shed charges		
First 3 days	MT per day	
First 7 days	MT per day	
7-21 days	MT per day	5.00
22-35 days	MT per day	10.00
After 35 days	MT per day	40.00
(iii) Open storage charges		
Hard Stand		
First 3 days	MT per day	
First 7 days	MT per day	0.00
7-21 days	MT per day	2.00
22-35 days	MT per day	4.00
After 35 days	MT per day	16.00
On Open Area		
First 3 days	MT per day	

Tariff Heads	Charge unit	Charges (INR)
First 7 days	MT per day	0.00
7-21 days	MT per day	1.00
22-35 days	MT per day	2.00
After 35 days	MT per day	8.00
(D) Composite Charges		
Movement of Over Dimensional Cargo	Per MT per km	1.50
Customs clearance convenience charges	Per MT	40.00
(E) Miscellaneous charges		
Crane, fork lift, bunkering of fuel, water supply, etc.	Of total revenue	
Crane (including Pontoon crane)		
5 MT capacity Crane	Per shift of 8 hrs	800.00
20 MT capacity Crane	Per shift of 8 hrs	2000.00
>20 MT capacity Crane	Per shift of 8 hrs	2500.00
Container Crane	Per hr	1100.00
Fork Lift (3MT capacity)	Per shift of 8 hrs	600.00
Electricity supply to Vessels		As per Electricity Board
Bunkering of fuel/ Petroleum Oil Lubricants		As per Market Rates
Water Supply	Per km	300.00
Sewage Disposal	Per km	100.00
Weighing scale	Per MT	5.00

In order to estimate the effective charge that the end users are expected to face, it is assumed that the margin charged by barge operators is Rs. 1.20 per MT per km.

FINANCING

The financing parameters considered for the study are as follows:

Suitable assumptions with relevant justification shall be made for any missing items.

Item	Unit	Value
Leverage Ratio	% Debt	70%
Moratorium	Quarters	2
Door-to-door Tenor	Years	15
Interest Rate	%	8%
Debt Drawal Start Quarter	No.	1
Debt Repayment Start Quarter	No.	22
Debt Repayment End Quarter	No.	60
Discount Rate (For NPV calculations)	%	16%

OTHER ASSUMPTIONS

Suitable assumptions with relevant justification shall be made for any missing items.

Tax Rate Assumptions

Type of Tax	Rate
Corporate Income Tax Rate	34.61%
Minimum Alternate Tax Rate	21.34%

Final IRR Reporting:

The consultant shall report the Project FIRR & EIRR considering different scenarios. Broadly the sensitivity shall include (but not limited to) following parameters as variable:

- Traffic (15-20% ± of projected divertible cargo, as at this stage the divertible cargo potential)
- Development Cost (15-20% ± of planned cost)
- Leverage Ratio (70:30 in base case, 1o-15% ± in optimistic & pessimistic scenarios)

ANNEXURE 11.2 –ABSTRACT OF COST FOR FAIRWAY DEVELOPMENT

Abstract of Cost for NW 9 Fairway Development

		9 (A)	9 (B)	9 (C)	
Sl.No.	**Item Description**	**Amount (in Lakh Rs)**	**Amount (in Lakh Rs)**	**Amount (in Lakh Rs)**	**Schedule**
A	**Fairway**				
1	Dredging				
(i)	General Soil	1161.70	3817.01	3954.72	
(ii)	Hard Soil	0.00	0.00	0.00	
2	Low Cost River Structures				
(i)	Bandaling				
(ii)	Bottom Paneling				
3	River Training Works				
(i)	Spurs				
(ii)	Bank Protection Works for river	86.10	4305.00	861.00	
(iii)	Porcupine				
4	Night Navigation				
(i)	Channel Marking Buoy, Mooring Gear & Lighting Equipments	179.89	147.51	143.92	
(ii)	Shore Marking with Latiice Bridge & Lighting Equipments				
5	Land Acquisition	130.68	3659.04	740.52	
	Sub-total (A)	**1558.37**	**11928.56**	**5700.16**	
B	**Modification of Structures**				
(i)	Bridges	0.00	330.00	0.00	
(ii)	Cables	12.50	26.00	7.00	
(iii)	Dams	0.00			
(iv)	Barrages	0.00			

Abstract of Cost for NW 9 Fairway Development

		9 (A)	9 (B)	9 (C)	
Sl.No.	**Item Description**	**Amount (in Lakh Rs)**	**Amount (in Lakh Rs)**	**Amount (in Lakh Rs)**	**Schedule**
(v)	Locks	0.00			
(vi)	Others	0.00			
	Sub-total (B)	**12.50**	**356.00**	**7.00**	
C	**Communication System**				
(i)	RIS Centre	0.00			
(ii)	AIS Base Station	0.00			
(iii)	Vessels - Survey vessel & Other Vessel	0.00			
(iv)	Buoys	0.00			
	Sub-total (C)	**0.00**			
D	**Institutional Requirement**				
(i)	Office Development Cost	40.00	0.00	40.00	
	Sub-total (D)	**40.00**	**40.00**	**40.00**	
	Sub-total (A)+(B)+(C)+(D)	**1610.87**	**12324.56**	**5747.16**	
E	Environmental Management Plan Cost as per chapter-9 of the DPR	111.23	111.23	111.23	
F	Project Management & consultancy Charges @ 3% of Prime cost	48.33	369.74	172.41	
G	Contingencies and Unforeseen Items of Works@ 3% of Prime cost	48.33	369.74	172.41	
	Project total Hard Cost	**1818.76**	**13175.27**	**6203.22**	

ANNEXURE 11.3 –COST OF DREDGING

9(A)
Cost of Dredging

S.No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
1	Dredging in General Soil	Cum	3,61,900	321	1161.70
2	Dredging in Hard Soil	Cum	0	900	0.00
	Total Cost of Dredging				**1161.70**

9(B)
Cost of Dredging

S.No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
1	Dredging in General Soil	Cum	11,89,100	321	3817.01
2	Dredging in Hard Soil	Cum	0	900	0.00
	Total Cost of Dredging				**3817.01**

9(C)
Cost of Dredging

S.No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
1	Dredging in General Soil	Cum	12,32,000	321	3954.72
2	Dredging in Hard Soil	Cum	0	900	0.00
	Total Cost of Dredging				**3594.72**

ANNEXURE 11.4 –COST OF BANK PROTECTION WORKS AT FAIRWAY

Cost of Bank Protection Works at Canal (with Pile & Slab)

S.No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)	Remarks/ References
1.0	**RCC Concrete Works (M40 grade concrete)**					
1.1.	3 Stages of slab of given sizes shall be considered:					
a)	1500x120x3000 =		0.54			
b)	1250x105x3000 =		0.39			
c)	1000x90x3000 =		0.27			
	Total Slab	**cum**	**1.20**			
1.2	Total depth of pile (from founding level)	m	8000.00			
	Pile section	sqm	250x250			
	Total Piles	**cum**	**0.50**			
	Total (1.1+1.2)	cum	1.70			
	Additional 10% for Filter		0.17			
	Additional 10% for Anchor		0.17			
	Total		**2.04**	**8297**	**16923.34**	DSR 2018, Cl.no. 5.33.1 & 5.34.3 - The rate has been updated with Wpi (3.02%) in 2019 & Wpi (1.89%) till march 2020. The combined effect is 1.011%.
2.0	**Steel Reinforcement**					

	Reinforcement (@0.15/cum)	MT	0.30	**84419**	**25325.55**	DSR 2018, Cl.no.5.22.4 - The rate has been updated with Wpi (3.02%) in 2019 & Wpi (-1.86%) till march 2020. The combined effect is 1.011%.
	Total				**42248.89**	
	Additional 3% PS/Labour/Contingencies				**1267.47**	
	Grand Total				**43516.36**	
	Cost/m				**14505.45**	
				Say	**14350.00**	
9 (A)	**Cost of Bank Protection Works for 600 m**				**86.10**	
9 (B)	**Cost of Bank Protection Works for 30000 m**				**4305.00**	
9 (C)	**Cost of Bank Protection Works for 6000 m**				**861.00**	

ANNEXURE 11.5 –COST OF NIGHT NAVIGATION WORKS

Cost of Night Navigation Works (Buoy & Lights)

Sl. No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
1	Providing and laying 1.8 m dia. Polythene Buoy, Mooring Gear & fixing Lighting Equipments **9 A**	No.	50	3,59,788	179.89
2.	**9 B**		41	3,59,788	147.51
3.	**9 C**		40	3,59,788	143.92

ANNEXURE 11.6 –COST OF LAND FOR FAIRWAY DEVELOPMENT

Cost of Land Acquisition for Fairway

Sl. No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
1	LAND ACQUISITION **9 A**	Sq. m	15,000	871.2	**130.68**
2.	**9 B**	Sq. m	4,20,000	871.2	**3659.04**
3.	**9 C**	Sq. m	85,000	871.2	**740.52**

The fairvalue of land shown in "Department of Registration-Govt. of Kerala" website is the value per Are (i.e 720 INR/ Are) as per SRO No.698/2014 dated 14.11.2014
The 10% increase as per the Gazette Notification SRO No.186/2018 dated 31.03.2018 is to be applied on all the fairvalue in this website.

The New Revised rate is		2018-19	792.0		
		2019-20	871.2		

ANNEXURE 11.7 –COSTING OF ENVIRONMENT AND SOCIAL ASPECT

Comparision of Cost for NW 9 Fairway Development					
Sl. No.	**Particulars**		**Basic Cost Amount -Rev.02 (in Crores Rs.)**		
			9A	**9B**	**9C**
1	Fairway		1818.76	13175.27	6203.22
2	Ro-Ro Terminal		656.25	656.25	656.25
	Total		**2475.01**	**13831.52**	**6859.46**
Bifurcation of EMP Cost					
Total EMP Cost					123.00
EMP cost of Fairway					111.23
EMP cost of Ro-Ro Terminal					**11.77**
					123.00

ANNEXURE 11.8 –WHOLESALE PRICE INDEX

India - Wholesale price index

1. Figure 0 may be treated as index for particular item not available.
2. Figures for the latest two months are provisional. Latest two months are to be reckoned with reference to the latest monthly press release issued.

Base Year: 2011-12 = 100 (Revision of base year of All-India Wholesale Price Index (WPI) from 2004-05 to 2011-12 vide Press release by GOVERNMENT OF INDIA MINISTRY OF COMMERCE & INDUSTRY DEPARTMENT OF INDUSTRIAL POLICY & PROMOTION OFFICE OF ECONOMIC ADVISOR Udyog Bhawan, New Delhi, Dated 12th May 2017) https://eaindustry.nic.in/choose_item_201112.asp

Yearly Wholesale Price Index
Name of Commodity : ALL COMMODITIES
Type : Group Item
Weight : 100
Base Year : 2011-12 = 100

Calendar Year	Index
2020 - March	122.23
2019	121.2
2018	118.9

Source - Office of the Economic Adviser, Govt. of India, Ministry of Commerce & Industry Department for Promotion of Industry and Internal Trade (DPIIT)

Month/Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg.
2018	116	116.1	116.3	117.3	118.3	119.1	119.9	120.1	120.9	122	121.6	119.7	118.9617

Month/Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg.
2019	119.2	119.5	119.9	121.1	121.6	121.5	121.3	121.5	121.3	122	122.3	122.8	121.1667

% Increase in the Year 2019 = (122.8-119.2)/119.2 = 3.02%

Month/Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg.
2020	123.4	122.2	121.1										122.23

% Increase/Decrease in the Year 2020 (Three Months) = (121.1-123.4)/123.4 = 1.86%

The combined effect of WPI from January 2019 to March 2020 shall be = (1+3.02%) X (1-1.86%) = 1.011%

ANNEXURE 11.9 –ABSTRACT OF COST FOR Lo-Lo DEVELOPMENT

Abstract of Cost for additional Infra in TCS Land for LOLO Facility

S.No.	Item Description	Unit	Amount (in Lakh Rs.)
A	**Terminals**		**Rev.02**
	Terminal		
(i)	Land		0
(ii)	Riverine Components		
(iii)	Infrastructure Components including internal roads		
(iv)	Approach Road (External) Cost		
(v)	Bank Protection Works for terminal		
(v)	**LS amount for 2 Nos Lo Lo berthing 50 m by 10 m of INR has been considered @ INR 50 lakhs / no**		100
	Sub-total (A)		**100.00**
B	**Vessels**		
(i)	Vessel Size		0
(ii)	Vessel Capacity		0
	Sub-total (B)		0
C	**Equipments for Terminals**		
(i)	Ambulance - 1 no.		18
(ii)	Dumper Trucks 16 T Capacity - Nil.		0
(iii)	Cranes with 125 T Capacity - 2 nos.		400.0
(iv)	Fork lift trucks 20 T Capacity - 2nos.		90.0
	Sub-total (C)		**508.00**
	Sub-total (A)+(B)+(C)		**608.00**
D	Environmental Management Plan Cost as per chapter-9 of the DPR		11.77
E	Project Management & consultancy Charges @ 3% of Prime cost		18.24
F	Contingencies and Unforeseen Items of Works@ 3% of Prime cost		18.24
	Project total Hard Cost		**656.25**

ANNEXURE 11.10 –COSTING OF STRUCTURAL MODIFICATION

For Class III Vessel, with single lane operation, the critical clearances in horizontal direction is taken as 13.5m to 15m.

Horizontal Clearance = 13.5 m

Vertical Clearance = 6 m

SL No	Chainage	Center Position		Location	Type of structure	Type of super structure	Width	No of span(Nos) x Length of Span(m)	Hz clearance	Height wrt MSL	Modification Required		Estimated Cost of Modification (INR)
		Latitude	Longitude								Hz	Vt	
9 -A													
1	20.02	9°33'43.75"	76°30'43.86"	Near Mulankuzha	Major Bridge	RCC	11	3x50	50	8	No	No	-
												Total Cost	-
9-C													
1	11.345	9°34'6.98"	76°29'17.53"	Kanjiram Junction	Road Bridge	RCC	12	2x40	40	6.5	No	No	
												Total Cost	-
9-B													
1	0.466	9°34'29.21"	76°30'39.80"	Chavdiyali Junction	Foot Over Bridge	RCC	2	1x20	16	2	No	Yes	33,50,000
2	1.1	9°34'24.12"	76°30'19.41"	Near Pathinaril Chira Bus Stop	Foot Over Bridge	RCC	2	1x20	20	2	No	Yes	33,50,000
3	1.109	9°34'23.85"	76°30'19.73"	Near Pathinaril Chira Bus Stop	Foot Over Bridge	RCC	2	1x20	20	8	No	No	
4	1.109	9°34'23.79"	76°30'19.44"	Veloor Bridge	Road Bridge	RCC	8	1x35	35	6	No	No	
5	1.924	9°34'17.32"	76°29'53.6"	Pulinakkal Boat jetty	Foot Over Bridge	RCC	2	1x25	20	2.4	No	Yes	33,50,000
6	2.349	9°34'13.71"	76°29'40.21"	Pathinachil Kadavu	Foot Over Bridge	RCC	2.5	1x25	20	2	No	Yes	33,50,000
7	2.82	9°34'6.98"	76°29'17.53"	Near Kamjiram Junction	Foot Over Bridge	RCC	2	1x20	20	2	No	Yes	33,50,000
8	4.956	9°34'53.28"	76°29'14.50"	Panampady	Foot Over Bridge	RCC	3	2x30	30	7	No	No	
9	6.14	9°35'18.58"	76°29'26.98"	Kottayam Kumarakom Elikkal Junctic	Road Bridge	RCC	8.5	1x45	45	5	No	Yes	51,00,000
10	7.273	9°35'27.01"	76°29'54.31"	Near Masjidul Majid Elikkal	Foot Over Bridge (Iron)	Iron	3	1x49	49	7	No	No	
11	8.015	9°35'44.28"	76°30'10.46"	Near Alimmood Bus Stop	Road Bridge	RCC	6	1x40	40	6	No	No	
12	10.338	9°36'21.02"	76°30'39.6"	Munniyel Bridge	Road Bridge	RCC	6	1x40	40	6	No	No	
13	12.798	9°36'37.92"	76°29'38"	Kudayampadi Parippu Road	Road Bridge	RCC	10	1x30	30	8	No	No	
14	13.529	9°36'57.69"	76°29'28.31"	Near Aymanam	Foot Over Bridge (Iron)	RCC	2.5	1x30	30	5.5	No	Yes	30,25,000
15	14.535	9°37'24.42"	76°29'32.98"	Aymanam Kallimathara Road	road Bridge	RCC	5	1x15	15	8	No	No	
16	14.95	9°37'36.9"	76°29'36.29"	Near Karappa Bus Stop	Road Bridge	RCC	5	1x15	15	5	No	Yes	51,00,000
17	15.633	9°37'58.20"	76°29'31.16"	Near Karipputha Bus Stop	Road Bridge	RCC	5	1x20	20	7	No	No	
18	15.05	9°38'19.64"	76°28'52.53"	Near St Thomas Church	Foot Over Bridge (Iron)	Iron	3	1x15	15	7	No	No	
19	17.806	9°38'39.63"	76°28'43.10"	Maniyaparambu Junction	Foot Over Bridge	RCC	2.5	1x15	15	5.5	No	Yes	30,25,000
												Total Cost	**3,30,00,000**

SUMMARY	
NW	Cost
9A	-
9B	3,30,00,000
9C	-

Notes

Note 1 No modification is required for structures in 9A.

Note 2 No modification is required for structures in 9C.

Note 3 For 9B, out of 19 Cross structures, 9 need modification. Road brisges at Chainages 6.14 and 14.95 and Foot Over Bridges at chainages 0.644, 1.10, 1.924, 2.349, 2.820, 13.529 and 17.806 require modification for vertical clearances. Since, this is single span, the top level is increased approximately by 1.0m to make vertical clearance of 6m and suitable gradient is provided at both ends. The Abutments will increase by required heights at both ends.Foundation will also need modification as per the increased height.

Note 4 The cost of modification may have to be updated before construction at Detailed Engineering Stage.

Note 5 The cost of modification may have to be updated before construction at Detailed Engineering Stage.

ANNEXURE 11.11 –FAIRVALUE OF LAND COST IN KERELA

Department of Registration
Government of Kerala

FAIRVALUE OF LAND

1.Select District	:	Kottayam
2.Select RDO	:	RDOKOTTAYAM
3.Select Taluk	:	Changanacherry
4.Select Village	:	Changanacherry
5.Select Desam	:	
6.Block No	:	
7.Land Type	:	Water logged land

8.Survey No :

9.Re Survey No :

View

District	Kottayam	Taluk	Changanacherry
Village	Changanacherry	Land Type	Water logged land

Download Gazette

Survey No	SubDiv.No	Resurvey No.	ReSubDiv.No	Land Type	Fairvalue Per Are(Rs.)

1

Additional Notification by the RDOs

Survey No	SubDiv.No	Resurvey No.	ReSubDiv.No	Land Type	Fairvalue Per Are(Rs.)

1

Fixation of Fairvalue by Collectors

Survey No	SubDiv.No	Resurvey No.	ReSubDiv.No	Fairvalue Per Are(Rs.)
		18	6	87120

1

Page 1 of 1

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ANNEXURE 11.12 A –FINANCIAL IMPACT OF KERELA GOVERNMENT LETTER ON NW 9

FINANCIAL IMPACT AS SUGGESTED BY GOVT. OF KERALA (NW-9 ; OPTION-2)									
Sl No.	**Name of Structure**	**Type & Owner of Structure**	**Waterway (NW-9) Nos. of Structure**			**Cost Per Structure**	**Approximate Amount of Reconstruction (In Crores)**		
			9-A	**9-B**	**9-C**		**9-A**	**9-B**	**9-C**
1)	Bridge	Cross Structure Under PWD	1	8	1	0	0	0	0
2)	Foot Bridges	Cross Structure Under PWD		2	0	1.2	0	2.4	0
2)	Foot Bridge	Cross Structure Under LSGD		9	0	1.2	0	10.8	0
3)	HT Lines	Kerala State Electricity Board	0	0	0	0.3	0	0	0
3)	LT Lines	Kerala State Electricity Board	25	52	14	0.01	0.25	0.52	0.14
4)	Regulator Cum Bridge & Navigation Lock	Irrigation Dept. & Navigation Dept.	0	0	0	0	0	0	0
5)	Water Pipe -line	Kerala water Authority	0	0	0	0	0	0	0
	Total						**0.25**	**13.72**	**0.14**

ANNEXURE 11.12 B –FINANCIALS OF OPTION 1 FOR NW 9 A

Description (Option-1)	Total Investment Cost (INR Lakhs)			
	(INR Lakhs)	1st Year	2nd Year	3rd Year
With Development				
Fairway Development (9A)				
Fairway	1,558.37	623.35	467.51	467.51
Structure Modification	12.5	5.00	3.75	3.75
Institutional Requirement	40.00	16.00	12.00	12.00
Environmental Management Plan Cost as per chapter-9 of the DPR	111.23	44.49	33.37	33.37
Project Management & consultancy Charges @ 3% of Prime cost	48.33	19.33	14.50	14.50
Contingencies and Unforeseen Items of Works@ 3% of Prime cost	48.33	19.33	14.50	14.50
Total Project Cost	**1,818.76**	**727.50**	**545.63**	**545.63**

Lo-Lo Terminal				
Terminal	100.00	40.00	30.00	30.00
Cargo Handling Equipment	508.00	203.20	152.40	152.40
Environmental Management Plan Cost as per chapter-9 of the DPR	11.77	4.71	3.53	3.53
Project Management & consultancy Charges @ 3% of Prime cost	18.24	7.30	5.47	5.47
Contingencies and Unforeseen Items of Works @ 3% of Prime cost	18.24	7.30	5.47	5.47
Total Project Cost	**656.25**	**262.50**	**196.87**	**196.87**

ANNEXURE 11.12 C –FINANCIALS OF OPTION 2 FOR NW 9 A

Description (Option-2)	Total Investment Cost (INR Lakhs)			
	(INR Lakhs)	1st Year	2nd Year	3rd Year
With Development				
Fairway Development (9A)				
Fairway	1,558.37	623.35	467.51	467.51
Structure Modification (DPR-Rev.01)	12.50	5.00	3.75	3.75
Structure Modification (Suggested By Kerala Govt.)	25	10.00	7.50	7.50
Institutional Requirement	40.00	16.00	12.00	12.00
Environmental Management Plan Cost as per chapter-9 of the DPR	111.23	44.49	33.37	33.37
Project Management & consultancy Charges @ 3% of Prime cost	48.33	19.33	14.50	14.50
Contingencies and Unforeseen Items of Works@ 3% of Prime cost	48.33	19.33	14.50	14.50
Total Project Cost	**1,843.76**	**737.50**	**553.13**	**553.13**
Ro-Ro Terminal				
Terminal	100.00	40.00	30.00	30.00
Cargo Handling Equipment	508.00	203.20	152.40	152.40
Environmental Management Plan Cost as per chapter-9 of the DPR	11.77	4.71	3.53	3.53
Project Management & consultancy Charges @ 3% of Prime cost	18.24	7.30	5.47	5.47
Contingencies and Unforeseen Items of Works @ 3% of Prime cost	18.24	7.30	5.47	5.47
Total Project Cost	**656.25**	**262.50**	**196.87**	**196.87**

ANNEXURE 11.12 D –FINANCIALS OF OPTION 1 FOR NW 9 B

Description (Option-1)	Total Investment Cost (INR Lakhs)			
	(INR Lakhs)	1st Year	2nd Year	3rd Year
With Development				
Fairway Development (9B)				
Fairway	11,928.56	4,771.43	3,578.57	3,578.57
Structure Modification	356	142.40	106.80	106.80
Institutional Requirement	40.00	16.00	12.00	12.00
Environmental Management Plan Cost as per chapter-9 of the DPR	111.23	44.49	33.37	33.37
Project Management & consultancy Charges @ 3% of Prime cost	369.74	147.89	110.92	110.92
Contingencies and Unforeseen Items of Works@ 3% of Prime cost	369.74	147.89	110.92	110.92
Total Project Cost	**13,175.27**	**5,270.11**	**3,952.58**	**3,952.58**
Lo-Lo Terminal (9B)				
Terminal	100.00	40.00	30.00	30.00
Cargo Handling Equipment	508.00	203.20	152.40	152.40
Environmental Management Plan Cost as per chapter-9 of the DPR	11.77	4.71	3.53	3.53
Project Management & consultancy Charges @ 3% of Prime cost	18.24	7.30	5.47	5.47
Contingencies and Unforeseen Items of Works @ 3% of Prime cost	18.24	7.30	5.47	5.47
Total Project Cost	**656.25**	**262.50**	**196.87**	**196.87**

ANNEXURE 11.12 E –FINANCIALS OF OPTION 2 FOR NW 9 B

Description (Option-2)	Total Investment Cost (INR Lakhs)			
	(INR Lakhs)	1st Year	2nd Year	3rd Year
With Development				
Fairway Development (9B)				
Fairway	11,928.56	4,771.43	3,578.57	3,578.57
Structure Modification (DPR-Rev.01)	356.00	142.40	106.80	106.80
Structure Modification (Suggested By Kerala Govt.)	1372	548.80	411.60	411.60
Institutional Requirement	40.00	16.00	12.00	12.00
Environmental Management Plan Cost as per chapter-9 of the DPR	111.23	44.49	33.37	33.37
Project Management & consultancy Charges @ 3% of Prime cost	369.74	147.89	110.92	110.92
Contingencies and Unforeseen Items of Works@ 3% of Prime cost	369.74	147.89	110.92	110.92
Total Project Cost	**14,547.27**	**5,818.91**	**4,364.18**	**4,364.18**
Ro-Ro Terminal (9B)				
Terminal	100.00	40.00	30.00	30.00
Cargo Handling Equipment	508.00	203.20	152.40	152.40
Environmental Management Plan Cost as per chapter-9 of the DPR	11.77	4.71	3.53	3.53
Project Management & consultancy Charges @ 3% of Prime cost	18.24	7.30	5.47	5.47
Contingencies and Unforeseen Items of Works @ 3% of Prime cost	18.24	7.30	5.47	5.47
Total Project Cost	**656.25**	**262.50**	**196.87**	**196.87**

ANNEXURE 11.12 F –FINANCIALS OF OPTION 1 FOR NW 9 C

Description (Option-1)	Total Investment Cost (INR Lakhs)			
	(INR Lakhs)	1st Year	2nd Year	3rd Year
With Development				
Fairway Development (9C)				
Fairway	5,700.16	2,280.06	1,710.05	1,710.05
Structure Modification	7.00	2.80	2.10	2.10
Institutional Requirement	40.00	16.00	12.00	12.00
Environmental Management Plan Cost as per chapter-9 of the DPR	111.23	44.49	33.37	33.37
Project Management & consultancy Charges @ 3% of Prime cost	172.41	68.97	51.72	51.72
Contingencies and Unforeseen Items of Works@ 3% of Prime cost	172.41	68.97	51.72	51.72
Total Project Cost	**6,203.22**	**2,481.29**	**1,860.97**	**1,860.97**
Lo-Lo Terminal (9C)				
Terminal	100.00	40.00	30.00	30.00
Cargo Handling Equipment	508.00	203.20	152.40	152.40
Environmental Management Plan Cost as per chapter-9 of the DPR	11.77	4.71	3.53	3.53
Project Management & consultancy Charges @ 3% of Prime cost	18.24	7.30	5.47	5.47
Contingencies and Unforeseen Items of Works @ 3% of Prime cost	18.24	7.30	5.47	5.47
Total Project Cost	**656.25**	**262.50**	**196.87**	**196.87**

ANNEXURE 11.12 G –FINANCIALS OF OPTION 2 FOR NW 9 C

Description (Option-2)	Total Investment Cost (INR Lakhs)			
	(INR Lakhs)	1st Year	2nd Year	3rd Year
With Development				
Fairway Development (9C)				
Fairway	5,700.16	2,280.06	1,710.05	1,710.05
Structure Modification (DPR-Rev.01)	7.00	2.80	2.10	2.10
Structure Modification (Suggested By Kerala Govt.)	14	5.60	4.20	4.20
Institutional Requirement	40.00	16.00	12.00	12.00
Environmental Management Plan Cost as per chapter-9 of the DPR	111.23	44.49	33.37	33.37
Project Management & consultancy Charges @ 3% of Prime cost	172.41	68.97	51.72	51.72
Contingencies and Unforeseen Items of Works@ 3% of Prime cost	172.41	68.97	51.72	51.72
Total Project Cost	**6,217.22**	**2,486.89**	**1,865.17**	**1,865.17**
Ro-Ro Terminal (9C)				
Terminal	100.00	40.00	30.00	30.00
Cargo Handling Equipment	508.00	203.20	152.40	152.40
Environmental Management Plan Cost as per chapter-9 of the DPR	11.77	4.71	3.53	3.53
Project Management & consultancy Charges @ 3% of Prime cost	18.24	7.30	5.47	5.47
Contingencies and Unforeseen Items of Works @ 3% of Prime cost	18.24	7.30	5.47	5.47
Total Project Cost	**656.25**	**262.50**	**196.87**	**196.87**

ANNEXURE 11.13 –KERALA GOVERNMENT LETTER FOR ADDITIONAL STRUCTURES

GOVERNMENT OF KERALA

No. A2 /114 / 2018 / CSIND

Coastal Shipping & Inland Navigation (A) Department,
Thiruvananthapuram,
Dated : 07 / 03 / 2020.

From

The Additional Chief Secretary to Government.

To

Dr. Amita Prasad IAS
Chairperson , IWAI (Ministry of Shipping)
Government of India .

The Director (Tech.)
Inland Waterways Authority of India ,
Ministry of Shipping ,
Government of India ,
A-13 , Sector – I , Noida – 201301 (U.P.)

Sir,

Sub :- CSIND – Comments on the Draft DPRs of extended portions of NW– 3 (Kottappuram – Kozhikkode), NW - 8 (Alappuzha - Changanassery canal , NW - 9 Alappuzha – Kottayam , NW - 59 (Kottayam – Vaikom Canal) by IWAI - reg.

Ref :-
1. Lr. No. IWAI / Hy / Kerala / 2016 / PMU – 106 / 15 / 412 dtd. 28/01/2019 from the Chief Engineer (Tech.) , IWAI , Ministry of Shipping , Govt. of India .
2. Lr. No. IWAI/NNW / DPR / 2017 – 18/04 dtd. 12/02/2019 from the Director (Tech.), IWAI, Ministry of Shipping, Govt. of India .
3. Lr. No. IWAI/NNW/DPR/ 2017 – 18 dtd. 26/11/2019 from the Chief Engineer (Tech.) , IWAI , Ministry of Shipping , Govt. of India .
4. D.O.Letter No. A2/114/2018/CSIND dtd. 17/12/2019 addressed to Chairperson , IWAI , Government of India .

Kind attention is invited to the references cited. The following comments / views of Kerala with regard to the DPRs NW-3 (Kottappuram – Kozhikkode) NW8 - Alappauzha- Changanassery canal , NW-9 Alappuzha – Kottayam, NW59 Kottayam -Vaikom Canal , is conveyed for your kind consideration

The Development of four National Waterway portions in Kerala (NW-3,NW-8,NW-9,NW-59) are undertaken by IWAI. The structures constructed by various departments like bridges (Public Works Department). foot bridges (Local Self Government Department) , HT&LT lines (Kerala State Electricity Board Limited) , regulators , check dams, locks (Irrigation Department) and water supply main lines (Kerala Water Authority) do not have sufficient vertical and horizontal clearances for navigation. Reconstruction of these structures involved huge financial commitments.

The list of cross structures (department wise) and approximate cost for the reconstruction of the structures are detailed below . The cost is worked out based on rough cost estimation arrived in consultation with concerned departments .

1. Cross structures under Public Works Department

Total of 57 bridges and 2 foot bridges come under the control of PWD and PWD already proposed to reconstruct 15 bridges in NW3 with the aid of various agencies. They have to arrange the balance 42 bridges and 2 foot bridges under NW norms. The approximate amount required to reconstruct these structures is 840 Crores for bridges and 2.40 Cr for foot bridges. Approximate amount for one bridge is taken as 20.00 Crores. The amount may vary from site to site. It depends upon the character of soil, depth of pile, land acquisition, approach road etc. Approximate amount for foot bridge is taken as 1.20Crores . Thus the total cost of re-construction of 42 bridges and 2 foot bridges come to Rs. 842.40 Crores.

Sl. No	Name of Structures / obstructions	NW-3 (Kottappuram - Kozhikode)	NW8 Alappauzha-Changanassery canal	NW-9 Alappuzha - Kottayam			NW59 Vechoor Athiram puzha	Structures already proposed to reconstruct by PWD as per NW norms	Bal. to be arranged	Approx. amt. to re-construct in Rs crores
				9A	9 B	9 C				
1	Bridges	41	1	1	8	1	5	15	42	840.00
2	Foot bridges			-	2	-			2	2.40

TOTAL Rs. 842 . 40 Cr.

2. Cross structures under LSGD

Total Amount required for the reconstruction of foot bridges (41 nos.) is 49.20 Crores. Approximate amount for foot bridge is taken as 1.20Crores

Sl No.	Name of Structures / obstructions	NW-3 (Kottappuram - Kozhikode)	NW-8 Alappauzha – Changanassery canal	NW-9 Alappuzha - Kottayam			NW 59 – Vechoor - Athirampuzha	Structures proposed to reconstruct as per NW norms	Balance to be arranged	Approx amount to reconstruct in crores
				9 A	9 B	9 C				
									41	49.20
1	Foot bridges	26	3	-	9	-	3			

TOTAL Rs. 49 . 20 Cr .

3. Cross structures under Kerala State Electricity Board

Total Amount comes to Rs. 7.08 Crores (for HT and LT lines (17+198 = 215 nos.). Approximate amount for shifting of one HT Line is taken as 30.00 Lakhs and1.00 Lakhs for LT lines.

Sl. No	Name of Structures / obstructions	NW-3 (Kottappuram - Kozhikode)	NW-8 Alappauzha – Changanassery canal	NW-9 Alappuzha -Kottayam			NW 59 – Vechoor - Athirampuzha	Structures proposed to reconstruct as per NW norms	Balance to be arranged	Approximate amount to reconstruct in crores
				9 A	9 B	9 C				
								Nil	17	5.10
1	HT Lines	17	-					Nil	198	1.98
2	LT Lines	32	50	25	52	14	25			

TOTAL Rs. 7. 08 Cr .

4. Cross structures under Irrigation / Inland Navigation Department

Total amount comes to Rs. 458.80 Crores for reconstruction of various structures (41 nos.). Approximate amount for one bridge is taken as 20.00 Crores. The amount may vary from site to site. It depends upon the character of soil.

depth of pile, land acquisition, approach road etc. Approximate amount for foot bridge is taken as 1.20Crores. Approximate amount for one Lock/Regulator/ Barrages is taken as 35.00 Crores.

Sl. No	Name of Structures / obstructions	NW-3 (Kottappuram – Kozhikkode)	NW-8 (Alappuzha – Changanassery Canal)	NW-9 (Alappuzha – Kottayam)			NW-59 – Vechoor – Athirampuzha	Structures proposed to reconstruct as per NW norms	Balance to be arranged	Approximate amount to reconstruct in crores
				9A	9B	9C				
1	Bridges	11							11	220.00
2	Foot Bridges	24							24	28.80
3	Regulator cum bridge without Navigation lock	2							2	70.00
4	Barrages	2			-				2	70.00
5	Navigation lock	3						1	2	70.00

TOTAL Rs. 458 . 80 Cr.

5. Cross structures under Kerala Water Authority

The proposed estimate is given by KWA is Rs. 0.187 Cr.

Sl. No.	Name of Structures / obstructions	NW-3 (Kottapuram – Kozhikkode)	NW – 8 (Alappuzha -Changanassery Canal)	NW-9 (Alappuzha - Kottayam)			NW-59 – (Vechoor – Athiramputha)	Structures proposed to reconstruct as per NW norms	Balance to be arranged	Approximate amount to reconstruct in crores
				9 A	9B	9C				
1	Water pipeline	-	1						1	0.1870

TOTAL Rs. 0 . 187 Cr .

The total Amount required for the reconstruction of cross structures as per IWAI norms come to **Rs. 1358 Crores**. The development works include land acquisition, reconstruction of these structures and eviction of encroachers. The reconstruction of these structures in NW standards involves huge financial commitments to the State Government. Now 15 bridges are proposed to reconstruct by PWD and 1 Navigation lock by Inland Navigation department. If IWAI has to bear the cost , these works can be arranged as deposit work and 12 to 18 months time is required to complete the structures. The structures can be reconstructed in phased manner with in 6 years period if IWAI provide funds for executing these reconstruction work as deposit work by concerned department . The land acquisition as per NW standards can be done by the aid of central assistance. The eviction of encroachments and hindrance free land will be provided by state Government.

May I therefore request you to kindly consider the above comments / views of the State Government and to provide funds for executing the above reconstruction works as deposit work by departments concerned within a time limit of 12 to 18 months to complete the major structures of National Waterways .

Yours faithfully,

DR. VISHWAS MEHTA
ADDITIONAL CHIEF SECRETARY

ANNEXURE 12.1 –IMPLEMENTATION SCHEDULE

NW - 9 (Alappuzha - Kottayam - Maniyapparambu Canal)

(24 Months Commencing from 2020)

Sl.No.	Items	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
A	**Fairway**																																				
	1.a) Dredging																																				
	Ordinary Soils / Hard Soils (Approval & Tendering)																																				
	Ordinary Soils (3.80 Lakhs Cu. M)																																				
	1.b) Dredging																																				
	Hard Soils																																				
	2. Low Cost Riverine Structures (NIL)																																				
	3. River Training Works/ Bank Protection (600 m)																																				
	4. Night Navigation																																				
	Buoy / Lights (Approval & Tendering)																																				
	Buoy / Lights (50 Nos)																																				
	5. Land Acquisition (1.5 Hectares for Fairway) #																																				
	# LA process may continue, but handing over / taking over is expected, before.																																				
B	**Modification of Structures (25 Power Lines)**																																				
C	**Communication System (NIL)**																																				
D	**Institutional Requirement (Along with Cl 6 development)**																																				
	Office / Manpower (Establishment & Recruittment)																																				
	Office / Manpower (Deployment)																																				
	Vessels (Approvals & Tendering)																																				
	Vessels (Procurement & Deployment of 2 SLs; 2 Tugs; 2 IBs)																																				
E	**Environmental Management Plan**																																				
A	**Fairway**																																				
	1.a) Dredging																																				
	Ordinary Soils / Hard Soils (Approvals & Tendering)																																				
	Ordinary Soils (10.5 Lakhs Cu. M)																																				
	1.b) Dredging																																				
	Hard Soils (1.5 Lakhs Cu. M)																																				
	2. Low Cost Riverine Structures (NIL)																																				
	3. River Training Works/ Bank Protection (Approval & Tendering)																																				
	River Training Works/ Bank Protection (6 Locations 3000 m)																																				
	4. Night Navigation																																				
	Buoy/ Lights (Approval & Tendering)																																				
	Buoy / Lights (70 Nos)																																				

*** Fairway Development (along with 2 Nos. Lo-Lo Terminal) is to be taken up after having the discussions and understanding with KPACT / TCL.**

ANNEXURE 12.2 –IMPLEMENTATION SCHEDULE RO-RO

NW - 9 (Alappuzha - Kottayam - Maniyapparambu Canal)

(24 Months Commencing from 2020)

Sl.No.	Items	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
A	**Lo - Lo Terminal - 2 Nos. ***																																				
	Land Acuisition																																				
	Riverine Components (Jetty Structure)																																				
	Infrastructure Components																																				
	Infrastructure Components internal roads (Execution)																																				
	Approach Road Construction																																				
	Bank Protection Works for terminal (Approvals & Tendering)																																				
	Bank Protection Works for terminal (Execution)																																				
	Cargo Handling Equipments																																				
	Ambulance - 1 no.																																				
	Cranes with 125 T Capacity - 3 nos.																																				
	Fork lift trucks 20 T Capacity - 3 nos.																																				
	Environmental Management Plan																																				
	Vessels																																				
B	**Ro - Ro Terminal**																																				
	Land Acuisition																																				
	Riverine Components (Jetty Structure)																																				
	Infrastructure Components internal roads (Approvals & Tendering)																																				
	Infrastructure Components internal roads (Execution)																																				
	Approach Road																																				
	Bank Protection Works for terminal (Approvals & Tendering)																																				
	Bank Protection Works for terminal (Execution)																																				
	Cargo Handling Equipments																																				
	Ambulance - 0 no.																																				
	Cranes with 125 T Capacity - 0 nos.																																				
	Fork lift trucks 20 T Capacity - 0 nos.																																				
	Environmental Management Plan																																				
	Vessels																																				

*** Fairway Development (along with 2 Nos. Lo-Lo Terminal) is to be taken up after having the discussions and understanding with KPACT / TCL.**

LIST OF DRAWINGS

Sl. No.	DRAWING NAME	DRAWING NUMBER	SHEETS
1	ALAPPUZHA-KOTTAYAM-MANIYAPARAMBU CANAL (KERALA) NW 9A LAYOUT PLAN	P.010631-W-20301-A02A	3
2	ALAPPUZHA-KOTTAYAM-MANIYAPARAMBU CANAL (KERALA) NW 9B LAYOUT PLAN	P.010631-W-20301-A02B	2
3	ALAPPUZHA-KOTTAYAM-MANIYAPARAMBU CANAL (KERALA) NW 9C LAYOUT PLAN	P.010631-W-20301-A02C	2
4	LAYOUT MAP SHOWING TERMINAL LOCATION (KERALA) NW 9	P.010631-W-20351-X02	1

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