CONSULTANCY SERVICES FOR PREPARATION OF SECOND STAGE DPR OF CLUSTER-6 : (NW-3 EXTENSION) OF NATIONAL WATERWAYS

DETAILED PROJECT REPORT: KOTTAPPURAM - KOZHIKODE (169 KM) - (NW-3 EXTENSION)
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DPR – WEST COAST CANAL NW-3 (EXTENSION) KOTTAPPURAM – KOZHIKODE (169.794 KM)

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

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

B C Jha

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 of National Waterways” by Inland Waterways Authority of India (IWAI). Accordingly, the study on NW 3 Extension – West Coast Canal has been carried out for this assignment / analyzed / compiled based on the findings of the following field studies / investigations.

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

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

Terminal Land Survey was carried out at “Ponnani” on 10/10/2017 and at “Beypore” on 08/10/2017.

Geotechnical Borehole was carried out at “Beypore” from 12/08/2017 to 16/08/2017 and at “Ponnani” from 09/08/2017 to 11/08/2017 and subsequently Laboratory Tests have been carried out on the collected samples.

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

B C Jha

Tractebel Engineering Pvt Ltd

DETAILED PROJECT REPORT – WEST COAST CANAL NW 3 (EXTENSION) KOTTAPPURAM – KOZHIKODE (169.794 KM)

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LIST OF ABBREVIATIONS

Abbreviations	Acronyms
BFL	Bombay Floating Light
BM	Benchmark
CD	Chart Datum
Ch	Chainage
cm	centimeter
CRZ	Coastal Regulation Zone
CWC	Central Water Commission
DGPS	Differential Global Positioning System
DMIC	Delhi Mumbai Industrial Corridor
DPR	Detailed Project Report
D/S	Down Stream
ETS	Electronic Total Station
FSL	Full Supply Level
GAIL	Gas Authority of India Ltd.
GPS	Global Positioning Systems
HC	Horizontal Clearance
HFL	High Flood Line
HTL	High Tension Line
HW	High Water
IHO	International Hydrography Organization
IO	Iron Ores
IOCL	Indian Oil Corporation Ltd.
IWAI	Inland Waterways Authority of India
IWT	Inland Water Transport
KIOCL	Kudremukh Iron Ore Company Limited
Km	Kilometer
KP	Km Points
KSINC / KINCO	Kerala State Inland Navigation Corporation Ltd.,.
LAD	Least Available Depth
Lat	Latitude
LBM	Local Benchmark
Long	Longitude
Lo-Lo	Lift On Lift Off
LW	Low Water
m	meter
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.

Abbreviations	Acronyms
MSME	Micro Small & Medium Enterprises
MSL	Mean Sea Level
MTPA	Metric Tonne per Annum
NA	Not Applicable
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
RCC	Reinforced Cement Concrete
RL	Reference Level / Reduced Level
Ro-Ro	Roll On-Roll Off
RTK	Real Time Kinematic
SD	Sounding Datum
SEB	State Electricity Board
SH	State Highway
TBC	Trimble Business Center
TBM	Temporary Benchmark
TP	Tide Pole
TS	Total Station
UHF	Ultra High Frequency
UPCL	Udupi Power Corporation Ltd
U/S	Up Stream
VC	Vertical Clearance
WGS	World Geodetic System
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	**Start**	**End**
	Place	Kottapuram	Kozhikode
	Latitude	10°11'38.32"N	11°13'38.83"N
	Longitude	076°12'4.39"E	075°46'43.90"E
B	**TECHNICAL**		
1	***Waterway***		
a	National Waterway Number	NW-3 - Extension	
b	Class	III (up to 169.55km)	
c	Type (Tidal / Non-Tidal)	Tidal Stretch: - 0 to 118.53km & 130.67km to 169.55km (length -157.41km). Non-Tidal Stretch: - 118.53 km to 130.67km (length -12.14km).	

#	Particulars	Total	Tidal	Non-Tidal
	Length (Km.)	**Total**	**Tidal**	**Non-Tidal**
		169.55 km	157.41 km	12.14 km

#	Particulars	Details
d	Average Tidal Variation, if applicable	The Average Tidal Variation is about 0.86 m.
e	Chart Datum (w.r.t. MSL)	

#	Particulars									
	Description / Basis	TP1 (IWT Terminal)	TP-3	TP-6	TP-9	TP-10	Downstream of Tanur lock	TP-15	TP-16	TP-18
	Value (m)	-0.6	-0.215	-0.495	-0.699	-0.3	-0.277	-0.009	-0.406	-0.097
		Note: -ve indicates below MSL								

#	Particulars	Details
f	LAD Status (w.r.t. CD)	see tables below

LAD (m) Reduced	0-25km	25-54.07km	54.07-82.01km	82.01-95.91km	Total
< 1.8 m (km)	13.00	7.55	27.94	12.35	60.84
1.8m to 2.0m (km)	2.50	0.30	0.0	0.0	2.80
2.0m to 2.2m (km)	0.00	0.15	0.0	0	0.15
2.2m to 2.5m (km)	4.25	5.75	0.0	0	10.0
> 2.5m (km)	5.25	15.32	0.0	1.55	22.12
Total	25	29.07	27.94	13.9	95.91

LAD (m) Reduced	95.91-114.67km	114.67-118.53km	118.53-130.67km	130.67-169.55km	Total
< 1.8 m (km)	18.15	2.91	2.65	24.50	48.21
1.8m to 2.0m (km)	0.61	0.0	0.0	0.35	0.96
2.0m to 2.2m (km)	0.0	0.35	0.0	0.50	0.85
2.2m to 2.5m (km)	0.0	0.0	1.50	5.53	7.03
> 2.5m (km)	0.0	0.60	7.99	8.00	16.59
Total	18.76	3.86	12.14	38.88	73.64
				Grand Total	169.55km

#	Particulars	Details
g	Target Depth of Proposed Fairway (m)	2.2 m
h	Conservancy Works Required	66.36 Lakh Cum of dredging (In case of Longitudinal development along the length of waterway). 136 Kms of Bank Protection (In case of Longitudinal development along the length of waerway). 1.19 Lakh Cum dredging at three locations (two at Beypore & one at Ponnani) suggested for crossing the water way along the ferry route.
i)	Existing Cross Structures	

Name of Structure	Type	Nos.	Range of Horizontal Clearance	Range of Vertical Clearance w.r.t. FRL/HFL
Dams/Barrages/ Weirs/Aqueducts	Barrages with locks	9	1-16m	4.5-7m

#	Particulars	Details					
	etc.						
	Bridges	Road Bridges/ Moving Bridges, /. Foot Bridges/Rail Bridges / temporary bridges (wooden)		128	6-185m		1-8.5m
	HT/Tele-communication lines	LT line HT Line		43 06	20-370m		2.5-13.5m
	Pipelines, underwater cables, etc.	Water PipeLine		1	82		6
2	***Traffic***						
a	Present IWT Operations (type of services)	Not Operational on extended stretch					
b	Major industries in the hinterland (i.e. within 25 km. on either side)	No large-scale industries exist, some Medium industries (in the form of steel plants) are located in Kozhikode district and small industries are operational in Malappuram & Thrissur however no future expansion plan. List of the companies/factories are presented in Chapter 4.					
c	Connectivity of major industries with Rail/Road network (Distances/Nearest Railway Stations etc.)	Major roads - National Highway-17 moves along the waterway from Kottapuram to Kozhikode Major railway – The Thiruvananthapuram and Palakkad division of Southern Railways passes through the catchment of West Coast Canal					
d	Commodities	**In-bound (Origin)**		**Out-bound**			
1.	Steel scraps	Cochin Port & Nearby area		n/a			
e	Future Potential (MMT)						
	Name of Commodity	5 yr. (Fy-20)	10 yr. (Fy-25)	15 yr. Fy-30)	20 yr. (Fy-35)		25 yr. (Fy-40)
	Terminal at Beypore	**0.4 Mtpa however stagnant in future years**					

#	Particulars	Details					
1.	Steel Scraps (mn T)	0.4	0.4	0.4	0.4	0.4	
	Proposed IWAI Terminal on NW-3 (Extn.)						
1	Tourism	--					
3	***Terminals/Jetties***						
a	Terminal/Jetty	None					
	Location (Bank/city/district)	NA					
	Type/Services	None					
	Facilities	None					
	Approach	Road is available					
	Land Ownership	Government and Private Land In case of Longitudinal Development along length of theWaterway – (169.55kms)					
	Area (ha.)	Name of the District	Land Acquisition Area (Hectares)				
		Thrissur	127.2				
		Malappuram	55.9				
		Kozhikode	26.0				
		Total	209.1				
4	***Design Vessel***						
a	Type	Passenger FerryVessel					
b	No. & Size	2 Passenger Ferry Vessel; • For steel boat i. Size (L x B x D) – 15m x 1.9m x 0.7m, 25pax ii. Engine - 1 Marine Diesel Outboard Engine of 120 hp each (approx). • For FRP boat iii. Size (L x B x D) – 15m x 1.9m x 0.4m, 30pax iv. Engine - 1 Marine Diesel Outboard Engine of 90 hp each (approx).					
c	Loaded Draft	<1.5 m					
d	Capacity & Speed	25-30 Pax. Max. Speed- -6 Knots					
5	***Navigation Aids***						

#	Particulars	Details		
a	Type	Buoy and Light		
b	Nos.	330 (In case of Longitudinal Development of Waterway along its length of 169.55kms)		
b	Communication Facilities	Not Suggested.		
C	**FINANCIAL**			
1	***Project Cost***			
a	Capital Cost	Fairway	Lo-Lo (Beypore/Ponnani)	
	Cost (INR)	2752.98 cr	None	
b	O & M Cost	None	None	
2	***User Charges***			
a	For IWAI	-		
b	For Operator	-		
3	***Financial Internal Rate of Return (%)***	Fairway	Lo-Lo Terminal	Whole Project
		Non-existent	None	Non-existent
4	***Economic Internal Rate of Return (%)***	Fairway	Lo-Lo Terminal	Whole Project
		Non-existent	None	Non-existent
5	***Any other Important Feature***	***(i) The longitudinal development of Waterway along the 169.55kms length has not been suggested for any investment in light of miniscule cargo without any future growth potential, as well as large investment cost having infinitesimal revenue stream.*** ***(ii) Confirmations of the IWT traffic with critical observation indicating positive growth may trigger for its development. Not Recommended investment for, longitudinal development along the length of river, as of now.*** ***(iii) Three Ferry Routes (two at Beypore and one at Ponnani) has been suggested for support at a nominal cost of 3.25 Crores for safe navigation round the year, yielding a FIRR of -2.6% & EIRR of 210.4%.***		

EXECUTIVE SUMMARY

West Coast Canal (WCC) system extending for a length of about 560 kms along the Kerala Coast from Kovalam to Hosdurg is formed by favourably linking the natural water bodies like Rivers / Lakes / Backwaters / Lagoons with dominant consideration of Navigation. This Waterway transport had its glory before the linkages of Road and Rail and facing the reduced importance with the quick / point to point connectivity through other modes. However, the Water Transport mode will attain its importance due to its basic advantage of Economic and Environment friendly mode.

The stretch of the West Coast Canal NW-3 Extension i.e., the study stretch, starts from Kottapuram 10°11'38.32"N, 76°12'04.39"E and ends at Kozhikode 11°13'38.83"N, 75°46'43.90"E. It takes the alignment which passes/crosses through Periyar River, Karuvannur River, Beeyam Kayal River, Bharathapuzha River, Kadalundipuzha River, Kadalundi River, Chaliyar River and Mampuzha River. The integrating points of canal and the said rivers are in the vicinities of Arabian Sea mouths at eight different locations including start and the end of the canal. The study stretches of about 169.55 kms has been proposed for undertaking the two stages DPR. M/s Tractebel has been assigned with the work of Preparation of the two stages DPR. Subsequent to the Stage 1 preliminary findings, the Waterway stretch 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.

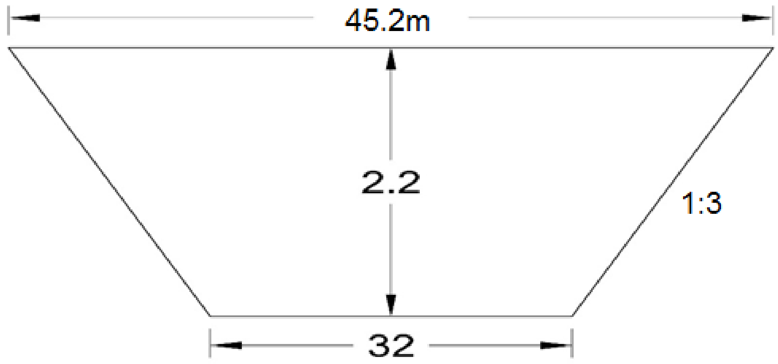
Based on the Hydrographic Survey inputs and other site data collected on NW 3 (Extension), it has been noticed that 128 Nos. of Bridges; 49 Nos. of Power Cables and 01 No. Pipeline are present / crossing the study area. No Dams / Weirs / Anicuts / Aqueducts are located. Barrages / Locks are in existence at 09 Locations and are to be reconstructed. 174 Nos of Bend locations have been identified in the study stretch, with 20 m as lowest bend radius at Ch. 159.45km. However, with the proposed widening, most of the bends will vanish. Provision of Bank Protection is inevitable due to the thickly habitant zone of the study stretches. Accordingly, 136 Kms of Pile & Slab type Bank Protection has been worked out. 106 Nos. of Bridges are suggested for modification. Lump Sum provision has been catered for stringing Power Cables. 330 Nos. of Day / Night Navigation system has been suggested. Land Acquisition of 209.1 Hectares is observed essential, district wise land area acquisition is shown in the below table:

Name of the District	Land Acquisition Area (Hectares)
Thrissur	127.2
Malappuram	55.9
Kozhikode	26.0
Total	209.1

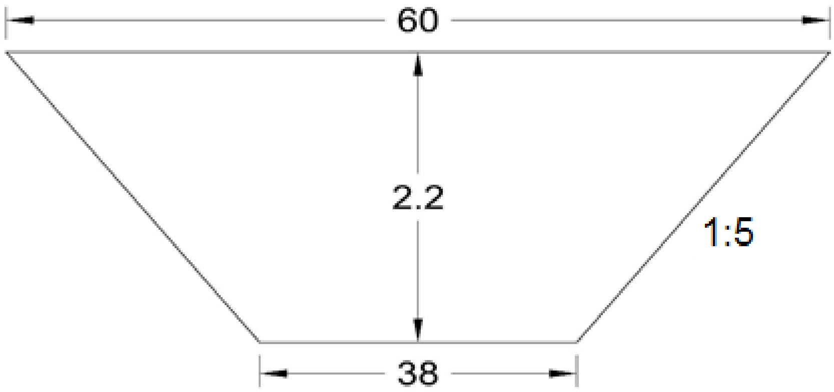
Present study stretch of NW 3 (Extension) is not having any utility from Navigation point of view. No Cargo mobility is observed in the stretch. The geographical advantage of the study stretch is that the same is interconnected with the existing NW 3 and inter alia connecting 11 IWT Terminals (Stretching from Kottappuram in the North and Kollam in the South) and also the Kochi area including the ICTT, Kochi through Waterway. Further, the study stretch is traversing through two Non Major Ports viz., Ponnani and Beypore.

In the study, 4 Lakhs T P. A of Steel Scrap has been identified only for mobility from Kochi area to Kozhikode area. No other cargo has been visualized for mobility through the study stretch. This volume is not justifying the development & IWT mobility is seemingly a remote possibility. However, an attempt has been made with such requirements of any future developments. Although, the mode shift will reduce the congestion on the road, especially in the land scarce state of Kerala, still, no development has been recommended on NW 3 (Extension) in light of limited cargo. In due course of time, if any improvement in cargo shift to IWT is observed for any obvious reason, development may be considered. In that case, development is estimated there upon in 5 yrs for this magnitude of development having fairway requirements conforming to **Class III** waterway with canal standards. Accordingly, 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 have been adopted as per the **Class III** waterway in line with existing canal standards being maintained in the present NW 3 stretch, as detailed.



Narrow Reaches with 50 m Land Acquisition.



Wider Reaches with No Land Acquisition.

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**			**Max**	**Min**		
0.0	25.00	TIDAL ZONE				8.1	-0.3	13000	414328.60
25.00	54.07					7.4	-0.3	7900	366817.64
54.07	82.01					2.5	-0.3	28000	2081191.80
82.01	95.91					4.8	-0.3	12450	712389.73
95.91	114.67					2.6	-0.3	18150	1113515.69
114.67	118.53					5.1	0.4	2950	79005.94
118.53	130.67	10.9	0.0	2050	27432.24	10.6	-0.3	2650	51916.40
130.67	169.50	TIDAL ZONE				11.9	-0.3	24800	1614976.23
								109900	6434142.03

Accordingly, the shoal length is of 109.9 kms with the quantity of Dredging is 64.34 lakhs cum & considering additional 5% which comes out to be 67.56 Lakhs Cu. M of general soil. This is the estimated quantity in case of longitudinal development along the length of waterway, however the situation is that some ferry services do provide facility for crossing across the waterway which is at three locations involving about one km at each location, thus three kms of dredging may be needed to support the passenger vessel movement and the quantity of dredging may be in the range of (67.56*3/169.56) cum = 1,19,533 cum. Hence the dredging quantity for longitudinal development has been considered as 66.36 Lakhs cum & dredging quantity for crossing the waterway at three locations for passenger ferry movement, the estimated dredging quantity is 1.19 Lakh cum.

According to the Origin and Destination of the cargo, the Terminals in the existing NW 3 stretch / Kochi Port may be at one end and the other end will be either at Ponnani Port vicinity or at Beypore Port vicinity. Since, there is no significant cargo, no IWT terminal has been suggested at either location. Also, no terminal structure has been suggested as well. Although, land survey had been carried out at both Beypore & Ponnani and described in the DPR for record purpose only. Preliminary designs have been worked out for bank protection with Pile & Slab; Navigational Aids through Buoys (Polyethylene) and Lights (4 NM) has been considered once the fairway development along the length of the waterway shall be taken for its development. Rightnow no fairway development, terminal development & terminal infrastructure has been suggested.

As described, the existing ferry services at three locations do provide facility for crossing across the waterway, which has been identified for its strengthening for safe navigability of passenger mobility, thus three kms of dredging may be needed to support the passenger ferry vessel movement and dredging quantity of 1.19 Lakh cum has been identified for crossing over development as immediate support for ensuring safe navigability. These three locations are:

Sl No.	Location and Existing Ferry Routes	Coordinates	Remarks
1	**BEYPORE** (Chaliyan-Kozikode road to Beypore) Chainage-148.90 Kms	Left Bank Lat:11° 09' 44.62"N & Long: 75° 48' 30.35"E To Right bank Lat:11° 10' 04.96"N & Long: 75° 48' 30.38"E	Ferry route identified at CHALIYAN Left bank of river to BEYPORE right bank of river. There already exists a ferry route which is used for river crossing by residents having a ferry length of about 750.0m.

Sl No.	Location and Existing Ferry Routes	Coordinates	Remarks
2	**BEYPORE** (Chaliyan-Kozikode road to Anangadi) Chainage-149.20 Kms	Left Bank Lat:11° 09' 45.11"N & Long:75° 48' 30.33"E To Right bank Lat:11° 09' 55.51"N & Long: 75° 48' 23.59"E	Ferry route identified at CHALIYAN Left bank of river to ANANGADI right bank of river. There already exists a ferry route which is used for river crossing by residents having a ferry length of about 500.0m
3	**PONNANI** (Thottaungal juma masid road to Purathur Pallikadam viewpoint) Chainage-89.40 Kms	Left Bank Lat: 10° 46' 56.45"N & Long: 75° 55' 16.97"E To Right bank Lat: 10° 47' 33.21"N & Long 75° 54' 44.55"E	Ferry route identified at KAILASAM KALAM Left bank of river to PURATHUR (Purathur Pallikadam viewpoint) right bank of river. There already exists a ferry route which is used for river crossing by residents having a ferry length of about 1250.0m.

Any passenger ferry with less than 1.5m draft is suitable for navigating in the defined stretch, as targeted depth of NW-3 waterway is 2.2 m. The recommended specification of passenger ferry that can be deployed in NW-3 for tourism and passenger movement is as follows.

- For steel boat
  i. Size (L x B x D) – 15m x 1.9m x 0.7m, 25pax
  ii. Engine - 1 Marine Diesel Outboard Engine of 120 hp each (approx).
- For FRP boat
  iii. Size (L x B x D) – 15m x 1.9m x 0.4m, 30pax
  iv. Engine - 1 Marine Diesel Outboard Engine of 90 hp each (approx).

The deployment of passenger vessel for ferry services shall be through 3rd party tour operators & such deployment of veseel shall be as per the Indian standard.

With regard to the Environmental aspects, keeping in view the 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. Marginal Impact on aquatic ecology is anticipated during the dredging. No structures are present over the land identified for construction of terminals or related project components. Land Acquisition is involved, however, can be mitigated with the standard laws of compensation etc., duly following the R & R Practices. The majority of the 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 3 (Extension) will be a part of the present Kochi office and no additional resources are needed at this stage, since this is not recommended for development.

The cost estimates have been worked out for longitudinal development along the length of waterway, which is 2752.98 Crores inclusive of INR.1315.42 Crores as suggested by Govt. of Kerala letter vide their L no. A2/224/2018/CSIND dated 07.03.2020 for inclusion of additional structures in NW-3 waterway as Option-II. However, the FIRR and EIRR have not been worked out since the waterway has not been recommended for its development in absence of cargo hence commercial & financial viability does not exist as there is no revenue stream to support such large investment.

The idea of crossing the waterway at three operational locations has been mooted, where the ferry services are existing, with suggested dredging at these three locations for facilitating safe navigation of the passenger vessels at a nominal cost of 3.25 Crores as Option-I. The costing and FIRR and EIRR have been calculated and the critical indicators are placed.

Parameter	Section	Unit	Outcome
Project Cost	Fairway	Cr.	3.25
	Terminals	Cr.	-
Revenue	Fairway (FY40)	Cr.	0.004
	Terminals (FY40)	Cr.	1.06
FIRR	Entire Project	-	-2.6%
EIRR	Entire Project	-	210.4%

Not recommended for any investment of longitudinal development along the waterway till the confirmations of the IWT traffic with critical observation. Investment on Development shall be feasible only with positive growth confirmations to develop the stretch of NW 3 (Extension) for about 169 Kms with Class III Canal system of the NW standards.

CHAPTER 1 INTRODUCTION

1.1 Project Background and Summary of previous study

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

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

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

Sl. No.	Name of Rivers/ Creeks	National Water Way (NW)	Length (km)	State
11.	Udayavara River	NW-105	16.000	Karnataka
	Waterways restricted to Stage I study.	**Total**	**453.895**	

Accordingly, the Stage II study of the West Coast Canal NW 3 (Extension) from Kottappuram to Kozhikode is under consideration in the present DPR.

The portion of the existing NW 3 from Kollam to Kottappuram; NW 8; NW 9 and NW 59 {traversing through the Vembanad Lake in Kerala} are having the inter connectivity with the NW 3 (Extension) i.e., the present study stretches. With the development of the present study stretch of NW 3 (Extension), there will be throughput from Kozhikode in the North to Kollam in the south also connecting the waterways in Kochi area hinterland.

A Macro Level Route Map of the NW 3 (Extension) and the route traversing is presented herewith for more understanding.

Figure 1-1: Index Map of NW 3 Extension Waterways (Source: Google Earth)

1.2 Brief Scope of Work and Compliance statement

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

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

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

1.2.1 Fairway Development

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

1.2.2 Traffic Confirmations

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

1.2.3 Terminal Development

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

1.2.4 Vessel Requirement

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

1.2.5 Financial Analysis

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

1.3 Brief Methodology & Approach:

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

1.4 Project Location / Details of Study Area:

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

TABLE 1-2: WATERWAYS FOR STAGE II STUDY

Sl. No.	NW-No. / Name of the Waterway	Defined Limits
	Cluster 6 (Karnataka)	
1.	NW-43 / GURUPUR RIVER	10.041 kms from starting point Lat 12°50' 44.093" N, Long 74° 49' 44.783" E.
2.	NW-51 / KABINI RIVER	23.56 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 / NETRAVATHI RIVER	30.00 kms from starting point Lat 12°50’44.6904" N, Long 74°49'33.3734" E.
5.	NW-90 / SHARAVATI RIVER	28.674 kms from starting point Lat 14°17’56.5621" N, Long 74°25'36.4534" E.
	Cluster 6 (Kerala)	
1.	NW-3 / WEST COAST CANAL	169.794 kms from starting point Lat 10°11'38.9421" N, Long 76°12'04.152" E.
2.	NW-8 / ALAPPUZHA – CHANGANASSERY CANAL	29.3 kms from starting point Lat 09°30'03"N, 76°20'37"E.
3.	NW-9 / ALAPPUZHA-KOTTAYAM-MANIYAPARAMBU CANAL	51.7 kms from starting point Lat 09°31'1.31"N, 76°22'44.15"E.
4.	NW – 59 / VECHOOR – ATHIRAMPUZHA CANAL	18.8 kms from starting point Lat 09°40'0"N, 76°24'11"E.

The present study is about the West Coast Canal NW 3 (Extension) from Kottappuram to Kozhikkode, in the state of Kerala.

TABLE 1-3: DESCRIPTION OF KOTTAPPURAM – KOZHIKODE CANAL – NW-3 (Extension)

Sl. No.	Introductory Consideration	Description of the Canal
1.	Name of the river / canal	The West Coast Canal NW 3 (Extension) from Kottappuram to Kozhikode.
2.	State / District through which river passes	The present study stretch of the West Coast Canal NW 3 (Extension) starts from Kottappuram IWAI Jetty area of Thrissur district of Kerala State and ends at Azheekal

Sl. No.	Introductory Consideration	Description of the Canal
		Pulimodu area of Mampuzha River of Kallai Estuary of Kozhikode district of Kerala State.
3	Length of the river / canal	The stretch of the West Coast Canal NW-3 Extension starts from Kottapuram 10°11'38.32"N, 076°12'04.39"E and ends at Kozhikode 11°13'38.83"N, 075°46'43.90"E. It takes the alignment which passes/crosses through Periyar river, Karuvannur river, Beeyam Kayal river, Bharathapuzha river, Kadalundipuzha river, Kadalundi river, Chaliyar river and Mampuzha river. The integrating points of canal and the said rivers are in the vicinities of Arabian Sea mouths at eight different locations including start and the end of the canal.
4	Map	The index map of NW 3 Extension showing proposed waterway stretch, topographic features and road networks is placed at Figure1.2. The layout plan of the study stretch of NW 3 Extension for the Detailed Project Report (DPR) is presented in **Drawing No. P. 010256-W-20301-A01**.
	Characteristic of River	
5	River / Canal Course	The waterway stretch from Kottappuram to Kozhikode (169.55 km) passes through backwaters, rivers and canals including man made canals known as canoli canal. The west coast canal from Kottappuram to Kozhikode runs almost parallel to the sea.
6	Tributaries / Network of Rivers / Basin	West Coast Canal NW 3 extension takes the alignment which passes/crosses through Periyar river, Karuvannur river, Beeyam Kayal river, Bharathapuzha river, Kadalundipuzha river, Kadalundi river, Chaliyar river and Mampuzha river. This is interlinking the above rivers / basins.
7	Catchment Area	Since NW 3 Extension is a canal, there is no specific catchment area.

CHAPTER 2 WATERWAY / DETAILED HYDROGRAPHIC SURVEY

2.1 Hydrographic Survey

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

2.1.1 Waterway in General and Hydro-morphological Characteristics

Waterway in General

Waterways have always been an important mode of transport in Kerala. The total length of navigable route in Kerala was 1,900 kilometers and the navigable rivers constitute about 54 per cent of the waterways. The 41 West-flowing rivers together with the backwaters are an integrated part of the inland navigation system in Kerala. The State's inland waterways pass through highly populated regions. The majority of those inhabiting the region were engaged in traditional industries such as coir, cashew, brickmaking and fishing. Any attempt to develop the inland waterways will favourably impact the well-being of this region.

West Coast Canal (WCC) system extending for a length of about 560 kms along the Kerala Coast from Kovalam to Hosdurg is formed by favourably linking the natural water bodies like Rivers / Lakes / Backwaters / Lagoons with dominant consideration of Navigation. This Waterway transport had its glory before the linkages of Road and Rail and facing the reduced importance with the quick / point to point connectivity through other modes. However, the Water Transport mode will attain its importance due to its basic advantage of Economic and Environment friendly mode.

The West Coast Canal between Kollam and Kottapuram is under development since 1994, in phased manner. Capital dredging for widening and deepening of canal between Kochi and Kollam was started in first phase during 1997-98 and is under the final stage of completion. Lot of impediments have been sorted out during the implementation of this work. The stretch facing the vulnerability has been provisioned with Bank Protection. In

Kochi – Kottapuram stretch, capital dredging was started in 2nd phase during September 2002 and completed. Work in Kochi – Kollam sector is facing the delay due to various problems such as disposal of dredged material, fishing nets, local issues leading to contractual problems etc. Out of entire length of 205 km of the waterway (including Udyogmandal Canal of about 23 kms + Champakkara Canal of 14 Kms), the total shoal length has been estimated as 87.16 km and ascertained that a small portion is under the final stage of completion near Kollam. Project for providing and maintaining 24 hrs navigational aids by way of buoys and lights had been completed during 2007-08 and now the entire waterway has the facility for 24 hrs navigation which is being maintained since 2009.

A number of industrial plants on the banks of Udyogamandal Canal are using this Water Transport system of NW 3, where the public sector FACT and Travancore Cochin Chemicals (TCC) are located. A sizeable quantity of chemicals and fertilizer imports of public sector FACT (raw materials) are being transported through the Udyogamandal canal and Champakkara canal by barges from the Kochi Port.

As a part of development, the present NW 3 system has been developed with Class III NW fairway standard and also provisioned with Inland Water Transport (IWT) Terminals at Kottappuram; Aluva; Kakkanad; Maradu; Vaikom; Thannermukkom; Alappuzha; Trikunnappuzha; Kayamkulam (Ayiramthengu); Chavara and Kollam.

International Container Trans-shipment Terminal (ICTT) at Vallarpadam at Kochi Coast is one of such external factors which will create lot of future potential for IWAI in Kerala. The expectations from ICTT are to attract more international cargo movement through India and to reduce the freight cost of India's international trade. IWAI has already taken steps to utilize such opportunity. Two special terminals, which support the interchange of containers by Lo-Lo (Lift On, Lift Off) and Ro-Ro (Roll On, Roll Off) barges, are constructed on NW3, near Kochi port. Traffic will, in all likelihood, come to a halt in Kochi when hundreds of container-laden Lorries take to the city roads and highways when the Vallarpadam container transhipment terminal becomes fully functional. Presuming that a container will be loaded and another one unloaded every minute, so about 2,880 Lorries will pass through Kochi's highways daily.

The stretch of the West Coast Canal NW-3 Extension starts from Kottapuram 10°11'38.32"N, 076°12'04.39"E and ends at Kozhikode 11°13'38.83"N, 075°46'43.90"E. It takes the alignment which passes/crosses through Periyar River, Karuvannur River, Beeyam Kayal River, Bharathapuzha River, Kadalundipuzha River, Kadalundi River, Chaliyar River and Mampuzha River. The integrating points of canal and the said rivers are in the vicinities of Arabian Sea mouths at eight different locations including start and the end of the canal.

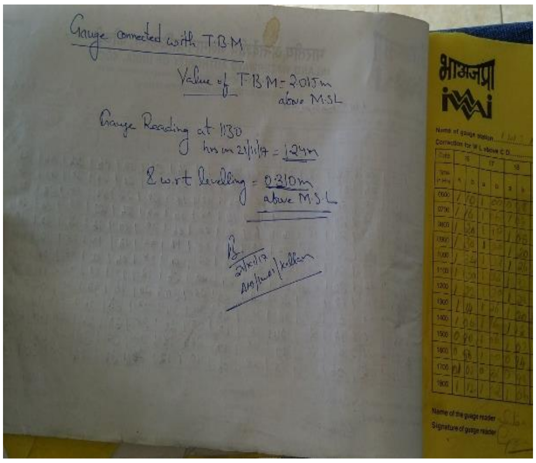
The climate of Kerala is tropical monsoon with seasonally excessive rainfall and hot summer. The Western Ghats plays a major role in the climatic conditions that prevail all along the state. The period of March to the end of May is the hot season, followed by South West Monsoon season that continued 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.

Kerala's rainfall averages 2,923 mm (115 in) annually. Some of Kerala's drier lowland regions average only 1,250 mm (49 in); the mountains of the eastern region receive more than 5,000 mm (197 in) of orographic precipitation, the highest in the state. In eastern Kerala, a drier tropical wet and dry climate prevails. During the summer, the state is prone to gale-force winds, storm surges, cyclone-related torrential downpours, occasional droughts, and rises in sea level. The mean daily temperature ranges from 19.8 °C to 36.7 °C. Mean annual temperatures range from 25.0–27.5 °C in the coastal lowlands to 20.0–22.5 °C in the eastern highlands.

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 Charnockites and charnockitic gneisses are the oldest rock complex units of Kerala state. 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.

2.1.2 Existing Hydrological / Topographical Reference levels

Reference Benchmark value 2.015m above MSL and 2.615 above chart datum (CD = 0.6m below MSL), on jetty level near IWAI centre bollard terminal jetty (IWT), Kottapuram was taken during survey.



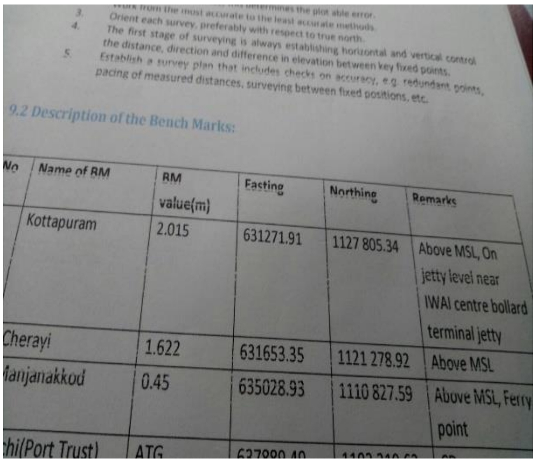


Table 2-1 Accepted Station coordinates (WGS-84)

Bench Mark	Chainage	Latitude N	Longitude E	Easting(m)	Northing(m)	BM Height above MSL (m)	BM Height above SD (m)
IWT center bollard	-0.215	10°12'1.29"N	76°11'54.27"E	631268.106	1127808.845	2.015	2.615
(NW3) 1	0	10°11'54.55"N	76°12'2.79"E	631528.388	1127602.526	1.468	2.068
(NW3) 2	9.95	10°15'36.25"N	76°11'58.17"E	631362.144	1134412.582	1.208	1.681
(NW3) 3	20.79	10°19'32.61"N	76° 9'21.33"E	626564.740	1141655.753	0.846	1.183
(NW3) 4	30.33	10°23'7.39"N	76° 8'29.54"E	624965.616	1148247.120	2.457	2.89
(NW3) 5	39.51	10°26'32.99"N	76° 6'4.17"E	620522.483	1154547.385	1.108	1.632
(NW3) 6	50.17	10°31'18.59"N	76° 3'58.92"E	616684.439	1163307.708	1.525	2.156
(NW3) 7	60.37	10°34'47.99"N	76° 1'16.47"E	611725.410	1169723.433	0.960	1.541

Bench Mark	Chainage	Latitude N	Longitude E	Easting (m)	Northing(m)	BM Hei	BM Hei
(NW3) 8	70.67	10°39'18.96"N	75°58'59.28"E	607529.320	1178033.568	1.232	1.763
(NW3) 9	80.09	10°43'57.20"N	75°57'2.55"E	603956.547	1186569.426	1.102	1.587
LBM 10*	87.96	10°47'3.80"N	75°55'16.88"E	600728.927	1192290.932	2.772	3.217
(NW3) 10	88.40	10°47'11.09"N	75°55'7.98"E	600458.796	1192514.852	2.006	2.451
(NW3) 11	99.38	10°52'25.97"N	75°54'20.23"E	598979.353	1202182.021	2.478	0.822
(NW3) 12	108.85	10°57'12.44"N	75°52'44.21"E	596038.902	1210973.886	2.039	1.631
LBM TANUR LOCK*	114.68	11° 0'13.88"N	75°51'53.97"E	594497.00	1216542.00	1.169	1.533
(NW3) 13	120.90	11° 2'12.15"N	75°52'42.49"E	595959.481	1220179.443	5.583	4.807
LBM 13	118.58	11° 1'19.55"N	75°53'1.68"E	596546.00	1218565.00	3.182	2.406
(NW3) 14	128.37	11° 4'29.38"N	75°52'37.13"E	595784.927	1224394.522	2.898	1.872
(NW3) 15	138.90	11° 7'45.40"N	75°51'50.71"E	594358.932	1230411.828	1.482	1.626
(NW3) 16	148.82	11° 9'43.27"N	75°48'33.44"E	588364.027	1234015.179	1.348	1.900
(NW3) 17	157.52	11°12'26.52"N	75°50'0.52"E	590991.354	1239037.405	2.928	3.530
(NW3) 18	169.04	11°13'50.70"N	75°46'50.85"E	585232.974	1241607.934	1.947	2.617
LBM 18*	169.34	11°13'41.96"N	75°46'46.60"E	585104.00	1241338.00	2.636	3.306

*LBM is local Benchmarks which is marked on existing structure and name (NW3) are constructed Benchmarks.

2.1.3 Chart Datum / Sounding Datum

The maximum Canal survey stretch is in tidal area. But only Ch-118.53km to Ch-130.67km is Non-Tidal stretch. Average Tidal variation is 0.86m in the waterways. Chart datum used in Tidal Stretch. The Chart datum is fixed/transferred by spring tidal 48hrs observation method.

Chart Datum at IWT terminal was taken 0.6m below MSL and discussed with IWAI, Kochi officials. Observed crest level was taken as a sounding datum of non-tidal region due to lack of water level data (for last 10 years) with concerned authority.

Transfer of Sounding datum									H533
Date and Time of 1st LW Observation at Established Gauge = 0.580 19/12/2017 1845 Hrs.									
Established Gauge (TP-1 at IWAI Terminal) Ch:- 0.215km Position: 076°11'53.64"E, 10°12'1.29"N					New Gauge (TP-3A) Ch:20.79km Position: 076° 9'21.52"E, 10°19'32.61"N				
Heights above chart datum					Heights above the zero of tide pole				
High Water	Low Water	Factor	HW	LW	High Water	Low Water	Factor	HW	LW
-----	0.28	1	-	0.28	-----	0.58	1	-	0.58
1.28	-----	1	1.28	-	1.35	-----	1	1.35	-
-----	0.73	3	-	2.19	-----	0.94	3	-	2.82
0.99	-----	2	1.98	-	1.14	-----	2	2.28	-
-----	0.28	3	-	0.84	-----	0.52	3	-	1.56
1.27	-----	1	1.27	-	1.32	-----	1	1.32	-
-----	0.7	1	-	0.7	-----	0.89	1	-	0.89
Sum			4.53	4.01	Sum			4.95	5.85
Mean			1.13	0.50	Mean			1.24	0.73
Range			R	0.63	Range			r	0.51
Observed mean tide			M'	0.82	Observed mean tide			m'	0.98
				d	0.329				
Value of Sounding datum					0.329	Above zero of tide pole			

Transfer of Sounding datum									H533
Date and Time of 1st LW Observation at Established Gauge = 0.720 19/12/2017 2000 Hrs.									
Established Gauge (TP-1 at IWAI Terminal) Ch:-0.215km Position: 076°11'53.64"E, 10°12'1.29"N					New Gauge (TP-6) Ch: 50.17km Position: 076° 3'59.13"E, 10°31'18.61"N				
Heights above chart datum					Heights above the zero of tide pole				
High Water	Low Water	Factor	HW	LW	High Water	Low Water	Factor	HW	LW
-----	0.28	1	-	0.28	-----	0.72	1	-	0.72
1.28	-----	1	1.28	-	1.61	-----	1	1.61	-
-----	0.73	3	-	2.19	-----	1.11	3	-	3.33
0.99	-----	2	1.98	-	1.35	-----	2	2.7	-
-----	0.28	3	-	0.84	-----	0.73	3	-	2.19
1.27	-----	1	1.27	-	1.59	-----	1	1.59	-
-----	0.7	1	-	0.7	-----	1.02	1	-	1.02
Sum			4.53	4.01	Sum			5.9	7.26
Mean			1.13	0.50	Mean			1.48	0.91
Range			R	0.63	Range			r	0.57
Observed mean tide			M'	0.82	Observed mean tide			m'	1.19
				d	0.457				
Value of Sounding datum					0.457	Above zero of tide pole			

Transfer of Sounding datum									H533
Date and Time of 1st LW Observation at Established Gauge = 0.650 25/01/2018 1100 Hrs									
Established Gauge (TP-6) Ch: 50.17km Position: 076° 3'59.13"E, 10°31'18.61"N					New Gauge (TP-10) Ch: 88.4km Position: 075°55'7.62"E, 10°47'11.45"N				
Heights above chart datum					Heights above the zero of tide pole				
High Water	Low Water	Factor	HW	LW	High Water	Low Water	Factor	HW	LW
-----	0.703	1	-	0.703	-----	0.65	1	-	0.65
1.313	-----	1	1.313	-	1.34	-----	1	1.34	-
-----	0.873	3	-	2.619	-----	0.89	3	-	2.67
1.273	-----	2	2.546	-	1.35	-----	2	2.7	-
-----	0.573	3	-	1.719	-----	0.6	3	-	1.8
1.393	-----	1	1.393	-	1.31	-----	1	1.31	-
-----	1.123	1	-	1.123	-----	0.94	1	-	0.94
Sum			5.252	6.164	Sum			5.35	6.06
Mean			1.31	0.77	Mean			1.34	0.76
Range			R	0.54	Range			r	0.58
Observed mean tide			M'	1.04	Observed mean tide			m'	1.05
				d	-0.066				
Value of Sounding datum					-0.066	Below zero of tide pole			

Transfer of Sounding datum									
Established Gauge (TP LBM-10) Ch: 87.98km Position: 075°55'17.05"E, 10°47'3.77"N					New Gauge (TP near Tanur lock) Ch: 114.72km Position: 075°51'53.61"E, 11° 0'15.35"N				
Heights above chart datum					Heights above the zero of tide pole				
High Water	Low Water	Factor	HW	LW	High Water	Low Water	Factor	HW	LW
-----	0.806	1	-	0.806	-----	0.46	1	-	0.46
1.516	-----	1	1.516	-	1.02	-----	1	1.02	-
-----	0.836	3	-	2.508	-----	0.58	3	-	1.74
1.326	-----	2	2.652	-	0.81	-----	2	1.62	-
-----	0.706	3	-	2.118	-----	0.5	3	-	1.5
1.506	-----	1	1.506	-	1.03	-----	1	1.03	-
-----	0.726	1	-	0.726	-----	0.57	1	-	0.57
Sum			5.674	6.158	Sum			3.67	4.27
Mean			1.42	0.77	Mean			0.92	0.53
Range			R	0.65	Range			r	0.38
Observed mean tide			M'	1.09	Observed mean tide			m'	0.73
				d	0.078				
Value of Sounding datum					0.078	Above zero of tide pole			

Transfer of Sounding datum									H533
Date and Time of 1st LW Observation at Established Gauge = 1.19 20/01/2018 700 Hrs									
Established Gauge (TP LBM-10) Ch: 87.98km Position: 075°55'17.05"E, 10°47'3.77"N					New Gauge (TP-15A) Ch: 138.92km Position: 075°51'50.08"E, 11° 7'45.23"N				
Heights above chart datum					Heights above the zero of tide pole				
High Water	Low Water	Factor	HW	LW	High Water	Low Water	Factor	HW	LW
-----	0.806	1	-	0.806	-----	1.19	1	-	1.19
1.516	-----	1	1.516	-	2.09	-----	1	2.09	-
-----	0.836	3	-	2.508	-----	1.41	3	-	4.23
1.326	-----	2	2.652	-	1.79	-----	2	3.58	-
-----	0.706	3	-	2.118	-----	1.35	3	-	4.05
1.506	-----	1	1.506	-	2.19	-----	1	2.19	-
-----	0.726	1	-	0.726	-----	1.44	1	-	1.44
Sum			5.674	6.158	Sum			7.86	10.91
Mean			1.42	0.77	Mean			1.97	1.36
Range			R	0.65	Range			r	0.60
Observed mean tide			M'	1.09	Observed mean tide			m'	1.66
				d	0.650				
Value of Sounding datum					0.650	Above zero of tide pole			

Transfer of Sounding datum									H533
Date and Time of 1st LW Observation at Established Gauge = 0.480 20/01/2018 745 Hrs.									
Established Gauge (TP LBM-10) Ch: 87.98km Position: 075°55'17.05"E, 10°47'3.77"N					New Gauge (TP-16A) Ch: 148.83km Position: 075°48'33.54"E, 11° 9'43.50"N				
Heights above chart datum					Heights above the zero of tide pole				
High Water	Low Water	Factor	HW	LW	High Water	Low Water	Factor	HW	LW
-----	0.806	1	-	0.806	-----	0.48	1	-	0.48
1.516	-----	1	1.516	-	1.51	-----	1	1.51	-
-----	0.836	3	-	2.508	-----	0.71	3	-	2.13
1.326	-----	2	2.652	-	1.09	-----	2	2.18	-
-----	0.706	3	-	2.118	-----	0.62	3	-	1.86
1.506	-----	1	1.506	-	1.51	-----	1	1.51	-
-----	0.726	1	-	0.726	-----	0.72	1	-	0.72
Sum			5.674	6.158	Sum			5.2	5.19
Mean			1.42	0.77	Mean			1.30	0.65
Range			R	0.65	Range			r	0.65
Observed mean tide			M'	1.09	Observed mean tide			m'	0.97
				d	-0.124				
Value of Sounding datum					-0.124	below zero of tide pole			

Transfer of Sounding datum								H533	
Date and Time of 1st LW Observation at Established Gauge = 0.40 17/01/2018 515 Hrs.									
Established Gauge (TP-16A) Ch: 148.83km Position: 075°48'33.54"E, 11° 9'43.50"N					New Gauge (TP-LBM18) Ch: 169.35km Position: 075°46'46.73"E, 11°13'41.76"N				
Heights above chart datum					Heights above the zero of tide pole				
High Water	Low Water	Factor	HW	LW	High Water	Low Water	Factor	HW	LW
-----	0.504	1	-	0.504	-----	0.4	1	-	0.4
1.654	-----	1	1.654	-	1.47	-----	1	1.47	-
-----	1.004	3	-	3.012	-----	0.82	3	-	2.46
1.344	-----	2	2.688	-	1.22	-----	2	2.44	-
-----	0.524	3	-	1.572	-----	0.42	3	-	1.26
1.684	-----	1	1.684	-	1.48	-----	1	1.48	-
-----	0.924	1	-	0.924	-----	0.88	1	-	0.88
Sum			6.026	6.012	Sum			5.39	5
Mean			1.51	0.75	Mean			1.35	0.63
Range			R	0.76	Range			r	0.72
Observed mean tide			M'	1.13	Observed mean tide			m'	0.99
				d	-0.094				
Value of Sounding datum					-0.094	below zero of tide pole			

Table 2-2 Chart Datum / Sounding Datum and Reduction Table

Sl. No	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 wrt MSL (m)	Correction in WL data for Bathymetric survey (m)	Topo level to be converted as depth for volume calculation w.r.t SD(m)
	A	B	C (50% stretch is to be selected on both side of tide gauge)	D +ve indicates above MSL -ve indicates below MSL	E	F = (E- WL data in MSL)	G=(E-topo levels in MSL)
1	TP1(IWT Terminal)	-0.215	0.0-5.0	-0.600	-0.600	Provided in digital format	Provided in digital format
2	TP-2	9.950	5.0-15.0		-0.473		
3	TP-3A	20.790	15.0-25.0	-0.337	-0.337		
4	TP-4	30.350	25.0-35.0		-0.433		
5	TP-5	39.510	35.0-45.0		-0.524		
6	TP-6	50.170	45.0-54.07	-0.631	-0.631		
8	TP-7	60.370	54.07-65.0		-0.581		
9	TP-8	70.670	65.0-75.0		-0.531		
10	TP-9	80.090	75.0-85.0		-0.485		
11	TP-10	88.400	85.0-95.91	-0.445	-0.445		
12	Kottayi Regulator (Crest level)	95.910		2.113	2.113		
13	TP-11	99.380	95.91-105.0		1.656		
14	TP-12	108.860	105.0 - 110.0		0.408		
15	Downstream of Tanur lock	114.720	110.0 - 118.53	-0.364	-0.364		
16	Newcut lock/weir (Crest Level)	118.530		1.633	1.633		
17	TP-13	120.900	118.53-121.03		0.776		
18	Palathingal barrage/lock (Crest Level)	121.030		0.729	0.729		
19	TP-14	128.360	121.03-130.67		1.026		
20	Manantampara lock (Crest Level)	130.670		1.120	1.120		
21	TP-15	138.890	130.67 - 140.0	-0.144	-0.144		
22	TP-16A	148.830	140.0-150.0	-0.552	-0.552		
23	TP-17	157.520	150.0-160.0		-0.602		
24	TP-LBM18	169.350	160.0-170.0	-0.670	-0.670		

2.2 Existing Waterway Structures

2.2.1 Bridges

There are 126 Cross Structure including 120 bridges in the waterways. Details are given in table.

TABLE 2-3: Details of existing Bridges and Crossings over waterway

SL. No.	Structure Name	Chainage (km)	Type of structure (RCC/Iron/Wooden)	Name of Bridge	Position (lat long)	Position (UTM)	Length (m)	Width (m)	No of Span	Horizontal clearance	Vertical clearance.r.t MHWS/HFL	Remarks
1	Road Bridge	0.00	RCC	Kochi-Mumbai National highway (Kottapuram Bridge)	10º11'37.13" 6º12'04.57"	631584.137 1127067.083	360	10	10	31.5	7.5	Tidal
2	Road Bridge	1.83	RCC	Thuruthipuram Kottapuram Bridge	10º11'56.52" 6º12'49.76"	632957.096 1127667.853	300	10	9	31.5	7.5	Tidal
3	Road Bridge	3.80	RCC	Anapuzha-Krishanankotta Bridge	10º12'35.58" 6º13'08.34"	633517.98 1128869.865	248	10	6	35.6	5.2	Tidal
4	Road Bridge	6.10	RCC	Pullut Bridge	10°13'38.20" 76°12'27.54"	632269.26 1130788.86	300	8	10	25.8	6	Tidal
5	Road Bridge	13.60	RCC	Poovathum Kadavu Bridge	10°16'44.47" 76°10'41.43"	629019.58 1136498.86	300	8	8	37	8.5	Tidal
6	Road Bridge	15.97	RCC	Mathilakam Bridge	10°17'44.18" 76°10'4.21"	627880.57 1138328.93	120	8	3	36	5.5	Tidal
7	Foot Bridge	17.23	RCC	Chakkarapadam Foot Bridge	10°18'16.79" 76° 9'58.00"	627688 1139329.98	50	2	5	9	5	Tidal
8	Foot Bridge	20.08	Iron	Edathirinji Foot Bridge	10°19'11.98" 76° 9'23.91"	626644.85 1141021.57	40	2	1	38	5	Tidal
9	Road Bridge	20.75	RCC	Kakkathuruthy Bridge	10°19'31.21" 76° 9'21.17"	626559.37 1141611.99	90	8	3	26	5.3	Tidal
10	Road Bridge	25.95	RCC	Parankadavu Foot Bridge	10°21'25.38" 76° 9'11.91"	626265.02 1145118.11	15	1.8	5	6	3	Tidal
11	Foot Bridge	27.76	RCC	Kattoor Foot Bridge	10°22'13.48" 76° 9'14.12"	626327 1146596	20	1.8	3	15.5	4	Tidal
12	Road Bridge	28.94	RCC	Kattoor Market Bridge (Old)	10°22'44.79" 76° 8'57.60"	625821.78 1147556.82	20	1.8	4	6	4	Tidal
13	Road Bridge	28.95	RCC	Kattoor Market Bridge New	10°22'44.96" 76° 8'57.60"	625821 1147561	20	1	3	11.5	5	Tidal
14	Road Bridge	29.25	RCC	Edathuruthy Kattor Bridge	10°22'53.97" 76° 8'57.37"	625813.15 1147838.7	20	8	3	11.5	6.6	Tidal
15	Foot Bridge	30.06	RCC	Karimchira Foot Bridge	10°23'7.98" 76° 8'37.76"	625215.81 1148266.35	25	1.2	3	11.5	5.5	Tidal
16	Road Bridge	35.75	RCC	Triprayar Bridge	10°24'47.51" 76° 7'0.46"	622245.46 1151313.78	155	7.5	7	14.3	4	Tidal
17	Hanging Bridge	37.10	Iron	Chemmappilly Hanging Bridge	10°25'26.93" 76° 6'43.92"	621738.13 1152522.07	110	1.2	1	110	6	Tidal
18	Road Bridge	39.52	RCC	Muttichur Kadavu Bridge	10°26'34.59" 76° 6'4.81"	620539 1154594	240	10	7	32.7	7	Tidal
19	Road Bridge	42.93	RCC	Kandasan Kadavu Bridge	10°28'15.21" 76° 5'35.52"	619640.5 1157684.96	150	6	7	14	3.6	Tidal

SL. No.	Structure Name	Chainage (km)	Type of structure (RCC/Iron/Wooden)	Name of Bridge	Position (lat long)	Position (UTM)	Length (m)	Width (m)	No of Span	Horizontal clearance	Vertical clearance.r.t MHWS/HFL	Remarks
20	Road Bridge	50.35	RCC	Pulikkadav Bridge	10°31'25.29" 76° 3'59.47"	616700 1163513	250	8	7	37.8	5	Tidal
21	Road Bridge	53.35	RCC	Chetuva Bridge	10°31'57.56" 76° 2'49.44"	614567.98 1164497.1	320	10	13	20	6	Tidal
22a	Orumanayur lock Gate 1	54.07	RCC	Lock	10°32'19.88" 76° 2'43.27"	614378 1165182			-	6	6	Tidal
22b	Orumanayur lock Gate 2	54.12	RCC	Lock	10°32'21.60" 76° 2'42.81"	614364 1165235			-	6	6	Tidal
23	Road Bridge	54.42	RCC	Moonnamkallu Bridge	10°31'57.56" 76° 2'49.41"	614263 1165517	30	7.5	3	16.5	6.2	Tidal
24	Road Bridge	55.27	RCC	Palamkadavu Foot Bridge (new)	10°32'54.51" 76° 2'26.14"	613854 1166244	30	2	1	28	5	Tidal
25	Road Bridge	56.62	Iron	Mattummalkare kadavu Bridge	10°33'13.84" 76° 1'48.37"	612704 1166834	40	4	1	30	4	Tidal
26	Moving Bridge	57.96	Iron	Williams Moving Bridge	10°33'53.18" 76° 1'52.39"	612822 1168043	14	4	1	10	2.7	Tidal
27	Foot Bridge	58.55	Iron	Foot Bridge (Thangal Padi)	10°33'55.88" 76° 1'34.99"	612293 1168124	24	1.8	1	20	4	Tidal
28	Road Bridge	60.29	RCC	Chavakkadu New Bridge (Edapally- Panvel highway NH-17)	10°34'46.23" 76° 1'18.38"	611783 1169669	40	7.5	3	9.3	5.8	Tidal
29	Road Bridge	60.38	RCC	Chavakkadu old Bridge	10°34'48.71" 76° 1'16.71"	611732 1169745	25	3	5	5.5	3.6	Tidal
30	Moving Bridge	61.32	Iron	Hospital Kadavu Bridge	10°35'16.03" 76° 1'4.72"	611365 1170583	14	3.5	1	10	3.2	Tidal
31	Foot Bridge	62.26	RCC	Old Foot Bridge	10°35'40.75" 76° 0'48.68"	610875 1171341	20	2	3	8.4	5.3	Tidal
32	Moving Bridge	62.78	Iron	Punnaputhiyara Kadavu Bridge	10°35'55.75" 76° 0'41.46"	610654 1171801	20	3.5	1	10.5	3.5	Tidal
33	Moving Bridge	65.30	Iron	Punnayur Edakazhiyur	10°37'4.25" 76° 0'29.47"	610282.75 1173903.81	20	3.5	1	10	2.1	Tidal
34	Road Bridge	66.10	RCC	Valayanthodu Bridge New	10°37'13.07" 76° 0'11.67"	609741.23 1174173.16	20	7.5	1	15	5.5	Tidal
35	Foot Bridge	66.14	RCC	Valanthodu Old foot bridge	10°37'12.78" 76° 0'10.88"	609717 1174164	20	1	1	10	3	Tidal
36	Foot Bridge	67.56	RCC	Punnayur foot bridge	10°37'48.13" 75°59'39.21"	608751.27 1175246.79	15	1.2	1	6.75	3.6	Tidal
37	Moving Bridge	67.63	Iron	Punnayur Moving Bridge	10°37'48.33" 75°59'39.15"	608749.43 1175253.05	16	3.5	1	10.5	3	Tidal
38	Foot Bridge	68.65	RCC	Andathodu old foot bridge	10°38'18.61" 75°59'25.74"	608339.00 1176182.00	16	1.2	1	8.5	3.6	Tidal
39	Moving Bridge	68.65	Iron	Andathodu moving bridge	10°38'18.72" 75°59'25.70"	608337.74 1176185.1	16	3.5	1	8.5	2.7	Tidal
40	Temporary bridge	69.64	Wooden	Temporary foot bridge	10°38'48.78" 75°59'13.97"	607978.32 1177107.59	15	1.2		2.5	2.3	Tida l

SL. No.	Structure Name	Chainage (km)	Type of structure (RCC/Iron/Wooden)	Name of Bridge	Position (lat long)	Position (UTM)	Length (m)	Width (m)	No of Span	Horizontal clearance	Vertical clearance.r.t MHWS/HFL	Remarks
41	Foot Bridge	70.65	RCC	Kuzhingara Omakadavu Bridge	10°39'18.48" 75°58'59.81"	607545.16 1178018.57	20	1.2	5	8.5	5.7	Tidal
42	Road Bridge	71.40	RCC	Kochannur mannalamkunnu Road Bridge	10°39'41.53" 75°58'52.42"	607318.38 1178725.68	20	4	1	10	5.5	Tidal
43	Foot Bridge	72.55	RCC	Panarthara foot bridge	10°40'13.99" 5°58'34.37"	606767.0 1179721.0	20	1	1	8	4.6	Tidal
44	Moving Bridge	72.56	Iron	Panarthara Moving bridge	10°40'14.20" 75°58'34.31"	606765.04 1179727.65	18	3.5	1	8.5	3	Tidal
45	Moving Bridge	73.60	Iron	Andathodu moving bridge	10°40'44.88" 75°58'19.54"	606313.24 1180668.63	20	3.5	1	8	2	Tidal
46	Moving Bridge	74.86	Iron	New Moving Bridge	10°41'20.83" 75°58'0.48"	605730.8 1181770.95	20	3.5	1	16	4	Tidal
47	Temporary bridge	74.86	wooden	Punnavoorkulam Temporary foot bridge	10°41'21.03" 75°58'0.40"	605728.26 1181777.11	15	1	-	15	1.2	Tidal
48	Road Bridge	76.00	RCC	Kunduchura Bridge	10°41'55.89" 75°57'48.89"	605375.45 1182846.94	20	7.5	1	16	4	Tidal
49	Temporary bridge	76.47	Iron	Temporary foot bridge	10°42'11.16" 75°57'45.90"	605282.96 1183315.67	20	7.5	1	18	6.3	Tidal
50	Temporary bridge	77.32	Wooden	Temporary foot bridge	10°42'36.18" 75°57'34.43"	604932.03 1184083.24	15	1.2	1	11	1	Tidal
51	Moving Bridge	78.12	Iron	Moving Bridge	10°43'1.42" 75°57'28.28"	604742.92 1184857.86	22	4	1	16	4	Tidal
52	Temporary bridge	79.32	Wooden		10°43'37.74" 75°57'18.42"	604440.07 1185972.53	24	1.2		12	1	Tidal
53	Foot Bridge	80.05	Iron	Foot bridge	10°43'56.08" 75°57'3.31"	603979.27 1186534.63	18	2	1	15	4	Tidal
54a	puranga lock gate no. 1	81.92	RCC	Veliancode Lock	10°44'53.71" 75°56'43.47"	603371 1188303						Tidal
54b	puranga lock gate no. 2	82.01	RCC	Veliancode Lock	10°44'54.83" 75°56'43.20"	603362.71 1188337.44						Tidal
55	Foot Bridge	82.18	Wooden	foot bridge	10°44'59.98" 75°56'40.87"	603291.43 1188495.21	22	1.2	1	16.5	1	Tidal
56	Moving Bridge	83.77	iron	Moving Bridge near Ponnani	10°44'57.79" 75°56'2.57"	602128.39 1188424.54	22	3.5	1	15	5	Tidal
57	Foot Bridge	84.62	Iron	Foot Bridge near Ponnani	10°45'23.67" 75°55'54.73"	601887.73 1189218.65	16	1.5	1	14	6.3	Tidal
58	Road Bridge	85.68	RCC	Bridge near Pallapram	10°45'56.82" 75°55'48.88"	601707.05 1190236.42	280	10	1	15/50	7	Tidal
59	Foot Bridge	85.90	RCC	Damaged Foot Bridge	10°46'3.03" 75°55'45.74"	601610.99 1190426.98	5.3	1.5	1	5	1.5	Tidal
60	Road Bridge	85.91	RCC	Road Bridge at NH-17	10°46'3.52" 75°55'45.52"	601604.37 1190441.92	40	6	3	8	4	Tidal
61	Foot Bridge	86.60	RCC	Foot Bridge between JM Road and MLA Road	10°46'23.64" 75°55'36.48"	601072 1191650	20	2	3	8	4	Tidal
62	Foot Bridge	87.24	RCC		10°46'51.73" 75°55'24.78"	601328 1191059	18	2.5	3	8	4	Tidal
63	Foot Bridge	87.53	RCC	Foot Bridge	10°46'51.77" 75°55'24.74"	601072 1191650	15	1.5	2	8	2	Tidal
64	Road Bridge	87.53	RCC	Road Bridge	10°46'51.77" 75°55'24.74"	601072 1191650	15	4	1	8	2	Tidal

SL. No.	Structure Name	Chainage (km)	Type of structure (RCC/Iron/Wooden)	Name of Bridge	Position (lat long)	Position (UTM)	Length (m)	Width (m)	No of Span	Horizontal clearance	Vertical clearance.r.t MHWS/HFL	Remarks
65	Hanning Bridge	94.69	Iron	Foot Bridge	10°50'11.62" 75°54'19.99"	598984 1198055	190	1.8	1	185	7	Tidal
66	Regulator cum Road bridge/ Barrage	95.91	RCC	Kuttayi Mangalam bridge	10°50'46.82" 75°54'28.56"	599241 1199137	120	4.5	16	6	6	Tidal
67	Foot Bridge	97.37	RCC	Vettamcheepu foot bridge	10°51'28.35" 75°54'9.88"	598670 1200411	40	2.5	4	10	4.5	Tidal
68	Temporary bridge	98.30	Wooden	Temporary foot bridge	10°51'53.34" 75°54'14.43"	598806 1201179	30	1	12	3	2	Tidal
69	Foot Bridge	99.50	Iron	Theendapali foot bridge	10°52'29.43" 75°54'18.76"	598934 1202288	20	2	4	10.4	6	Tidal
70	Road Bridge	100.50	RCC	Arumparathi bridge	10°52'51.17" 75°53'59.03"	598333 1202954	30	3	3	12	5.1	Tidal
71	Road Bridge	101.83	RCC	Arikanchira bridge	10°53'32.84" 75°53'46.01"	597934 1204233	25	7.5	3	18	7	Tidal
72	Road Bridge	103.05	RCC	Paravana bridge	10°54'10.80" 75°53'35.19"	597602 1205398	30	7.5	1	16.5	6.5	Tidal
73	Road Bridge	103.75	RCC	Kanjavu bridge	10°54'32.57" 75°53'28.40"	597394 1206066	25	2.5	3	8	4.6	Tidal
74	Road Bridge	105.00	RCC	Unniyal Bridge	10°55'10.36" 75°53'16.49"	597029 1207226	30	6.5	3	18	5	Tidal
75	Temporary bridge	105.68	IRON PIPE	Temporary foot bridge	10°55'32.59" 75°53'8.95"	596798 1207908	18			15	1	Tidal
76	Temporary bridge	106.27	IRON PIPE	Temporary foot bridge	10°55'50.87" 75°53'2.78"	596609 1208469	18			13	1	Tidal
77	Foot Bridge	107.20	RCC	Foot Bridge near Puthiya Kadappuram	10°56'20.54" 75°52'57.53"	596447 1209380	25	1.5	3	11.5	4.6	Tidal
78	Foot Bridge	107.51	Iron	Foot Bridge	10°56'30.31" 75°52'55.51"	596385 1209680	25	1.5	3	12	4.6	Tidal
79	Foot Bridge	107.82	Iron	Bridge near Pattarupparambu	10°56'39.99" 5°52'52.94"	596306 1209977	40	1.5		35	1.5	Tidal
80	Foot Bridge	108.85	RCC	Foot Bridge near Cheeran Kadappuram	10°57'12.57" 75°52'44.70"	596053 1210977	30	1.5	3	10	4.5	Tidal
81	Temporary bridge	109.72	Wooden	temporary bridge near Muhyiddeen masjid cheeran kadappuram	10°57'39.81" 75°52'36.48"	595801 1211813	25	0.8		18	1.2	Tidal
82	Foot Bridge	110.16	RCC	Foot Bridge near Badhar Juma Masjid, Edakadappuram	10°57'53.59" 75°52'32.37"	595675 1212236	25	1.5	3	10.2	8	Tidal
83	Foot Bridge	110.87	RCC	Foot Bridge near Ratheeb Palli, Tanur	10°58'16.04" 75°52'26.83"	595505 1212925	25	2	3	10.2	4.2	Tidal
84	Road Bridge	111.62	RCC	Tanur beach road near Tanur Angadi	10°58'39.01" 75°52'19.55"	595282 1213630	25	4	1	10	3.5	Tidal
85	Road Bridge	112.32	RCC	Hospital road near Tanur	10°59'1.00" 75°52'14.08"	595114 1214305	30	6	1	12	5	Tidal
86	Foot Bridge	113.00	RCC	Foot Bridge near Chappapadi	10°59'22.53" 75°52'9.30"	594967 1214966	25	2	3	10	2	Tidal
87	Temporary bridge	113.52	wooden	Temp. Foot Bridge near Tanur	10°59'37.88" 75°52'3.27"	594782.62 1215436.97	30	1		25	1.2	Tidal

SL. No.	Structure Name	Chainage (km)	Type of structure (RCC/Iron/Wooden)	Name of Bridge	Position (lat long)	Position (UTM)	Length (m)	Width (m)	No of Span	Horizontal clearance	Vertical clearance.r.t MHWS/HFL	Remarks
88	Temporary bridge	114.27	Bamboo	Temp. Foot Bridge near Ottumpuram	11° 0'2.05" 75°51'57.71"	594611.81 1216178.86	20		12	2	2.5	Tidal
89	Foot Bridge	114.65	RCC	Foot Bridge	11° 0'12.94" 75°51'53.37"	594479 1216513	12	1.5	1	6.5	1	Tidal
90	Lock	114.67	RCC	Tanur Lock	11° 0'15.35" 75°51'53.61"	594486 1216587						Tidal
91	Road Bridge	116.91	RCC	Poorappuzha Bridge	11° 1'3.93" 75°52'12.68"	595060.64 1218080.99	130	8.5	7	16	5	Tidal
92	Railway Bridge	117.05	RCC	Railway Bridge near Poorappuzha old	11° 1'4.50" 75°52'17.23"	595198.54 1218098.76	105	5	5	17	6	Tidal
93	Railway Bridge	117.05	RCC	Railway Bridge near Poorappuzha new	11° 1'4.55" 75°52'17.47"	595205.93 1218100.52	105	5	5	17	7	Tidal
94	Road Bridge	132.10	RCC	Koottumoochi bridge	11° 5'28.27" 75°52'27.83"	595496.35 1226202.02	105	7.5	5	23	4	Tidal
95	Road Bridge	133.20	RCC	Chellari Madapuzha bridge	11° 5'56.95" 75°52'8.90"	594919.71 1227081.54	100	7.5	4	20	4	Tidal
96	Road Bridge	138.85	RCC	Olipramkadavu Bridge	11° 7'42.92" 75°51'50.98"	594366.39 1230335.04	135	4	6	18	4	Tidal
97	Road Bridge	140.87	RCC	Mukkathu Kadavu Bridge	11° 8'34.05" 75°51'26.39"	593615.99 1231903.54	40	4	2	7.5	6	Tidal
98	Foot Bridge	142.30	RCC	Chekkadavu foot bridge	11° 9'1.16" 75°51'17.81"	593353.22 1232735.36	30	2.5	2	7.5	5	Tidal
99	Foot Bridge	142.66	RCC	Mannur Bridge	11° 9'14.56" 75°51'6.82"	593018.64 1233146.07	30	4	3	9	2.5	Tidal
100	Road Bridge	143.61	RCC	Kadalundi bridge (old)	11° 9'25.42" 75°50'57.99"	592750.00 1233479.0	80	5	3	15	3.0	Tidal
101	Road Bridge	143.61		Kadalundi bridge (New)	11° 9'25.61" 75°50'57.75"	592742.78 1233484.66	80	10	5	21.2	3.6	Tidal
102	Railway Bridge	145.97	RCC	Vadakkumpadu Railway Bridge-I	11° 9'29.73" 75°49'46.29"	590574.69 1233605.03	100	5	4	16.5	3	Tidal
103	Railway Bridge	145.98	RCC	Vadakkumpadu Railway Bridge-II	11° 9'29.79" 75°49'45.89"	590562.60 1233606.78	100	5	4	16.5	3	Tidal
104	Road Bridge	147.71	RCC	Karuvanthiruthy Kadavu Bridge	11° 9'38.06" 75°48'58.87"	589135.66 1233857.05	170	7.5	7	18	7	Tidal
105	Railway Bridge	152.13	RCC	Feroke Railway bridge	11°10'49.14" 75°49'43.69"	590489.07 1236044.28	230	10	7	29	4	Tidal
106	Railway Bridge	152.16	RCC	Feroke Old Bridge near Feroke	11°10'49.40" 75°49'44.73"	590520.58 1236052.29	230	8	6	37	4.75	Tidal
107	Road Bridge	153.03	RCC	Feroke new road bridge	11°11'2.11" 75°50'8.22"	591231.95 1236444.57	250	10	8	27	5.5	Tidal
108	Road Bridge	156.87	RCC	Kolathara Chungam bridge	11°12'37.60" 75°50'13.29"	591377.33 1239378.17	30	5	1	15	3.5	Tidal
109	Road Bridge	157.63	RCC	Thuvvsseri Kadavu Bridge	11°12'29.74" 75°49'58.46"	590928.37 1239135.61	30	2	3	10	3.5	Tidal
110	Temporary bridge	158.95	Bamboo	Temporary bridge	11°12'29.06" 75°49'43.98"	590489.14 1239113.4				12	1.3	Tidal
111	Foot Bridge	160.05	RCC	Foot bridge	11°12'34.81" 75°49'20.88"	589788.3 1239288.19	15	2	3	8	3	Tidal
112	Road Bridge	161.00	RCC	Poolakadavu Bridge	11°12'58.59" 75°49'29.32"	590041.96 1240019.44	30	8	3	11	5.5	Tidal

SL. No.	Structure Name	Chainage (km)	Type of structure (RCC/Iron/Wooden)	Name of Bridge	Position (lat long)	Position (UTM)	Length (m)	Width (m)	No of Span	Horizontal clearance	Vertical clearance.r.t MHWS/HFL	Remarks
113	Foot Bridge	161.93	RCC	Kayatiyilkadavu foot bridge	11°13'25.33" 75°49'23.19"	589853.79 1240840.13	20	2	2	10	2	Tidal
114	Road Bridge	164.61	RCC	Odumbra Bridge	11°13'27.90" 75°48'33.97"	588361.23 1240914.95	75	7	4	10	4	Tidal
115	Foot Bridge	165.78	RCC	Mankavu foot bridge	11°14'1.09" 75°48'18.39"	587885.78 1241933.07	60	2	6	13	3.5	Tidal
116	Road Bridge	165.99	RCC	Mankavu Bridge	11°14'6.37" 75°48'13.96"	587751.09 1242094.89	100	10	5	16	4	Tidal
117	Road Bridge	167.99	RCC	Kalai Bridge	11°14'15.41" 75°47'14.50"	585947.3 1242367.73	80	10	2	25	5	Tidal
118	Railway Bridge	168.00	RCC	Rialway Bridge near Vattmpoyil	11°14'15.61" 75°47'13.72"	585923.57 1242373.89	80	12	3	25	5	Tidal
119	Road Bridge	169.27	RCC	Kothi Bridge near chakkumkadavu	11°13'43.46" 75°46'48.68"	585166.89 1241384.31	170	8	7	18	5	Tidal
NON TIDAL – BRIDGES / BARRAGE / LOCKS												
120	Barrage and Bridge	118.53	RCC	New cut Barrage near Keernallur	11° 1'17.35" 75°53'2.13"	596560.01 1218497.57	70	1.8	10	4.5	-	Non Tidal
121	Road Bridge	119.26	RCC	Keeranallur road bridge	11° 1'37.86" 75°53'13.85"	596913.69 1219128.59	80	8	7	11	5.5	Non Tidal
122	lock + road bridge/Barrage	121.03	RCC	Palathingal Road Bridge	11° 2'15.72" 75°52'40.83"	595908.3 1220288.58	70	4	7	7	5.5	Non Tidal
123	Road Bridge	121.44	RCC	Chuzhali Bridge near Palathingal juma masjid	11° 2'19.67" 75°52'28.97"	595547.92 1220408.78	75	7.5	7	9.7	5	Non Tidal
124	Road Bridge	124.15	RCC	Kundamkadavu bridge	11° 3'19.77" 75°52'39.36"	595857.96 1222255.89	120	7.5	5	17.5	7	Non Tidal
125	Road Bridge	128.38	RCC	Karyad Bridge	11° 4'31.88" 75°52'36.19"	595755.1 1224470.63	200	7.5	5	15	5	Non Tidal
126	Barrage	130.67	RCC	Mannitampara lock with Foot bridge	11° 4'56.72" 75°53'1.68"	596526.23 1225236.03	110	1.8	1 & 10	4.5	8.5	Non Tidal

2.2.2 Letter on Modification of Structures from Kerala Govt.

Referring to the comments received from Kerala Government vide Letter No# A2/114/2018/CSIND dated 07/03/2020 for consideration of list of cross structure along with cost to be considered for modifications in the NW-3 DPR. Modification of the structures identified and listed in the letter for Nw-3 have been consided in the DPR as an option-2 for computing the total cost of the project. The referred letter is attached in **Annexure 2.1**.

2.2.3 Electric Lines / Communication Lines

There is total 49 no. of Electric lines including 06 no.- HT & 43 no.- LT lines crossing the study stretch of NW 3 (Extension) waterways.

TABLE 2-4: Details of High Tension and Low-Tension Lines

SL. No.	Type of line	Chainage Km	Location	Position (Latitude Longitude)		Position (UTM)		Horizontal clearance (m)	Vertical clearance w.r.t HFL / MHWS (m)	Remark Complete/under construction
				Left bank	Right bank	Left bank	Right bank			
1	33Kv	3.65	Near Krishnan kotta	10º12'28.54" 76º13'09.21"	10º12'32.44" 76º13'16.08"	633545.15 1128653.88	633754.03 1128774.49	280	8.50	Tidal
2	LT	14.89	Near mathilakam village	10º17'27.46" 76º10'24.58"	10º17'29.27" 76º10'30.39"	628502.40 1137817.86	628678.92 1137874.12	200	5.50	Tidal
3	11KV	15.47	Near kadavu road	10º17'39.73" 76º10'19.55"	10º17'40.98" 76º10'22.45"	628347.88 1138194.12	628436.04 1138232.78	100	10.50	Tidal
4	LT	16.77	Near mathilakamragisrrar office road	10º18'03.73" 76º09'49.40"	10º18'03.70" 76º09'50.99"	627427.99 1138927.97	627476.40 1138927.35	49.5	4.50	Tidal
5	LT	17.12	Near chakrapadam	10º18'12.55" 76º09'54.02"	10º18'11.51" 76º09'55.06"	627567.69 1139199.50	627599.16 1139167.48	60	4.50	Tidal
6	LT	19.87	Near ponmanikkudam	10º19'06.61" 76º09'27.87"	10º19'07.39" 76º09'28.27"	626765.86 1140857.16	626778.01 1140881.31	30	6.50	Tidal
7	LT	20.09	Near ponmanikkudam	10º12'28.54" 76º13'09.21"	10º19'11.82" 76º09'24.95"	626632.86 1141002.46	626676.52 1141017.04	30	5.50	Tidal
8	11KV	20.65	Near potta to moonupeedika highway Bridge	10º17'27.46" 76º10'24.58"	10º19'27.83" 76º09'19.55"	626480.24 1141515.65	626510.61 1141508.07	40	6.50	Tidal
9	LT	21.98	Near ottathai	10º17'39.73" 76º10'19.55"	10º19'58.26" 76º09'17.0"	626406.29 1142428.67	626430.25 1142442.52	30	4.50	Tidal
10	LT	22.03	Near ottathai	10º18'03.73" 76º09'49.40"	10º1969.69" 76º09'16.66"	626388.09 1142474.21	626419.17 1142486.50	25	7.50	Tidal
11	LT	22.85	Near kozhithumbumuhiyadheen masjid	10º18'12.55" 76º09'54.02"	10º20'22.07" 76º09'17.19"	626420.77 1143147.08	626432.75 1143174.08	30	7.50	Tidal
12	LT & CABLE	23.64	Near chalingadu road	10º19'06.61" 76º09'27.87"	10º20'37.65" 76º09'16.96"	626405.98 1143677.12	626424.10 1143652.62	25	2.50	Tidal
13	LT	24.66	Near uppumthurithikadauv road	10º19'11.35" 76º09'23.51"	10º21'05.50" 76º09'16.96"	626870.32 1144524.34	626889.31 1144509.78	25	2.50	Tidal

SL. No.	Type of line	Chainage Km	Location	Position (Latitude Longitude)		Position (UTM)		Horizontal clearance (m)	Vertical clearance w.r.t HFL / MHWS (m)	Remark Complete/under construction
14	LT	26.35		10º19'28.08" 76º09'18.55"	10º21'32.22" 76º09'19.88"	626493.56 1145339.67	626506.72 1145329.29	20	6.50	Tidal
15	LT	27.10	Near parayankadavukammayi road	10º19'57.81" 76º09'16.23"	10º21'52.99" 76º09'17.76"	626431.80 1145956.01	626440.16 1145967.13	20	7.50	Tidal
16	LT	28.45	Near albab school	10º19'59.29" 76º09'15.64"	10º22'30.50" 76º09'03.60"	625989.56 1147115.66	626005.07 1147117.76	20	6.50	Tidal
17	LT	28.66	Near irinjalakudakattoor road	10º20'21.19" 76º09'16.79"	10º22'36.81" 76º09'03.31"	625984.08 1147297.92	625995.63 1147311.56	30	2.50	Tidal
18	LT	28.73	Near irinjalakudakattoor road	10º20'38.45" 76º09'16.37"	10º22'39.63" 76º09'00.27"	625892.15 1147390.64	625903.02 1147397.93	35	6.50	Tidal
19	LT	28.82	Near kattoorangadi	10º21'05.97" 76º09'31.74"	10º22'40.68" 76º08'59.64"	625871.52 1147419.31	625883.58 1147429.99	25	6.50	Tidal
20	33KV	34.33	Near kuzhikkalkadavu road	10º21'32.56" 76º09'19.45"	10º24'05.15" 76º07'19.08"	622740.91 1149951.17	622816.12 1150013.76	120	10.50	Tidal
21	132KV S/C	34.41	Near kuzhikkalkadavu road	10º21'52.63" 76º09'17.49"	10º24'06.67" 76º07'17.37"	622709.00 1150023.03	622763.89 1150060.50	65	13.50	Tidal
22	11KV	34.44	Near kuzhikkalkadavu road	10º22'30.43" 76º09'03.09"	10º24'07.54" 76º07'16.74"	622689.02 1150063.42	622744.67 1150086.96	65	5.50	Tidal
23	11KV	35.33	Near kuzhikkalkadavu road	10º22'36.37" 76º09'02.93"	10º24'41.32" 76º07'05.91"	622330.13 1151082.17	622411.83 1151123.51	120	3.50	Tidal
24	11KV	39.39	Near muttichurkadavu masjid	10º22'39.40" 76º08'59.92"	10º2634.51 76º06'08.10"	620562.63 1154497.38	620641.76 1154594.39	130	7.50	Tidal
25	11KV	42.92	Near kadassankadavu	10º2240.33 76º08'59.24"	10º28'16.24" 76º05'37.98"	619570.90 1157720.63	619714.92 1157716.14	150	5.50	Tidal
26	11KV	43.22	Near mampally road	10º24'05.12" 76º07'16.60"	10º28'23.28" 76º05'40.84"	619622.99 1157981.36	619801.20 1157932.75	180	9.50	Tidal
27	11KV	43.78	Near mampally road	10º24'05.46" 76º07'15.56"	10º28'43.70" 76º05'30.72"	619395.63 1158483.74	619491.17 1158558.99	130	8.50	Tidal
28	33KV ON TOWER	44.30	Near mampally road	10º2406.78 76º07'14.91"	10º28'55.90" 76º05'23.10"	619098.39 1158857.34	619258.41 1158932.76	180	11.50	Tidal

SL. No.	Type of line	Chainage Km	Location	Position (Latitude Longitude)		Position (UTM)		Horizontal clearance (m)	Vertical clearance w.r.t HFL / MHWS (m)	Remark Complete/under construction
29	11KV	46.02		10º24'39.98" 76º0703.22	10º29'43.66" 76º05'12.42"	618732.26 1160442.50	618928.51 1160398.98	210	11.50	Tidal
30	LT	48.50	Near Vettekkorumakankadavu road	10º26'31.36" 76º0605.49	10º30'31.48" 76º04'32.62"	617361.95 1161766.53	617713.45 1161863.63	370	10.50	Tidal
31	11KV ON TOWER	53.18	Near rajah island	10º28'16.40" 76º05'33.24"	10º32'00.94" 76º02'58.20"	614767.05 1164272.71	614834.21 1164602.02	280	12.50	Tidal
32	11KV	53.81	Near chettuva	10º28'24.88" 76º05'34.99"	10º32'10.05" 76º02'46.09"	614433.38 1164873.44	614465.05 1164880.44	35	8.50	Tidal
33	11KV	82.23		10º2841.26 76º05'27.56"	10º44'58.72" 75º56'41.94"	603292.80 1188443.73	603324.40 1188456.70	35	13.50	Tidal
34	11KV LINE	104.67	Near Tipu sultan road	10º28'53.46" 76º05'17.83"	10º545'2.93" 75º53'22.50"	597183.39 1206683.87	597213.23 1206691.05	30	5.50	Tidal
35	LT LINE	104.7	Near Tipu sultan road	10º29'45.10" 76º05'05.97"	10º54'54.34" 75º53'22.1"	597174.31 1206722.88	597202.68 1206734.33	30	4.50	Tidal
36	11KV	107.52	Near Tipu sultan road	10º30'28.36" 76º04'21.04"	10º56'22.08" 75º52'57.65"	596415.91 1209422.77	596450.69 1209427.46	35	6.50	Tidal
37	11KV LINE	116.66	Near Poorapuzha	10º31'50.23" 76º02'55.9"	11º01'00.09" 75º51'56.19"	594493.94 1218119.09	594560.46 1217961.77	170	6.50	Tidal
38	LT	131.81	Near Kodakkad	10º54'52.70" 75º53'21.52"	11º05'16.94" 75º52'41.73"	595883.52 1225790.03	595919.26 1225855.37	80	5.50	Tidal
39	LT LINE	133.02		10º54'53.97" 75º53'21.22"	11º05'45.94" 75º52'20.55"	595184.45 1226707.41	595274.04 1226744.30	90	2.50	Tidal
40	33KV T/L	138.62	Near Glipramkadavu	10º56'21.93" 75'52'56.50"	11º07'30.42" 75º52'05.72"	594707.64 1229911.73	594814.94 1229952.50	120	8.50	Tidal
41	11KV	152.89	Near thekkejumuathpalli	11º01'05.22: 75º51'54.01"	11º10'45.89" 75º49'55.34"	59767.75 1236220.11	590842.74 1235945.34	300	8.50	Tidal
42	LT	158.97		11º02'02.52" 75º52'47.61"	11º12'22.97" 75º49'45.98"	590541.30 1238896.64	590550.43 1238926.67	30	4.50	Tidal
43	LT	160.56	Near thondilakkadavu road	11º02'02.52" 75º52'47.61"	11º12'39.77" 75º49'18.24"	589678.59 1239427.11	589707.96 1239440.33	35	4.50	Tidal
44	LT LINE	162.76	Near odumbrajuma masjid	11º05'14.81"	11º13'21.35"	589324.17	589297.22	30	8.50	Tidal

SL. No.	Type of line	Chainage Km	Location	Position (Latitude Longitude)		Position (UTM)		Horizontal clearance (m)	Vertical clearance w.r.t HFL / MHWS (m)	Remark Complete/under construction
				75º52'40.54"	75º49'04.82"	1240702.04	1240716.40			
45	LT LINE	162.83		11º05'44.74" 75º52'17.59"	11º13'20.28" 75º49'05.46"	589316.82 1240683.73	589284.33 1240698.15	30	4.50	Tidal
46	LT LINE	163.05	Near pex international school odumbra	11º07'29.10" 75º52'02.18"	11º13'16.51" 75º49'00.84"	589200.66 1240525.61	589177.12 1240567.5	30	5.50	Tidal
47	66KV TL	168.75	Near thekepuram	11º10'54.84" 75º49'52.89"	11º14'08.16" 75º46'59.43"	585647.47 1242000.36	585491.07 1242143.99	165	5.50	Tidal
NON-TIDAL – LT LINES										
48	11KV LINE	120.70	Near Palathingal	10º32'09.82" 76º02'45.05"	11º02'04.21" 75º52'48.51"	596204.25 1219856.11	596226.67 1219899.26	55	4.50	Non-Tidal
49	11KV LINE	120.78	Near Palathingal	10º44'58.30" 75º56'40.90"	11º02'04.21" 75º52'48.51"	596115.36 1219884.06	596142.65 121935.83	55	6.50	Non-Tidal

HT LINE =06, LT LINES =43, TOTAL HT/LT LINES = 49

2.2.4 Pipelines / Cables

There is 01 no. Pipeline and no underwater cable present in the entire survey stretch of waterways.

2.2.5 Dams / Barrages / Locks / Weirs / Anicuts / Aqueducts

There are 4 barrages, and 5 locks are present including navigational lock. Details are given in the table

SL. No.	Structure Name	Chainage (km)	Location	Position (lat, long)	Length (m)	Width (m)	Horizontal clearance	Vertical clearance/MHWS	Remark
1	Orumanayur lock Gate 1	54.07	Moonnamkallu	10°32'19.88" 76° 2'43.27"			-	6	working
	Orumanayur lock Gate 2	54.12	Moonnamkallu	10°32'21.60" 76° 2'42.81"			-	6	damaged
2	Puranga lock Gate 1	81.92	Lock near Puranga	10°44'53.71" 5°56'43.47"					Damaged/not working
	Puranga lock Gate 2	82.01	Lock near Puranga	10°44'54.83" 75°56'43.20"					Damaged/not working
3	Regulator/Barrage cum Road bridge	95.91	Kuttayi	10°50'46.82" 75°54'28.56"	120	4.5	16	6	working
4	Navigational Lock	114.67	Tanur	11° 0'15.35" 75°51'53.61"					Damaged/not working
5	Newcut Barrage + Foot Bridge	118.53	Keernallur	11° 1'17.35" 75°53'2.13"	70	1.8	10	4.5	
6	Palathingal Barrage/lock + road bridge	121.03	Palathingal Town	11° 2'15.72" 75°52'40.83"	70	4	7	7	working
7	Regulator/ Barrage/Lock	130.67	Bridge and barrage near Mannattampara	11° 4'56.72" 75°53'1.68"	110	1.8	1 & 10	4.5	Lock Not working

2.3 Bends

There are 174 bends in the longitudinal length of the waterway. The Bend Radius observed in the stretch of NW 3 at various locations is tabulated here under.

TABLE 2-5: DETAILS OF BENDS

Sl No.	Chainage (In Km)	Radius (In Km)	Sl No.	Chainage (In Km)	Radius (In Km)
1	1.25	200	47	56.7	160
2	2	425	48	57.3	120
3	3	175	49	57.7	150

Sl No.	Chainage (In Km)	Radius (In Km)	Sl No.	Chainage (In Km)	Radius (In Km)
4	9.65	230	50	57.8	100
5	10.15	200	51	58	100
6	11.25	160	52	58.7	140
7	11.7	225	53	59.3	100
8	12.7	155	54	59.45	65
9	15.55	130	55	60.1	350
10	16.75	290	56	61.15	200
11	17.65	80	57	61.5	175
12	18.6	65	58	62.8	120
13	19.5	800	59	63.2	140
14	20.3	60	60	63.3	40
15	20.65	180	61	63.4	40
16	21.35	200	62	63.8	90
17	22	370	63	64.1	125
18	22.6	50	64	65.8	25
19	23.3	265	65	66.15	25
20	24.6	80	66	78.9	250
21	24.75	30	67	80.45	320
22	25.2	150	68	82.3	95
23	25.4	70	69	83.3	65
24	25.7	40	70	83.5	45
25	25.95	150	71	83.6	45
26	26.7	90	72	85.5	160
27	26.9	90	73	89.55	735
28	27.25	230	74	90.15	290
29	27.85	130	75	94.8	190
30	28.5	60	76	95.7	750
31	28.6	50	77	97.2	85
32	29.5	360	78	97.8	325
33	29.85	100	79	98.1	100
34	30.2	80	80	98.6	110
35	32	90	81	100	35

Sl No.	Chainage (In Km)	Radius (In Km)	Sl No.	Chainage (In Km)	Radius (In Km)
36	34.25	190	82	100.2	90
37	36.9	600	83	112.95	50
38	37.15	135	84	114.5	25
39	40.25	450	85	114.6	50
40	45.5	575	86	114.85	75
41	47	140	87	115.15	200
42	47.55	300	88	116.3	245
43	51.95	600	89	118.35	70
44	53.25	295	90	119.4	345
45	56.2	100	91	119.75	40
46	56.35	140	92	120.65	115
93	120.85	220	134	146.9	165
94	121.2	75	135	147.6	250
95	121.4	140	136	148.5	200
96	121.9	260	137	149.3	310
97	122.7	230	138	155.75	260
98	122.95	115	139	155.95	110
99	123.45	55	140	156.1	55
100	123.75	55	141	156.35	20
101	124	60	142	156.55	45
102	124.75	330	143	156.7	40
103	125.3	150	144	156.8	85
104	126	430	145	156.9	135
105	126.25	65	146	157.25	35
106	127.2	195	147	157.5	40
107	128	90	148	157.75	70
108	128.75	80	149	157.85	145
109	129.1	85	150	158.05	25
110	129.7	60	151	158.2	50
111	130.6	270	152	158.4	55
112	133	150	153	158.7	40
113	135.2	340	154	158.85	55

Sl No.	Chainage (In Km)	Radius (In Km)	Sl No.	Chainage (In Km)	Radius (In Km)
114	136	270	155	159.1	55
115	136.65	515	156	159.2	25
116	137.95	160	157	159.3	50
117	139.5	300	158	159.4	60
118	140.8	75	159	159.45	20
119	140.95	50	160	159.65	45
120	141.45	80	161	159.85	35
121	141.65	190	162	160.05	105
122	141.85	80	163	160.3	40
123	142	65	164	160.8	60
124	142.3	110	165	161.35	125
125	142.5	70	166	161.6	150
126	142.85	270	167	161.75	110
127	143.25	90	168	162.4	110
128	143.6	75	169	163.7	95
129	143.85	170	170	164.25	275
130	144.2	190	171	165.05	260
131	145.25	585	172	166	50
132	145.9	580	173	166.6	220
133	146.45	210	174	167.45	245

2.4 Velocity and Discharge Details

The details of velocity and discharge in the NW-3 extension waterways are given below in Table, as observed.

TABLE 2-6: CURRENT METER DEPLOYMENT LOCATIONS AND DISCHARGE DETAILS

Particulars	Chainage (km)	Position		Observed Depth (m) (D)	Velocity (m/sec.)	X-Sectional area (sq. m.)	Discharge (Cum/sec)
		Easting (m) Northing (m)	Latitude Longitude				
WSS-1	0.57	632144.06 1127455.97	10°11'49.7216" 076°12'23.0170"	2.0	0.35		The discharge in the tidal region is different at
WSS-2	10.50	630806.08 1134680.97	10°15'45.0778" 076°11'39.9290"	1.5	0.25	-	
WSS-3	20.77	626539.69 1141595.95	10°19'30.6903" 076°09'20.52"	4.7	0.2	-	

Particulars	Chainage (km)	Position		Observed Depth (m) (D)	Velocity (m/sec.)	X-Sectional area (sq. m.)	Discharge (Cum/sec)
		Easting (m) Northing (m)	Latitude Longitude				
WSS-4	30.77	624528.61 1148302.03	10°23'09.2301" 076°08'15.1946"	3.7	0.25	-	
WSS-5	39.50	620564.06 1154579.51	10°26'34.0392" 076°06'05.5525"	3.1	0.28	-	
WSS-6	49.95	616854.5 1163144.33	10°31'13.2712" 076°04'04.5091"	3.2	0.33	-	
WSS-7	60.48	611711.82 1169785.15	10°34'50.0148" 076°01'16.0471"	2.0	0.02	-	
WSS-8	70.68	607541.63 1178030.28	10°39'18.8661" 075°58'59.6928"	1.0	0.05	-	
WSS-9	80.09	603957.2 1186563.15	10°43'57.0141" 075°57'02.5889"	1.2	0.35	-	
WSS-10	88.39	600527.78 1192589.66	10°47'13.5447" 075°55'10.2866"	3.0	0.38	-	
WSS-11	99.48	598942.3 1202278.02	10°52'29.1001" 075°54'19.0300"	1.6	0.3	-	
WSS-12	108.86	596055.5 1210992.15	10°57'13.0625" 075°52'44.7843"	2.0	0.3	-	
WSS-13	120.93	595975.45 1220211.63	11°02'13.2064" 075°52'43.0355"	6.0	0.02	460	9.2
WSS-14	128.37	595732.51 1224458.94	11°04'31.4985" 075°52'35.4403"	5.9	0.02	495	9.9
WSS-15	138.93	594307.45 1230375.51	11°07'44.2447" 075°51'49.0387"	4.9	0.3	-	The discharge in the tidal region is different at different time.
WSS-16	148.84	588580.87 1234045.78	11°09'44.2557" 075°48'40.5950"	2.0	0.4	-	
WSS-17	159.19	590285.16 1239029.18	11°12'26.3348" 075°49'37.2430"	1.2	0.36	-	
WSS-18	169.18	585219.63 1241467.39	11°13'46.1602" 075°46'50.4264"	1.3	0.4	-	

2.5 Waterway description

The waterway stretches from Kottappuram to Kozhikode (169.55 km) passes through backwaters, rivers and canals including manmade canals known as canola canal. The west coast canal from Kottappuram to Kozhikode runs almost parallel to the sea. The details are as follows:

2.5.1 Stretch-1 Kottapuram Bridge, Ch-0.0km to Ch-25.0km

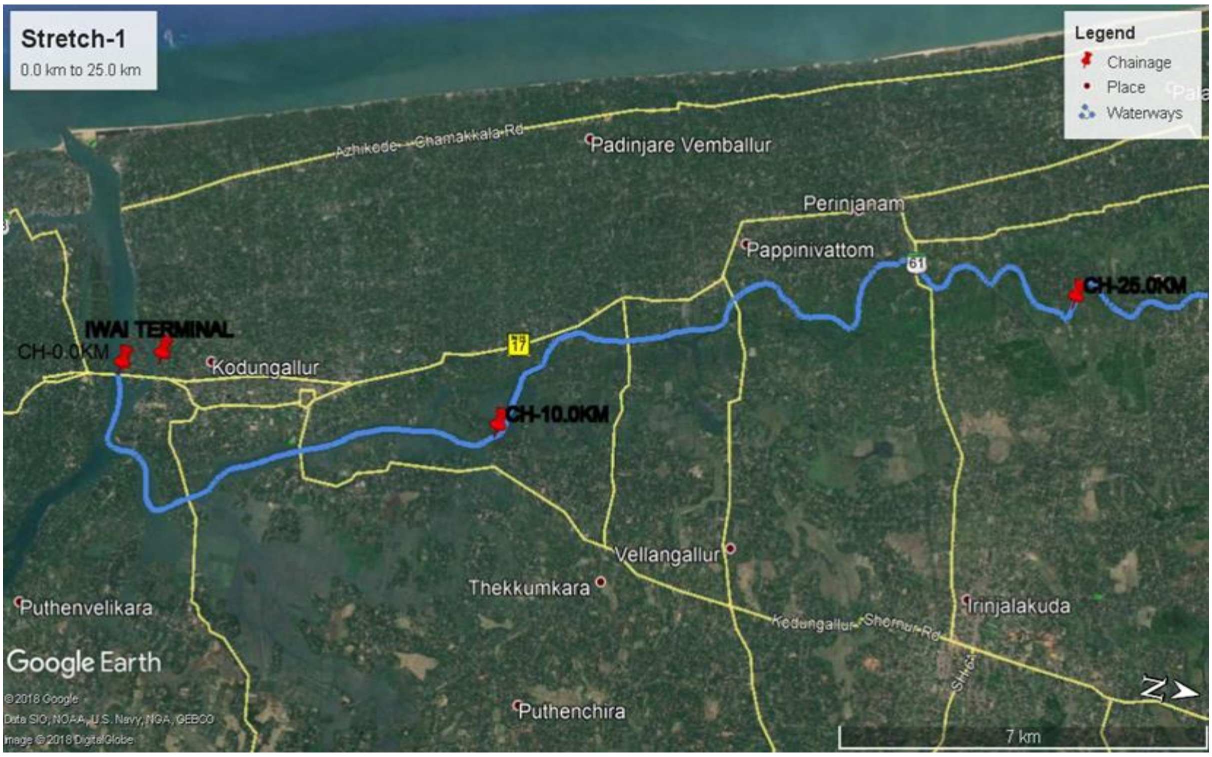


Figure 2-1 Stretch form Kottapuram Bridge,Ch-0.0 km to 25.0km

The maximum and minimum LAD for the above-mentioned stretch is given in the table (as per class III). This full stretch is tidal in nature with a variation about 1m. The river/canal bed is flat and sandy in nature. This stretch has a width varying from 15 to 530 meters. The reduced depth of the channel ranges from -0.3 meter to 8.1 m. The canal has to be widened to get navigable width. Land acquisition is to be done. Dredging is also required after 15.0km. The soil is sandy and bank protection is to be provided when the canal is widened. The average bank slope in this stretch is 1:1. One terminal in Kottappuram is operational, which is a part of NW-3. There are 07 road bridges and 02 foot bridges in this stretch, which have clearance about 5m or more for navigation. The artificial canoli canal start from about 21km of this stretch. Old Kottapuram ferry on left bank of chaiange 0.5km. To and fro Kadavu– Vallivattom Ferry Service also available in this stretch at Chainage11.62km. RCC jetty is provided at the ferry and is operational. Fishing nets are available on both bank of this stretch upto 3km. both banks are protected with stone wall.

Villages/areas fall in this stretch are Anapuzha, Krishanakota, Chappara, Pantheerampala, Sringapuram Kunnumpuram, Kavilkadavu, Chanda Nagar, Pullut, Narayanamangalam and Palivalavu. On both sides of the canal/river is residential and agriculture land. Stretch is well connected by Road. There are 13 electric lines are crossing the stretch including low tension. The gradient of the river/canal is very gentle and there are no rapids or obstructions in this stretch. Details of Ferry/ jetty given below

Details of Ferry/ jetty

S.No	Features	Geographic coordinates	UTM coordinates	Chainage in km	Side of Bank
		Lat / Lon	Easting /Northing		Right / Left
1	Old Kottapuram Ferry Jetty	10°11'52.45"N 76°12'20.27"E	632060.22m E 1127539.40 m N	0.5	Left
2	Vallivattam Kadavu Ferry jetty	10°15'53.08"N 76°11'5.31"E	629751.90 m E 1134922.89 m N	11.6	Left
3	Vallivattam Kadavu Ferry jetty	10°15'56.36"N 76°11'9.42"E	629876.58 m E 1135024.11 m N	11.6	Right

Table 2-7 Least Available Depth in Stretch-1 Kottapuram Bridge, Ch-0.0km to Ch-25.0km

Chainage (Km.)	Observed					Reduced w.r.t Sounding Datum				
	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)
0-1	tidal zone					3.7	6.5	0	0.00	0.00
1-2						2.3	5.5	0	0.00	0.00
2-3						1.4	4.4	200	3678.90	3678.90
3-4						1.7	8.1	0	0.00	3678.90
4-5						0.3	3.3	1000	45358.43	49037.33
5-6						0.4	1.8	1000	42814.00	91851.33
6-7						1.3	3.0	300	5516.66	97367.99
7-8						1.4	2.9	600	12489.32	109857.31
8-9						0.6	3.3	700	23419.77	133277.08
9-10						-0.3	4.5	600	19215.83	152492.91
10-11						0.5	2.3	1000	53757.23	206250.14
11-12						0.4	3.3	550	11740.57	217990.71
12-13						0.4	3.6	400	6851.94	224842.65
13-14						0.8	4.5	50	104.64	224947.29
14-15						0.1	3.4	800	42104.11	267051.40
15-16						-0.3	3.5	650	22710.78	289762.18
16-17						-0.3	3.5	450	8598.01	298360.19
17-18						-0.3	3.8	350	2730.61	301090.80
18-19						-0.3	4.3	300	2260.19	303350.99
19-20						-0.3	3.9	400	7401.65	310752.64
20-21						-0.3	4.9	500	11625.76	322378.40

Chainage (Km.)	Observed					Reduced w.r.t Sounding Datum				
	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)
21-22						-0.3	4.5	550	14135.71	336514.11
22-23						-0.3	4.8	600	15408.07	351922.18
23-24						-0.3	4.1	1000	29753.40	381675.58
24-25						-0.3	4.0	1000	32653.02	414328.60
	TOTAL					**-0.3**	**8.1**	**13000**	**414328.60**	

2.5.2 Stretch-2 Ch-25.0 km to Orumanyur lock (Ch-54.07 km)

Figure 2-2: Stretch-2 form Ch-25.0 km to Orumanyur lock (Ch-54.07 km)

The maximum and minimum LAD for the above-mentioned stretch is given in the table (as per class III). Widening is required in this stretch wherever width is lesser, since the width varies between 15m to 350m. The depth of Channel in the stretch ranges between -0.3 m. to 7.4 m. The famous Thriprayar temple is on the left bank of the canal near the bridge about chainage 35.9km. The waterway is connected to the sea through Chettuva, Sea opening which is about 4.5 km from the waterway route. Water sports are also present near to Chetuva Lake that is near to this stretch. Enamavu Lake is present at chainage 47.0km.

Orumanyur lock is present the end of this stretch. There are 09 road bridges, one hanging bridge (Chemmappilly) and 02 Foot bridges across this section. The banks are protected by natural vegetation/ coconut plantation. Banks are protected by dry rubble packing and slope about 1:1 to 1:1.5. The soil is clayey and coconut plantation is seen on both banks.

Karuvannur River enter into this stretch at chainage 30.15km. Kunduvakadavu River enter into this stretch at Chainage 53km. details of ferry as given

S. No	Features	Geographic coordinates	UTM coordinates	Chainage in km	Side of Bank
		Lat / Lon	Easting / Northing		Right / Left
1	ferry near Pulikkadvu Bridge	10°31'9.95"N 76° 4'0.90"E	616745.08 m E 1163041.82 m N	49.9	Left

Table 2-8 Least Available Depth in Stretch-2 Ch-25.0 km to Orumanyur lock (Ch-54.07 km)

Chainage (Km.)	Observed					Reduced w.r.t Sounding Datum				
	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)
25-26						-0.3	3.3	1000	48568.47	48568.47
26-27						-0.3	2.7	1000	57866.13	106434.60
27-28						-0.3	2.0	1000	61804.81	168239.41
28-29						-0.3	1.4	1000	61541.06	229780.47
29-30						-0.3	1.3	1000	73482.01	303262.48
30-31						-0.3	4.3	800	18694.28	321956.76
31-32						-0.3	4.1	50	44.22	322000.98
32-33						-0.3	7.4	300	3823.76	325824.74
33-34						-0.3	7.1	150	682.91	326507.65
34-35						-0.3	5.4	200	835.40	327343.05
35-36						2.2	4.6	0	0.00	327343.05
36-37			tidal zone			2.2	5.1	0	0.00	327343.05
37-38						-0.3	5.7	50	17.31	327360.36
38-39						1.1	3.8	50	19.22	327379.58
39-40						1.8	4.2	100	306.32	327685.90
40-41						2.0	3.3	50	165.18	327851.08
41-42						2.6	3.4	0	0.00	327851.08
42-43						2.5	4.0	0	0.00	327851.08
43-44						2.1	4.3	50	5.20	327856.28
44-45						2.2	3.6	0	0.00	327856.28
45-46						2.1	2.8	50	42.22	327898.50
46-47						2.3	4.6	0	0.00	327898.50
47-48						2.6	6.1	0	0.00	327898.50
48-49						2.8	5.4	0	0.00	327898.50

Chainage (Km.)	Observed					Reduced w.r.t Sounding Datum				
	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)
49-50						2.5	4.3	0	0.00	327898.50
50-51						2.3	4.0	0	0.00	327898.50
51-52						1.9	3.0	200	3163.20	331061.70
52-53						1.5	5.2	200	2432.13	333493.83
53-54						-0.3	3.6	580	28361.19	361855.02
54-54.07						-0.3	3.6	70	4962.62	366817.64
	TOTAL					**-0.3**	**7.4**	**7900**	**366817.64**	

Villages/areas fall in this stretch are Kattoor, Valapad, Thriprayar, Padiyam, Kandassankadavu, Kadamukku, Toyakkavu and Kundazhiyur. The E Village Resort & Ayurveda Engandiyur Ferry is also present at chainage 49.9km on left bank of the river. On both sides of the canal/river is residential and agriculture land. Stretch is well connected by Road. There are 19 electric lines are crossing the stretch including low tension. The gradient of the river/canal is very gentle and there are no rapids or obstructions in this stretch.

2.5.3 Stretch-3 Orumanyur lock to Veliancode lock (Ch-54.07 km to Ch-82.01 km)

Figure 2-3: Stretch-3 from Orumanyur lock to Veliancode lock (Ch-54.07 km to Ch-82.01 km)

The maximum and minimum LAD for the above-mentioned stretch is given in the table (as per class III). Orumanyur lock is present in starting of this stretch. The width of the waterway ranges between 10 meter to 180 meter.

Land acquisition is required. The depth of Channel in the stretch ranges between -0.3 m. to 4.8m. Soil is sandy clay. Capital dredging is required for the entire stretch. Bank protection is to be provided when the canal is widened. The land is mainly used for coconut plantations. Banks of canal near Chavakkad is heavily built-up area with commercial and residential purposes. Side slope of 1:1.5 is available along the waterway. There are 8 road bridges, 10 moving bridges, 10 foot-bridges and 04 temporary bridges are present at this section.

There is an old lock structure at chainage 82.01 km known as Veliancode lock (Puranga lock) near Puthuponnani where the waterway meets the Biyyamkayal. Biyyamkayal joins the sea at west Veliancode which is 1.7 km away from waterway route.

Villages fall in this stretch are Moonnamkallu, Vettakad, Mattummal, Orumanyur, Thangalpadi, Manathala, Chavakad, Gurupadapuri, Kannanchira, Nallamkallu, Edakkara, Punnayur, Andathode and Veliancode. On both sides of the canal/river is residential and agriculture land. Stretch is well connected by Road.

Table 2-9 Least Available Depth in Stretch-3 from Orumanyur lock to Veliancode lock (Ch-54.07 km to Ch-82.01 km)

Chainage (Km.)	Observed					Reduced w.r.t Sounding Datum				
	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)
54.07-55						-0.3	1.6	1000	47250.92	47250.92
55-56						-0.3	1.5	1000	47056.72	94307.64
56-57						-0.3	1.3	1000	60596.01	154903.65
57-58						-0.3	1.1	1000	66177.30	221080.95
58-59						-0.3	1.0	1000	71164.51	292245.46
59-60						-0.3	0.9	1000	77425.07	369670.53
60-61						-0.3	1.3	1000	67824.55	437495.08
61-62						-0.3	1.2	1000	51453.37	488948.45
62-63						-0.3	1.1	1000	59023.04	547971.49
63-64						-0.3	1.3	1000	59316.51	607288.00
64-65	tidal zone					-0.3	1.3	1000	53694.07	660982.07
65-66						-0.3	2.5	1000	47837.01	708819.08
66-67						-0.3	1.1	1000	71038.43	779857.51
67-68						-0.3	0.9	1000	81190.15	861047.66
68-69						-0.3	0.7	1000	84574.39	945622.05
69-70						-0.3	0.8	1000	81089.87	1026711.92
70-71						-0.3	0.8	1000	82263.26	1108975.18
71-72						-0.3	0.9	1000	87531.68	1196506.86
72-73						-0.3	0.7	1000	85059.32	1281566.18
73-74						-0.3	0.7	1000	85105.31	1366671.49
74-75						-0.3	0.7	1000	89886.13	1456557.62
75-76						-0.3	-0.1	1000	89283.66	1545841.28

Chainage (Km.)	Observed					Reduced w.r.t Sounding Datum				
	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)
76-77						-0.3	0.2	1000	91730.53	1637571.81
77-78						-0.3	0.3	1000	90322.46	1727894.27
78-79						-0.3	0.3	1000	88355.37	1816249.64
79-80						-0.3	0.4	1000	86756.43	1903006.07
80-81						-0.3	0.3	1000	88981.84	1991987.91
81-82.01						-0.3	0.3	1000	89203.89	2081191.80
	TOTAL					**-0.3**	**2.5**	**28000**	**2081191.80**	

2.5.4 Stretch-4 Veliancode lock to Kottayi Regulator cum bridge (Ch-82.01 km to Ch-95.91 km)

The maximum and minimum LAD for the above-mentioned stretch is given in the table (as per class III). This stretch passes through three rivers namely Beeyam Kayal River,

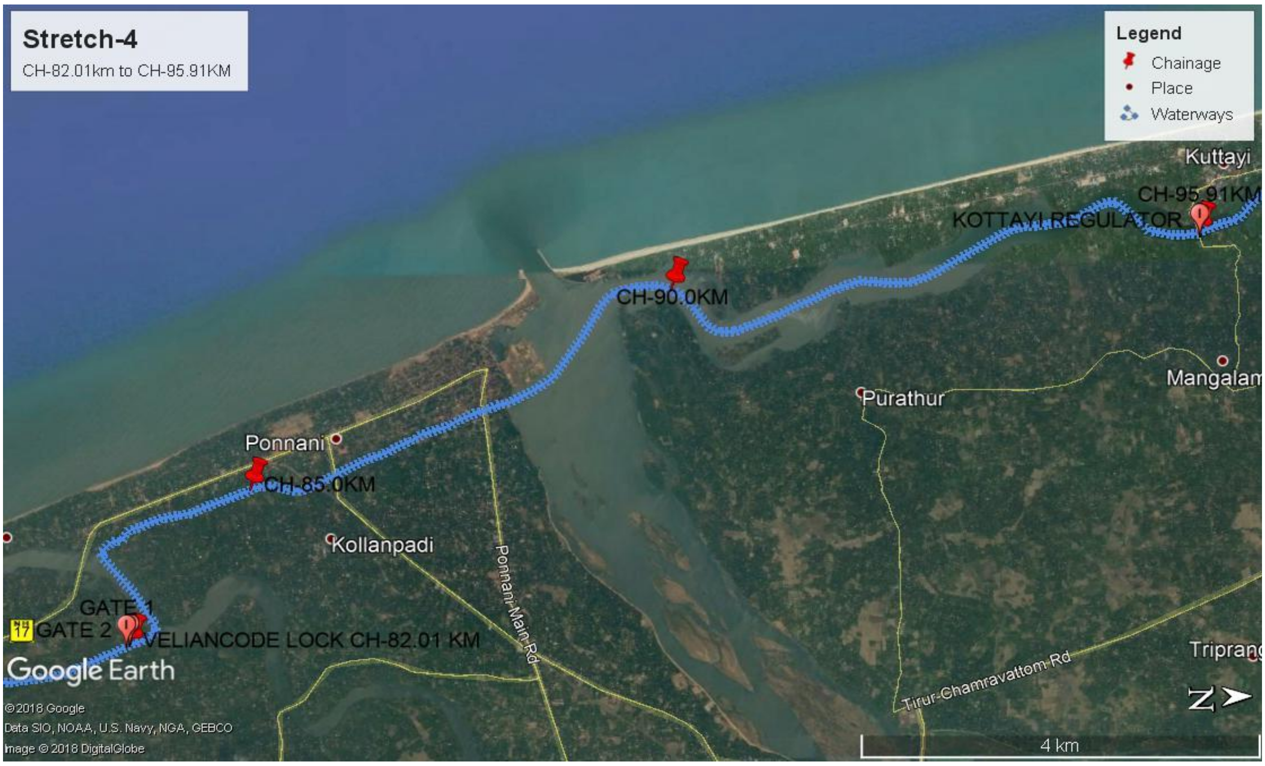


Figure 2-4: Stretch-4 form Veliancode lock to Kottayi Regulator cum bridge

Bharatapuzha River and Ponnani River. This reach has width ranging between 10m and 530m. Hence land acquisition is required wherever width is lesser for navigation. The depth of Channel in the stretch ranges between -0.3 m. to 4.8m. Canal is very congested in Ponnani town and sewage directly enter into in this channel. Dredging is required in this section.

Ponnani port is available at left bank of the waterways at Ch: 88km. It is used for fishing. This section passes through Thirur, Ponnanipuzha and Kuttayi Bridge cum regulator at chainage 95.91 km is an obstruction for navigation. This bridge cum regulator is originally proposed with 24 spans and one lock Chamber for navigation. 14 spans of the bridge cum regulatory completed and shutters are also provided. No provision of navigation is currently available here. There is one moving bridge, one hanging bridge, 05 foot bridges and 05 Road Bridges including Kuttayi regulator cum bridge present at this section. Banks are mainly protected by stone rubbles. Bank slope is about 1:2 to 1:3.

Area falls in this stretch Ponnani and Kottayi. On both sides of the canal/river is residential and agriculture land. Stretch is well connected by Road. There is Sea entry about 800m from away from the waterways. The gradient of the river/canal is very gentle and there are no rapids. Details of ferry/ port as given.

Details of Ferry/port

S.No	Features	Geographic coordinates	UTM coordinates	Chainage in km	Side of Bank
		Lat / Lon	Easting / Northing		Right / Left
1	Ponnani port	10°47'9.44"N 75°55'5.15"E	600372.16 m E 1192463.25 m N	88.3	Left
2	Ponnani Ferry Terminal	10°46'56.45"N 75°55'6.01"E	600399.47 m E 1192064.17 m N	87.9	Left
3	Padinjarekara Jankar Terminal	10°47'32.00"N 75°54'41.51"E	599652.00 m E 1193154.00 m N	89.4	Left
4	Jankar Jetty	10°47'33.21"N 75°54'40.55"E	599623.00 m E 1193191.00 m N	89.4	Left

Table 2-10 Least Available Depth in Stretch-4 form Veliancode lock to Kottayi Regulator cum bridge (Ch-82.01 km to Ch-95.91 km)

Chainage (Km.)	Observed					Reduced w.r.t Sounding Datum				
	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)
82.01-83	tidal zone					-0.3	1.8	1000	70632.80	70632.80
83-84						-0.3	0.9	1000	76389.50	147022.30
84-85						-0.3	1.6	1000	66726.52	213748.82
85-86						-0.3	1.0	1000	78265.87	292014.69

Chainage (Km.)	Observed					Reduced w.r.t Sounding Datum				
	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)
86-87						-0.3	0.7	1000	83624.77	375639.46
87-88						-0.3	1.4	1000	72826.63	448466.09
88-89						1.0	4.8	350	5279.50	453745.59
89-90						1.6	4.3	100	456.41	454202.00
90-91						1.1	2.5	1000	31965.19	486167.19
91-92						0.8	1.7	1000	43623.38	529790.57
92-93						0.7	2.4	1000	37817.54	567608.11
93-94						0.8	1.3	1000	49587.57	617195.68
94-95						0.9	2.2	1000	26224.12	643419.80
95-95.91						0.0	1.3	1000	68969.93	712389.73
	TOTAL					**-0.3**	**4.8**	**12450**	**712389.73**	

Figure 2-5: Stretch-5 Kottayi Regulator to Tanur lock (Ch-95.91 km to Ch-114.67 km)

The maximum and minimum LAD for the above-mentioned stretch is given in the table (as per class III). The width varies between 10 meter to 40 metres and depth of Channel in the stretch ranges between -0.3 m. to 2.6m. The entire stretch is a narrow canal passing through coconut plantations. The bank of canal near Tanur town is used for residential purpose. A Mosque and a school are also situated along the canal side. The entire reach needs to be widened and deepened. In this reach full canal is protected by stone rubbles, however after widening of canal need to be protected.

Capital dredging is required in this stretch. The soil is Sandy. An old Lock/Damaged lock structure is present at end of this stretch at Tanur, where the canal connects with Purappuzha River. There is a sea opening is also present at about 2 km away from the waterway where the Purappuzha meets with the sea. There are 06 Road Bridges, 17 foot bridges (including temporary bridges) and lock present at this section.

Area falls in this stretch Kottayi, Mangalam Thiruthmmal, Vakkad, Paravanna, Puthiyakadapuram, Unniyal, Olappeedika and Tanur. On both sides of the canal/river is residential and agriculture land. Stretch is well connected by Road.

Table 2-11 Least Available Depth in Stretch-5 Kottayi Regulator to Tanur lock (Ch-95.91 km to Ch-114.67 km)

Chainage (Km.)	Observed					Reduced w.r.t Sounding Datum				
	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)
95.91-97	tidal zone					1.9	2.6	600	23031.54	23031.54
97-98						-0.3	2.0	1000	50734.38	73765.92
98-99						-0.3	1.8	1000	50968.24	124734.16
99-100						-0.3	1.8	1000	63080.14	187814.30
100-101						-0.3	1.9	950	52607.40	240421.70
101-102						-0.3	1.4	1000	70685.40	311107.10
102-103						-0.3	1.2	1000	80209.97	391317.07
103-104						-0.3	1.2	1000	78688.64	470005.71
104-105						-0.3	0.9	1000	76567.75	546573.46
105-106						-0.3	1.0	1000	69397.72	615971.18
106-107						-0.3	1.0	1000	69120.63	685091.81
107-108						-0.3	2.5	1000	36953.03	722044.84
108-109						-0.3	2.0	1000	24665.49	746710.33
109-110						-0.3	1.5	1000	55632.98	802343.31
110-111						-0.3	1.3	1000	68559.41	870902.72
111-112						-0.3	1.3	1000	62724.24	933626.96
112-113						-0.3	1.2	1000	67066.12	1000693.08
113-114						-0.3	1.2	1000	69465.81	1070158.89
114-						-0.3	2.4	600	43356.80	1113515.69

114.67						
	TOTAL	-0.3	2.6	18150	1113515.69	

2.5.5 Stretch-6 Tanur lock to Newcut Barrage (Ch-114.67 km to Ch-118.53 km)

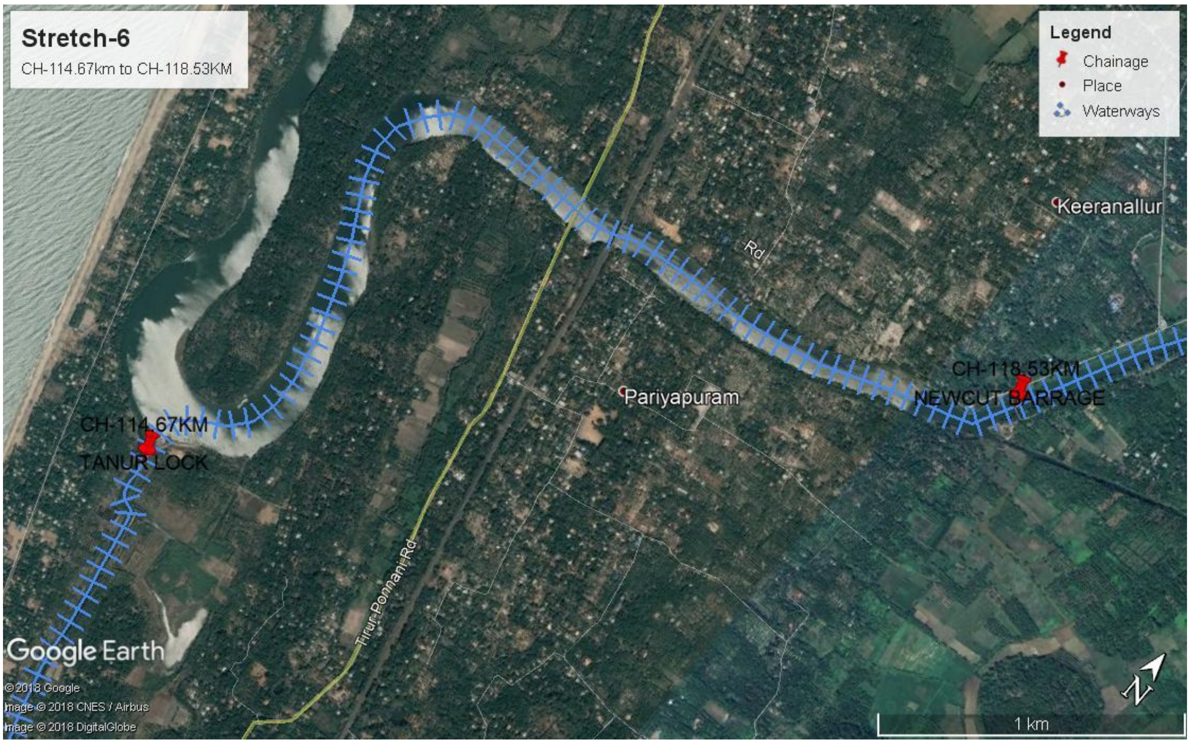


Figure 2-6: Stretch-6 Tanur lock to Newcut Barrage (Ch-114.67 km to Ch-118.53 km)

Table 2-12 Least Available Depth in Stretch-6 Tanur lock to Newcut Barrage

(Ch-114.67 km to Ch-118.53 km

Chainage (Km.)	Observed					Reduced w.r.t Sounding Datum				
	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)
114.67-116	tidal zone					0.8	3.3	1400	39591.88	39591.88
116-117						0.6	5.1	400	9282.87	48874.75
117-118						0.6	4.4	650	10721.32	59596.07
118-118.53						0.4	3.4	500	19409.87	79005.94
	TOTAL					**0.4**	**5.1**	**2950**	**79005.94**	

The maximum and minimum LAD for the above-mentioned stretch is given in the table (as per class III). The waterway passes through Purappuzha River along this stretch. The width of waterway varies between 60m to 150 m. The Keeranellur New Cut Barrage is obstructing the waterway. Depth of Channel in the stretch ranges between 0.4 m to 5.1m, an alternate Canal route with a lock structure is available which after developing can be used bypassing Keeranellur New Cut Barrage and Keeranellur Road Bridge. There are one Road Bridge, 02 Railway bridges, a barrage and a lock present at this section. Area falls in this stretch Pariyapuram and Keeranellur. On both sides of the canal/river is residential and agriculture land. Stretch is well connected by Road.

2.5.6 Stretch-7 New cut Barrage to Manantampar lock (Ch-118.53 km to Ch-130.67 km

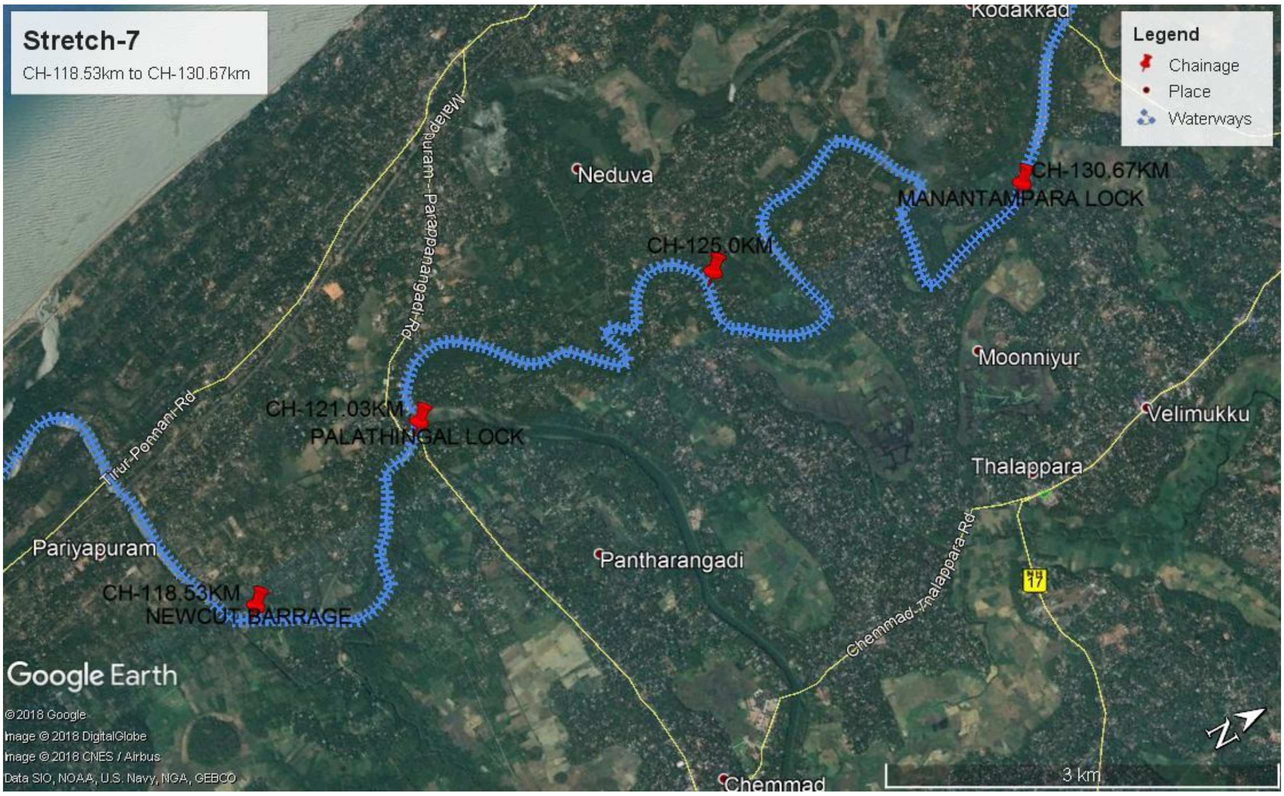


Figure 2-7: Stretch form New cut Barrage to Manantampar lock (Ch-118.53 km to Ch-130.67 km)

Table 2-13 Least Available Depth in Stretch form New cut Barrage to Manantampar lock (Ch-118.53 km to Ch-130.67 km)

Chainage (Km.)	Observed					Reduced w.r.t Sounding Datum				
	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)
118.53-119	1.1	3.3	200	1449.36	1449.36	0.8	2.9	200	2157.02	2157.02
119-120	0.0	6.5	400	7541.66	8991.02	-0.3	6.1	500	14846.60	17003.62
120-121	0.0	6.8	400	8107.67	17098.69	-0.3	6.3	500	14344.01	31347.63
121-122	0.0	7.0	300	2987.07	20085.76	-0.3	6.6	300	6230.24	37577.87
122-123	0.6	5.1	150	3241.83	23327.59	0.2	4.7	200	5428.30	43006.17
123-124	2.0	8.9	100	702.93	24030.52	-0.3	8.6	150	1062.48	44068.65
124-125	0.6	7.1	150	2010.58	26041.1	-0.3	6.8	250	4517.03	48585.68

Chainage (Km.)	Observed					Reduced w.r.t Sounding Datum				
	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)
125-126	2.1	10.9	50	125.47	26166.57	-0.3	10.6	100	736.16	49321.84
126-127	2.2	7.0	0	0	26166.57	0.5	6.7	50	180.72	49502.56
127-128	2.1	7.9	150	789.06	26955.63	0.0	7.5	150	1474.55	50977.11
128-129	2.1	9.7	100	367.56	27323.19	-0.3	9.3	150	706.15	51683.26
129-130	2.0	9.6	50	19.05	27342.24	1.7	9.1	50	176.97	51860.23
130-130.67	2.3	7.2	0	0	27342.24	2.0	6.8	50	56.17	51916.40
TOTAL	0.0	10.9	2050	27342.24		-0.3	10.6	2650	51916.40	

The maximum and minimum LAD for the above-mentioned stretch is given in the table (as per class III). This full stretch is Non tidal in nature. The river/canal bed is flat and sandy/rocky in nature. This stretch has a width varying from 35 to 100 meters. The depth of the channel ranges from -0.3 meter to 10.6 meter making it necessary for dredging on a limited scale to provide the requisite depth of 2.2 meter. Kadalundi Puzha River meets the waterway at chainage121. 2 km. Palathingal Lock Bridge present at Ch-121.03 km. There are Four Road bridges, and 03 locks are present in this section. Minimum Dredging is required in this section for navigation.

Villages/areas fall in this stretch are Keeranellur, Palathingal, Chuyali and Manatampara. On both sides of the canal/river is residential and agriculture land. The gradient of the river/canal is very gentle and there are no rapids or obstructions in this stretch.

2.5.7 Stretch-8 Manantampara lock (Ch-130.67 km) to Kozhikode (Ch-169.55km)

Figure 2-8: Stretch form Manantampara lock (Ch-130.67 km) to Kozhikode (Ch-169.55 km)

The maximum and minimum LAD for the above-mentioned stretch is given in the table (as per class III). Land acquisition is required in this is stretch at some portions only since the waterway has a width ranging between 7m to 700m. Depth ranges from -0.3 to 11.9m. This stretch connects with Kadalundi River, Chaliyar River and Mampuzha River. Kadalundi estuary is about 4.5 km away from the waterway at Ch-140.25km. Chaliyar estuary is about 1.6km away from the waterways at Ch-149km and Kalai estuary is end of these waterways. Soil type is clay and sandy in this section.

Table 2-14 Least Available Depth in Stretch form Manantampara lock (Ch-130.67 km) to Kozhikode (Ch-169.55 km)

Chainage (Km.)	Observed					Reduced w.r.t Sounding Datum				
	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)
130.67-131						2.0	6.4	50	73.98	73.98
131-132						-0.3	4.8	50	786.69	860.67
132-133						1.7	5.3	200	2751.28	3611.95
133-134						-0.3	7.9	200	1943.38	5555.33
134-135	tidal zone					1.9	4.8	200	840.35	6395.68
135-136						1.7	4.9	500	11350.48	17746.16
136-137						1.7	5.2	300	3397.38	21143.54
137-138						-0.3	6.6	250	1955.40	23098.94
138-139						1.6	7.5	50	68.44	23167.38

Chainage (Km.)	Observed					Reduced w.r.t Sounding Datum				
	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cum)	Acc. Dredging Qty. (cum)
139-140						2.9	4.2	0	0.00	23167.38
140-141						-0.3	3.6	1000	38089.87	61257.25
141-142						-0.3	1.3	1000	61907.94	123165.19
142-143						-0.3	2.1	1000	60852.35	184017.54
143-144						-0.3	2.2	1000	65342.35	249359.89
144-145						-0.3	1.5	1000	61069.01	310428.90
145-146						0.2	2.4	1000	54783.24	365212.14
146-147						0.5	2.8	1000	49656.31	414868.45
147-148						0.5	1.8	1000	48136.30	463004.75
148-149						0.3	2.8	1000	59989.53	522994.28
149-150						1.0	2.7	250	4528.16	527522.44
150-151						2.1	3.2	50	114.50	527636.94
151-152						3.1	9.3	0	0.00	527636.94
152-153						4.3	11.9	0	0.00	527636.94
153-154						3.0	8.8	0	0.00	527636.94
154-155						2.9	4.6	0	0.00	527636.94
155-156						1.0	2.6	500	17665.03	545301.97
156-157						-0.3	0.8	1000	66751.04	612053.01
157-158						-0.3	1.3	1000	64590.36	676643.37
158-159						-0.3	1.3	1000	58307.10	734950.47
159-160						-0.3	1.1	1000	70821.53	805772.00
160-161						-0.3	0.8	1000	84871.94	890643.94
161-162						-0.3	0.9	1000	85490.21	976134.15
162-163						-0.3	0.7	1000	82624.78	1058758.93
163-164						-0.3	0.6	1000	88711.93	1147470.86
164-165						-0.3	0.7	1000	83997.47	1231468.33
165-166						-0.3	1.7	1000	77414.73	1308883.06
166-167						-0.3	1.2	1000	89407.27	1398290.33
167-168						-0.3	2.5	800	65329.84	1463620.17
168-169						-0.3	3.6	1000	91366.22	1554986.39
169-169.55						-0.3	1.3	400	59989.84	1614976.23
	TOTAL					**-0.3**	**11.9**	**24800**	**1614976.23**	

Beypore port is available at left bank of the waterways at Ch-149.3km. This is second largest port of Kerala after Cochin port. Beypore port is one of the oldest ports in Kerala from where trading was done to the Middle East. It is well connected with road as well as rail network. Chaliyam-Beypore ferry is available in this section at Ch-148.85km.

There are 15 Road bridges and 05 Railway bridges, and 06-foot bridges (including Temporary bridges) are present in this section.

Villages/areas fall in this stretch are Kodakkad, Kashayapadi, Cherupurakal, Madathilpadam, Cheruvennur, Kottummal, Thiruvannur, Feroke and Kalai. On both sides of the canal/river is residential and coconut plantation. The gradient of the river/canal is very gentle and there are no rapids or obstructions in this stretch. Details of ferry/ port as given.

Details of Ferry/ Port

S.No	Features	Geographic coordinates	UTM coordinates	Chainage in km	Side of Bank
		Lat / Lon	Easting /Northing		Right / Left
1	Chaliyam Ferry Jetty	11° 9'44.62"N 75°48'30.35"E	588270.00 m E 1234056.00 m N	148.9	Left
2	Beypore Ferry Jetty	11° 9'55.51"N 75°48'23.59"E	588064.00 m E 1234390.00 m N	149.2	Left
3	Beypore Port	11°10'1.24"N 75°48'28.94"E	588225.93 m E 1234566.52 m N	149.3	Left
4	Beypore Jetty	11°10'21.19"N 75°48'35.95"E	588437.00 m E 1235180.00 m N	150.0	Left

2.6 Water and Soil Samples analysis and Results

Bed soil and water sampling was undertaken at average 10 Km evenly distributed throughout the Canal Stretch and also collected from same location. The Van Veen 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 2-15: WATER TEST RESULT

Sr. No.	Sample No.	Latitude N	Longitude E	Sediment Concentration (mg./lit.)	pH
1	NW-3-1	10°11'49.7216"	076°12'23.0170"	34	7.35
2	NW-3-2	10°15'45.0778"	076°11'39.9290"	52	7.02
3	NW-3-3	10°19'30.6903"	076°09'20.52"	57	7.12
4	NW-3-4	10°23'09.2301"	076°08'15.1946"	59	7.05
5	NW-3-5	10°26'34.0392"	076°06'05.5525"	65	7.25
6	NW-3-6	10°31'13.2712"	076°04'04.5091"	68	7.46
7	NW-3-7	10°34'50.0148"	076°01'16.0471"	77	7.37
8	NW-3-8	10°39'18.8661"	075°58'59.6928"	84	7.01
9	NW-3-9	10°43'57.0141"	075°57'02.5889"	90	7.07
10	NW-3-10	10°47'13.5447"	075°55'10.2866"	92	7.19
11	NW-3-11	10°52'29.1001"	075°54'19.0300"	94	7.26

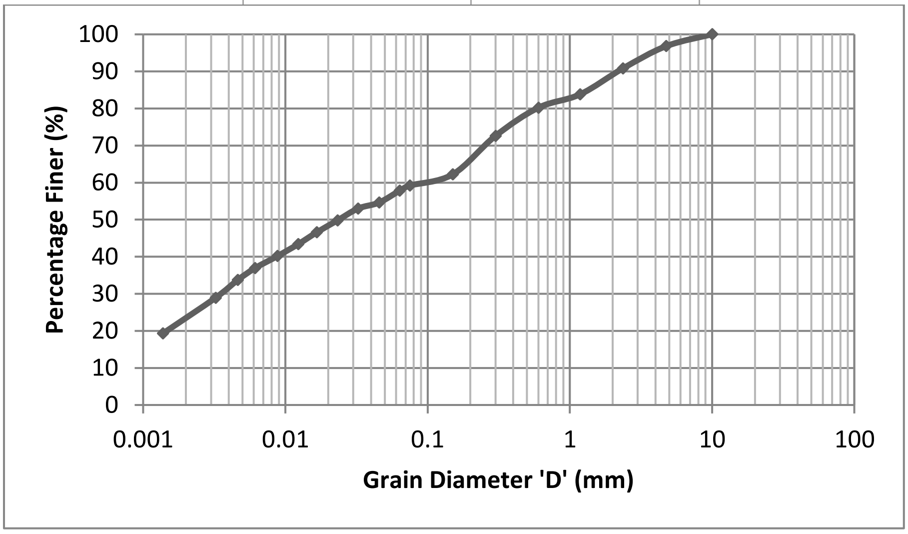
Sr. No.	Sample No.	Latitude N	Longitude E	Sediment Concentration (mg./lit.)	pH
12	NW-3-12	10°57'13.0625"	075°52'44.7843"	97	7.07
13	NW-3-13	11°02'13.2064"	075°52'43.0355"	98	7.34
14	NW-3-14	11°04'31.4985"	075°52'35.4403"	99	7.31
15	NW-3-15	11°07'44.2447"	075°51'49.0387"	152	7.24
16	NW-3-16	11°09'44.2557"	075°48'40.5950"	197	7.01
17	NW-3-17	11°12'26.3348"	075°49'37.2430"	40	6.91
18	NW-3-18	11°13'46.1602"	075°46'50.4264"	55	7.55

Table 2-16 Soil Test Result

Particle size distribution curve

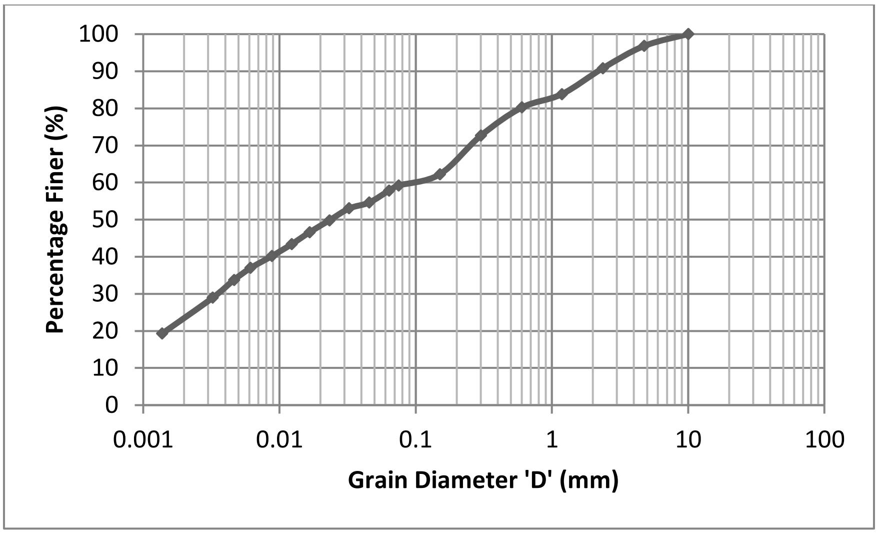
Sample No: NW-3-1

Clay	Silt	Sand	Gravel
23%	36%	38%	3%



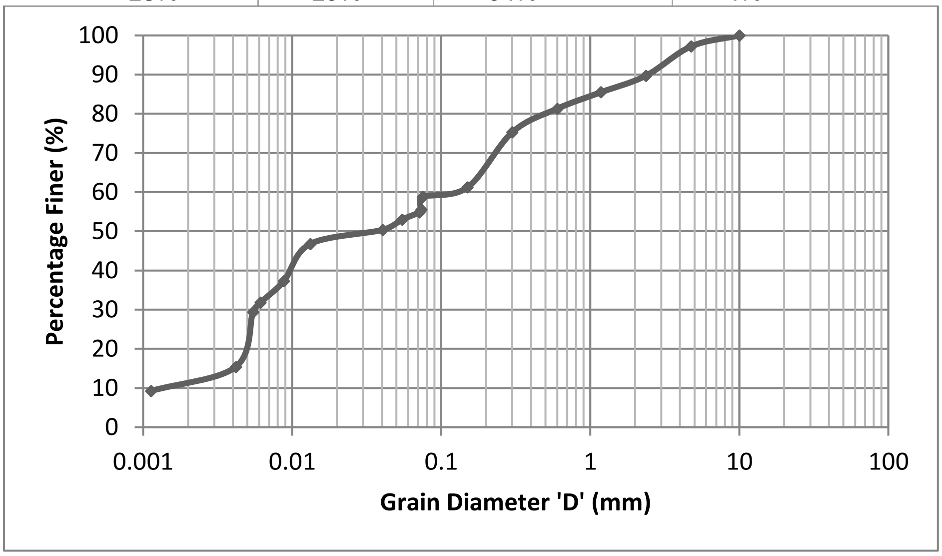
Sample No: NW-3-2

Clay	Silt	Sand	Gravel
13%	38%	46%	3%



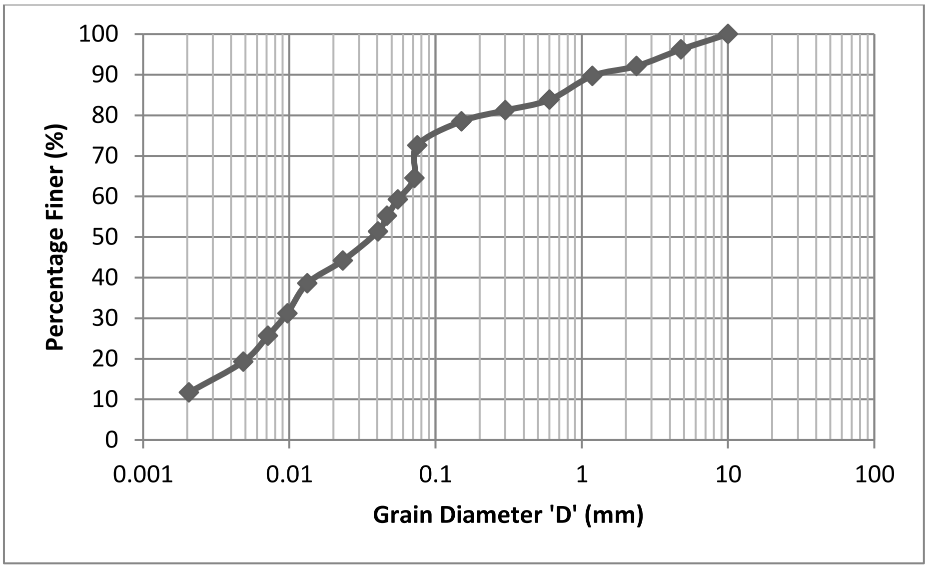
Sample No: NW-3-3

Clay	Silt	Sand	Gravel
13%	19%	64%	4%



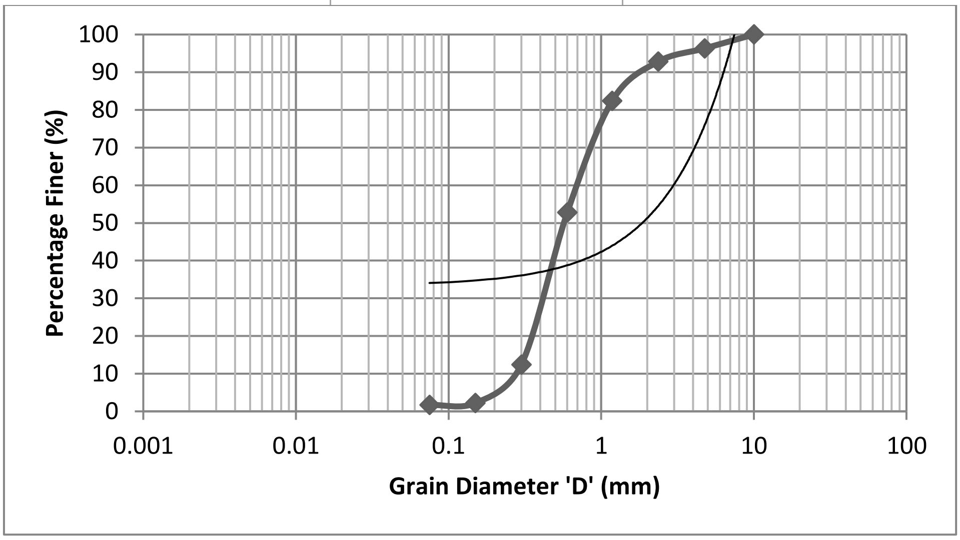
Sample No: NW-3-4

Clay	Silt	Sand	Gravel
9%	11%	77%	3%



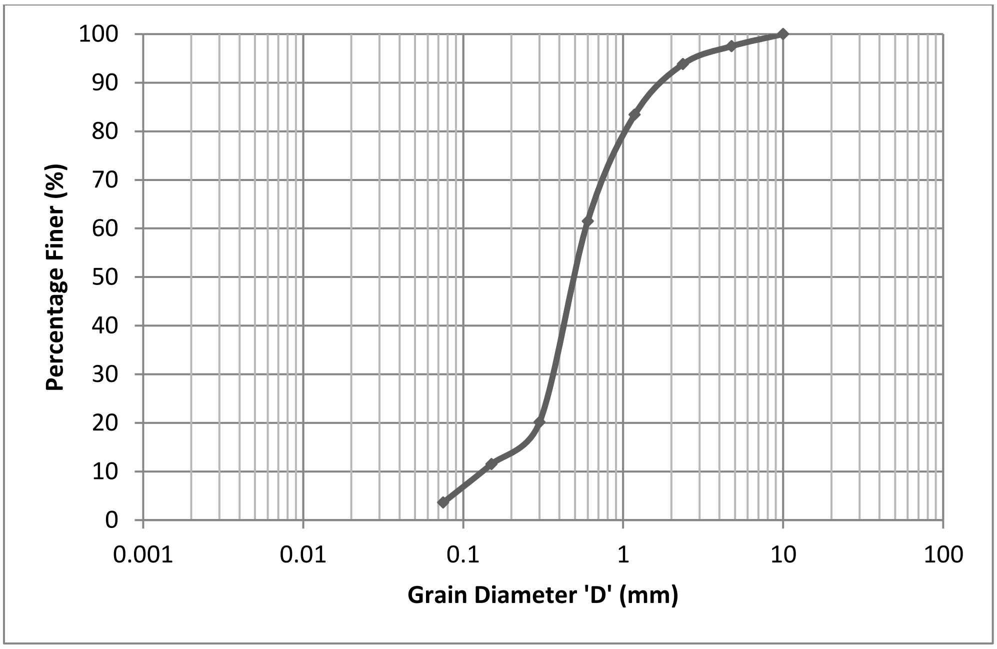
Sample No: NW-3-5

Clay and Silt	Sand	Gravel
1%	95%	4%



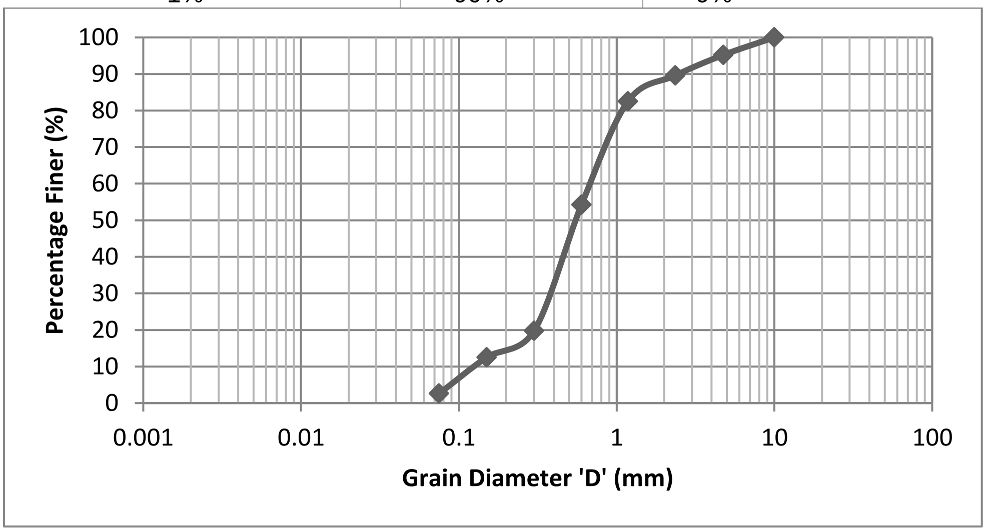
Sample No: NW-3-6

Clay and Silt	Sand	Gravel
1%	92%	7%



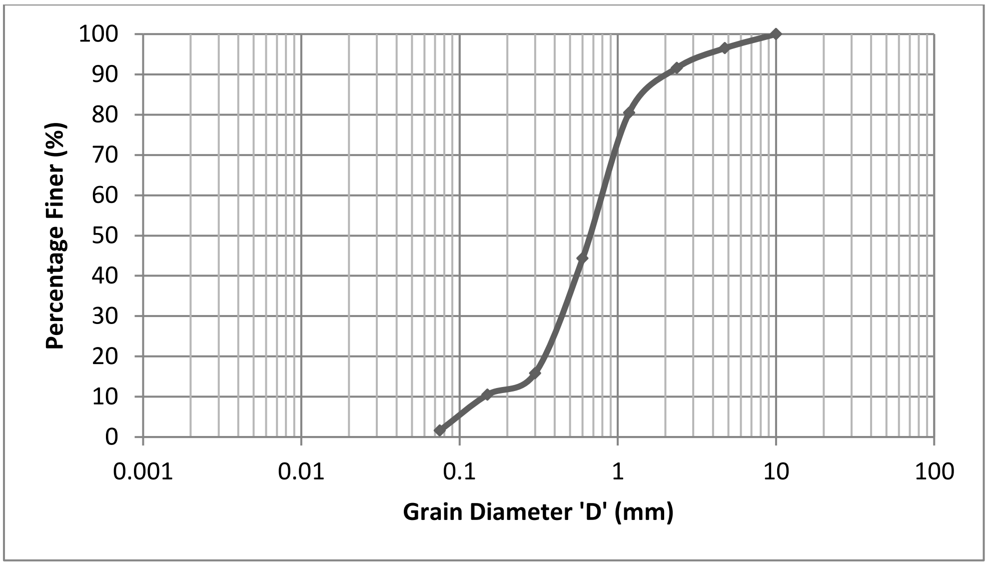
Sample No: NW-3-7

Clay and Silt	Sand	Gravel
1%	90%	9%



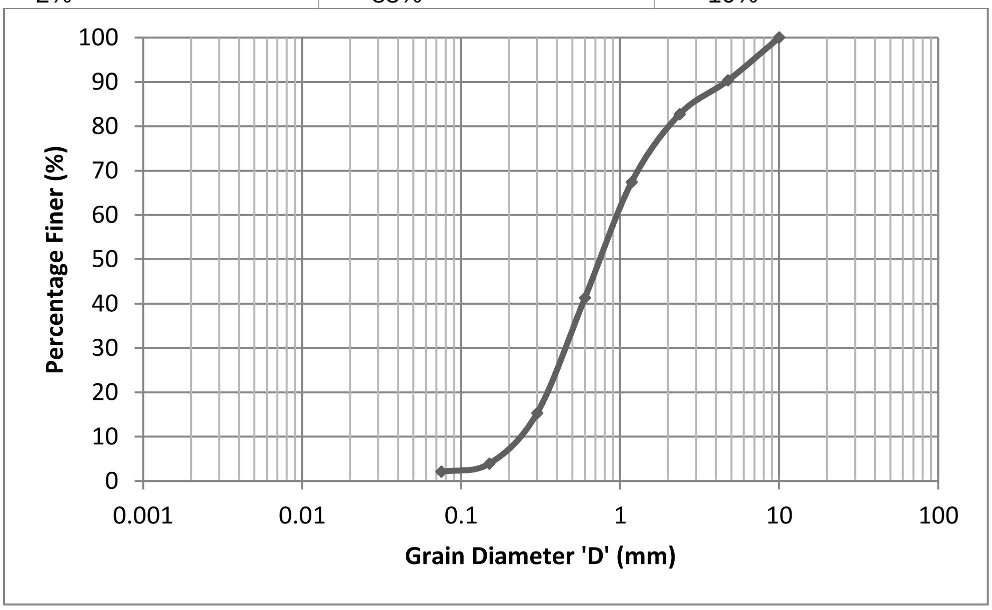
Sample No: NW-3-8

Clay and Silt	Sand	Gravel
1%	89%	10%



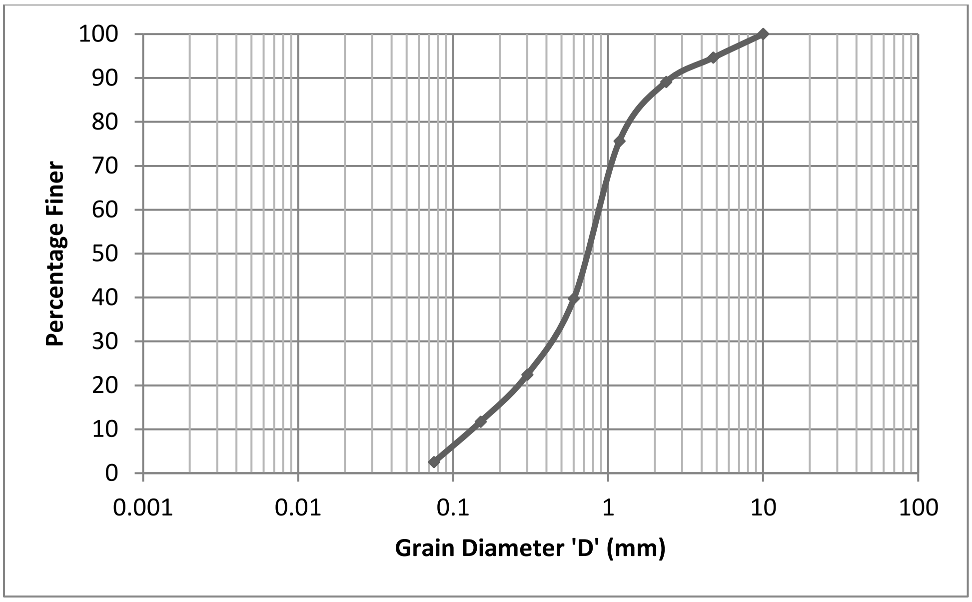
Sample No: NW-3-9

Clay and Silt	Sand	Gravel
2%	88%	10%



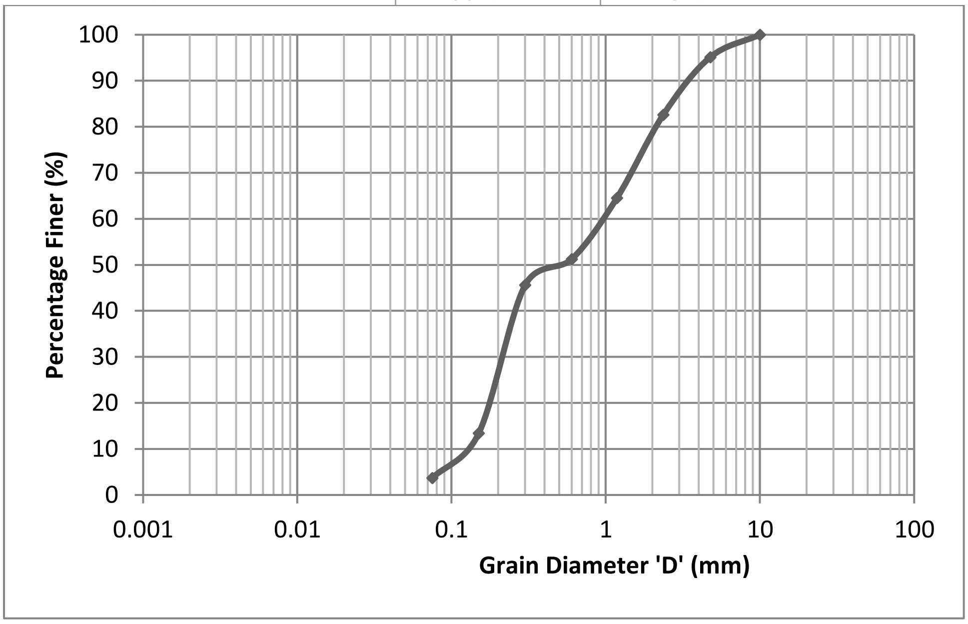
Sample No: NW-3-10

Clay and Silt	Sand	Gravel
1%	90%	9%



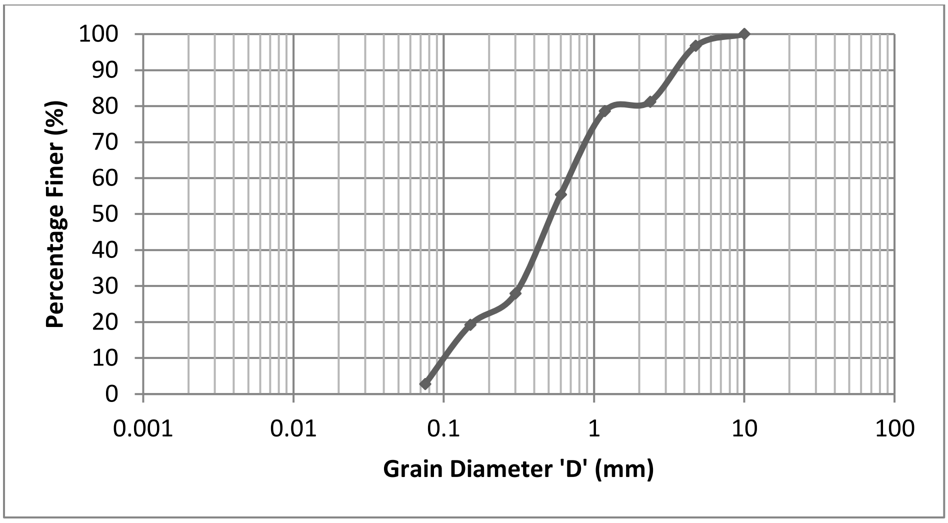
Sample No: NW-3-11

Clay and Silt	Sand	Gravel
2%	85%	13%



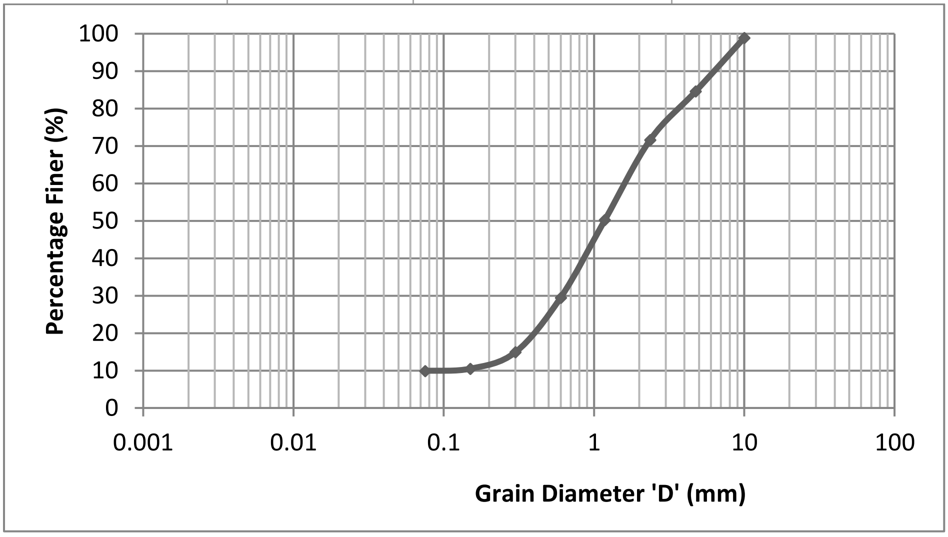
Sample No: NW-3-12

Clay and Silt	Sand	Gravel
1%	82%	17%



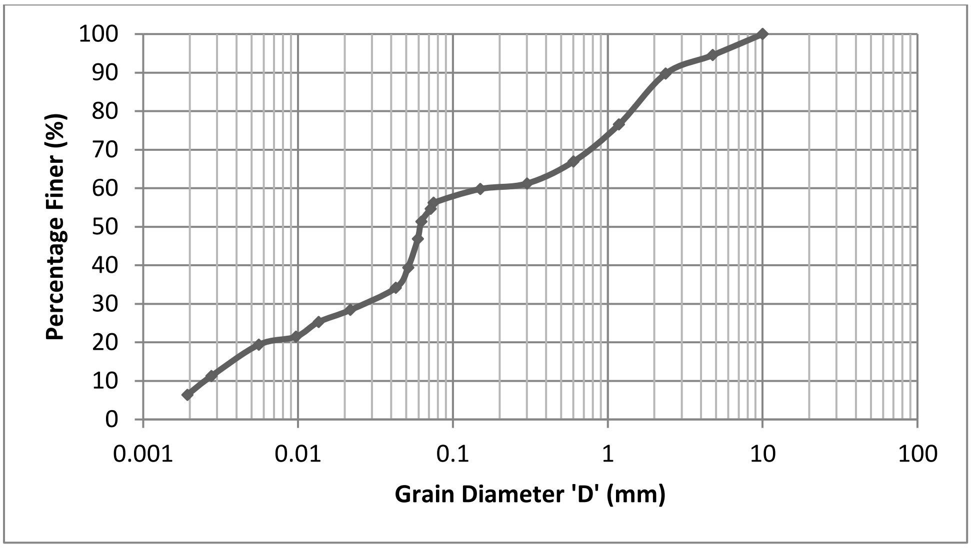
Sample No: NW-3-13

Clay	Silt	Sand	Gravel
7%	23%	58%	12%



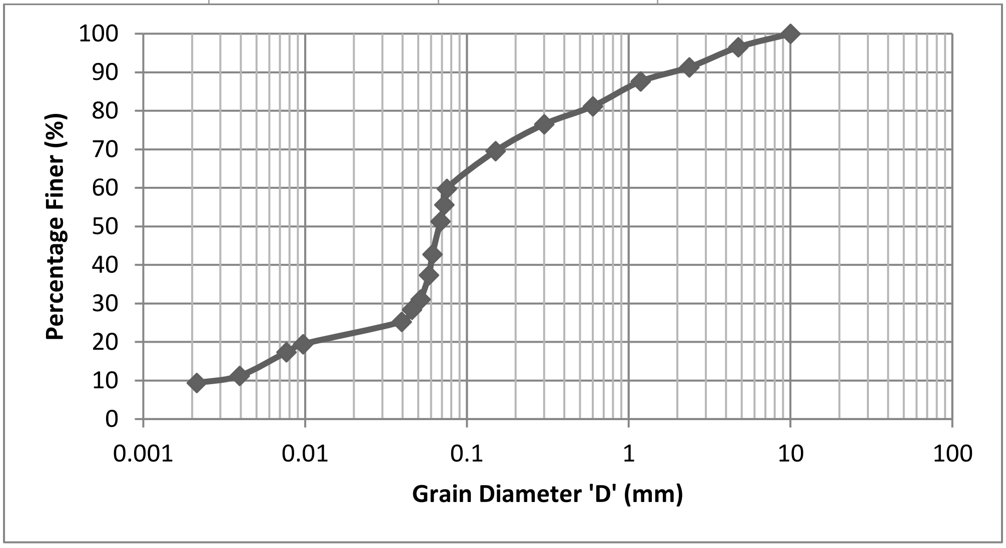
Sample No: NW-3-14

Clay	Silt	Sand	Gravel
10%	35%	48%	7%



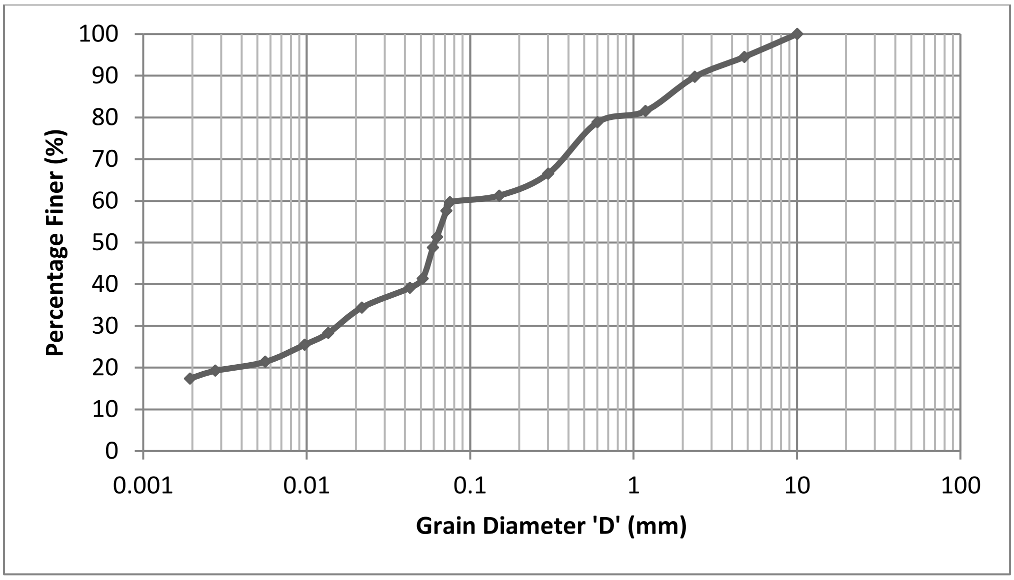
Sample No: NW-3-15

Clay	Silt	Sand	Gravel
6%	28%	62%	4%



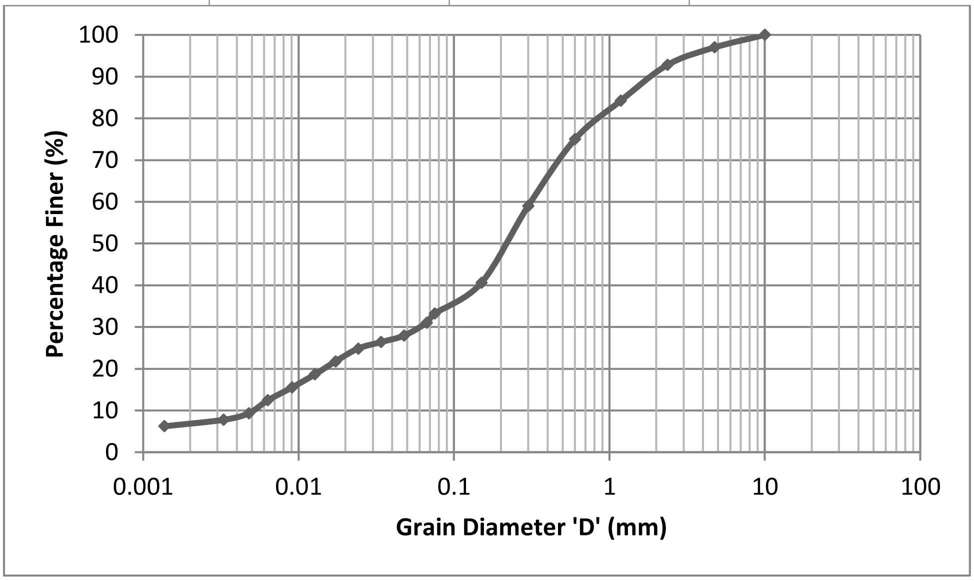
Sample No: NW-3-16

Clay	Silt	Sand	Gravel
9%	39%	46%	6%



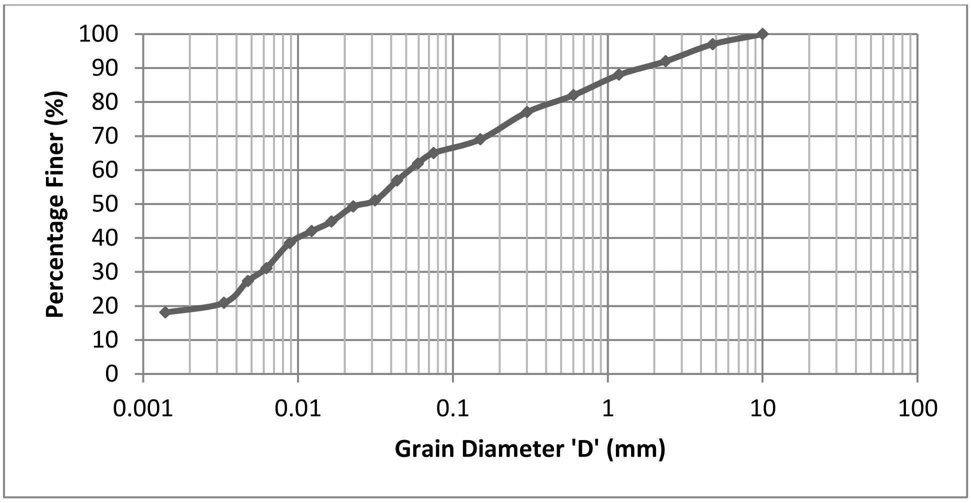
Sample No: NW-3-17

Clay	Silt	Sand	Gravel
7%	26%	64%	3%



Sample No: NW-3-18

Clay	Silt	Sand	Gravel
8%	28%	62%	4%



Percentage Finer (%)
100
90
80
70
60
50
40
30
20
10
0
0.001
0.01
0.1
1
10
100
Grain Diameter 'D' (mm)

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 view point 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 3 Extension is having direct connectivity to Two Non-Major Ports viz., Ponnani Port and Beypore Port apart from other local fishing ports. Further, it is having extended connectivity to the Kochi Port and ICTT, Kochi through the existing NW 3. In addition, it will have connectivity to all the IWAI Terminals developed all along the existing NW 3 and hence it is most preferred choice to develop the fairway with **Class III** waterway however the other constraints for visibility on the revenue stream is to be established. Development of the NW 3 Extension may ease the road traffic in Kerala. The Road Traffic in Kerala already facing lot of other constraints, in particular on the widening aspects. The traffic density on the road can be eased with the availability of such alternative system of IWT mobility.

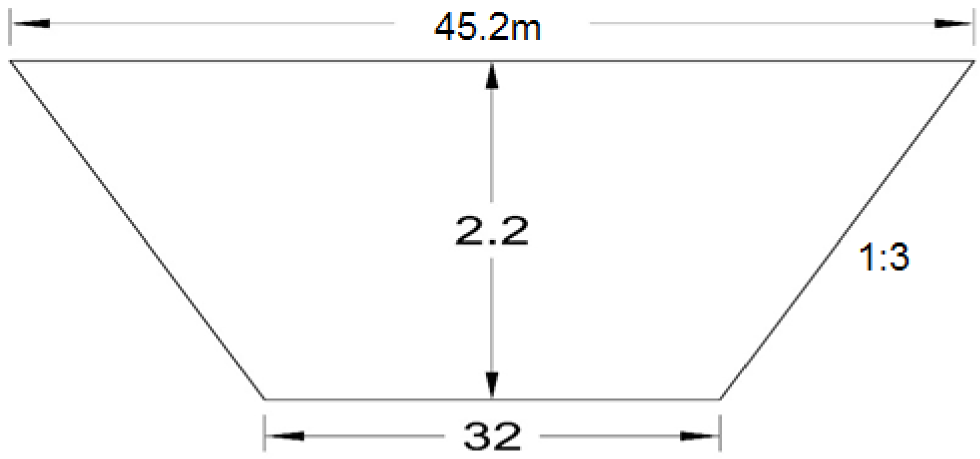
NW 3 Extension is the waterway as a canal system not of the river system, which is having a distinct standard made available as per the Classification of Waterways.

The present Study stretch of NW 3 Extension can be considered for development as a ***Class III*** waterway, for carrying out the through put traffic. The time frame for development of Infrastructure, on establishing the viability, can be considered as 5 years (60 months) from 2020.

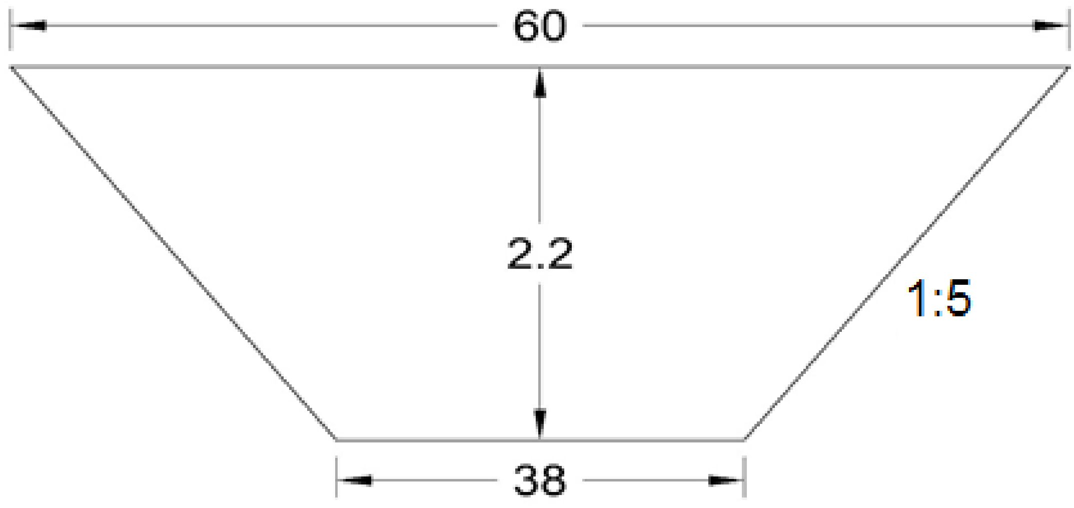
3.2 Details of Shoals (Length, Width and proposed development works)

Dredging quantities have been worked out for the suggested Class III Waterway standards of the canal system. The total shoal length is 109.90 kms. The stretch of NW 3 (Extension) is being planned accordingly and the cross section of the fairway is being considered, as detailed in the following sketch with segregation for the Narrow Reaches (Needs Widening) and Wider Reaches (Lake Regions).

CLASS – 3 (Depth – 2.2m)



Narrow Reaches with 50 m Land Acquisition.



Wider Reaches with No Land Acquisition.

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			Max	Min		
0.0	25.00	TIDAL ZONE				8.1	-0.3	13000	414328.60
25.00	54.07					7.4	-0.3	7900	366817.64
54.07	82.01					2.5	-0.3	28000	2081191.80
82.01	95.91					4.8	-0.3	12450	712389.73
95.91	114.67					2.6	-0.3	18150	1113515.89
114.67	118.53					5.1	0.4	2950	79005.94
118.53	130.67	10.9	0.0	2050	27432.24	10.6	-0.3	2650	51916.40
130.67	169.50	TIDAL ZONE				11.9	-0.3	24800	1614976.23
TOTAL								**109900**	**6434142.03**

3.3 Proposed Conservancy Activities

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

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

In the study stretch, there is no need of any conservancy activity due to the canal area, except the Dredging and Bank Protection (in Narrow Reaches) and Dredging (in Wider Reaches).

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 harbours). Dredging often is focused on maintaining or increasing the depth of navigation channels, anchorages, or berthing areas to ensure the safe passage of boats and ships. Vessels require a certain amount of water in order to float and not touch bottom. This water depth continues to increase over time as larger and larger ships are deployed and with the increased volumes of bulk cargo operation, dredging plays a vital role in the nation's economy.

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

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

In the study stretch, Dredging has been identified along with Land Acquisition with widening. In order to meet the inter connectivity, **Class III standard** has been considered. The shoal length for Class III is 109.9 kms with an estimated quantity of dredging as 64.34 Lakhs Cu. M. The stretch from 149.5 km to 169.56 km is not amenable for development due to the passage of the canal system in the thickly populated “Kozhikode” town. However, the Dredging quantities, as worked out above, have been considered, keeping in view the development strategy. Accordingly, the shoal length is working to 109.9 kms and the quantity of Dredging is 64.34 lakhs Cu. M. Taking into the possibility of depth variation in dredging, the estimated dredging quantity has been modified by additional 5% which comes out to be 67.56 Lakhs Cu. M of General

Soil. This is the estimated quantity in case of longitudinal development along the waterway, however the situation is that some ferry services do provide facility for crossing across the waterway which is at three location involving about one km at each location, thus three kms of dredging may be needed to support the passenger vessel movement and the quantity of dredging may be in the range of (67.56*3/169.56) cum = 1,19,533 cum. Hence the dredging quantity for longitudinal development has been considered as 66.36 Lakhs cum & dredging quantity for crossing the waterway at three location for passenger ferry movement, the estimated dredging quantity is 1.19 Lakh cum.

3.3.2 River Training

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

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

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

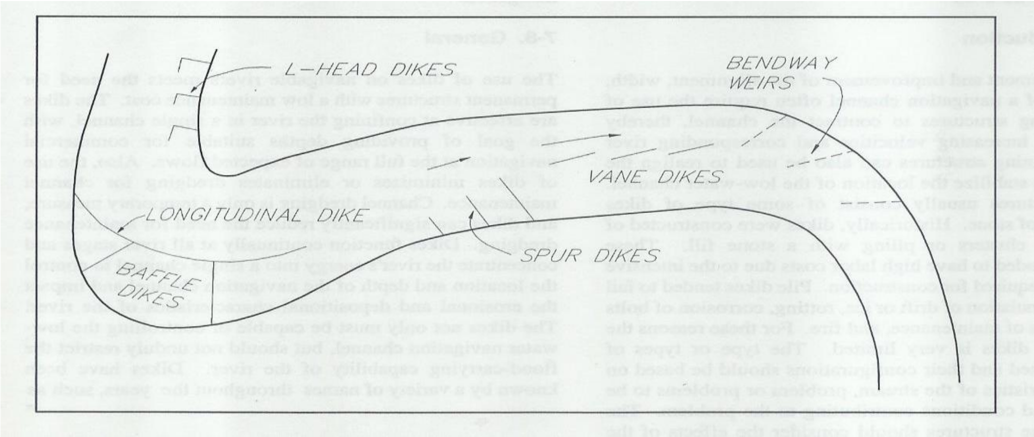


FIGURE 3-1: Types of dike structures

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

NW 3 Extension is basically a canal stretch available with a lesser natural width / lesser depth of the channel than the standard navigational criteria, in most of the stretches. This is probing the necessity of Land Acquisition / Widening / Bank Protection etc.

In the present study stretch, there is no need of any River 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 3 Extension 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 for the Narrow Reaches and a km wise LA / Bank Protection requirement has been worked out. The details are placed at **Annexure 3.1** and **Annexure 3.2**.

The Bank Protection requirement has been worked out to 136,000 m, on both the sides of the narrow reaches. In canals, the usual types of Bank Protection in Kerala are Revetment / Riprap or Pile & Slab. Since the NW 3 (Extn) is traversing through the Narrow & Wider Reaches and keeping in view the Land Acquisition also into criteria, the preferred type is Pile & Slab for which a preliminary drawing with the details is provisioned in the Chapter 6. Accordingly, about 136,000 m of Pile & Slab bank protection has been suggested and recommended herewith.

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 3, (Extn), 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.

In order to optimize the Buoy / Light quantity, it is preferred to have a segregation of wider reach and narrow reach, wherein the spacing is preferred at 750 m in wider reaches and 500 m in narrow reaches. The details are provisioned herewith.

WIDER REACH		**NARROW REACH**	
Stretch (in Km)	**Length (in M)**	**Stretch (in Km)**	**Length (in M)**
0.00 to 15.6	15600	15.6 to 33.15	17550
33.15 to 53.50	20350	53.50 to 64.40	10900
64.40 to 65.20	800	65.20 to 82.25	17050
82.25 to 83.35	1100	83.35 to 87.85	4500
87.85 to 97.00	9150	97.00 to 114.80	17800
114.80 to 140.45	25650	140.45 to 142.90	2450
142.90 to 156.05	13150	156.05 to 165.70	9650
165.70 to 169.55	3850		
Total	89650	Total	79900

Accordingly, with the suggested placement in Zig-zag position (i.e., 1 Left then 1 Right Mark and 1 Left Mark), the requirement is working out to 330 Nos. {(89650 / 750 + 79900 / 500) + about 8 % addition for Bends + 10% addition for close marking near structures}.

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

In the present study stretch of NW 3 (Extension), 128 Bridges are existing and the same has been analysed according to the Horizontal and Vertical clearances and the same is placed at **Annexure 3.3**.

Further, 49 Nos. of Power Cables + 1 No. Pipeline are in existence. Most of the cables may not require any modification. However, anticipated stringing of Cables for which lumpsum provision has been considered.

No cross structures viz., Dams / 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 the study stretch of NW 3 (Extension), it has been noted that the Water Level variations are observed at 7 Locations, where Locks are essential for the vessels to manoeuvre. The existing Locks structures are in damaged condition, which may have to be addressed for throughput navigation. Further, there may need to fix the Lock chamber dimensions to suit to the proposed vessel dimensions. Accordingly, it is proposed to have the Lock Length of 85 m, to accommodate 1 PT + 1 Barge (an extreme possible scenario) and 20 m width + 2 times the width which will one time on either side + Free area.

SL. No.	Structure Name	Chainage (km)	Location	Position (lat / long)	Remark
1	Orumanayur lock Gate 1	54.07	Moonnamkallu	10°32'19.88" / 76° 02'43.27"	Working
	Orumanayur lock Gate 2	54.12	Moonnamkallu	10°32'21.60" / 76° 02'42.81"	Damaged
2	Puranga lock Gate 1	81.92	Lock near Puranga	10°44'53.71" / 75°56'43.47"	Damaged / not working
	Puranga lock Gate 2	82.01	Lock near Puranga	10°44'54.83" / 75°56'43.20"	Damaged / not working
3	Regulator/Barrage cum Road bridge	95.91	Kuttayi	10°50'46.82" / 75°54'28.56"	Working
4	Navigational Lock	114.67	Tanur	11° 0'15.35" / 75°51'53.61"	Damaged / not working
5	Newcut Barrage + Foot Bridge	118.53	Keernallur	11° 1'17.35" / 75°53'2.13"	Damaged
6	Palathingal Barrage/lock + road bridge	121.03	Palathingal Town	11° 2'15.72" / 75°52'40.83"	Working
7	Regulator/ Barrage/Lock	130.67	Bridge and barrage near Mannattampara	11° 4'56.72" / 75°53'1.68"	Not working

3.8 Land Acquisition

The 50 m corridor has been considered for Land Acquisition for fairway development, where the canal width is less (Narrow Reaches) and the extent of width in Left and Right have been worked out. Further the District wise Land Acquisition probable cost has been taken into account. A segregation also has been considered for thickly habitant zone with appropriate cost factor.

As above, the details are placed at Annexure 3.1 and Annexure 3.2. The Land Acquisition requirement has been worked out to 20.91 Lakhs Sq. m, out of which the habitant zone is about 8.085 Lakhs Sq. m. Districtwise land acquition is presented below:

Name of the District	Land AcquisItion		Acquisition of land only for Habitation	
	Area in Hectares	Cost in Cr	Area in Hectares	Cost in Cr
Thrissur	127.2	70.72	40.2	68.74
Malappuram	55.9	20.98	11.3	21.19
Kozhikode	26.0	19.46	29.4	16.59
Total	209.1	111.16	80.9	106.52

Total area of 209.1 Ha is inclusive of 80.9 Ha of land acquisition for structures.

3.9 Fairway Costing

3.9.1 Capital Cost

The identified Traffic for IWT for this Waterway is only 4 Lakhs T P. A of Steel scrap from Kochi Port area to Beypore Port area. In order to maintain the safe navigable channel in this route, the investment is very high and hence the development does not appear to be financially / economically viable. Investment is suggested only with Positive growth and confirmations, if observed in future.

The Capital Cost for the fairway has been considered for 66.36 Lakhs Cu. M of Dredging in general soils considering the longitudinal development of the waterway & 1.19 Lakh cum of dredging in crossing for passenger ferry servives across the river at three existing ferry lines; 136,000 m of Pile & Slab Bank Protection (30 locations marked in **Annexure 3.4**) ; 330 Nos. of Buoy with Light; 209.1 Hectares (81 Hectares of Habitation); 128 Nos. of Bridges; lumpsum provision has been catered for stringing Power Lines; Reconstruction of 07 Locks etc.,. Cost estimates for all these items are placed with its detail 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 analyzed and considered. Some more assumptions have been considered appropriately, wherever required.

CHAPTER 4 TRAFFIC STUDY

4.1 General

Kerala is the southeast coastal state of India. It comprises of mountainous regions, valleys, large coastal plains, central midlands and dense forests. Kerala is famous for its backwaters, which comprises of green lakes, criss- crossing canals, numerous lagoons, estuaries and delta of 44 rivers. Out of these 44 rivers, 41 rivers originate in this region, and the Cauvery river descends from there and drains eastwards into neighboring states.

The navigable length of the proposed extension of NW 3 / West Coast Canal is 169 km. The study stretch of West Coast Canal (from Kottapuram to Kozhikode) is proposed to serve as an extension to the existing National Waterway 3 (from Kollam to Kottapuram). Based on the deepest bathymetry single line survey carried out during the study and as per the classification of “Inland waterways” by Ministry of Shipping, Govt. of India notification; it can be classified as “Class III” for the entire study stretch. The proposed waterway would further enhance the connectivity with Kochi, Kollam & Alappuzha districts through IWT.

FIGURE 4-1: West Coast Canal

Source: Consultant’s Site Visit

4.2 Hinterland Analysis

The primary hinterland of West Coast Canal includes the areas, which are located within 25 km from the river. The proposed waterway on West Coast Canal covers Kozhikode, Malappuram, Pallakad & Thrissur districts of Kerala. West Coast Canal is bounded by Kozhikode district on the North, Malappuram district in the East, Thrissur district on the South-East, and Arabian Sea on the West. These districts have a combined coastal belt of 195 km on the Western side from Kozhikode till Kottapuram in Thrissur.

The distance between the Canal to Pallakad is around 60 km; hence Pallakad is not considered as the primary hinterland of West Coast Canal. Only Kozhikode, Malappuram and Thrissur districts are considered as the primary hinterland for West Coast Canal. These districts are divided into different talukas. The map below shows West Coast Canal and its hinterland, which come under 25 km from the river.

Figure 4-2 Hinterland of Extension of NW 3 / West Coast Canal

The navigable stretch of West Coast Canal runs almost parallel to the sea, and the National Highway 17.

4.2.1 Demography Profile of Hinterland

The below table presents a list of districts, along with talukas, that come in the catchment area of West Coast Canal. The table shows district wise and talukas wise population in the catchment area.

Table 4-1 Population of the catchment area

District	Population	Density (Per sq. m)	Taluka	Population (in Lakhs)
Malappuram	41,12,920	1,157	Tirur	9.3
			Ernad	10.5
			Tirurangadi	7.1
			Perinthalmanna	6.1
			Ponnani	3.8
			Nilambur	5.7
Thrissur	31,21,200	1,0 31	Kodungallur	3.1
			Thrissur	6.8
			Mukundapuram	8.3
			Talappilly	6.3
			Chavakkad	4.7
Kozhikode	30,86,293	1,316	Vadakara	6.9
			Kozhikode	16.7
			Quilandy	7.3
Total	1,03,20,413			

Source: Census 2011

Vadakara & Quilandy talukas of Kozhikode district are mentioned in the above table but they would not be considered as the catchment area of the proposed waterway as they are far from West Coast Canal. Approximately 103 lakh people reside in the talukas in the hinterland of West Coast Canal.

As shown in the above table, the taluka with highest population in the catchment area of WCC is Kozhikode with 16.7 lakhs population. Kodungallur taluka of Thrissur district and Ponnani of Malappuram district have less population in the catchment area than other talukas.

Malappuram District

The district with highest population in Kerala is Malappuram district. It has population of around 41,12,920. As per Census 2011, out of the total Malappuram population, 44% lives in urban regions of the district. In Malappuram district, Ernad taluka has the highest population of 10.5 lakh. The total geographic area is around 3,554 sq. km, whereas population density of Malappuram district for 2011 is 1,157 people per sq. km.

Kozhikode District

In 2011, Kozhikode had population of 30,86,293 people. Out of the total Kozhikode population for 2011 census, 67.15 percent lives in urban areas of the district. Total geographic area is around 2,345 sq.km whereas population density is 1,316 people per sq. km.

Thrissur District

In 2011, Thrissur had population of 31,21,200 people. In Thrissur district, Mukundapuram has the highest population i.e. 8.3 lakhs. Population density of Thrissur is about 1,031 persons per sq. km. Total geographical area of Thrissur is 3,032 sq. km.

4.2.2 Economic profile

The contribution of major industries to the overall economy of Kerala is Service sector with 71% share, Agricultural sector with 9% and Industrial sector with 20% share. The economy of Kerala has high dependence on foreign remittance. In most of the districts along the stretch of West Coast Canal like Thrissur, majority of families have some member working in Gulf Countries mainly Saudi Arabia, UAE, Kuwait, Oman, Bahrain, Qatar etc. Hence, remittance income from overseas countries is one of the major sources of local economic development. This also influences higher share of service sector in the economy of Kerala.

Table 4-2 shows Gross State Domestic Product at constant prices of Kerala and **Figure 4-3** shows the percentage increase over the years.

Table 4-2 Historic GSDP of Kerala

Year	GSDP (INR. Lakhs)	Increase in GSDP of Kerala
FY 05	119	N.A
FY 06	131	10%
FY 07	142	8%
FY 08	154	8%
FY 09	163	6%
FY 10	178	9%
FY 11	190	7%
FY 12	201	6%
FY 13	213	6%
FY 14	226	6%

Source: Economics & Statistics, Kerala

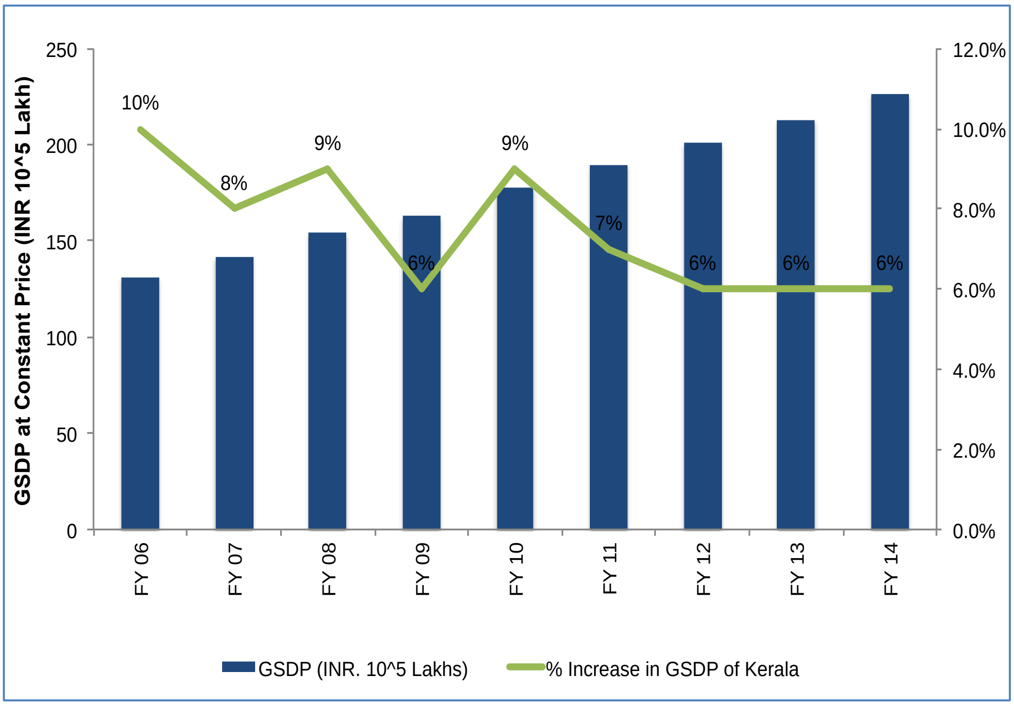


Figure 4-3 Percentage growth (GSDP) of Kerala over the years

Table 4-3 indicates the distribution of different sectors with respect to GSDP of Kerala. It can be seen that GSDP of primary sector has decreased, whereas there is significant growth in Secondary and Tertiary Sector over the years.

Table 4-3 Sector wise distribution of GSDP Kerala

(INR in Lakhs)

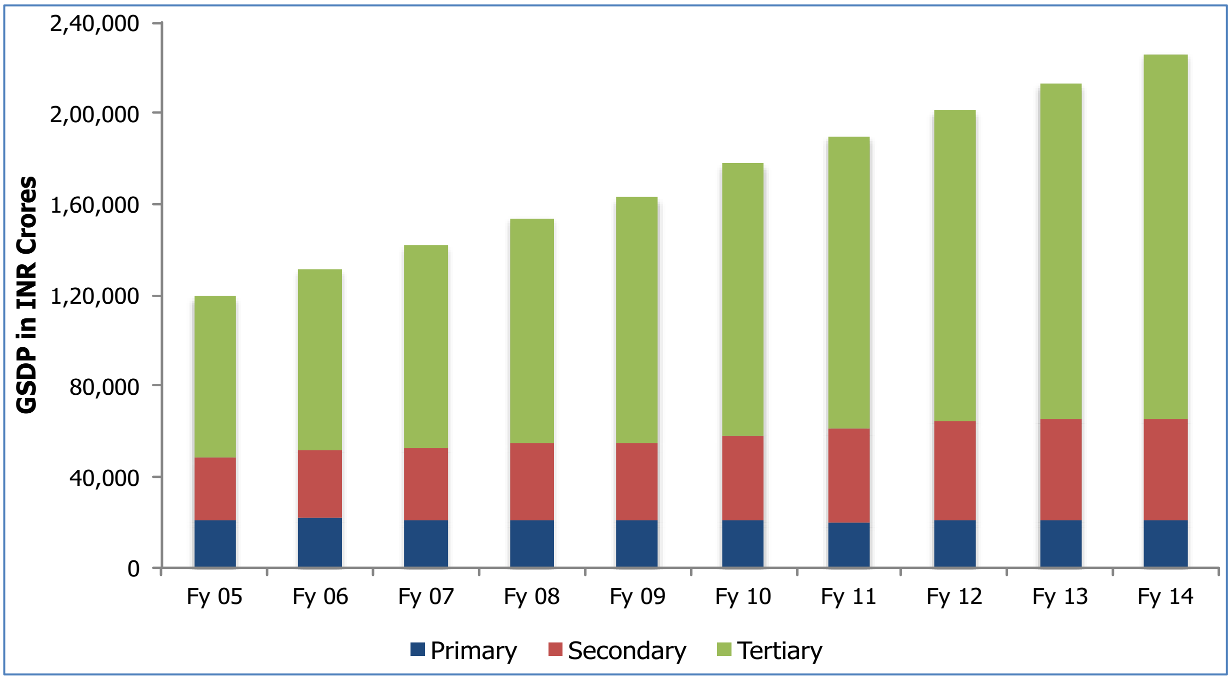
Sectors	FY 05	FY 08	FY 11	FY 14
Primary	21,30,200	20,80,200	19,77,900	20,73,700
Secondary	26,89,100	34,02,900	41,78,300	45,10,500
Tertiary	71,07,100	99,26,200	1,28,28,900	1,60,36,700
GSDP	1,19,26,400	1,54,09,300	1,89,85,100	2,26,20,900

Source: Economics Statistics, Kerala Govt.

There is 1% growth in Primary sector since FY 11. Secondary sector i.e. manufacturing industry has shown approximately 4% of increase between FY 11 to FY 14. Tertiary sector also has witnessed growth between FY 11 and FY 14. Hence, GSDP of Kerala has increased by 6.3%. State per Capita Income of Kerala has increased by 5.7% in FY 14.

Source: Economics Statistics, Kerala Govt.

Figure 4-4 shows sector wise GSDP growth in the state in last ten years. Whereas Primary & Secondary sector has remained stagnant in last ten years, there is constant growth in Tertiary sector, as Tertiary sector mostly dominated by service sector. Tourism growth in Kerala has boosted the Tertiary sector.



Source: Economics Statistics, Kerala Govt.

Figure 4-4 Sector Wise GSDP Growth of Kerala

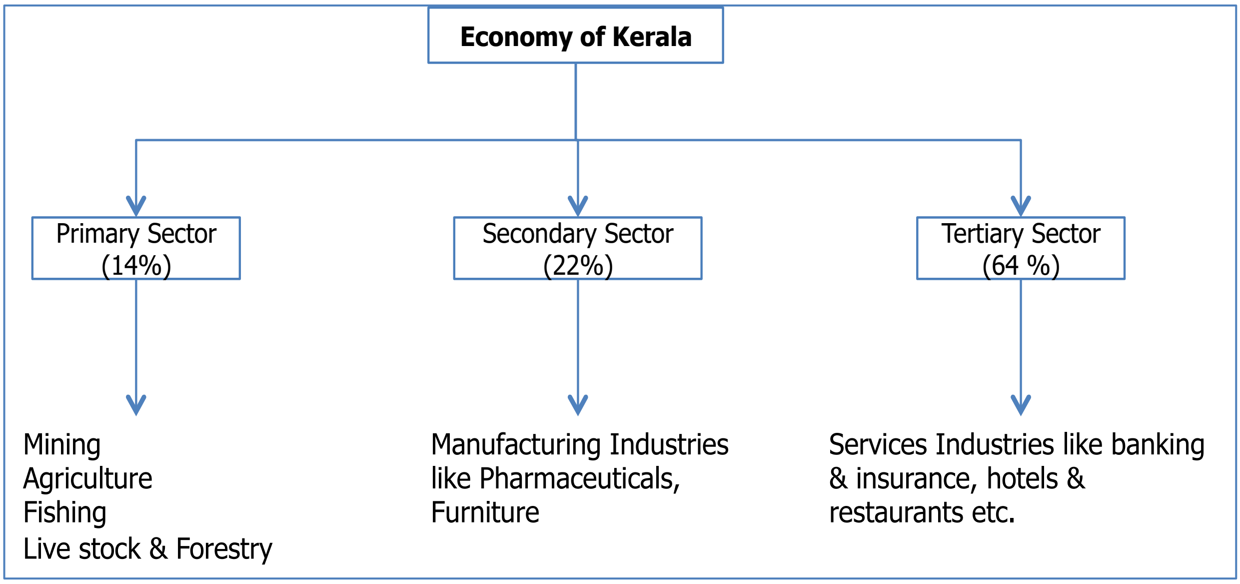


Figure 4-5 Contribution of different Sectors in Economy of Kerala

4.2.2.1 PRIMARY SECTOR

Primary sector consists of Agriculture, Forestry, Fishing and Mining. The main occupation of majority of people is fishing, agriculture, mining work etc. Ban on sand mining sector has affected the primary sector. In **Table 4-4** of primary sector of Kerala for consecutive 10 years has been clearly discussed.

Table 4-4 Breakup of Primary Sector of Kerala

Activities	FY 05	FY 08	FY 11	FY 14
Agriculture	16,981	16,197	14,869	15,473
Forestry & logging	2,049	2,263	2,375	2,572
Fishing	1,814	1,795	1,794	1,927
Total of Agriculture and Allied Sectors	**20,844**	**20,255**	**19,039**	**19,972**
Mining & Quarrying	458	547	740	765
Total Primary Sector	**21,302**	**20,802**	**19,779**	**20,737**

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.

There is possibility that majority of agriculture-based cargo could be transported in the region by West Coast Canal. For example, Veekesy Rubber Industries in Kozhikode uses Rubber and Polyurethane as raw materials. These raw materials and finished products are mainly transported through PAN India. Veekesy Rubber Industries is located at 5.7 km from Beypore Port. Beypore port can be developed for major cargo movement from Kozhikode and could be used by Veekesy Rubber Industries.

Other companies like South Indian Industries, Mannachira, Kozhikode process coconut products, like fresh coconuts, desiccated coconuts, coconut milk powder, virgin coconut oil etc. Finished products are transported to Middle East countries. To transport these coconut products, the company could use the proposed waterway.

Table 4-5 shows the land utilisation pattern of Kerala in FY 14-15. Maximum land i.e. 52.6% land is used for agriculture purpose, whereas 27.8% land is for forest. These forest areas consist of wildlife sanctuaries, bird sanctuaries and National parks, which attract tourists.

Table 4-5 Land Utilization Pattern (FY 14-15)

Land Covered	Area (Ha)	% Distribution
Net Area Sown	20,42,881	52.6
Forest	10,81,509	27.8

Land Covered	Area (Ha)	% Distribution
Non-Agricultural Use	4,19,128	10.8
Cultivable Waste	1,00,676	2.6
Still Water	1,00,453	2.6
Current Fallow	65,329	1.7
Fallow Other than Current Fallow	54,741	1.4
Barren & Uncultivable Land	12,952	0.3
Water Logged Area	3,148	0.1
Social Forestry	2,662	0.1
Land Under Misc. Tree Crops	2,653	0.1
Marshy Land	150	0.0
Permanent Pastures & Grazing Land	5	0.0
Total	**38,86,287**	**100.0**

Source: Ministry of Environment, Kerala

Approximately 1 lakh Tonnes of cereals, pulses & oil seeds (excluding coconut) are produced in the catchment of West Coast Canal. In addition to food grains 2,419 million nuts of coconut are also grown in the districts of Thrissur, Malappuram & Kozhikode.

Table 4-6 Food Grain Production in the catchment area of WCC (FY 14-15)

District	Cereals		Pulses		Oil Seeds		Total	
	Area (Ha)	Production (T)	Area (Ha)	Production (T)	Area (Ha)	Production (m.nuts,T)*	Area (Ha)	Production (m.nuts,T)*
Thrissur	24,151	76,016	1	1	83,227	4,854	107,379	48,576,021
Malappuram	8,402	22,279	299	221	103,798	93,336	112,499	93,322,536
Kozhikode	2,321	3,423	6	5	123,066	10,010	125,393	10,013,428
Total	**34,874**	**101,718**	**306**	**227**	**310,091**	**241,940**	**345,271**	**2,419,101,985**

*- Million nuts for Coconut, rest all in Tonnes

Source: Economics & Statistics Dept., Govt. of Kerala

b. Horticulture

Table 4-7 Horticulture Production in the catchment area of WCC (Tonnes)

District	Mango	Banana	Plantain	Pappaya	Tapioca	Rubber	Green Chillies	Others (Mn. No.)
Thrissur	38,762	19,803	33,229	5,217	54,613	12,900	138	504
Malappuram	43,017	64,990	27,379	11,964	1,98,203	32,450	70	1,071
Kozhikode	39,509	17,723	18,626	7,992	39,368	19,000	116	996
Total	**1,21,288**	**1,02,516**	**79,234**	**25,173**	**2,92,184**	**64,350**	**324**	**2,571**

Source: Agriculture Statistics, 2015-16

The above table shows the Horticulture Production in the catchment area of WCC. Districts considered are Thrissur, Malappuram and Kozhikode. Malappuram tops the list of production in the catchment area.

All these products are consumed locally among various industries like Fruit Jam, Sauce, Pickles types agro based industry.

c. Fishing

Fishing industry has always been a prominent industry for any coastal region. Kerala is not only situated near sea, but it also has delta of 44 rivers. The geographic appearance of the state helps Kerala with a good output of marine and freshwater fish haul each year. People earn their livelihood from fishing and allied activities such as drying, processing, packaging, exporting and transporting fish catch. The well being of these fishermen and workers depends on proper implementation of the various schemes devised by the Department of Fisheries. The state alone yields 6.75 lakh tonnes of fish every year.

Total marine fish catch of Kerala in FY 12-13 was 1.66 lakh Tonnes. Table 4-8 shows the marine fish catch statistics for Kerala from FY 11 to FY 15.

Table 4-8 Marine Fish Statistics of Kerala

Year	FY 11	FY 12	FY 13	FY 14	FY 15	Fy 16
Fish Catch (MT)	5.6	5.5	5.3	5.2	5.2	5.2
Exports (MT)	1.2	1.6	1.7	1.7	1.7	1.5
% (Export to Total)	22%	28%	31%	32%	32%	33%

Source: Directorate of Fisheries, Kerala

Table 4-9 Inland Fish Statistics of Kerala

Year	FY 11	FY 12	FY 13	FY 14	FY 15	FY 16
Fish Catch (MT)	1.2	1.4	1.5	1.9	2.0	2.1

Source: Directorate of Fisheries, Kerala

It has been observed that 33% of the total marine fish catch of Kerala is exported. Export has been increased by 10 % from FY 10 to FY 16.

There are companies who sell fish or seafood, like Uniroyal Marine Exporters, Vengalam, which is a seafood exporter company in Kozhikode. To transport this perishable cargo, special types of refrigerated trucks are used. This company transports seafood from Kozhikode to Kochi via road route. If the waterways come into existence, then companies like Uniroyal Marine Exporters could easily move their cargo through waterways. As the annual volume of finished seafood of Uniroyal Marine Exporters is around 1,800 Tonnes, it would be a potential customer for the proposed waterways.

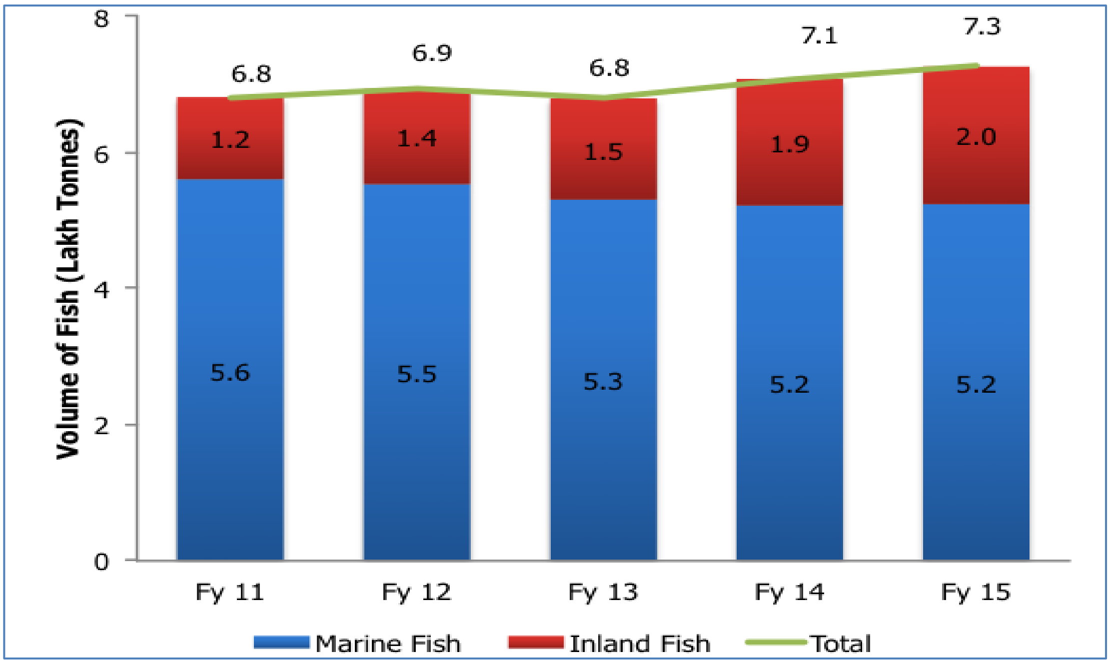


Figure 4-6 Growth of Fish production in Kerala

Both marine & inland fishing are popular in Thrissur, Malappuram & Kozhikode districts in the hinterland of West Coast Canal. A total of 17 minor inland fish landing centers are available in these three districts. Out of these, 8 landing centers are located along the proposed West Coast Canal.

Table 4-10 shows inland fish landing centers, located in Thrissur, Malappuram & Kozhikode, in the hinterland of West Coast Canal. These three districts have a total coastline of 195 km (33% of total Kerala's coastline).

Table 4-10 Inland Fish Landing Centres

Sl. No.	Inland Fish Landing Centers	
	District	**Landing Centre**
1	Thrissur	Anapuzha
		Mala
		Poyya
		Kodamukku
		Nedupuzha
		Peechi Dam site
		Vazhani Dam site
2	Malappuram	Ayilakkad
3	Kozhikode	Odassery
		Manakkadavu
		Petta(Faroqu)
		Mukkathu thazham
		Pulikkal Kadavu

Source: Ministries of Fisheries, Kerala

As it can be seen from the table above that maximum inland fish landing centres are in Thrissur. In Malappuram, there is a single inland fishing centre.

From the analysis of fish catch data, it has been observed that approximately 25,000 MT of fish are caught from various rivers, lakes & reservoirs in the districts of Thrissur, Malappuram & Kozhikode. Table 4-11 shows the volume of inland fish catch in these districts from FY 11 to FY 13.

Table 4-11 Marine & Inland Fish Catch in Thrissur, Malappuram & Kozhikode

District	FY 15		Fy 16	
	Marine	Inland	Marine	Inland
Thrissur	31,164	26,251	21,057	26,781
Malappuram	20,004	6,517	59,920	6,831
Kozhikode	94,740	5,264	93,443	6,124
Total	1,45,908	38,032	1,74,420	39,736

Source: Kerala Inland Fishery Statistics, Govt. of Kerala

Two fishing harbors namely, Beypore in Kozhikode district & Ponnani in Malappuram district are also located in the catchment area of the proposed waterway. Potential of sending the fish catch of these harbors to Kochi Port via Inland navigation exists because these harbors have direct accessibility to the proposed West Coast Canal. Fish catch at both the harbors and other areas can be transported using the proposed waterway in West Coast Canal.

Figure 4-7 Ponnani Fishing Harbour

Source: Consultant's Site Visit

d. Forestry

About 10.8 Lakh hectare land of Kerala is densely forested. This constitutes 27.8% of the total geographic land. Forestry and wildlife play a major role in the state's economy. The revenue earned from export of herbs and herbal byproducts such as oils, tree barks, natural incense, scents, ivory, sandalwood, teakwood, rosewood etc contribute as a major foreign exchange earner. There are a number of industries, which trade these forest and wildlife products. These include leather product manufacturing units, fragrance and incense preparing cottage industry, sandal and ivory carving business and coir product manufacturing units. These industries may also be a potential market for the waterways as they could use waterways for transporting their products. It would be convenient to transport the forests and wildlife products from forests to the nearby waterways. Kozhikode is famous for Timber wood, which has various usages, like making furniture, as building material etc. As timber produced from the hinterland is mostly locally consumed and the remaining timber is less in volume; hence it would not provide any opportunity for the waterway.

e. Minerals

The state is rich in mineral ores. The finest variety of China Clay in India is available in Kerala. Bauxite, quartz, silica etc. are some minerals available freely in the state. Quartz, Iron ore, Granite Building stone, Laterite Building stone, Brick clay, Ordinary sand River sand are the mineral deposits found in Kozhikode district.

Five Iron Ore deposits in Kozhikode and one along Malappuram district have around 84 million tonnes of reserves with varying 32% - 41% Iron. Thrissur & Malappuram have around 0.47 million tonnes of Lime shell. There also exist reserves of Granite Stone, Ordinary Sand, and Laterite in Thrissur District. But most of the quarries & Crushers are located far from the waterway; hence it is very unlikely that these minerals would be diverted to the proposed waterway in WCC.

4.2.2.2 SECONDARY SECTOR

Manufacturing industries, Electricity, Gas, Water supply providing and construction companies come under secondary sector. There doesn't exist many industries along the West Coast Canal. Major Industries are mostly located at Kozhikode. It consists of different types of industries, like Iron & Steel, Chemicals like Paints, Rubber Industry like footwear and Wooden Industry like furniture.

4.2.2.3 TERTIARY SECTOR

Hotels, Restaurants, Transport, storage and other communication industries, Banking & insurance, Public administration etc. comes under tertiary sector. Tertiary sector has increased over the years. Growth in service sector is due to increasing Tourism as well as development of the State.

4.2.3 Infrastructure Analysis

Infrastructure plays major role in the development. It is essential to understand various types of infrastructure around the river 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 West Coast Canal are well connected by an extensive road & rail network. Below figure shows the existing NW 3 stretch along with its extension. It also highlights the road & rail connectivity of the region.

Figure 4-8 Connectivity around WCC

Roadway

Kerala has well-developed network of roads, with 8 National Highways. These highways are constructed in such a way that they easily connect the cities and towns of Kerala and also the neighboring states to Kerala. There are 50 State highways also in the state to improve the road connectivity. These state highways give easy passage and connect all the towns and cities of Kerala. The maximum highway roads are broad and in very good condition thus making journey of travellers comfortable. However, sometimes weather of Kerala is responsible for deteriorating the condition of the roads. Kerala experiences heavy rainfall and monsoon stretches over a long period of time. The movement of heavy traffic is another reason for the bad roads in Kerala. Main Highways of Kerala are NH-17, NH-47, NH-47A, NH-49, NH-208, NH-212, NH-213 and NH-220.

However, along the stretch of West Coast Canal, major districts such as Kozhikode, Malappuram & Thrissur are well connected by a network of State & National Highways.

National Highway-17 moves along the waterway from Kottapuram to Kozhikode. Various other State Highways that bisect the waterway are SH-20, SH-69 connecting the waterway with Thrissur, NH-213 connects the waterway with Malappuram, and NH-17 & SH-28 connect the waterway with Kozhikode city. State Highway-28 connects Kozhikode with Beypore Port.

Railway

West Coast Canal region is served by the Southern Railways. The Thiruvananthapuram and Palakkad division of Southern Railways passes through the catchment of West Coast Canal. The Palakkad division railway connects the region to Mangalore and further moves towards North. The city of Thrissur is served by Thiruvananthapuram Railway Division and Kozhikode city is served by Palakkad Railway Division. The nearest railway station to Ponnani Port is Thirunavaya Railway Station, which is 24 km away from the port and Feroke Railway Station is the nearest station from Beypore port, it is only 6 km away from the port. There is no direct rail connectivity available for Malappuram city. The nearest railway station from Malappuram is Angadipuram, which is located at a distance of around 21 km.

Airport

Kozhikode and Kochi are well-connected airports in Kerala. They are connected to all major cities in India. Kochi has an international airport.

4.2.3.2 EXISTING INFRASTRUCTURE

Figure 4-9 shows the present infrastructure of Proposed West Coast Canal at Ponnani, Malappuram. Picture 1 in the below picture indicates the bridge over Canoli canal near Ponnani port. Picture 2 shows the outer part of Ponnani Fishing Harbour at Ponnani in Malappuram. Fishing boats are visible in Picture 2. Picture 3 & 4 show the route of WCC near Ponnani port. Ponnani port has appointed Malabar Port as developer for expansion purpose. It is also planning for development of Canoli Canal to start cargo movement to Kochi Port, as till now Ponnani Port is used as a fishing harbour only. Ponnani port has abundant space for its expansion plan for cargo handling.

Source: Consultant's Site Visit

Figure 4-9 Existing Infrastructure of Canal at Ponnani

Figure 4-10 shows Moothakunnam Bridge at the proposed waterway in West Coast Canal. It is near to starting point of extension of Inland Waterways NW 3/ West Coast Canal.

Source: Consultant's Site Visit

Figure 4-10 Existing Moothakunnam bridge over WCC

4.2.3.3 EXISTING NATIONAL WATERWAYS 3 (NW 3)

National Waterways III connects Kollam to Kottapuram through waterways. It is totally a stretch of 205 Km, i.e West coast canal (Kottapuram - Kollam) 168 km, Udyogmandal canal (Kochi Pathalam bridge) 23 km, Champakara canal (Kochi - Ambalamugal) 14 km. It has sea opening at 4 places like Munambam, Kochi, Kayamkulam and Neendakara. There is a tidal influence of 0.7m to 1 m rise at the time of high tide. In the whole stretch, there are 2 lock gates made for cargo movement, for example, Lock gates at Thanneermukkom, and Thrikunnapuzha.

Figure 4-11 Maps showing NW 3

4.2.3.4 UPCOMING INFRASTRUCTURE

Ponnani Port- At present, Ponnani is a fishing harbour in the catchment area of WCC. Ponnani is going to be developed through public-private participation (PPP) model. Chennai-Based Malabar Ports Private Ltd. would develop the port on build-operate-transfer (BOT) basis. The port would be a non-major port for handling cargo and it would be designed to handle vessels of up to 50,000 DWT. The port will have both rail and road connectivity for the movement of cargo to hinterland destinations. Development of this port would boost the development of Malappuram, Palakkad and Thrissur districts and also serve the Palakkad-Coimbatore industrial region. The development of the port will not affect the functioning of the existing fishing harbour in Ponnani.

4.2.4 Existing & Proposed Industries

4.2.4.1 EXISTING INDUSTRIES

The districts that form the primary hinterland of the proposed waterway are Kozhikode, Malappuram & Thrissur. The industrial development of this region has been very limited. No large-scale industries are present in these districts, although some Medium industries (in the form of steel plants) are located in Kozhikode district and small industries are operational in Malappuram & Thrissur.

Kozhikode- This district has various types of industries. Most of the existing medium units are in the form of steel plants. These steel plants located at Kozhikode are SAIL-SCL Kerala, Peekay Steels Casting & Rolling, Malabar Steel Company, Minor Ispat etc. Small & Micro industries consist of Engineering units, Agro based, Readymade garments & embroidery, Leather based industries etc. The major exportable items from Kozhikode district are marine processing and handicrafts.

Diversion from Kozhikode Industries- At present, the iron & Steel industries of Kozhikode get raw material like scrap from Kochi Port via roadways. The industries, which are located within 25 km from West Coast Canal are trying that Beypore Port would bring scrap from Kochi Port and from Beypore Port these industries could get scrap transported to their units. These Iron & Steel Companies would provide opportunity for the West Coast Canal because during meeting with them they had showed willingness to get their raw material transported through the proposed waterway.

Thrissur- Most of the industries in Thrissur are micro and small industries. The sectors are Agro based, Wood, Textile, Chemical, Rubber, Food products, plastics, Electronics, IT, Paper & Printing, Engineering and non-metallic mineral based. The major exportable items from Thrissur district are Ayurvedic Products, Handicraft items, Textiles, Food Products, Dry Fish, Rubber Products, Coconut Oil, Soap, Spice oil, Food Processing machineries, Concrete Product machineries etc.

Diversion from Thrissur Industries- During site visit, it was found that most of the industries of Thrissur in the catchment area of WCC are small scale industries, like Food processing industries, sauce making, pickle making units. These industries distribute the product locally. Industries give products to dealers for distribution. The area of distribution is scattered in the catchment area, hence it would not be convenient and economic way to transport using waterway. Roadways is more preferred way of transporting these products as per the interaction with industries. Hence, Thrissur would not provide any opportunity.

Malappuram- There is no large-scale industry located in the hinterland of WCC in Malappuram. The existing industries are small scale.

Small & Micro industries consist of engineering units, Readymade garments & embroidery, Wood/wooden based furniture, Paper & Paper products, Rubber, Plastic & petro based, Agro based, leather based etc. The district is famous for its textile industries, such as Lamiya Silks, Limra White House, Seems Silks, Henna Textiles etc. Apart from textiles, there are other industries like Kasaco Steel Industries, Catalyst Chemical Industries, AMS Agro Industries, Pmh Rubber Industries etc. The major exportable items from Malappuram district are Agro & Food based products, Spices, Condiments, Ayurvedic products, Furniture, Rubber based & Coconut Oil. They are not willing to use inland waterways for their cargo transportation.

Authorities & Industries associated with existing NW 3 (from Kollam to Kottapuram)

Following are the stakeholders around NW-3 (Kollam to Kottapuram)

- ✓ Kerala Water Transport Authority
- ✓ Kerala Shipping Inland Navigation Corporation
- ✓ TCC
- ✓ FACT
- ✓ Binnani Zinc Ltd.
- ✓ Kochi Mineral Rutile Ltd
- ✓ Malabar Cement Limited
- ✓ Kottayam Port & Container Terminal

There exists Ferry Service from Kochi to Ernakulam as well as Lakshadweep.

TCC (The Travancore Cochin Chemicals Ltd.)– TCC Udyogamandal is a State Public Sector Undertaking owned by Government of Kerala. Cargo movement is not fully utilised. It is transporting industrial salt. This waterway NW-3 is underutilised due to various reasons.

- ✓ Industries are nearer to Kochi Port; hence they do not have any interest to use NW-3.
- ✓ Production of some industries has reduced over the years due to various reasons. These products would not provide opportunity for the waterway as their volume is less.

Caustic Soda Lye, Caustic Soda Flakes, Liquid Chlorine, Hydrochloric Acid & Sodium Hypochlorite.

FACT – A sizeable quantity of chemicals and fertilizer imports of public sector FACT (raw materials) were being transported through the Udyogamandal canal by barges.

The company is importing cargo from various locations via barges from Kochi to these locations. Rock phosphate, Sulphuric Acid, Phosphoric Acid & Liquid Ammonia are the major commodities transported.

Bennani Zinc Ltd. – It moves its cargo from Kochi to various locations via barges. It has stopped cargo movement from last 1 year.

Kochi Mineral Rutile Ltd.– It has already owned a jetty but have some issues with their barges. There is also news of presence of rocks on the riverbed near its jetty.

Malabar Cement Ltd. – It has a grinding unit, which is located 65 km away from Kochi. IWAI has put a jetty but it has not started operation yet. This jetty would be use to transport clinker, Fly ash & Coke.

Kottayam Port & Container Terminal - They are ready to use NW 3 for transportation of container to ICTT, Vallarpadam, Kochi. Since, NW 3 is already operational & in working condition. Cargo Movement will be possible through NW 9 only when entire stretch of NW 9 is developed and navigable and finally connected to NW 3.

Figure 4-12 Existing Industries in the catchment area of West Coast Canal

The above image shows various industries located on the catchment area of West Coast Canal and the connectivity around them. There is good road, rail and air connectivity. There are two airports at Kochi and Calicut in the catchment area.

Above picture shows the commodities wise Import & Export in Kochi to/from different major cities. Major commodities exported to other cities via rail are Food Products, RMG/Textiles, Frozen Food, Machineries & Spares Parts and Automobiles from Kochi. Food Products are easily exported to Bangalore as well as RMG/ Textile & Frozen food too exportable items.

Major Industries imports commodities like Rubber, Metal, Wood, Chemical, and Construction Material from different cities.

4.2.5 Traffic from Major & Non Major Ports

a. Non Major Ports

A number of non-major ports are located along the proposed section of waterway, which includes Beypore /Kozhikode Port, Munambam Port and Ponnani Port. Out of all these ports Beypore/Kozhikode is currently handling cargo. Ponnani Port is predominantly used for fishing activities.

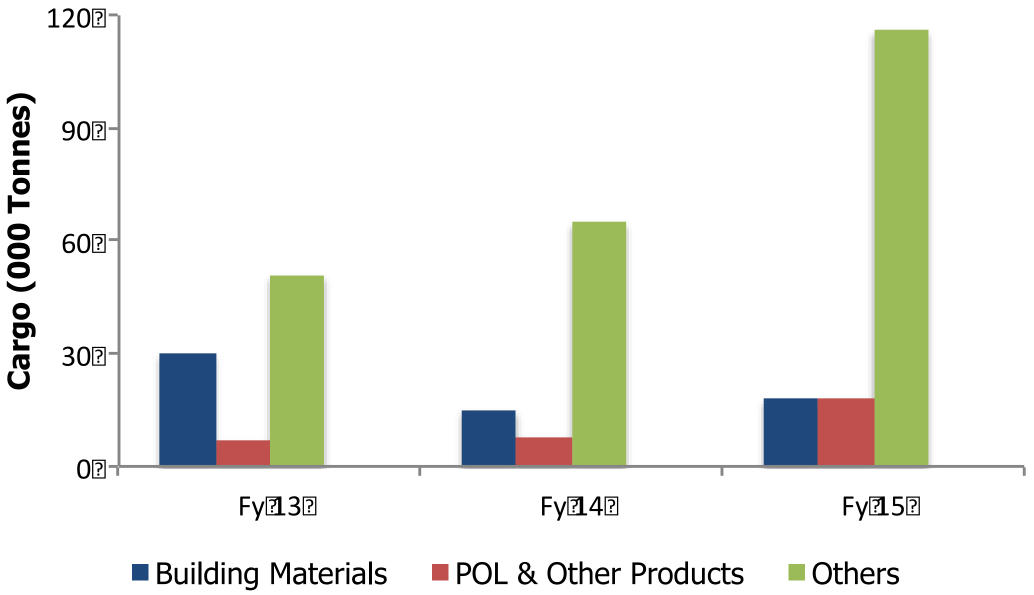


Figure 4-13 Cargo handled at Non-Major Ports in Kerala ('000 Tonnes)

Source: Kerala Ports

The graph above clearly depicts that non-major ports of Kerala handles large volume of other cargoes. Building material and POL & other products are also handled majorly. In FY 13 and FY 14, volume of POL and other products was less but in FY 15, volume of building material and POL & other products was almost equal.

b. Beypore Port/ Kozhikode

Commodities handled at Beypore port are either in form of bulk or break bulk. Major commodities handled at the port are machinery items, timber, tiles, POL products, spices and cement items.

In FY 14-15, out of the 1,52,000 Tonnes cargo handled at all nine Non-Major Ports in Kerala, about 1,30,000 Tonnes (81%) was handled at Kozhikode/Beypore Port. Cargo traffic at Kozhikode/Beypore Port has increased by 72% in FY 14-15 compared to previous years. Figure 4-14 shows volume of cargo handled at Beypore Port for last 5 years. Volume of Cargo handled in FY 17 (till 31st December 2016) is around 75,000 Tonnes. FY 15 has shown the highest growth in last 5 years. It is around 43% enhancement, i.e. 91,000 Tonnes to 130,000 Tonnes of Cargo. In FY 16, Beypore Port handled 5,000 Tonnes of cargo, which was less than cargo handled in FY 15.

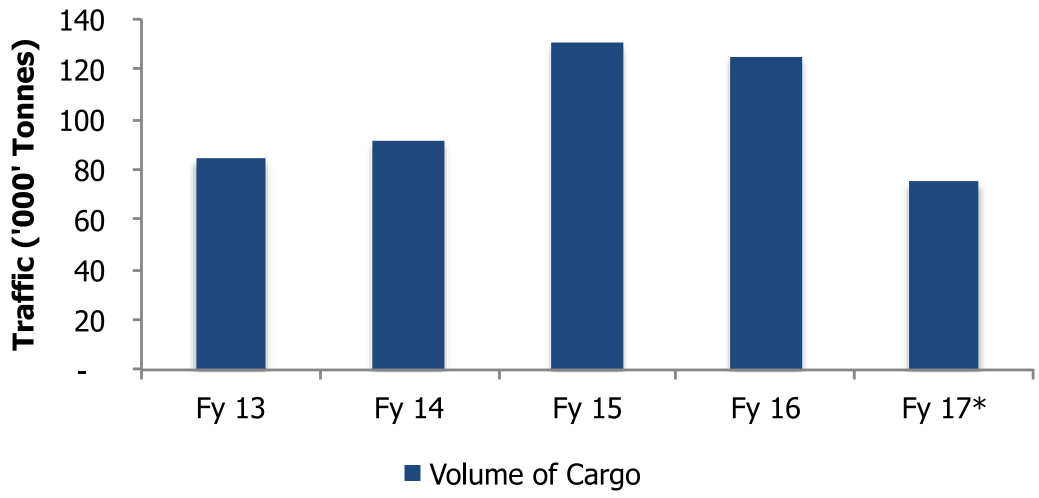


Figure 4-14 Volume of Cargo handled at Beypore Port

Source: Beypore Port

Note – FY 17* i.e '*' indicates April 2016 – December 2017.

c. Munambam Port

It is a major fishing harbour located in Ernakulam District at Ernakulam-Thrissur border. Munambam is an estuary where one branch of Periyar river after joining the Chalakudy and Pullut rivers meets the Arabian sea. Munambam fishing harbour is surrounded by the Arabian sea at the west, river Periyar at the east and mouth of the sea at the north end. Munambam harbour is about 40 km north of Kochin harbour, 85 km south of Ponnani Port and 5 km north of the famous Cherai beach. Kodungalloor Municipal Town is 22 km away from the site whereas Parur town is 12 km away on the southern bank. Munambam fishing harbour is a harbour with international amenities and is acclaimed as the clean and hygienic harbour.

d. Ponnani Port

Ponnani Fishery harbour is situated in Malappuram District, in the estuary of Bharathapuzha river. NH-66 passes near from the harbour. The harbour is going to be developed as a cargo port at Ponnani beach; however the fishing activity would continue to be carried out here.

Ponnani Port is going to be developed as a large cargo port. It could be used for handling export cargo. Ocean going vessels would be used for movement of these cargoes. Industries near Ponnani Port would not provide any opportunity to the inland waterway, as there exists only small scale industries, MSMEs, like food processing units in the region. Products of these industries are locally consumed and hence would not provide opportunity for the proposed waterway.

There are major challenges for development of IWT route from Ponnani Port to Kottapuram, as most of the part of stretch in West Coast Canal has width of around 6 mtr. and depth of less than 1 mtr. Also, the canal is surrounded by concrete structures, like houses etc.

e. Diversion from non-major Port

Beypore Port- Beypore Port handled 1.25 lakh tonnes of cargo in FY 15-16. As the proposed waterway in WCC runs parallel to coastal line; hence it is very unlikely that shipping cargoes that is handled at Beypore Port would get diverted to inland waterways.

Munambam Port- This port is a fishing harbour and the fish catch is consumed locally and a part of total fish catch is exported to other countries. As fish is a highly perishable item, it needs proper handling and adequate storage facilities in vessels to be moved in the proposed waterway. It is very unlikely that fish would provide any opportunity for the waterway in WCC.

f. Major Ports

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

g. Kochi Port Trust

The proposed waterway in West coast canal is connected to Kochi 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 Kochi Port for the cargo traffic. Kochi Port is the only major port handling cargo by the route of proposed inland waterways at West Coast Canal.

Kochi Port is an all-weather port, which handles all types of commodities including POL & non-POL products. **Table 4-12** shows the traffic handled at Kochi Port from FY 13 to FY 17. In FY 13, approximately 19.84 MMTPA of cargo has been handled at Kochi Port Trust. The traffic has grown from 19.8 MMTPA to 25 MMTPA from FY 13 to FY 17.

Table 4-12 Cargo handled at Kochi Port

In '000' Tonnes

Sl. No.	Commodity	FY 13	FY 14	FY 15	Fy 16	Fy 17
(Liquid Cargo, in '000' Tonnes)						
1	Crude oil	10,186	10,228	10,746	10,734	12,078
2	POL	3,709	4,093	3,271	3,041	3,715
3	LNG	0	115	395	481	430
	Edible Oil	4	4	4	12	9
4	Liquid Ammonia	21	68	163	80	41
5	Sulphuric Acid	8	35	10	15	15
6	Phosphoric Acid	143	154	82	133	200
7	Benzene	6	18	18	27	16
8	Methanol	112	77	80	87	88
9	Others	14	44	51	97	73
Total		**14,199**	**14,832**	**14,816**	**14,707**	**16,665**
(Bulk Cargo, in '000' Tonnes)						
Sl. No.	**Commodity**	**FY 13**	**FY 14**	**FY 15**	**FY 16**	**FY 17**
1	Muriate of Potash (MOP)	22	36	68	22	17
2	Urea	-	-	-	0	0
3	Sulphur	148	148	173	106	149
4	Rock Phosphate	183	123	204	125	85
5	Cement	311	604	703	824	816
6	Coal	28	-	98	88	44
	Wheat	0	0	0	95	174
7	River sand	-	32	163	0	0
8	Shredded Scrap	29	27	-	28	0
9	Zinc Concentrate	82	33	11	0	105
10	Others	112	89	67	256	77
Total		**915**	**1092**	**1487**	**1,544**	**1,467**
(Break Bulk, in '000' Tonnes)						
Sl. No.	**Commodity**	**FY 13**	**FY 14**	**FY 15**	**FY 16**	**FY 17**
1	Defense Cargo	2	0.8	1	0	1
2	Machinery	-	-	11	3	2
3	Iron & Steel	14	6	16	38	25
4	Timber Logs	95	156	11	5	0
5	Project Cargo	1	2	1	15	3
6	Others	12	13	6	1	4
Total		**124**	**177.8**	**46**	**62**	**35**
(Container Traffic)						

Sl. No.	Commodity	FY 13	FY 14	FY 15	Fy 16	Fy 17
1	TEU's	3,34,925	3,46,204	3,66,377	4,19,550	4,91,087
2	Weight ('000' Tonnes)	4,607	4,785	5,246	5,785	6,840
Total		**4,607**	**4,785**	**5,246**	**5,785**	**6,840**
Grand Total (Cargo Handled, '000' Tonnes)		**19,845**	**20,887**	**21,595**	**22,098**	**25,007**

Source: Kochi Port, Kerala

Below chart shows the total volume of commodity handled at Kochi Port in FY 2017. Liquid Bulk cargo of 16.6 mn T (67%) has highest trade at Kochi Port.

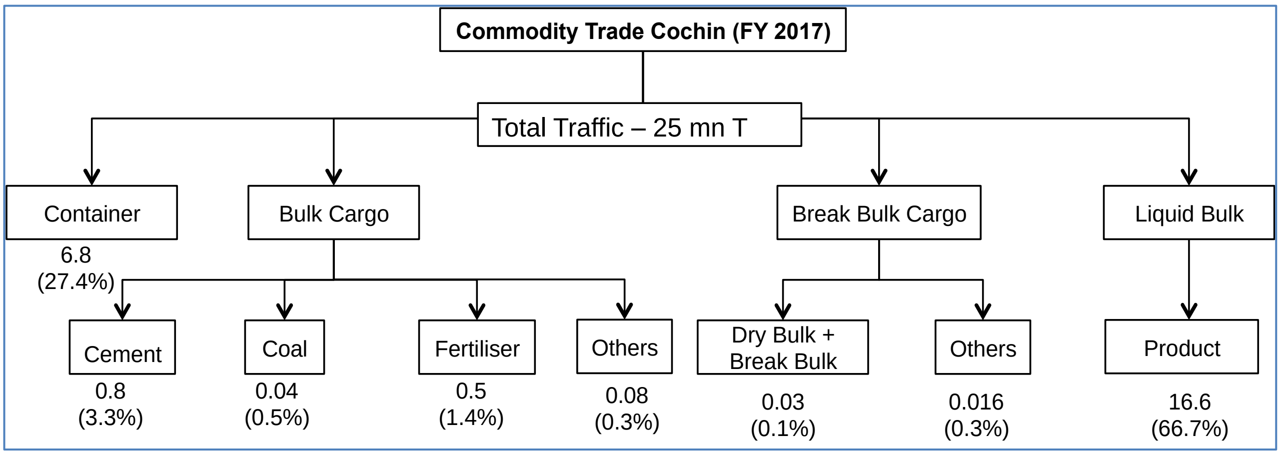


Figure 4-15 Kochi Port Traffic (FY 2015)

Source: Kochi Port, Kerala

h. Diversion from Kochi Port

Following commodities, which are handled at Kochi Port as mentioned in Table 4-12 could be potential commodities and could be transported through the proposed waterway.

Steel Scraps

Kochi Port currently handles approximately 27,000 Tonnes shredded scraps per annum. However, the volume differed in FY 14-15. but is likely to be continued in future. This scrap is used for manufacturing re-rolled steel shutters. It was also analysed that the same is transferred from Kochi Port to Plants in Kozhikode by Trucks. The same can be diverted to inland waterways for shipping till Kozhikode. The additional benefit of shipping via waterways will be the reduction in pilferage during transportation. The industries in Kozhikode are interested for waterways movement of scraps.

There is requirement to move around 0.37 mn tonnes of Steel scrap to the IWT waterway as per industry demand.

Sand

Sand mining is banned in Kerala. However, for draft, approximately 21 million cubic meters of sand is dredged from the Kochi port every year. A part of the dredged material is currently being dumped by the Port in the designated dumping grounds in the sea, 20 km from the shoreline and some of the sand is sent to Thrissur for brick construction. The same is currently being shipped through trucks. This sand could be moved to the construction site using the proposed waterway; however, there is no specific region where construction sites are concentrated. Construction sites where sand would be required are scattered in the region; hence it is difficult to move sand through waterways because unloading sand would be a challenging task. There could not be several terminals in the route of the canal.

a. ICD

i. ICD Kannur

An ICD has been setup at Kannur over an area of 4.84 Acres. There are two godowns with 1,825 tonnes capacity each and open container yard of 3,600 sq. meter. This ICD serves both Mangalore & Kochi Port. The major commodities that are stored in the region are food grains, industrial goods, FMCG consumer durables and rubber. ICD Kannur provides facilities such as transportation of loaded/empty containers to and from the gateway ports, stuffing/de-stuffing, customs examination and delivery.

ii. ICTT Kochi

There exists an Inland container transshipment terminal at Kochi. ICTT transports around 3 lakh TEU's of cargo annually to North Kerala. Most of the traffic to North Kerala comes to this terminal through roadways, using trucks. There exists no potential of diverting this traffic because as per meeting with the official of ICTT Kochi, it was observed that transportation of goods from ICTT is handled by dealers and dealers are not willing to divert the traffic to the waterway. According to them transportation through waterway is not commercially viable.

ICTT, Kochi handles around 3 lakh TEU of cargo annually. This cargo is destined to Northern part of the state. Cargo is distributed locally in northern part via roadways. ICTT does not have any information about the destination and industries, where this cargo is consumed. Industries along with roadway dealers handle the evacuation and transportation of this cargo from ICTT to the destination. These dealers as well as industries are not willing to shift this movement of cargo from roadways to IWT. Also, ICTT is not sure in which region cargo is consumed; hence shifting this cargo from ICTT to north side of state is not possible.

Table 4-13 Traffic Volume Count at Varapuzha, Kochi

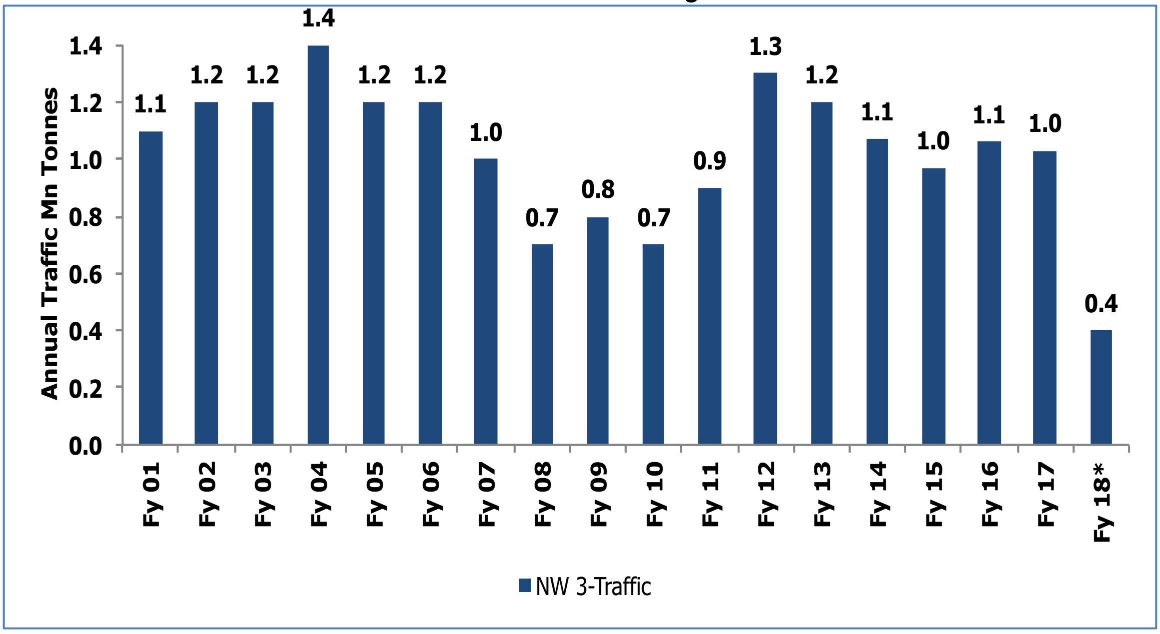
Period	From Kochi			To Kochi		
	Loaded Trucks	Empty Trucks	Containers	Loaded Trucks	Empty Trucks	Containers
Per Day (No.)	172	114	210	226	60	180
Annual (No.)	62,780	41,610	76,650	82,490	21,900	65,700

Source: Traffic Survey/Site Visit

b. Existing Waterways – NW 3

In NW 3, cargo terminals have been set up at almost nine locations with berthing facility for inland vessels, storage go-downs, cargo handling equipment. These locations are Kottapuram, Aluva Maradu (Kochi), Vaikkom, Cherthala (Thanneermukkom) Thrikkunnapuzha, Alappuzha, Kayamkulam (Ayiramthengu) and Kollam. In addition, for decongesting the Kochi city by providing an alternate transport route to International Container Transhipment Terminal (ICTT), a pair of Ro-Ro terminals at Willingdon Island and Bolghatty have been provided.

Table 4-14 Historic Traffic at Existing NW 3



Source: IWAI

Note - Reduction in cargo movement on NW-3 is due to termination of contract for Ro-Ro service between Willington Island and Bolgatty since 4th June 2017.

4.3 Commodity Composition

At present, the waterway is not being used for cargo movement. However, fishing activities are conducted in the waterway at some locations on West Coast Canal. Only Beypore port handles cargo among all three ports namely Munambam, Ponnani & Beypore port. Remaining two ports work as fishing harbor only, however Ponnani port is going to be developed as a non-major port for cargo handling.

4.4 Originating & Terminating commodities

The below table shows commodities handled at Kochi Port, which could be potential market for the proposed waterway in West Coast Canal. The table also presents reasoning for targeting these commodities and potential they would provide for the waterway.

Table 4-15 Commodities and potential for WCC

Cargo	Volume (mn T)	Potential for Proposed terminal	Origin	Destination	Reasoning
Steel Scrap	0.4	✓	Kochi Port	Beypore Port/ Kozhikode	Iron & Steel Industry requires raw materials like scraps for their

Cargo	Volume (mn T)	Potential for Proposed terminal	Origin	Destination	Reasoning
					finished products.
Sand	N.A	✗	Kochi Port	N.A	Destination is not fixed in case of Sand transportation as it is going to be used locally in construction industry only.

Source: Consultant's Analysis

4.5 Road Survey for Cargo Movement

Consultant has conducted road survey at Varapuzha on Panvel - Kochi National Highway (NH 66) to assess the roadways movement of cargo trucks towards Northern Kerala. Followings are the details outcome of road survey.

Table 4-16 Road Survey at NH - 66

Period	From Kochi		To Kochi	
	Loaded Trucks	Containers	Loaded Trucks	Containers
Per Day (No.)	172	210	226	180
Annual (No.)	62,780	76,650	82,490	65,700

Source: Consultant's Analysis

As per discussion with ICTT, it handles around 3 lakh TEU of cargo annually. This cargo is destined to Northern part of the state. Cargo is distributed locally in northern part via roadways. ICTT does not have any information about the destination and industries, where this cargo is consumed. Industries along with roadway dealers handle the evacuation and transportation of this cargo from ICTT to the destination. These dealers as well as industries are not willing to shift this movement of cargo from roadways to IWT. Steel plants in Kozhikode showed interest in shifting their roadways cargo to waterway for shredded steel. Also, ICTT is not sure in which region cargo is consumed; hence shifting this cargo from roadways to waterways for movement from ICTT to north side of state is not possible.

Shift of road traffic of NH 66 to NW 3 would be entirely dependent on government subsidy because at present as per the transporters, they are not facing any problem in the existing roadway movement. In case of containers, the share considered is minimum because containers commodities are time bound therefore it is very much unlike that containers could use waterways service for 169 Km. Although Lo-Lo service of extension of NW 3 to existing NW 3 is theoretically possible connecting Kollam to Kozhikode, however this is not recommended in light of limited cargo having insignificant revenue stream.

4.6 Passenger Traffic

Passenger Ferry Terminal

During site visit, it was observed that there are existing passenger ferries at Ponnani and Beypore to cross the channel. At Ponnani, there are 2 passenger terminals. They took almost 24 trips each (to & fro) per day with almost 25 passengers each time for one side and 4 vehicles each time. Similarly, at Beypore, ferry took almost 32 trips (to & fro) per day with almost 50 passengers each time for one side and 8 vehicles each time. Total operational days for ferry movement is around 300 days. Hence, 4,80,000 passengers in Beypore and 3,60,000 passengers in Ponnani use ferry terminal for transportation annually.

Table 4-17 Existing Passenger terminals in the catchment area

Passenger Terminal	Trips	Passenger/ Trip	Annual Passenger	Vehicle/ Trip	Annual Vehicle Traffic
Ponnani (2 different Terminals)	24 (each)	25	3,60,000	4	57,600
Beypore	32	50	4,80,000	8	76,800

Source: Consultant's Site Visit


Picture 1


Picture 2


Picture 3

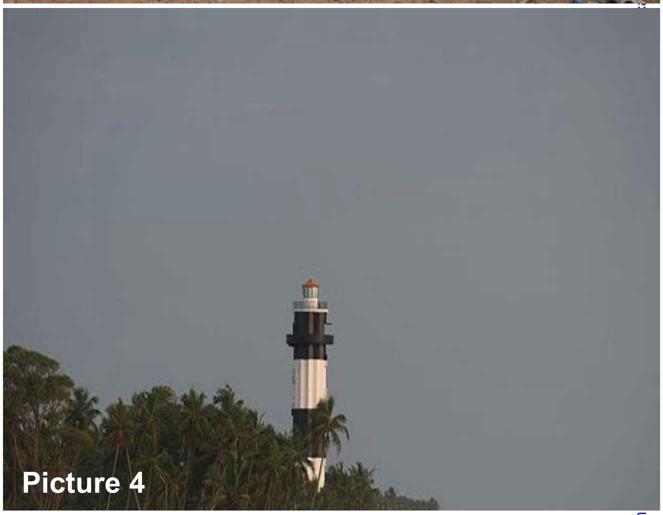

Picture 4

Figure 4-16 Ponnani Passenger Jetty

Source : Consultant's Site Visit

Figure 4-17 Beypore Passenger jetty

Source : Consultant's Site Visit

Also, three existing ferry services is considered where a dredging support is being proposed, which are two ferry routes at Beypore and one ferry route at Ponnani.

Table 4-18 Existing Ferry Routes at Beypore & Ponnani

Sl No.	Location and Existing Ferry Routes	Coordinates	Remarks
1	**BEYPORE** (Chaliyan- Kozikode road to Beypore) Chainage-148.90 Kms	Left Bank Lat:11° 09' 45.11"N & Long: 75° 48' 30.33"E To Right bank Lat:11° 10' 04.96"N & Long: 75° 48' 30.38"E	Ferry route identified at CHALIYAN Left bank of river to BEYPORE right bank of river. There already exists a ferry route which is used for river crossing by residents having a ferry length of about 750.0m.
2	**BEYPORE** (Chaliyan- Kozikode road to Anangadi) Chainage-149.20 Kms	Left Bank Lat:11° 09' 45.11"N & Long:75° 48' 30.33"E To Right bank Lat:11° 09' 55.69"N & Long: 75° 48' 23.57"E	Ferry route identified at CHALIYAN Left bank of river to ANANGADI right bank of river. There already exists a ferry route which is used for river crossing by residents having a ferry length of about 500.0m
3	**PONNANI** (Thottaungal juma masid road to Purathur Pallikadam viewpoint) Chainage-89.40 Kms	Left Bank Lat: 10° 47' 02.87"N & Long: 75° 55' 16.97"E To Right bank Lat: 10° 47' 39.8"N & Long 75° 55' 01.74"E	Ferry route identified at KAILASAM KALAM Left bank of river to PURATHUR (Purathur Pallikadam viewpoint) right bank of river. There already exists a ferry route which is used for river crossing by residents having a ferry length of about 1250.0m.

Population of the talukas in the catchment area of WCC would also affect passenger traffic as these local people would use ferry to cross the river and hence would constitute passenger traffic. Keeping in view the high population, potential exists for the development of ferry services along the waterway. It is evident from the table that the taluka with highest population in the catchment area is Kozhikode, followed by Thrissur.

4.7 Tourism Traffic

Kerala is one of the states of India, which attract a large number of tourists every year, both domestic and foreign. Following table shows overall tourist traffic of Kerala. The table depicts that both domestic and foreign tourist flow has increased in last few years. There is continuous growth in tourist traffic of Kerala. Every year, domestic tourists dominate the tourism traffic of the state.

Table 4-19 Historic Tourists Traffic in Kerala

Year	Domestic Tourists (Lakh)	Foreign Tourist (Lakh)	Total Tourist (Lakh)
FY 04	59.7	3.5	63.2
FY 05	59.5	3.5	62.9
FY 06	62.7	4.3	67.0
FY 07	66.4	5.2	71.6
FY 08	75.9	6.0	81.9
FY 09	79.1	5.6	84.7
FY 10	86.0	6.6	92.5
FY 11	93.8	7.3	101.1
FY 12	100.8	7.9	108.7
FY 13	108.6	8.6	117.2
FY 14	117.0	9.2	126.2
FY 15	124.7	9.8	134.4

Source: Kerala Tourism

However, there is no scope to link them with NW3 waterways. The scope for tourism for NW3 has been explored from 2 perspective. First one is if there is any possibility for development of NW3 that could be used as transportation mode in connecting the tourist locations Second one is that if NW3 be used as tourism activities. Tourist locations are situated either in Kozhikode or Kochi (both ends of waterways spread over 177 kms). And the tourist sites are not linked to waterways except for beaches.

There are several potential tourist spots in the catchment of WCC. The tourist places near extension of NW 3 consist of beaches, temples, wildlife sanctuaries, zoo, museum, Church and some other heritage sites. In Kozhikode district, there are Forest & Animal Reserves & Waterfalls, beaches like Kozhikode Beach, Beypore Beach & Varrakkal Beach, various temples, gardens and museum. Malappuram district also boasts of many beautiful beaches. Thrissur district attracts tourists with its many temples, churches, museum & Shakthan Thampuran Palace. It is not possible to connect all these tourism locations through waterways. Thus, consultant has considered all the tourism sites in the hinterland of extension of NW 3 but there is no opportunity for development of tourism terminal in the national waterway. The below table shows the tourist sites located in the districts that fall in the hinterland of the proposed waterway.

Table 4-20 Tourism Sites in Proposed Region

District	Tourist Spots	Distance from WCC (km)
Kozhikode	Mananchira	10
	Kozhikode Beach	2
	Beypore Beach	On the river
	Regional Science Centre	5
	Mananchira Square	3
	Thalikkunu Shiva Temple	4
	Azhakodi Devi Temple	5
	Mishkal Mosque	3
	Sarovaram Bio Park	7
	Krishna Menon Museum	8
	Malabar Botanical Garden	7
	Lions Park	5
	Varrakkal Beach	8
	Thiruvachira Sree Krishna Temple	3
	Kamburam Beach	7
Malappuram	Tirur Puzha Backwaters	On the river
	Biyam Kayal Backwaters	23
	Kadalundipuzha	3
	Vallikunnu Beach	4
	Ponnani Beaches	On the river
	Valanchery	23
	Kuttippuram Parks	20
	Kondotty	21
	Tanur Beach	12
	Parappanangadi Beach	2
	Marancherry	4
	Kottakunnu Fort	24
	Padinharekara Beach	On the river
	Kadampuzha Temple	20
Thrissur	Vadakkunnathan Temple	18
	Shakthan Thampuran Palace	20
	Thrissur Zoo	19
	St. Thomas Church	21

District	Tourist Spots	Distance from WCC (km)
	Thiruvambadi Sri Krishna Temple	20
	Basilica of Our Lady of Dolours	19
	Viyyur Jail Park	23
	Poonkunnam Shiva Temple	23
	Mural Art Museum	21
	Vaidyaratnam Ayurveda Museum	20

Table 4-21 and **Table 4-22** show the tourists traffic in the districts of Thrissur, Malappuram & Kozhikode. It is observed that approximately 38 lakh tourists visited the districts of Thrissur, Malappuram & Kozhikode in 2014.

Around 40,317 foreign tourists along with 37.6 lakh domestic tourists visited these districts. Large number of tourists visiting these districts would provide good opportunity for tourism traffic in the waterway.

Table 4-21 Statistics of International Tourist Traffic in the catchment area

District	International Tourist Traffic								
	FY 06	FY 07	FY 08	FY 09	FY 10	FY 11	FY 12	FY 13	FY 14
Thrissur	4,142	4,645	3,398	3,452	4,326	5,011	5,946	6,459	7,391
Malappuram	7,109	9,766	10,166	13,499	16,915	18,394	19,417	20,569	21,613
Kozhikode	11,154	10,020	9,966	7,513	9,017	9,892	10,476	10,489	11,313
Total	22,405	24,431	23,530	24,464	30,258	33,297	35,839	37,517	40,317

Source: Kerala Tourism Statistics, 2014 (Govt. of Kerala)

Table 4-22 Statistics of Domestic Tourist Traffic in the catchment area

District	Domestic Tourist Traffic								
	FY 06	FY 07	FY 08	FY 09	FY 10	FY 11	FY 12	FY 13	FY 14
Thrissur	13,98,014	15,46,576	16,71,174	17,33,862	18,74,211	20,62,032	22,13,893	23,66,389	25,45,376
Malappuram	3,03,844	3,13,200	3,23,448	3,19,635	3,47,311	3,69,773	3,88,323	4,19,884	4,49,420
Kozhikode	5,50,694	5,70,832	5,95,985	5,74,896	6,12,316	6,50,676	6,86,395	7,28,041	7,69,425
Total	22,52,552	24,30,608	25,90,607	26,28,393	28,33,838	30,82,481	32,88,611	35,14,314	37,64,221

Source: Kerala Tourism Statistics, 2014 (Govt. of Kerala)

4.8 Growth Trend

4.8.1 Cargo Growth for WCC

The consultant has suggested to develop Beypore port as existing non-major ports in the catchment area. Once this port is developed, it would eventually boost Cargo traffic in the proposed waterway. Steel industries at Kozhikode transport 0.4 mn tonnes cargo annually from Kochi port to their plant at Kozhikode. Scrap steel cargo of these industries could be shifted to the waterway in West Coast canal. As there is no plan for further expansion of these steel-rolling plants, hence, traffic would remain same every year. Thus consultant has considered zero growth rates for future projection.

4.8.2 Comparison of FSR & DPR study

The below table shows an analysis of the commodities, which are considered as potential traffic for the proposed waterway in FSR and also considered in DPR. There is suitable reasoning for those commodities, which are not considered in DPR. The table also shows potential of tourist and passenger traffic along with suitable reasoning.

Commodities considered in previous study that is Feasibility Study Report are also been analysed. The commodities, which are considered in FSR and are also considered 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 provide no opportunity for West Coast Canal, they are presented below with proper reasoning. Potential of all commodities with reasoning is explained in the below table.

Table 4-23 Analysis of FSR study

Commodity	Source	Considered in DPR	Potential	Reasoning
Coal	Kochi Port	✓	✗	There is no thermal power plant near catchment area and steel plants do not use coal as per interaction with industry.
Steel Scraps	Kochi Port	✓	✓	It is used by Steel casting plants. Around 0.4 mn tonnes steel scrap is required for these plants.
Cement Clinker	Cement Industries at Kochi & Kochi Port	✓	✗	Industries are not ready to use waterways for transportation. Water transport is not possible because the distribution area (destination) is scattered in a region and not located in a particular area. It is not possible to develop terminals in various places in that region for distribution. Roadway is the preferred mode of transportation for these companies.
Cement	Cement Industries at Kochi & Kochi Port	✓	✗	Cement Companies at Kozhikode are not willing to use waterways. Maximum dealers are located at Kozhikode. JSW Cement has a manufacturing unit in neighboring state, Andhra Pradesh. Road route is preferred by these industries. Ambuja Cement, Ultra tech cement & Zuari are also not willing to use the waterway.
Sand	Catchment of WCC	✓	✗	Sand mining is illegal and there is ban on sand mining. Also dredged sand from Kochi Port could not be diverted to waterway because construction sites, which are the major consumers of dredged sand are scattered in the region. Unloading sand through waterway would be difficult.
Minerals	Extracted from mines	✓	✗	Some mineral reserves are located in the catchment area, but they are not fully operational till now.
Food Grains	Produced in catchment area	✓	✗	Locally consumed and distribution is done via roadways.
Fertilizer	Allotted in catchment area, used in agriculture	✓	✗	Maximum Fertiliser dealers are ready to shift to waterways as roadway is preferred as time saving mode. Roadways take around 5-6 hrs. to reach the destination, whereas waterway would take longer time.
Fisheries	Caught in WCC catchment area	✓	✗	Less Volume, locally consumed; hence no opportunity for the waterway.
Passenger	Population of the catchment area	✓	✓	Approximately 8.4 Lac Passenger use the existing terminals (Ponnani, Beypore) to cross the waterway.
Tourism	Tourist Spots	✓	✗	There is no opportunity for inland waterways development for Tourism purpose.

Source: Consultant’s Analysis

The below table shows potential for the river from Industrial and other cargo, fish products, passenger and tourism.

Table 4-24 Overall attractiveness of West Coast Canal

Traffic	Attractiveness	Reasoning
Cargo (Industrial & Commodities)	Steel Scraps	Steel Casting Plant in Kozhikode has already talked to Beypore Port for handling its shredded scraps, which is currently handled at Kochi Port. From Kochi Port, it is transported through roadways to the Kozhikode plant, covering distance of 177 km. After the development of Beypore Port, this plant intends that its cargo would be transported from Kochi Port to Beypore Port and further from Beypore Port, roadway would be used for the last mile delivery. Peekay Rolling's plant is located at a distance of 7.8 km from Beypore Port; hence it would be convenient and cost effective for the company to transport its cargo from Beypore Port to the plant by roadways.
Passenger	Ponnani & Beypore Ferry Terminal	Ponnani & Beypore passenger ro-ro ferry terminals are already developed. These are developed to cross the waterway.

Source: Consultant's Analysis

4.9 Forecasting & Potential IWT Assumption

Assumption

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

- ✓ Peekay Rolling Mills Ltd., which has showed willingness to use Beypore Port after its development for the transportation of its raw material, i.e. shredded steel scrap. This cargo is handled at Kochi Port at present. The consultant has assumed that from Kochi Port, cargo would be further moved to Beypore Port using IWT. This cargo traffic movement is considered for traffic projection of WCC.
- ✓ The future projection is based on interaction with prospective stakeholder, Peekay Rolling Mills Ltd.
- ✓ Consultant has assumed zero growth rate during cargo projection. As industry is not having any expansion plan.

- ✓ Cargo traffic is proposed based on the assumption that IWAI would widen the identified stretch of the canal, meeting minimum class requirement of vessels. At present, West Coast Canal has very less width for a very long stretch of the river.
- ✓ The consultant assumes that IWAI would undertake dredging and maintain depth of the river round the year for seamless movement of vessels.
- ✓ Major threat for IWT movement on WCC is sea route, which is running parallel to WCC. This coastal route has adequate depth and shippers would prefer the coastal route for bringing their cargo to Beypore & Ponnani Port, as it is easier and more convenient. This coastal route would pose serious competition to WCC.
- ✓ Based on the inputs of the authorities of Ponnani Port, it is evident that Ponnani Port would be developed as a large port and would cater the hinterland of Southern Karnataka, Western Tamil Nadu & Kerala. It would mostly handle large containers and bulk cargo. It is very likely that after the development, traffic from major ports, like Chennai, Tuticorin, Kochi and New Mangalore Port would be diverted to Ponnani Port.

4.9.1 Projection of Cargo Traffic

4.9.1.1 TERMINAL AT BEYPORE

IWT terminal at Beypore would attract steel scraps moved from Cochin port or nearby areas to Beypore Port by roadways to the Industry. Traffic moving from Cochin Port would utilize the extended west coast canal i.e NW3 to reach till final destination, Beypore Port. The Industry would require 0.4 mn T of steel scraps annually for its plants.

Table 4-25 Traffic Projection at Proposed Terminal at Beypore Port

Commodity	Fy 16	Fy 20	Fy 25	Fy 30	Fy 35	Fy 40
Steel Scraps (Mn tonnes)	0.4	0.4	0.4	0.4	0.4	0.4

Source: Consultant's Analysis

4.10 Terminal wise IWT Traffic analysis

4.10.1 Terminal at Beypore Port

Figure 4-18 Proposed Cargo Terminal Near Beypore Port

4.10.2 Logistic Cost Comparison for Lo-Lo

At present hinterland industries use roadway to reach Cochin Port from Kozhikode and vice versa. Roadway distance between Kozhikode and Cochin Port is 177 km by NH 66. Time required to reach port is 7 hr. 5 minutes. Unless and until there is very strong and a practical driving factors, industries would not shift to waterways. Lower integrated logistics cost of waterways, as compared to road logistics cost, can act as the most ideal distinguishing criterion in this regard. Based on this comparison only, viability of the proposed Lo-Lo Terminal can be ascertained.

The following figure 4-19 illustrates time and distance difference between the current roadway movement and the proposed route using WCC for transportation of steel scraps. It is assumed that speed of vessel would be 20 kmph in waterway while calculating time & distance for multimodal facility. Speed of truck for roadways is expected to be 25 kmph.

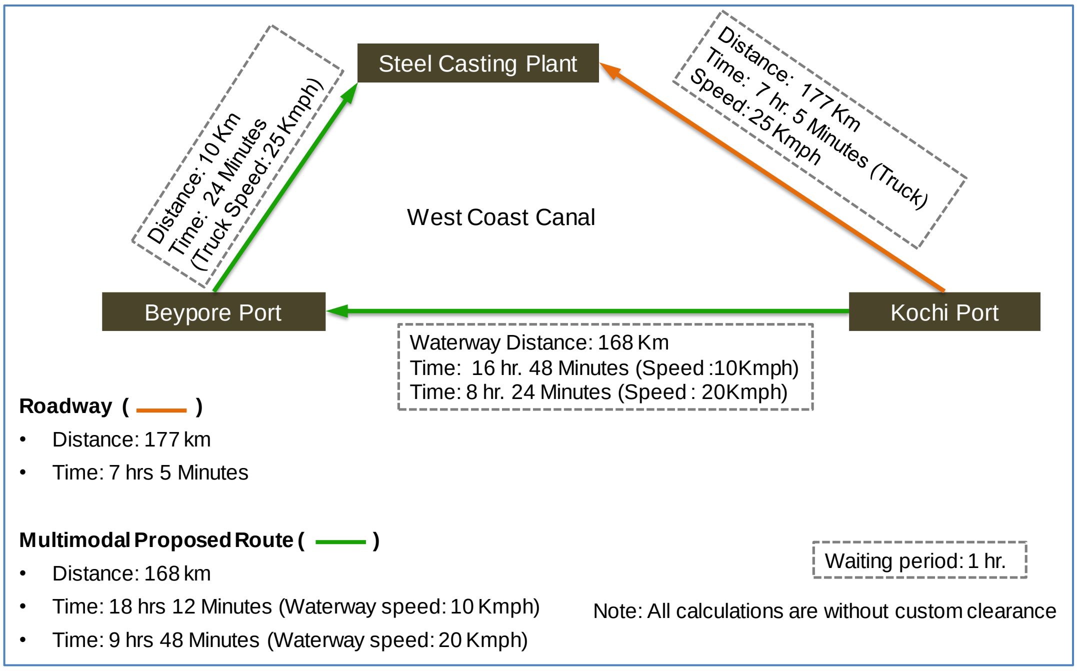


Figure 4-18 Time & Distance Comparison

It is clear from above chart representation that time required to cover the distance to reach Cochin Port is more in case of multimodal route of waterway and road. Therefore, time and cost involved in multimodal transportation is also more compared to roadway. Proposed IWT route also involves multiple handling of trucks. This adds to the total logistic cost involved in transportation. An elaboration on the impact on overall logistics cost difference is depicted in the logistics cost comparison chart between the two modes in the following chart. The table shows logistics comparison in two different cases under Lo-Lo cost dynamics. In Case I, vessel with a cumulative engine power of 839 kW and 20 kmph speed has been considered. In Case II, vessel with only one engine of 350 kW power and loaded speed of 10 kmph has been taken for cost comparison.

Lo-Lo/Trade Cost Dynamics

Origin	Destination
Cochin Port	Beypore Port

Lo-Lo Cost Dynamics (168 km.)

Components	Unit	Case I	Case II
Engine	kW	839	350
Engine fuel requirement	l/hr	222	102
Per Ton Tariff	INR/Ton	684	654
Port-related charges	INR/Ton	8	8
Total Cost	**INR/Ton**	**692**	**662**

Truck Cost Dynamics (177 km.)

Components	Unit	Cost
Fuel	INR	3,036
Toll Charges	INR	300
Truck Finance Cost	INR/Day	1,850
Driver/Crew	INR/Day	1,000
Total Cost	**INR/Truck**	**6,186**
Total Cost	**INR/Ton**	**364**

Figure 4-19 Logistics Cost Comparison

Two scenarios have been considered to arrive at logistic cost for a possible Lo-Lo service on the proposed IWT route. In case of Lo-Lo logistics cost analysis, Lo-Lo Tariff assumes costs related to the multi-modal logistics. This includes nominal fairway charges, charges associated with vessel chartering and 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 Lo-Lo 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. in order to increase the appeal of any Lo-Lo service on extension of NW 3.

Costs involved in both the Lo-Lo cases are on the higher side when compared to roadways. This cost difference favors the roadway, as the difference between the two discussed transportation modes is at least over INR 298 per Tonne. In case of just Lo-Lo cost comparison, Case II is slightly cheaper than Case I. The cost involved in both the cases is relatively on higher side as compared to roadways. There are various costs associated with multi-modal transportation, like cost of multiple handling (loading, unloading whenever there is a change in mode of transportation) etc. which are not applied to roadways transportation. Lo-Lo terminal is not recommended near Beypore Port as well as near Ponnani location.

4.10.3 Lo-Lo terminal with Subsidy

It is perfectly visible from the logistics cost comparison that both the cases of waterway movement will be costlier than existing mode of transportation using roadways by a significant margin. As per Case I (higher engine power 839 KW), the logistics cost difference for roadway and waterway is INR 328/Ton. Cost of transporting per Tonne on the waterway with the said engine configuration would be almost twice as expensive as roadway. In Case II (Lower engine power 350 KW), this cost difference is narrower with INR 298/Ton.

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.

Table 4-26 Terminal & commodity wise projections

Name of the waterway: West Coast Canal														
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**
Proposed Terminal Opportunity for IWAI														
1	Steel Scrap	Break Bulk	Kochi Port	Kochi Port	Beypore Port	Beypore Port		Mn Tonnes	0.4	0.4	0.4	0.4	0.4	0.4

Source: Consultant's Analysis

4.11 Summary of Interviews

Sl. No.	Name of Port/Industries	Designation
1	Kochi Port	Deputy Traffic Manager / Sr. Asst. Traffic Manager
2	Kerala Shipping & Inland Navigation Corporation	Company Secretary
3	Ponnani Port	Executive Engineer
4	Beypore Port	Sr. Port Conservator
5	Spice Board	Director
6	Peekay Steel Casting	General Manager / Sales Manager
7	Peekay Rolling Mills	General Manager / Sales Manager
8	Minar Ispat Ltd	Managing Director
9	SAIL-SCL Kerala Ltd	Deputy Material Manager
10	Uniroyal	CEO
11	Parisson Agro	Senior Executive
12	Mebran Spices Pvt Ltd	Director
13	District Industrial Center - Kozhikode	General Manager
14	District Industrial Center - Thrissur	General Manager
15	Peejay Agro Foods	Director
16	JSW Cement	Marketing Manager

Sl. No.	Name of Port/Industries	Designation
17	Veekesy Rubber	Company Secretary
18	Swaraj Paint Industries	Marketing Manager
19	Rollring Industry	General Manager
20	Vijayprakash Industries	Company Secretary
21	South Indian Industries	Manager
22	Orchid Wooden Industries	Director

Name of Company: Kochi Port

Contact Person: Mr. Girish Thomas

Designation: Deputy Traffic Manager

Following are the stakeholders around NW-3 (Kollam to Kottapuram)

- ✓ Kerala Water Transport Authority
- ✓ Kerala Shipping Inland Navigation Corporation
- ✓ TCC
- ✓ FACT
- ✓ Binnani Zinc Ltd.
- ✓ Kochi Mineral Rutile Ltd
- ✓ Malabar Cement Limited
- ✓ Kottayam Port & Container Terminal

There exists Ferry Service from Kochi to Ernakulam as well as Lakshadweep.

TCC– Cargo movement is not fully utilised. It is transporting industrial salt. This waterway NW-3 is under utilised due to various reasons.

- ✓ Industries are nearer to Kochi Port; hence they do not have any interest to use NW-3.
- ✓ Production of some industries has reduced over the years due to various reasons. These products would not provide opportunity for the waterway as their volume is less.

FACT – Adequate quantity of chemicals and fertilizer imports of FACT (raw materials) were being transported through the Udyogamandal canal by barges. The company was importing cargo from various locations via barges from Kochi ports to FACT plant in Udyogmandal. Rock phosphate, Sulphuric Acid, Phosphoric Acid & Liquid Ammonia are the major commodities transported.

Bennani Zinc Ltd. – It transported its cargo from Kochi port to its plant via barges. It has stopped cargo movement since 2016.

Kochi Mineral Rutile Ltd.– It owned jetty but have some issues with their barges. There is also news of presence of rocks on the riverbed near its jetty.

Malabar Cement Ltd. – It has a grinding unit, which is located 65 km away from Kochi. IWAI has put a jetty but it has not started operation yet. This jetty would be used to transport clinker, Fly ash & Coke.

Name of Company: Kochi Port

Contact Person: Mr. D Anil Kumar

Designation: Sr. Asst. Traffic Manager

Coal handling at Kochi Port has reduced to 44,000 T. Coal from Kochi 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: Kerala State Inland Navigation Corporation

Contact Person: Mr. Raju Designation: Company Secretary

Important Points of Discussion

- ✓ Even existing NW-3 is not utilised by the industries
- ✓ Widening & Deepening of proposed canal is very necessary. But the stretch for NW 3 extension is around 169 Km.
- ✓ Industries are mainly in Kozhikode and they transport their raw materials or finished products through roadways only.
- ✓ Tourism option can be explored
- ✓ Stakeholders of NW 3
    - Kerala Minerals Metals
    - India Rare Earth
    - Kochi Refinery
    - FACT
    - Travancore Kochi Chemicals
    - Bennani Zinc
    - Philips Carbon

None of the stakeholder industries are utilizing the waterways to maximum. Bennani Zinc has also stopped moving cargo for last 1 year

Name of Company: Ponnani Port

Contact Person: Kunhimammu Paravath

Designation: - Executive Engineer

Ponnani Port is widely used as fishing harbour. Malabar Port Private Limited has been appointed as developer for Ponnani Port. Ponnani Port is planning for expansion. There is no large-scale industries near Ponnani port. Hence, there is no inland cargo opportunity for WCC. The West Coast Canal passes Ponnani Port via Canoli Canal.

Therefore, development of national waterways needs the development of Canoli Canal.

The Canoli Canal is manmade water body passing through Kozhikode City and connects the Korapuzha Estuary in the north and the Estuary River in the south. The canal is subjected to tidal action on both sides. Due to these tidal action & surrounding people, the canal is totally polluted.

Following are the main issues raised by Ponnani Port.

- ✓ Canoli Canal has depth of even 1m at some points.
- ✓ The width of Canoli Canal is around 8-10m.
- ✓ Bridges have no vertical clearance.
- ✓ There is no industries near Ponnani Ports which would create opportunity for cargo movement in WCC.
- ✓ Local people are dumping wastes in Canoli canal.
- ✓ On the both sides of Canal, there are residential buildings (concrete construction). Thus, there is no scope for widening of the canal.

Name of Company: Beypore Port

Contact Person: Mr. Girish Kumar & Captain Aswani Prathap K

Designation: Sr. Port Conservator & Port Officer

Total length of Navigation Channel is around 2640m. Present draft is around 5m and length of wharf is 310m.

At Present, Beypore Port has one crane of 5 tonnes and four cranes of 3 tonnes. There are 4 mobile cranes, one for 12 Tonne and other for 3 Tonne and two cranes for 20 Tonne each. There is a forklift truck facility for 20 Tonne Trucks. There are two godowns of 600 Tonnes capacity. The area for one godown is around 300 sq.m. Beypore is connected to roadways transport. Two small tugs are also present at Beypore Port.

Currently they are looking for a capital dredging at Beypore port to attain 6 meter draft, which has been given high priority. They are also planning for expanding berthing facilities to another 200 Meters on Western side and 200 meters on Eastern side of existing wharfs. They are also looking for some portable cranes to cater the demand at peak operational time

It could be more appreciable if you are able to mobilize any central governments funds towards our port development mission.

Name of Company: Beypore Port

Contact Person: Mr. Jaydeep

Designation: Assistant Executive Engineer

Following are the main points of discussion

- Timber is the main product of Kozhikode.
- Widening & Deepening of West Coast Canal
- At some location width of proposed canal is even 5-6m.
- It can also be developed for tourism purpose, as there is a bird sanctuary at Kadalundi.
- Fisheries industry can be developed.
- The waterway from Ponnani to Tanur is straight and has adequate width.
- Kadalundi is famous as bird sanctuary. Therefore, Beypore to Kadalundi can be developed as tourism ferry.
- The waterways from Ponnani to Ernakullam should be widened.
- Many bridges are in the route of Proposed inland waterways without proper vertical clearance.
- Between Cheeran Kadappuram & Ekadappuram, there are some obstacles in the waterways.
- Ponnani is coming with some expansion of Ponnani port.

Name of Company: Spice Board

Designation: Director

- Spice Board clearly denied using waterway for movement of spices. The distribution of spices is very scattered and less in quantity too. Thus, Spices wouldn't create any opportunity for WCC.

Name of Company: Peekay Rolling Mills Pvt. Ltd/ Peekay Steels, Nallalam

Contact Person: Prashant Kumar/ Mr. K P Nazar

Designation: Export Manager

Manufacturers and exporters of steel castings, gate valve components, plug valve components, control and special valve components and other engineering components. Major suppliers of steel castings to India's Navratna companies and major original equipment manufacturer in the oil, gas, power, transportation, earth moving and engineering sectors.

Mode of transport

- ✓ Raw materials are mainly transported from Kochi to Plant via road route. Major cities which are involved in raw materials transportation to plant are Bellary, Calcutta, Chattisgarh, Mumbai & Chennai.
- ✓ Finished products are exported to USA, UK, Germany and Middle East.

Volume of raw materials imported from above places are around 60,000 Tonnes to 72,000 Tonnes annually and that of finished product is 12,000 Tonnes annually.

Handling Price is around 600 INR/Tonne.

Following are the major suggestions:

- ✓ Development of terminal at Beypore port by providing necessary facilities for cargo movement.
- ✓ Chaliyar River is 3Km away from Peekay Plant. This point can be considered for location.
- ✓ Ready to use inland waterways route of NW -3/ West Coast Canal but not sure of its development as width & depth of proposed canal is very less for most of the stretch.
- ✓ They are willing to handle 0.37 Mn Tonnes of shredded steel at Beypore port via coastal or inland movement from Kochi Port with less than roadway transportation cost than waterway transportation cost.

Name of Company: Minar Ispat Pvt Ltd, Kuttikatoor, Kozhikode

Contact Person: Mr. Zulfiker

Designation: General Manager/Managing Director

Minar Ispat is a steel manufacturing Industry and has license for manufacturing Temcore TMT steel. They are not using coal for any purpose. It is getting scraps from Kochi Port. At present, total volume of cargo transported by roadways is around 12,000 Tonnes.

Mode of Transport

- ✓ It is around 19km from beypore port.
- ✓ Steel is imported for Minar Ispat Pvt. Ltd.
- ✓ It has production of TMT bars 8mm, 12mm, 16mm, 20mm and 25mm sizes

It would become probable customer for proposed inland waterways as the waterway movement begins.

Name of Company: SAIL – SCL Kerala Ltd., Nallalam

Contact Person : Ms. Meera R Nair

Designation: Dy. Material Manager

This unit of SAIL–SCL is 50% owned by central & 50 % by state government. It is only converting steel plant. The capacity of plant is around 66,000T annually. The movement of material is performed by SAIL from Kochi to Converting Unit. All the handling cost is taken by Steel Authority of India.

Name of Company: Uniroyal Marine Exporters, Vengalam

Contact Person: Mr. Thomas Pkoshy

Designation: CEO

Uniroyal is a seafood exporter company In Kozhikode.

Mode of Transport

- ✓ At First collection of empty containers from Kochi Port is carried out. Then, it is filled under custom supervision and transported to Kochi again.
- ✓ Seafood is transported from Kozhikode to Kochi via road route
- ✓ Special Types of Refrigerated trucks are used for transport.

Annual Volume of finished seafood is around 1800 Tonnes. The transportation cost from Kozhikode to Kochi is approximately 25,500 INR/ 20 Tonnes.

Suggestion for Development of Proposed Extension of NW-3

- ✓ Terminal point should be nearer to our plant.

- ✓ Adequate Facilities like cranes, barges should be mobilised.
- ✓ Interested to shift their cargo movement via inland waterways.

Name of Company: Parisson Agro Group of Companies

Contact Person: Mr. P K Mohammed Ali

Designation: Senior Executive

Parisson Agro mainly uses palm oil, wheat etc. as raw materials.

Mode of Transport

- ✓ Raw materials are transported from Kochi Port or Managalore Port via road route.
- ✓ Mainly wheat is imported from Australia to Kochi Port whereas Palm Oil from Malaysia to Managalore Port. After that road route is followed till plant.
- ✓ Wheat is also imported from Gujrat, U.P, M.P & Rajasthan also.

Suggestions for Development of NW -3

- ✓ Import of Palm Oil is banned in Kerala. Therefore, they use Mangalore Port for importing Palm Oils from Malaysia
- ✓ They have 1 barge at Beypore but not used due to lack of facility
- ✓ Terminal should be developed with adequate facilities.

Name of Company: Mebran Spices Pvt. Ltd.

Designation: Director

Mebran Spices Pvt. Ltd. is 100% export-oriented manufacturing unit of spices products to various countries. It exports Spices to western and Middle East countries. Therefore, it also denies using waterways for transportation of spices

Name of Company: District Industries Centre (DIC), Kozhikode

Designation: General Manager

DIC, Kozhikode discussed in detail the type of MSME in the district and their preferred existing mode of transportation. DIC clearly mention that it doesn't play any role in transportation of raw materials or finished product.

Mode of transportation is entirely dependent on the local dealer. Therefore, discussion with DIC – Thrissur helps in understanding the industrial profile of the district.

Name of Company: District Industries Centre (DIC), Thrissur

Designation: General Manager

DIC, Thrissur provides all the services and support facilities to the entrepreneur for setting up Micro, Small and Medium Enterprises. It acts as a facilitator for developing industrial hub in the District. DIC, Thrissur shared the list of MSME registered in Thrissur district. It discussed in detail the type of MSME in the district and their preferred existing mode of transportation. DIC doesn't play any role in transportation of raw materials or finished product. Therefore, discussion with DIC – Thrissur helps in understanding the industrial profile of the district.

Name of Company: Peejay Agro Foods Pvt. Ltd, Thrissur

Contact Person: Mr. C Padmakumar

Designation: Director

- ✓ It is basically into Pickles, Jams making company.
- ✓ Raw Materials are obtained locally. The capacity of the plant is around 6000 Tonnes per day. Vegetable items, lime, mango are the major items used as raw materials. Finished product is consumed in Kerala. They too have one rice mill with capacity of around 2 Tonnes per day.
- ✓ Peejay Agro Foods is not interested in using inland waterways as raw materials are from locals and finished products to different dealers in Kerala itself.
- ✓ No scope for waterway transportation

Name of Company: JSW Cement, Kozhikode

Designation: Marketing Manager

JSW Cement, Kozhikode is the cement dealer who procures cement from JSW, Karnataka manufacturing plant. Thus, transportation of cement from Karnataka Manufacturing unit to Kozhikode or distributing cement in the nearby areas of Kozhikode wouldn't create any cargo transportation opportunity for WCC.

Name of Company: Veekesy Rubber Industries, Kolathara P.O, Kozhikode

Designation: Company Secretary

Veekesy Rubber Industries has 20 manufacturing units across 6 states in India. It is located at 5.7Km from Beypore Port. Beypore port can be developed for major cargo movement from Kozhikode. Rubber and Polyurethane are used as raw materials.

Mode of Transport - Raw materials as well as finished products are mainly transported through PAN India.

Daily Production of all 20 manufacturing plant is around 4 Lakhs pairs of slippers.

Major Exporting countries are GCC countries, Singapore and Malaysia.

Name of Company: Swaraj Paint Industries, Kozhikode

Designation: Marketing Manager

Across three states Kerala, Tamil Nadu and Karnataka under registered trademark Sunflower Brand paint Products. Supplier of paints for wagons and Bridges of Indian Railways. Main suppliers are Railways, Electricity Boards, Transport corporations and other public and private sector Industries.

Mode of Transport

- ✓ Raw Materials are imported through Kochi port via road route. Raw materials are Pigments, Solvents, Resins and additives
- ✓ The plant is 3km from Kozhikode beach

Volume of Production

Production Capacity of the plant is around 360 Kiloliters annually. Raw materials are imported.

Name of Company: Rollring Industry, Madura Bazar Road, Kozhikode

Designation: General Manger

Rollring industry is located 4.1 km from Beypore port.

Mode of Transport

- ✓ Raw materials are transported from Kochi Port to the plant via road route. Rollring industries manufacture and export Traverse units in India.
- ✓ Export to countries like USA, Brazil, Argentina, Singapore, Malaysia
- ✓ Manufacture Linear Drives and Traverse units.
- ✓ Rollring uses Kochi Port for its exports

Finished products are exported through Kochi port.

Suggestions for Development of NW – 3

- ✓ Assembly parts and Raw materials like steel can be brought from Kochi port through waterways.
- ✓ Terminal should be developed with ideal facilities for cargo movement.

Name of Company: Vijayprakash Industries, Kolathara Kozhikode

Contact Person: Mr. Joseph

Designation: Company Secretary

Mode of transport

- ✓ Finished Products is exported to Srilanka, Nigeria, Uganda, Rwanda etc.
- ✓ Vijayprakash industries provide clay processing machines and equipment.
- ✓ It is around 5.4km from beypore port
- ✓ Specialization in fabricating and commissioning of clay processing installations.

Name of Company: South Indian Industries, Mannachira, Kozhikode

Designation: Manager

Weighing scale and Coconut products. Products like fresh coconuts, weighing instruments, desiccated coconuts, RO water purifiers, Billing printer, currency counting machines. It is transported locally also. The volume of cargo is very less. Therefore, they are not interested in waterways transportation.

Mode of transport

- ✓ Finished Products are transported to middle east countries.
- ✓ It is transported to Kochi Port via road route.
- ✓ It is located at 10 Km from Beypore

Volume of Product Manufactured are as followed.

- ✓ Coconut milk powder – 1200 MT/annum
- ✓ Desiccated coconut – 1200 MT/annum
- ✓ Coconut milk powder – 720000 liters/annum
- ✓ Virgin coconut oil – 1200 MT/annum
- ✓ Weighing machines – 25000 pieces/annum
- ✓ Rubber products – 100 MT/annum

Name of Company: Orchid Industries Ltd.

Designation: Director

Demand of raw material for the industry is very low. The mode of transportation of raw material are roadways. Finished product is locally consumed in Kerala. The time of transporting goods from Kochi to Kozhikode is around 6-7 hrs. Hence, most of the wooden industries are not interested. Volume of Timber handled at Kochi port has reduced drastically due to government policies.

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 West Coast Canal NW 3 (Extension) from Kottappuram to Kozhikkode 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 at Kavalam, Kidangara etc. Large Agricultural Lands, Manorama Church at Kuppappuram, 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.

Keeping in view the above all, the sites for locating the terminal have been identified at Beypore and Ponnani Locations at West Coast Canal NW 3 (Extension). The most probable location has been considered at approx. Lat 10°47' 3.87" N and Long 75°55'16.29" E, at approx. Ch. 87.95 km for Ponnani Terminal Location and at approx. Lat 11°10'5.48" N and Long 75° 48'30.31" E, at approx. Ch. 149.45 km for Beypore Terminal Location. However, terminals have not been proposed as this is not economically & commercially viable and the existing terminal facility at Beypore and Ponnani shall be adnatageously used to serve the purpose, if need be.

National Highway-17 moves along the waterway from Kottapuram to Kozhikode. Various other State Highways that bisect the waterway are SH-20, SH-69 connecting the waterway with Thrissur, NH-213 connects the waterway with Malappuram, and NH-17 & SH-28 connect the waterway with Kozhikode city. State Highway-28 connects Kozhikode with Beypore Port.

The traffic volumes, as identified is only 4 Lakhs T P. A with origin in Kochi area and destination at Kozhikkode area. This is a very meagre traffic, while comparing with the range of investment for development. At one end near Kochi area, there are other CPT / ICTT / IWAI Terminals to take care of the Loading / Unloading aspects if any such requirement is needed.

Any development of new terminal facility is to be considered only in case of increase in cargo volumes and visibility on the revenue stream.

A tentative Land requirement has been worked out before undertaking the Land Survey etc., considering the requirements for the Lo-Lo operation however not proposed for its construction. This is for record purpose only.

Terminal Land Area Requirement for Beypore Lo-Lo Terminal

S.No.	Facility	Nos.	Size	Area (in m^2)
1	Open Storage Area	1	_	2500
2	Covered Storage Godown	1	50m x 20m	1000
3	Parking for Handling equipments	1	30m x 15m	450
4	Public Utility	1	6m x 4m	24
5	Weigh bridge	1	8m x 3m	24
6	Utility Room (Near Weigh Bridge)	1	3m X3m	9
7	Internal Roads	1	100 m X 7.5m	-
8	Administration building	1	12 m x 15 m	180

S.No.	Facility	Nos.	Size	Area (in m^2)
9	Business Area	1	10m x 3m	30
10	Staff Parking Area-4 wheelers	1	13.5m x 6m	81
11	Staff Parking Area-2 wheelers	1	8m x 2m	16
12	Security shed for watch and ward	2	4m x 4m	32
13	Electrical facility	1	5m x 5m	25
14	Fuel Bunkers	1	10m x 5m	50
15	Water Supply Room	1	3m x 4m	12
16	Fire and Safety Room	1	3m x 4m	12
17	DGPS receiver & transmitter shed	1	8m x 4m	32
18	DG shed	1	5m x 5m	25
19	Canteen with Store	1	12m x 8m	96
20	Sewerage Treatment Plant (STP)	1	15m x 15m	225
21	Overhead Tank	1	10m dia	78.5
22	Green area	1	-	1000
				5901.5 m2

Terminal Land Area Requirement for Ponnani Lo-Lo Terminal

S.No.	Facility	Nos.	Size	Area (in m^2)
1	Open Storage Area	1	_	2500
2	Covered Storage Godown	1	50m x 20m	1000
3	Parking for Handling equipments	1	30m x 15m	450
4	Public Utility	1	6m x 4m	24
5	Weigh bridge	1	8m x 3m	24
6	Utility Room (Near Weigh Bridge)	1	3m X3m	9
7	Internal Roads	1	100 m X 7.5m	-
8	Administration building	1	12 m x 15 m	180
9	Business Area	1	10m x 3m	30
10	Staff Parking Area-4 wheelers	1	13.5m x 6m	81
11	Staff Parking Area-2 wheelers	1	8m x 2m	16
12	Security shed for watch and ward	2	4m x 4m	32
13	Electrical facility	1	5m x 5m	25
14	Fuel Bunkers	1	10m x 5m	50
15	Water Supply Room	1	3m x 4m	12
16	Fire and Safety Room	1	3m x 4m	12

S.No.	Facility	Nos.	Size	Area (in m²)
17	DGPS receiver & transmitter shed	1	8m x 4m	32
18	DG shed	1	5m x 5m	25
19	Canteen with Store	1	12m x 8m	96
20	Sewerage Treatment Plant (STP)	1	15m x 15m	225
21	Overhead Tank	1	10m dia	78.5
22	Green area	1	-	1000
				5901.5 m2

5.3 Terminal Layout / Master Planning including phases of development

The Terminal facility for constructing new Lo-Lo terminal has been dropped as the existing terminal facility at Beypore & Ponnani shall be used for any limited services in NW-3 waterway, if at all required. Any new terminal facility shall entail huge cost without any commercial benefit.

The detail of land is mentioned only for record purpose, if any future requirement is needed.

5.4 Land Details

The Land area identified is described in table below:

TABLE 5-1: TERMINAL LAND DETAILS OF BEYPORE

Coordinates (UTM) N/E	**1234697**	**588267**
Coordinates (DMS) N/E	**11°10'5.48" N**	**75°48'30.31" E**
Village	Beypore	
Taluka	Beypore	
District	Kozhikkode	
State	Kerala	
Nearest Town	Kozhikkode	
Distance of town (km)	11	
Land use	Close proximity to Port area	
Ownership	Close proximity to Port area	
Water Distance	0 m	
Nearest Road	Meenchanda-Beypore road	
Road Distance (m)	50 m	
Nearest Railhead	Feroke Railway Station	
Railhead Distance	6 km	
Nearby major Structure	Beypore Port	

Coordinates (UTM) N/E	**1234697**	**588267**
Coordinates (DMS) N/E	**11°10'5.48" N**	**75°48'30.31" E**
Terrain	Coastal area	
Soil/Subsurface strata	Black Yellow Medium Dense to Dense Silty Sand	
Surveyed Area (Approx)	5905 (m2)	

TERMINAL LAND DETAILS OF PONNANI

Coordinates (UTM) N/E	**1192293.5**	**600711.5**
Coordinates (DMS) N/E	**10°47'3.87" N**	**75°55'16.29" E**
Village	Ponnani	
Taluka	Ponnani	
District	Malappuram	
State	Kerala	
Nearest Town	Thrissur	
Distance of town (km)	50	
Land use	Close proximity to Port area	
Ownership	Close proximity to Port area	
Water Distance	0 m	
Nearest Road	Ponnani port access road	
Road Distance (m)	290 m	
Nearest Railhead	Kuttipuram railway station	
Railhead Distance	16 km	
Nearby major Structure	Ponnani Harbour Terminal	
Terrain	Coastal area	
Soil/Subsurface strata	Black Yellow Medium Dense to Dense Silty Sand	
Surveyed Area (Approx)	10110 (m2)	

5.5 Geotechnical Investigations

Geotechnical investigation has been carried out at proposed terminal locations to find out the subsoil stratification in the project area and to collect data for deciding type of foundation and the using the parameter in design of the foundation. The scope of geotechnical investigation work consists of one bore hole at terminal, terminated at a depth of 25.6 m below EGL.

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 5.2**.

TABLE 5-2: 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

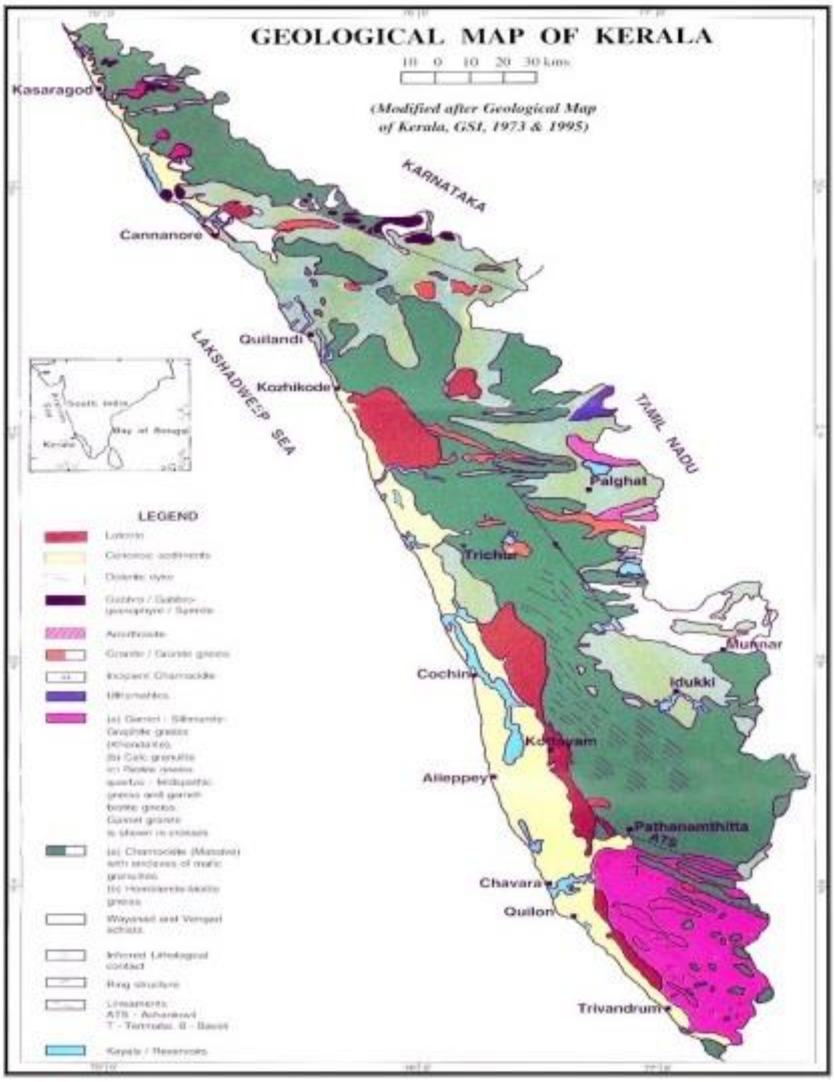


Figure 5-1: Geological Map of Kerala

5.5.2 Physical Condition and Drainage

Physiographically the state can be divided into four domains from east to west, viz., the Western Ghats, the foothills, the midland and the coastal low- land.

The Western Ghats, bordering the eastern boundary of the State, form an almost continuous mountain wall, except near Palakkad where there is a natural mountain pass known as the Palakkad Gap. The average elevation of the Ghats is about 1500 meters above sea level, occasionally soaring to peaks of 2000m to 2500m. From the Ghats, the land slopes to the west on to the plains, into an unbroken coastline.

The foothills of the Western Ghats comprise the rocky area from 200 to 600m.above MSL. It is a transitional zone between the high-ranges and midland. The strip of hills and valleys on the eastern edge, close to the Ghats, comprises of steep mountains and deep valleys, covered with dense forests. Almost all the rivers of the state originate here.

In the Midland Plains of central region, the hills are not very steep and the valleys are wide. This forms an area of gently undulating topography with hillocks and mounds. Laterite capping is commonly noticeable on the top of these hillocks. The low, flat-topped hillocks forming the laterite plateau range in altitude from 30-200m and are observed between coastal low-land and the foothills. The valleys have been developed as paddy fields and the elevated lands and hill slopes are converted into estates of rubber, fruit trees and other cash crops like pepper, arecanut and tapioca. Tea and coffee estates have cropped up in the high ranges during the last two centuries.

Coastal low-land is identified with alluvial plains, sandy stretches, abraded platforms, beach ridges, raised beaches, lagoons and estuaries. The low- land and the plains are generally less than 10m above MSL. The Coastal Belt strip is comparatively plain. Extensive paddy fields, thick groves of coconut trees and picturesque backwaters, interconnected with canals and rivers, are the features of this region. No wonder, Alappuzha an old sea port town of this region is known as the 'Venice of the East'. In the southern and northern parts of the state, the coastal belt also has some small hillocks.

Drainage:

The State is drained by 44 rivers, of which 3 are east flowing **(Figure 5.2)**. Rivers are generally swift flowing having very steep gradient in their higher reaches. Absence of delta formation is characteristics if Kerala rivers. The general drainage pattern of these rivers is dendritic, although at places trellis, sub-parallel and radial occur. The segments of river courses are nearly straight, indicating structural control, coinciding with prominent lineament directions (NW-SE and NE-SW). Many of the rivers do not have a continuous flood plain. 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, 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. The river flow is modulated by about 30 reservoirs, mostly located in highlands (KSLUB, 2002; CWRDM, 1995). Apart from the 44 rivers, there are few streams with separate watersheds draining an area of about

900 km2 with lengths falling short of the 15 km limit set for the categorization as river (Anon, 1974).

Figure 5-2: Drainage Map of Kerala

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 forms a part of Ponnani & Beypore river basins which constitutes the major drainage of the area. The location of the selected site on Google earth is shown as **Figure 5.3** while the enlarged view of the same is shown as **Figure 5.4.**

- **Beypore Location**

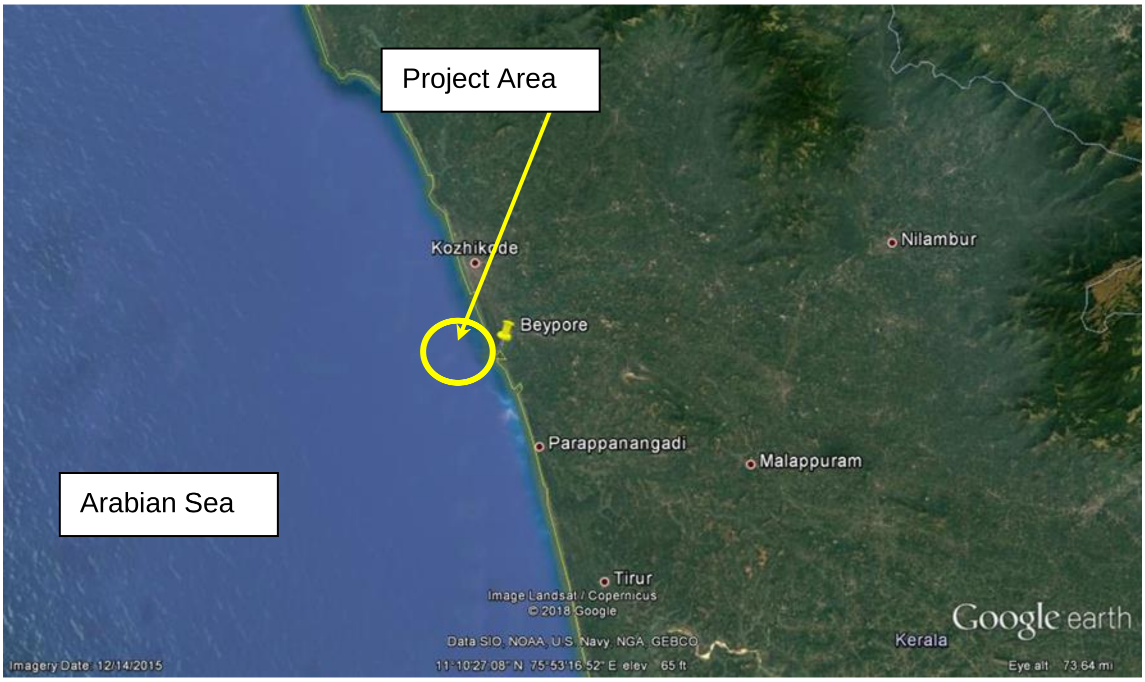


Figure 5-3: Google Earth Image showing Project Area (Beypore Location)

Figure 5-4: Enlarged View of Google Earth Image showing Project Area (Beypore Location)

- **Ponnani Location**

Figure 5-5: Google Earth Image showing Project Area (Ponnani Location)

Figure 5-6: Enlarged View of Google Earth Image showing Project Area (Ponnani Location)

5.5.3 General Geology and Stratigraphy

- **Beypore**

The Kozhikode area can be divided into three geological belts viz., (i) a linear NW-SE trending gneissic belt, along the middle extending from north to south, (ii) a charnockite belt occupying areas in the northeast and south, extending to the adjacent districts and also occurring as pockets within the gneissic terrain and (iii) a narrow coastal belt.

Granite gneiss belonging to the Peninsular Gneissic Complex is the oldest unit of the area and occurs north of Alampore. Charnockite belonging to the Charnockite Group has a very wide distribution, especially in the northeast and south with variations like biotite-hypersthene gneiss, biotite-hornblende-hypersthene gneiss and hornblende-hypersthene gneiss. Magnetite quartzite, another unit of this group, occurs as narrow linear bodies within charnockite. Hornblende-biotite gneiss of the Migmatite Complex extends from north to south and is well foliated. Garnetiferous quartzo-feldspathic gneiss, another member of Migmatite Complex, occurs as lenses within charnockite, in the east. NW-SE trending dolerite dykes. These dykes are 10-20m wide.

Pebble beds occur on the coast and along banks of the Beypore river. The pebble bed is associated with grit and clay and it is lateritised. It comprises well rounded pebbles of quartz, granite, quartzite and granulite. It is considered to be of Pleistocene origin. Sporadic laterite is recorded from the charnockite country to the southwest. Quaternary deposits are of marine and fluvial origin. Periyar Formation is a fluvial deposit comprising an admixture of sand, silt and clay. Guruvayur Formation is a strand line deposit of palaeo-marine origin and mostly comprises medium- to fine sand. Kadappuram Formation represents contemporary marine deposits, constituting the present and barrier beach.

The drill hole completed within the project area reveals the stratification as below:

Strata I: Medium Dense Silty Sand

Strata II: Dense Silty Sand

- **Ponnani**

From the exposure pattern of the rock types, the district can be divided into two geological belts: (i) Charnockite group of rocks covering a major part and (ii) Migmatite Complex towards the east. Wayanad group is represented by small bodies of metaultramafites (tal-tremolite schist, talc-pyroxene-garnet schist, banded magnetite quartzite) and high-grade schist and gneiss (hornblende-biotite schist and gneiss+garnet with amphibolite band) which extends into Tamil Nadu where it is known as Sathyamangalam Group. The rocks of Peninsular Gneissic Complex, represented by granite gneiss and hornblende-biotite gneiss, form the next younger sequence. They have a very limited distribution near the eastern boundary. They have a very limited distribution near the estern boundary, extending into the adjacent district where they are known as Bhawani Group. A linear band of granite gneiss NE of Perinthalmanna and a large body of hornblende-biotite gneiss east of Manjeri are prominent units. Charnockite Group includes charnockite/charnockite gneiss, having the largest areal distribution, followed in decreasing order of abundance by banded magnetite quartzite, pyroxene granulite, amphibolite/hornblende granulite and pyroxenite, which occur as concordant as well as discordant bands, lenses, layers and enclaves both within charnockite as well as within gneisses of Migmatite Complex. The Migmatite Complex is represented by biotite-hornblende gneiss (or hornblende-biotite gneiss) and quartzo-feldspathic gneiss/garnet-biotite gneiss with enclaves of garnet-sillimanite gneiss+graphite distributed mostly in the central and north-eastern part. Pegmatite and quartz veins constitute the acid intrusives, whereas gabbro and dolerite are basic intrusives. Near the coast, isolated cappings of Neogene Warkalli sediments comprising grit and clay beds are noticed. Lateritisation is widespread, at places attaining a thickness of more than 10m. Extensive plateaus with laterite 'mesas' are common in the area. Angadipuram (west of Perinthalmanna), the type locality of laterite falls in this district. Quaternary unconsolidated sediments are restricted to the coastal plain. They have been classified into different morpho-stratigraphic units based on their lithic content and environment of formation.

The drill hole completed within the project area reveals the stratification as below:

Strata I: Blackish Medium Dense Silty Sand

Strata II: Grey Medium Stiff to Stiff Silty Clay

Strata III: Black Yellow Medium Dense Silty Sand

Strata IV: Black Yellow Dense Silty Sand

5.5.4 Sub-surface Investigations

- **Beypore**

The selected site has been investigated by one drill hole (NW3B) which has been drilled for depth of 25.6 m. The detail of the drill hole is tabulated below in **Table 5.3**.

Table 5-3: Summary of Drill hole

Sl. No	Hole No.	Location	Total Drilled Depth (m)	Depth		Thickness (m)	Description of Strata	N-Value	Core Recovery	RQD	Remarks
				From (m)	**To (m)**				**%**	**%**	Water Table 3.15 m below GL
1.	NW3B (NGL – 13.25 m)	Right bank of Beypore river **(11^0 10' 05.15'' N, 75^0 48' 30.32'' E)**	25.6	0	0.5	0.5	Backfilled Soil	-	-	-	
				0.5	17.5	17.0	Grey/ Yellow Medium Dense Silty Sand	11 – 30	-	-	
				17.5	25.6	8.1	Grey/ Yellow Dense Silty Sand	31 – 44	-	-	

The description of the drill hole is as given below.

NWB1: Drill hole NWB1 has been drilled over the terminal location area on the Right bank of Beypore river, near Beypore village, Kozhikode, Kerala. The drill hole has been drilled vertically down to the depth of 25.6m from EL.13.25 m to EL.-12.35m. The drill hole encountered 0.5m thick Back filled Material, 17.0m thick strata of Medium Dense Silty Sand underlain by 8.1m thick succession of Dense Silty Sand.

The drill hole log and photographs of execution of drill hole and core box are appended in Volume IV- Geotechnical Investigation Report for record.

- **Ponnani**

The selected site has been investigated by one drill hole (NW3P) which has been drilled for depth of 25.6 m. The detail of the drill hole is tabulated below in **Table 5.4**.

Table 5-4: Summary of Drill hole

Sl. No	Hole No.	Location	Total Drilled Depth (m)	Depth		Thickness (m)	Description of Strata	N-Value	Core Recovery	RQD	Remarks
				From (m)	**To (m)**				**%**	**%**	

Sl. No	Hole No.	Location	Total Drilled Depth (m)	Depth		Thickness (m)	Description of Strata	N-Value	Core Recovery	RQD	Remarks
1.	NW3P (NGL – 2.0 m)	Left bank of Ponnani river (10^0 47' 2.87'' N, 75^0 55' 16.97'' E)	25.6	0	3.0	3.0	Blackish Medium Dense Silty Sand	14	-	-	Water Table 2.65 m below GL
				3.0	12.9	9.9	Grey Medium Stiff to Stiff Silty Clay	6 - 16	-	-	
				12.9	20.0	7.1	Black Yellow Medium Dense Silty Sand	23 - 30	-	-	
				20.0	25.6	5.6	Black Yellow Dense Silty Sand	32 - 42			

The description of the drill hole is as given below.

NW3P: Drill hole NW3P has been drilled over the terminal location area on the Left bank of Ponnani river, near Ponnani village, Malappuram, Kerala. The drill hole has been drilled vertically down to the depth of 25.6m from EL.2.0m to EL.-23.6m. The drill hole encountered 3.0m thick Blackish Medium Dense Silty Sand and 9.9m Grey Medium Stiff to Stiff Silty Clay underlain by 12.7m thick strata of Black Yellow Sand.

The drill hole log and photographs of execution of drill hole and core box are appended in Volume IV- Geotechnical Investigation Report for record.

5.5.5 Geotechnical Results and Analysis

- **Beypore**

In-situ Test Results

Seven Standard penetration test (SPT) has been carried out in accordance with IS 2131 in the drill hole to ascertain the consistency of the different soil strata. The depth wise N-values from the SPT for soil strata are as tabulated in **Table 5.5**.

TABLE 5-5: SUMMARY OF IN-SITU TEST RESULTS

Sl. No.	Strata Description	Depth		SPT 'N' Value
		From	To	Observed
1	Grey/ Yellow Medium Dense Silty Sand	1.5	2.1	11
		3.0	3.6	13
		4.5	5.1	16
		6.0	6.6	18
		7.5	8.1	19
		9.0	9.6	22
		10.5	11.1	26
		12.0	12.6	27
		13.5	14.1	28
		15.0	15.6	29
		16.5	17.1	30
2	Grey/ Yellow Dense Silty Sand	18.0	18.6	31
		19.5	20.1	33
		21.0	21.6	21
		22.5	23.1	21
		24.0	24.6	21
		25.0	25.6	22

Laboratory Test Results

Testing on soil samples from SPT & Undisturbed Samples (UDS)

5 SPT soil samples has been collected from the drill hole from different depths and has been tested in laboratory to know the engineering properties of sub-surface strata like Mechanical analysis, Consistency Limits (atterberg limits), Shear strength parameters, consolidation test, Natural Moisture content, Density, soil classification, specific gravity etc. The details of the soil sample collected and summary of results of the various tests are tabulated in **Table 5.5-3** for record.

Table 5-6: Summary of Laboratory Test Results on Soil Samples

Bore Hole	Strata Description	Depth		Sample Type	Density		Natural Moisture Content, w	Mechanical Analysis				Consistency Limits				IS Soil Classification	Shear Strength			Consolidation		Specific Gravity
					Wet	Dry		Gravel	Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index, I_p	Shrinkage, S_L		Type	Cohesion	Friction	Compression Index	Initial Void Ratio	
		From	To		Kg/cm³		%	%	%	%	%	%	%	%	%			Kg/cm²	degree	C_C	e_0	G
NW3B	Grey/ Yellow Medium Dense Silty Sand	1.50	2.1	SPT	1.787	1.51	18.25	2	80	18	---	Non - plastic				SM	---	---	---	---	---	2.63
		7.5	8.1	SPT	1.858	1.55	20.01	3	73	20	4	Non - plastic				SM	DS	0	27	---	---	2.63
		12.0	12.6	SPT	1.862	1.54	21.02	0	65	22	13	Non - plastic				SM	---	---	---	---	---	2.64
		16.5	17.1	SPT	1.823	1.60	14.25	9	73	18	---	Non - plastic				SM	DS	0.001	31	---	---	2.65
	Grey/ Yellow Dense Silty Sand	21.0	21.6	SPT	1.842	1.62	13.65	2	57	26	---	Non - plastic				SM	DS	0.056	33	---	---	2.64

Geotechnical Analysis

Bearing Capacity Calculations

The bearing capacity and pile load capacity is worked out based on following soil parameters adopted for the analysis.

SOIL PARAMETERS ADOPTED FOR THE ANALYSIS

Depth From (m)	Depth To (m)	Strata Type	Average N Value	Thickness (m)	Unit Weight (kN/m^3)	Cohesion (kN/m^2)	Angle of Internal Friction (Degrees)	Compression Index (Cc)	Initial void Ratio (e_0)
0	0.5	Backfilled Soil	-	0.5	16.0	-	-	-	-
0.5	16.5	Silty Sand	21	16.0	18.3	0.0	27	-	-
16.5	21.0	Silty Sand	31	4.5	18.2	0.001	31	-	-
21.0	25.6	Silty Sand	21	4.6	18.4	0.056	33		

The bearing capacity is calculated for different size of isolated footing at different proposed depth. The details are given below. The sample calculations are given in **Annexure-5.1**.

SUMMARY OF BEARING CAPACITY CALCULATIONS (KN/M^2)

S. No	Size of Isolated Footing	Depth of Footing (m)			
		1.5	2.0	2.5	3.0
1.	1.5 m x 1.5 m	40	53	67	82
2.	2.0 m x 2.0 m	42	54	67	80
3.	2.5 m x 2.5 m	44	55	67	80
4.	3.0 m x 3.0 m	46	57	69	81

Pile Capacity Calculations

The pile capacity is calculated for different diameters of piles resting over rock. The details are given below. The sample calculations are given in **Annexure-5.2**.

SUMMARY OF PILE CAPACITY CALCULATIONS

S. No	Diameter of Pile	Penetration Depth of Pile below Scour Level (m)	Capacity of Pile in compression (kN)	Uplift Capacity of Pile (kN)
1.	1.0 m	30	4099	2901
2.	1.3 m	30	6765	4315

S. No	Diameter of Pile	Penetration Depth of Pile below Scour Level (m)	Capacity of Pile in compression (kN)	Uplift Capacity of Pile (kN)
3.	1.4 m	30	7722	4737

- **Ponnani**

In-situ Test Results

Ten Standard penetration test (SPT) has been carried out in accordance of IS 2131 in the drill hole to ascertain the consistency of the different soil strata. The depth wise N-values from the SPT for soil strata are as tabulated in **Table 5.7**.

Table 5-7: Summary of In-Situ Test Results

Sl No.	Strata Description	Depth		SPT 'N' Value
		From	To	Observed
1	Blackish Medium Dense Silty Sand	1.5	2.1	14
2	Grey Medium Stiff to Stiff Silty Clay	3.0	3.6	16
		4.5	5.1	6
		7.5	8.1	7
		10.5	11.1	9
		12.0	12.6	14
3	Black Yellow Medium Dense Silty Sand	13.5	14.1	23
		15.0	15.6	23
		16.5	17.1	26
		18.0	18.6	27
		19.5	20.1	30
4	Black Yellow Dense Silty Sand	21.0	21.6	32
		22.5	23.1	36
		24.0	24.6	38
		25.0	25.6	42

Laboratory Test Results

Testing on soil samples from SPT & Undisturbed Samples (UDS)

8 SPT and 2 UDS soil samples has been collected from the drill hole from different depths and has been tested in laboratory to know the engineering properties of sub-surface strata like Mechanical analysis, Consistency Limits (atterberg limits), Shear strength parameters, consolidation test, Natural Moisture content, Density, soil classification, specific gravity etc. The details of the soil sample collected and summary of results of the various tests are tabulated in **Table 5.8** for record.

Table 5-8: Summary of Laboratory Test Results on Soil Samples

Bore Hole	Strata Description	Depth		Sample Type	Density		Natural Moisture Content, w	Mechanical Analysis				Consistency Limits				IS Soil Classification	Shear Strength			Consolidation		Specific Gravity
					Wet	Dry		Gravel	Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index, I_p	Shrinkage, S_L		Type	Cohesion	Friction	Compression Index	Initial Void Ratio	
		From	To		Kg/cm³		%	%	%	%	%	%	%	%	%			Kg/cm²	degree	C_C	e_0	G
NW3P	Grey Medium Stiff to Stiff Silty Clay	3.0	3.6	SPT	1.678	1.37	22.15	0	35	38	27	41	21	20	---	CI	---	---	---	---	---	2.65
		4.5	5.1	SPT	1.758	1.46	20.25	0	22	47	31	43	25	18		CI	UU	0.352	12			2.61
		7.5	8.1	SPT	1.726	1.41	22.58	0	11	54	35	49	25	24		CI	UU	0.543	2			2.63
		6.0	6.5	UDS												CI	CU	0.13	24	0.342	0.82	
		9.0	9.6	UDS												CI	CU	0.009	26	0.301	0.83	
	Black	13.5	14.1	SPT	1.775	1.58	12.12	3	76	21	---	Non Plastic				SM	DS	0.003	30			2.64

Bore Hole	Strata Description	Depth		Sample Type	Density		Natural Moisture Content, w	Mechanical Analysis				Consistency Limits		IS Soil Classification	Shear Strength			Consolidation		Specific Gravity
	Yellow Medium Dense Silty Sand	16.5	17.1	SPT	1.815	1.61	12.56	2	80	18	---	Non Plastic		SM	DS	0	31			2.64
		18.0	18.6	SPT	1.820	1.59	14.52	5	63	22	10	Non Plastic		SM	DS	0	32			2.64
	Black Yellow Dense Silty Sand	21.0	21.6	SPT	1.874	1.64	14.02	3	69	18	10	Non Plastic		SM	---	---	---			2.63
		25.0	25.6	SPT	1.862	1.64	13.56	9	73	18	---	Non Plastic		SM	DS	0	31			2.62

Bearing Capacity Calculations

The bearing capacity and pile load capacity is worked out based on following soil parameters adopted for the analysis.

SOIL PARAMETERS ADOPTED FOR THE ANALYSIS

Depth From (m)	Depth To (m)	Strata Type	Average N Value (observed)	Thickness (m)	Unit Weight (kN/m^3)	Cohesion (kN/m^2)	Angle of Internal Friction (Degrees)	Compression Index (Cc)	Initial void Ratio (e_0)
0	3.0	Sand	14	3.0	17.0	0.0	30.0	-	-
3.0	7.5	Clay	6-16	4.5	18.0	35.2	12	0.342	0.82
7.5	12.9	Clay	7-14	5.4	17.26	54.3	2	0.301	0.83
12.9	16.5	Medium Dense Sand	23	3.6	17.75	0.003	30	-	-
16.5	18.0	Medium Dense Sand	26	1.5	18.15	0.000	31	-	-
18.0	20.0	Medium Dense Sand	27-30	2.0	18.20	0.000	32	-	-
20.0	25.6	Dense Sand	32-42	5.6	18.68	0.000	31	-	-

The bearing capacity is calculated for different size of isolated footing at different proposed depth. The details are given below. The sample calculations are given in **Annexure-5.1**.

SUMMARY OF BEARING CAPACITY CALCULATIONS (KN/M^2)

S. No	Size of Isolated Footing	Depth of Footing (m)			
		1.5	2.0	2.5	3.0
1.	1.5 m x 1.5 m	116	125	135	145
2.	2.0 m x 2.0 m	111	118	126	135
3.	2.5 m x 2.5 m	108	114	121	128
4.	3.0 m x 3.0 m	106	112	118	124

Pile Capacity Calculations

The pile capacity is calculated for different diameters of piles resting over dense sand. The details are given below. The sample calculations are put on record in **Annexure-5.2**.

SUMMARY OF PILE CAPACITY CALCULATIONS

S. No	Diameter of Pile	Penetration Depth of Pile below Ground Level (m)	Capacity of Pile in compression (kN)	Uplift Capacity of Pile (kN)
1.	1.0 m	36.0	2614	2331
2.	1.3 m	36.0	4542	3728
3.	1.4 m	36.0	5537	4291

5.6 Terminal Infrastructure including equipment

The land areas identified are measuring to about 7250 Sq. m at Beypore and 10000 Sq.m at Ponnani, however no Land acquisition is proposed. Lo-Lo facility as proposed earlier is dropped in light of limited cargo whereas the existing facility at both the location of Beypore & Ponnani shall serve the purpose as need be.

5.7 Berthing Structure

No berthing structures is proposed.

5.8 Terminal Costing

5.8.1 Capital Cost

Not Required.

5.8.2 O&M Cost

Not Required.

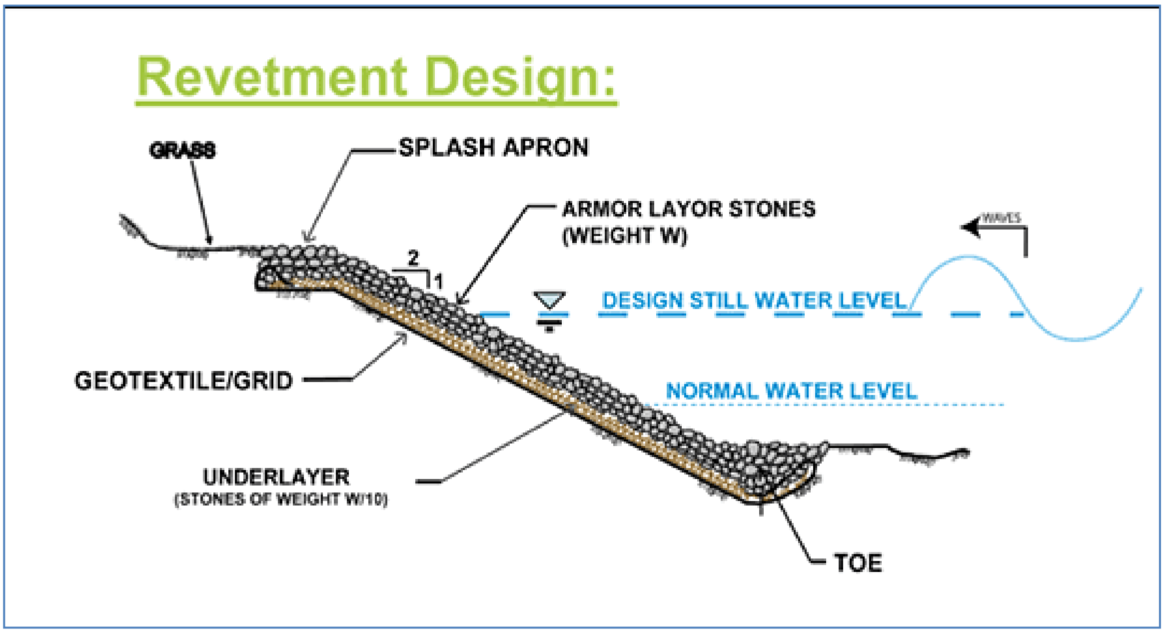
CHAPTER 6 PRELIMINARY ENGINEERING DESIGNS

6.1 Bank Protection

6.1.1 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.

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

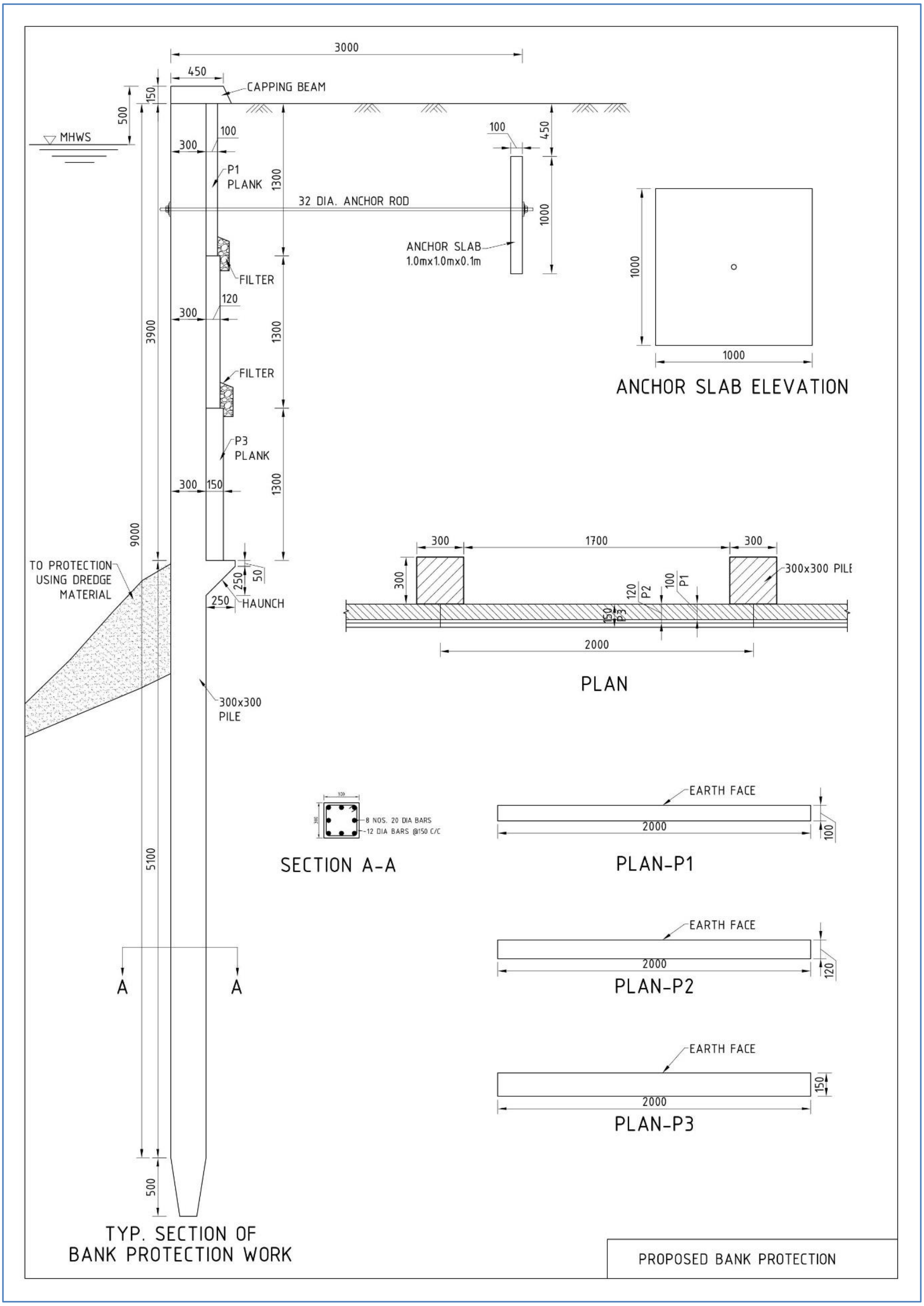


Gabion revetments at the site shall be considered in the present study stretch. As the gabions do not need special equipment nor high-skilled labour for execution, their maintenance is not cumbersome and further they are more durable and economical than geotubes or geobags.

6.1.2 Typical Pile and Slab

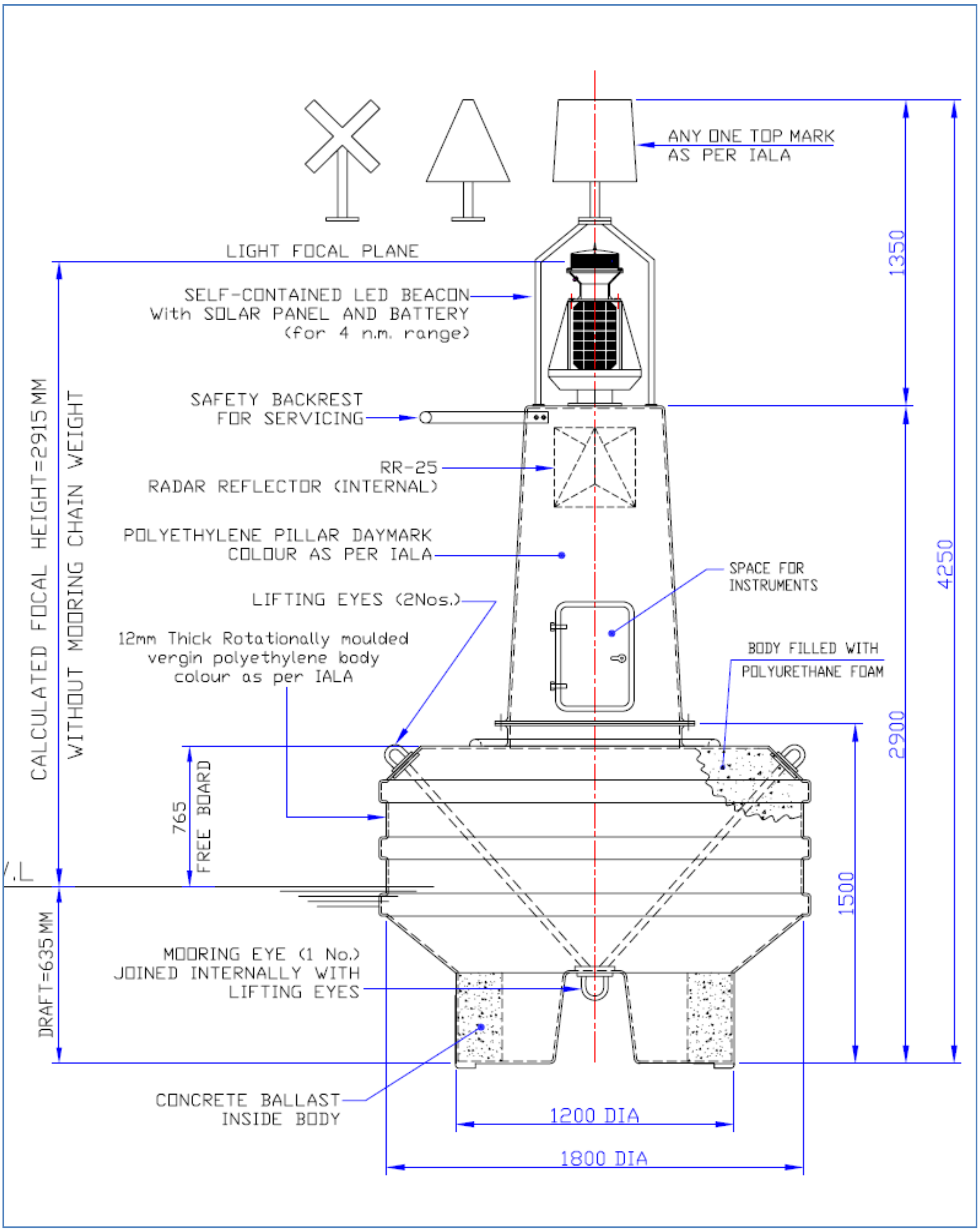
The present study stretch of NW 3 (Extension) is a canal amenable for Class III Waterway and similar to that of present NW 3 waterway and having connectivity. Further, the throughput traverse is through the interlinked NWs viz., NW 8 / NW 9 / NW 59 in Kuttanad area. Keeping all the above in view, and also considering the narrow reaches with Land Acquisition, 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. These are provisions which is to be taken up only on the positive growth and confirmations, if observed in future.


3000
450
CAPPING BEAM
150
500
MHWS
300
100
P1
PLANK
1300
100
450
32 DIA. ANCHOR ROD
1000
ANCHOR SLAB
1.0mx1.0mx0.1m
FILTER
120
300
3900
1300
FILTER
P3
PLANK
300
150
1300
9000
TO PROTECTION
USING DREDGE
MATERIAL
250
50
250
HAUNCH
300x300
PILE
5100
A
A
500
TYP. SECTION OF
BANK PROTECTION WORK
1000
1000
ANCHOR SLAB ELEVATION
300
1700
300
300
300x300 PILE
120
P2
100
P1
150
P3
2000
PLAN
8 NOS. 20 DIA BARS
12 DIA BARS @150 C/C
SECTION A-A
EARTH FACE
2000
100
PLAN-P1
EARTH FACE
2000
120
PLAN-P2
EARTH FACE
2000
150
PLAN-P3
PROPOSED BANK PROTECTION

6.2 Navigation Aids

The detailed Drawing and Specifications are reproduced herewith for consideration.



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

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

1 Set - Mooring gear – Each set comprised of the following:
1 No. - 3M x 26 mm dia open link chain with enlarged end links.
1 No. - 15M x 26 mm dia open link pendant chain with enlarged end links.
4 Nos. - 26 mm nom. dia forelock end shackles.
1 No. - 26 mm nom. dia swivel piece with end links.
1 No. - 250 kg. M.S. stockless Anchor.

Note: The chains shall be made as per 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 I6 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°C to + 60°C.
SOLAR SUPPLY SYSTEM FOR MLB-200-4 LED Light: 1 Set — Solar supply system as detailed below:

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

6.3 Cargo Terminals and River Ports

Crago terminal, birthing structure as well as terminal structure has not been proposed in light of existing facility at Beypore & Ponnani hence design criteria is not required.

6.4 Construction Schedule

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

CHAPTER 7 VESSEL DESIGN

7.1 General Review

West Coast Canal [WCC (NW-3)] extension is proposed to be develop for passenger for across the river movement. Development of Beypore and Ponnani for river crossing facility would be the huge support for daily commuters. Industries located in Kozhikode exports scraps using Kochi Port. This movement does not create any opportunity for IWT on WCC (NW-3). There already exists well developed road infrastructure for truck movement. Also, tourism does not provide any opportunity for IWT, as most of the tourist spots are well connected with roadways.

Total 3 routes are proposed on WCC (NW-3) extension for development of passenger movement i.e. 2 at Beypore and 1 at Ponnani. IWT movement is already operational at Beypore and Ponnani. There exist small terminals that are handling Ro-Pax traffic. IWAI would use same terminals to accommodate the projected passenger traffic.

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

7.2 Design Basis

Vessel design is usually influenced by the factors like traffic type and density, channel type and characteristics, flow current, operational and navigational factors, etc. The selection of vessels for WCC (NW-3) extension has been made using traffic type and volume. Higher traffic / volumes and lower transport cost induce need for larger vessels or deployment of smaller vessels in several numbers.

7.2.1 Vessel Classification adopted in Indian Inland Waterway

Ministry of Shipping and Inland Waterways Authority of India has classified the Inland waterways into seven categories for rivers and canals for safe plying of self-propelled vessels (Ref: IWAI, Gazette Notification 2006). The classification criteria of waterways are mentioned in **Table 7.1** for Rivers and in **Table 7.2** for canals.

TABLE 7-1: Classification of Inland Waterways for Rivers

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

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

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

TABLE 7-2: Classification of Inland Waterways for Canals

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	-	-	-	-	-

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 Traffic; Terminal facilities etc. The study stretch of WCC (NW-3) extension has been considered as Class III waterways which as of now can operate passenger vessel for crossing over the waterway at three locations only.

Vessel Requirement for a waterway can be segregated mainly into two parts i.e., Waterway maintenance vessels and Cargo/Passenger vessels. There are many vessels required for maintenance of waterway viz., Dredgers; Tugs; Survey vessels; Navigational Equipment maintenance vessels; Patrol Boats; Pilot Boats; Inspection Vessels etc. WCC (NW-3) extension due to its small cross over stretch and no commercial opportunity at this stage, hence, does not require deployment of any exclusive vessels for maintenance of waterway.

7.4 Proposed Vessel Size and Specifications

Targeted depth of WCC (NW-3) extension is considered as 2.2 m. Any passenger vessel with less than 1.7 m draught is suitable for navigating in the defined stretch. The table below lists down the sample specifications of few vessel along with pictures that could be deployed in WCC (NW-3).

TABLE 7-3: Specification of Vessels – Sample

Vessel Name	Length (m)	Beam (m)	Draught (m)	Capacity (Pax.)
ODC Marine, Mono Pax	12.2	4.2	1.2	36
FRP Water Taxi Without Engine	10.5	3.8	1.4	40
Fiberglass 50ft	15.2	4.4	1.3	48
Solar Electric 30 Pax Ferry	12	3.5	1.2	30
Grandsea 12m Fibreglass	11.8	2.9	1.2	30
Touring 36	10.9	2.8	0.5	29

Source: Consultant’s Analysis

Figure 7-1: Passenger Vessel 12m 36 Seats

Figure 7-2: FRP Water Taxi Without Engine – 40 Pax

Figure 7-3 Fiberglass 50ft – 48 Pax

Figure 7-4: Grandsea Fibreglass 30 Pax Water taxi / Passenger Boat

Figure 7-5: Touring 36 – 29 Pax Vessel (similar recommended)

Any passenger ferry with less than 1.7 m draught is suitable for navigating in the defined stretch, as targeted depth of WCC (NW-3) is 2.2 m. The sample vessel specification proposed for tourist mobility considered at the initial stage is as follows.

(For Steel Boat)

- Size (L x B x D) – 15m x 1.9m x 0.7m
- Capacity – 25 Passengers (seating capacity)
- Engine - 1 Marine Outboard Engines of 120hp (approx.)
- Speed - 6 Knots (max.)

(For FRP Boat)

- Size (L x B x D) – 15m x 1.9m x 0.4m
- Capacity – 30 Passengers (seating capacity)
- Engine - 1 Marine Outboard Engines of 90hp (approx.)

7.5 **Speed – 6 Knots (max.)**Turn Around Time

Turn Around Time (TAT) for the Inland Navigation is the most critical analysis, involving many practical issues, linked with the Fairway constraints; Terminal Operational Constraints; Availability of Day / Night Navigation system; Vessel speed etc. The navigable stretch between proposed routes for river crossing is around 450 – 500 mtrs i.e. 0.5 km. The table below shows the calculation and assumptions considered to arrive at Turn Around time for single vessel on both the stretches.

TABLE 7-4: Turn Around Time Calculation for Single Vessel

Sr. No.	Parameters	Unit	Ponnani	Beypore
1	NW-3 Stretch (Across River Movement)	Km.	0.5	0.5
2	Traffic Type Proposed	Type	Passengers	Passengers
3	Terminal Proposed	Type	Existing Terminal	Existing Terminal
4		No.	2	1
5	Load / Unload (both side)	Mins	15	15
6	Total Handling Time	Mins	15	15

Sr. No.	Parameters	Unit	Ponnani	Beypore
7	Average Sailing Speed	Knots	4	4
8	Sailing Time	Mins	6	6
	Total Turn-around Time/trip/voyage	**Mins**	**40**	**40**

Based on the above assumptions, a loaded vessel would take at least 40 mins to complete one trip. Vessel speed and operational time consumed at terminal and in transit are the primary influencing factor of turnaround time.

7.6 Number of Vessels Required

This section discusses the number of vessels required to handle projected traffic on the of WCC (NW-3). Below listed are the relevant factors are considered to arrive at the requirement of number of vessels;

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

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

TABLE 7-5: Assumptions for Calculating Vessel Requirement

Sr. No.	Parameters	Unit	Ponnani	Beypore
1	Operational Days	Days	300	300
2	Daily Operational	Hours.	8	8
3	Carrying Capacity	No.	25	25
4	Vessel Speed	Nm. / km.	4 / 7.41	4 / 7.41
5	Loading and Unloading Time	Mins	15	15
6	Chainage	Km.	0.5	0.5
7	Turn Around Time/trip/voyage	Mins	40	40

Based on the above assumptions, number vessels required on the of WCC (NW-3) is represented in the table below.

TABLE 7-6: Number of Vessel Requirement on Ponnani Route

Parameters	Unit	FY25	FY30	FY35	FY40
Passenger Traffic	No.	451,610	493,725	539,768	561,685
Annual Vessel Calls	No.	18064	19749	21590	122467
Daily Vessel Calls	No.	60	65	72	75
Vessels Requirement	No.	5	5	6	6
Additional Vessel Requirement		0	0	1	0

TABLE 7-7: Number of Vessel Requirement on Beypore Route

Parameters	Unit	FY25	FY30	FY35	FY40
Passenger Traffic	No.	602,146	658,300	719,691	748,913
Annual Vessel Calls	No.	15054	16458	17993	18723
Daily Vessel Calls	No.	51	55	60	63
Vessels Requirement	No.	3	3	3	3
Additional Vessel Requirement		0	0	0	0

The above calculation concludes that initially 2 numbers 25-Pax passenger vessel will be required to cater to the proposed traffic on Ponnani river crossing route. Thereafter additional 1 vessel will be required in FY32. As per the considered speed and operational hours, each vessel will require to make 20 - 22 calls in a day. It takes around 40 mins to complete trip at Ponnani.

Traffic projected for ferry service at Beypore could be accommodated in 3 vessels of 25 pax capacity each. As shown in the table above, each vessel will require to make around 20-22 trips in a day to cater to the projected traffic. It takes around 40 mins to complete the trip at the Beypore terminal.

7.7 Vessel Costing

7.7.1 Capital Cost

The deployment of ferry for tourism would be by 3rd party tour operators. However, this aspect needs some careful scrutiny with respect to the safety features, gears and such other measures by which any mechanically propelled inland vessel, identified as special category vessel, shall comply with and be equipped in accordance with the categorisation of such vessel. All the vessels thus proposed for its deployment by the boat operators are to be approved by Classification society and other statutory bodies for safety.

Since the vessels shall be deployed by the third party, IWAI would not make any investment in acquiring vessel or operating it. Hence, Capital Cost of the vessel is not part of financial analysis or project cost calculation. The indicative ferry acquisition cost, as ascertained from the Market, is being furnished herewith. The recommended specification of passenger ferry that can be deployed in River WCC (NW-3) for tourism and passenger movement is as follows.

- ✓ Market Price for steel boat – Approx. INR 90 Lakhs
- ✓ Size (L x B x D) – 15m x 1.9m x 0.7m, 25pax
- ✓ Engine - 1 Marine Outboard Engines of 120 hp each.
- ✓ Market Price for FRP boat – Approx. INR 75 Lakhs
- ✓ Size (L x B x D) – 15m x 1.9m x 0.4m, 25pax
- ✓ Engine - 1 Marine Outboard Engines of 90 hp each.

7.7.2 O&M Cost

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

1 Passenger Vessel (For 1 Year)

- 1 passenger vessel Running cost for 300 days operation with 0.6 Hrs mobility in a cycle and having 12 cyclic maximum operation in a day, cost per annum will be as detailed.
- 3600 cycles x 0.66 Hrs x {0.16 Litre per hour x 1Engines x 150 Bhp} x INR 97 per Litre =

  INR 55.31Lakhs Per Annum.
- 2 Nos. Crew on 1 passenger vessel @ INR 0.50 Lakhs per month.
- Crew cost for 12 months will be 12 x 2 x 0.5 = **INR 12 Lakhs Per Annum** per Unit.
- Repair Cost for **steel boat** is @ 2 % P. A of CAPEX i.e., 0.02 {1 x 120} = **INR 2.4 Lakhs Per Annum**
- Repair Cost for **FRP boat** is @ 1% P. A of CAPEX i.e., 0.01 {1 x 75} = **INR 0.75 Lakhs Per Annum**
- Depreciation is proposed by considering the life of vessels as 20 Yrs.
- Interest factor is proposed as per the industry norms.
- Insurance factor is proposed as per the industry norms.

CHAPTER 8 NAVIGATION AND COMMUNICATION SYSTEM

8.1 General Requirements

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

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

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

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

8.1.1 VHF / HF

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

8.1.2 GPS

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

8.1.3 RIS / AIS / Radar / VTMS

RIS is a concept for harmonised information services which supports traffic and transport management in inland navigation, including interfaces to other transport modes.
The general technical solution is depicted in Figure below.

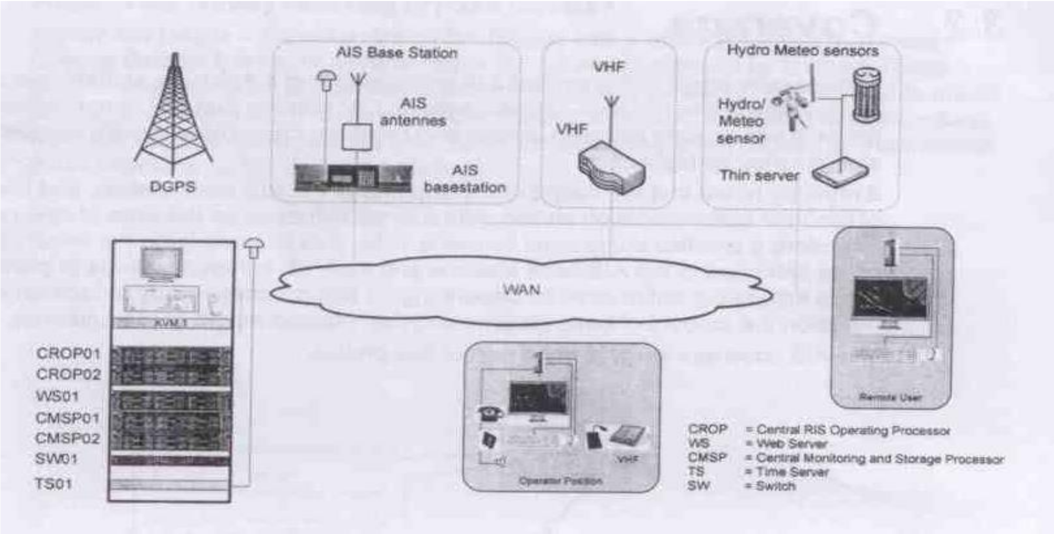
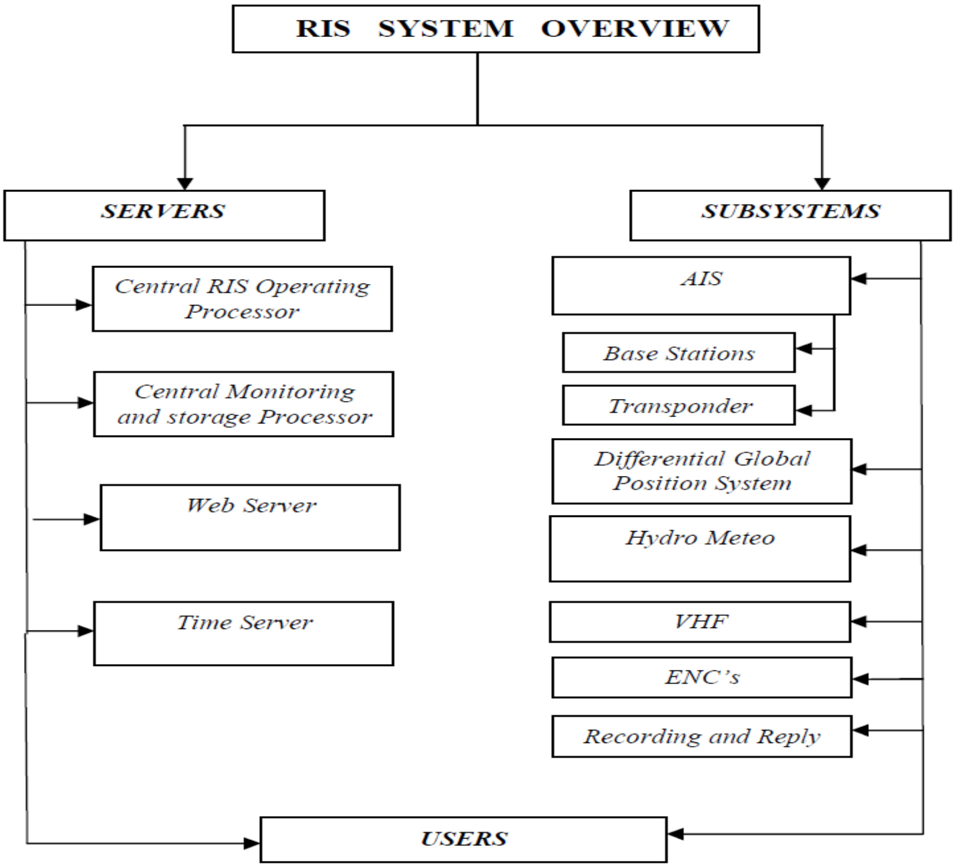


Figure 8-1: Main components of the RIS system are given below in flowchart:



Servers

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

CROP (Central RIS Operating Processor)

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

CMSP (Central Monitoring and Storage Processor)

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

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

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

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

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

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

Recording and Replay

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

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

The recording and replay system can be used for:

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

Additional requirement

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

Users

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

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

The following users/ roles are:

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

8.1.4 Vessel / Hydrographic Survey equipment

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

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

8.2 Existing System

IWAI is already having the communication system on NW 1 / NW 2 along with Day / Night Navigation system which have been developed considering the AIS and DGPS stations. Further, the adaptable Digitized charts are already being used linked with Survey Equipments viz., Echo-sounders and GPS with a provision for updating the charts. Provision also is under consideration to link up with the Day / Night Navigation Buoys. However, the present NW 3 is yet to be developed with a communication system. NW 3 Extension is linked with the present stretch of NW 3 and also linked with NW 8; NW 9 and NW 59 and it is very much essential to have exclusive communication system and also such requirement is to be justified before implementation with critical analysis.

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. A comprehensive communication system may have to be established, in the long run, as per the requirement / on need basis, interlinking the existing NW 3 / NW 8 / NW 9 / NW 59, if justified.

8.4 Costing

8.4.1 Capital Cost

Regarding the Navigation & Communication System, it was observed that the same is not cost effective and not recommended.

8.4.2 O&M Cost

The operation & Maintenance expenditure has been considered as at Annexure 11.1 and as per the industrial standards.

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 West Coast Canal or National Waterway No 3 is a 169km stretch of inland navigational route located in Kerala, India and runs from Kollam to Kottapuram and was declared a National Waterway in 1993. It has been extended to Kozhikode as per National Waterways Act, 2016.

NW-3 passes through Periyar river, Karuvannur river, Beeyam Kayal river, Bharathapuzha river, Kadalundi river, Chaliyar river and Mampuzha river. The integrating points of canal and the said rivers are in the vicinities of Arabian Sea mouths at eight different locations including start and the end of the canal. The Ponnani and Beypore Port are located along the West Coast Canal. Ponnani Port is predominantly used for fishing activities and Beypore Port is utilized for Cargo transportation.

The present project covers the stretch comprising extension of NW-3 from Kottapuram till Kozhikode. It starts from Kottapuram in Thrissur District Lat 10°11'38.32" N / Long 76°12'04.39" E and ends at Kozhikode in Kozhikode District Lat 11°13'38.83" N / Long 75°46'43.90" E of Kerala State. The total length of the NW-3 from Kottapuram to Kozhikode is about 169 km. The waterway covers the districts of Kozhikode, Malappuram, and Thrissur in its catchment.

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

9.2.1 Physiography

Kerala State is situated between 8º8' and 18º48' North latitude and 74º4' to 77º50' 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 38,863 sq km, 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 it 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 acuminata)*, 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.

(Sources:
http://shodhganga.inflibnet.ac.in/bitstream/10603/87093/9/09_chapter%204.pdf)

Thrissur District

Thrissur District is in the central region of Kerala State lying between 10º10' and 10º46' north latitude and 75º57' and 76º54’ east longitudes. Based on the topographical pattern, the District is divided into three natural regions, viz. Low land, Midland and High land regions. Kodungallur, Thalikkulam Mathilakam and Chavakkad Blocks belong to the low land region, Irinjalakuda, Cherpu, Anthikkad, Thrissur, Puzhakkal, Mullassery, Kunnamkulam, Chowannur Blocks belong to mid-land region and Chalakudy, Ollukkara, Kodakara and Pazhayannur Blocks belong to High Land regions. (Source: Brief Industrial Profile of Thrissur District, 2015-16, Ministry of MSME, Government of India)

Malappuram District

Like most of the other districts of the state, Malappuram too consists of three natural divisions; lowland, midland and highland. The low land stretches along the sea coast, the midland in the centre and the highland region towards the east and north eastern parts. The topography of the district is highly undulating; starting from the hill tops covered with thick forests on the east along the Nilgiris, it gradually slopes down to the valleys and the small hills, before finally ending on the sandy flat of luxuriant coconut groves in the west.

The district has more or less the same climatic conditions prevalent elsewhere the state, viz. Dry season from December to February, hot season from March to May, the Southwest Monsoon from June to September and the North East Monsoon from October to November. The South West Monsoon is usually very heavy and nearly 75% of the annual rains is received during this season. The climate is generally hot and humid; the range of temperature varying between 30° C and 20° C. The average annual rainfall is 2900 mm.

Four important rivers of Kerala flow through Malappuram district. They are, Chaliyar (Beypore river), Kadalundipuzha, Bharathapuzha and Tirurpuzha. Chaliyar has a length of 169 km and originates from Illambalieri hills in Tamilnadu. Important tributaries of this river are Chalipuzha, Punnapuzha, Pandiyar, Karimpuzha, Cherupuzha and Vadapurampuzha. Chaliyar traverses through Nilambur, Mampad, Edavanna, Areekade, Vazhakkad and flows into the sea at Beypore in Kozhikode district. Kadalundipuzha is formed by the confluence of two rivers, the Olipuzha and Veliyar. Olipuzha originates form Cherakomban hill and Veliyar from Erattakomban hill.

They flow by the wild of Silent Valley and traverse through Ernad and Valluvanad regions, before flowing into the sea at Kadlundi Nagaram. It passes through places like Melattur, Pandikkad, Malappuram, Pankkad, Parappur, Kooriyad and Tirurangadi. Kadalundipuzha has a circuit course of 130 kms. Bharathapuzha the Second longest river in Kerala, flows by the southern border of the district and drains into the sea at Ponnani. Its main tributary, Thoothapuzha, originates form the Silent Valley, flow through Thootha, Elamkulam, Pulamanthole and joins the main river at Pallippuram. After a course in Palakkad and Thrissur districts, the Bharathapuzha again enters Malappuram district at Tiruvegapura and from Kuttippuram onwards, the river belongs entirely to Malappuram. Tirurpuzha, 48 km. long, originates from Athavanad hills in Tirur town and flows south west, parallel to the sea, until it joins the Bharathapuzha near Ponnani port.

Of these rivers, only Chaliyar is perennial; all others get dried up in summer and hence Malappuram district is prone to draught. In Tirur and Ponnani taluks, kayals (backwaters) like Biyyamp, Veliyancode, Manur, Kodinhi etc offer fishing and navigation facilities.

(Source: http://www.stateofkerala.in/districts/malappuram.php)

Kozhikode District

The physiographic divisions of Kozhikode district from west to east are viz., coastal plain - low land (<7.6 m amsl), mid land (7.6 to 76 m amsl) and high land – hilly terrain (above 76 m amsl).

The coastal plain is very narrow, 5 – 10km wide, gently sloping with a maximum height of about 10m in the east. It comprises depositional landforms of marine, fluvial and fluvio-marine origin. There is a well-developed beach all along the coast with sea cliffs and rocky beaches near Quilandy, Elattur and Kappad. The low land extends as a narrow stretch of land lying along the coast from South Kadalundi to North Mahe. The plain is interrupted by steep laterite cliffs and rock outcrops. The low land forms 6.7% of the total area of the district.

The midland area lies at a height between 7.6 and 76 m amsl. It may be further classified into low rolling terrain and moderately undulating terrain.

The low rolling terrain has a slope of less than 15%. It consists of rolling laterite hills surrounded by valleys. The valleys are flood plain alluvium and red loamy soil. The moderately undulating terrain covering large area of the district has a slope between 15 and 25%. In addition to the agricultural crops of paddy and coconut, cash crops like rubber and arecanut are cultivated.

Area with elevation above 76 m amsl is called the highland. It is in the eastern part of the district. The area is prone to landslides and land slips and comprises of steep slopes and barren rocks. The highest elevation of the district is 1935 m amsl at Nilamala in northeastern corner of the district.

The Kozhikode district is drained by six rivers of which one is of medium nature and all others are minor ones namely Chaliyar, Kuttiyadi, Mahe, Kadalundi, Kallayi and Korapuzha. The Chaliyar River is a medium river and originates at a height of 2066 m amsl in Ilambalari hills of Western Ghats of Gudallur district, Tamil Nadu.

The Chaliyar drains in to Beypore estuary. It is a sixth order stream with a length of 169 km. At its upper reaches it is formed by Punnurpuzha, Pandiyur, Karimpuzha, Cherupuzha, Kanhirampuzha, Kurumbanpuzha, Vathatpurampuzha & Iruvantipuzha. At its lower reaches near Cheruvannur, it is flowing as a broad river developing inlets.

(Source: District Survey Report of Minor Minerals, Kozhikode District, Department of Mining and Geology, Government of Kerala, November 2016)

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)

Thrissur district can be broadly divided into four geological units viz. (i) Charnockite belt which is widespread and most prominent in the district; (ii) Gneissic belt represented by biotite gneiss, hornblende-biotite gneiss and quartzo-feldspathic gneiss, (iii) Granitic gneiss (PGC) restricted to the south eastern part and (iv) the Quaternaries of the coastal tract.

Pink granite (granite gneiss) of Peninsular Gneissic Complex is seen along the south eastern border, the major part of which extends to the adjacent Idukki district in the east. The rock is seen to occur interbanded with the associated rocks. It consists of varying proportions of orthoclase, plagioclase, quartz, green hornblende and brown biotite.

Calc-silicate rock belonging to the Khondalite group occurs as small outcrops near Vadakkethara in the north eastern part of the district. The distribution in the area is very limited and it occurs as thin bands within the charnockite. Charnockite is the widespread rock of the area. It is generally massive but when foliated has a gneissic look. Varieties like medium- and coarse-grained, highly feldspathic and migmatitic are also not rare. Pyroxene granulite, a member of the Charnockite Group, occurs as thin bands enclosed by charnockite and/or biotite gneiss. These bands are a few metres in width and a few tens of metres in length.

Biotite gneiss of Migmatite Complex is next to charnockite in abundance. This is the major rock in the western part extending from Thrissur in the north to Kottapuram in the south. Small lenticular bodies of biotite gneiss are seen within the charnockite terrain as well. The rock is well foliated and is characterised by banding due to alternate foliae rich in biotite and quartzo-feldspathic material. In places they tend to become massive and granitic. The other members of the Migmatite Group namely quartzo-feldspathic gneiss and hornblende biotite gneiss have restricted distributions.

Fairly large area around Vellani Mala and Peechi are occupied by hornblende-biotite gneiss. The major part of the quartzo-feldspathic gneisses seen as linear band in the north eastern part is extending to adjacent Palakkad district in the east. Linear bands of this rock is seen in the south eastern part also. Near Ambalapara in the south eastern part there is a quartz syenite acid intrusive body. It is leucocratic, medium- to coarse-grained, medium- to coarse-grained, composed of feldspars with rare green pyroxene. Dolerite and gabbro dykes are seen cutting across these older rocks and are generally aligned in NNW-SSE trend. Pegmatites and quartz veins occur within the charnockite and gneisses, mostly as fracture fillings.

They are of small dimension and show no concentration in specific locality. A small patch of Warkalli bed is seen near the coast in the northern part. Unconsolidated Quaternary sediments overlie these basements unconformably. The sediments are classified into different morphostratigraphic units based on their lithic content and environment of formation. Guruvayur Formation is an older marine deposit while Periyar Formation, Viyyam Formation and Kadappuram Formation are the contemporary fluvial, fluvio-marine and marine deposits.

(Source: District Survey Report of Minor Minerals, Thrissur District, Department of Mining and Geology, Government of Kerala, November 2016)

Malappuram district can be divided into two geological belts: (i) Charnockite group of rocks covering a major part and (ii) Migmatite Complex towards the east.

Wayanad group is represented by small bodies of metaultramafites (tal-tremolite schist, talc-pyroxene-garnet schist, banded magnetite quartzite) and high-grade schist and gneiss (hornblende-biotite schist and gneiss+garnet with amphibolite band) which extends into Tamil Nadu where it is known as Sathyamangalam Group.

The rocks of Peninsular Gneissic Complex, represented by granite gneiss and hornblende-biotite gneiss, form the next younger sequence. They have a very limited distribution near the eastern boundary. They have a very limited distribution near the estern boundary, extending into the adjacent district where they are known as Bhawani Group. A linear band of granite gneiss NE of Perinthalmanna and a large body of hornblende-biotite gneiss east of Manjeri are prominent units.

Charnockite Group includes charnockite/charnockite gneiss, having the largest areal distribution, followed in decreasing order of abundance by banded magnetite quartzite, pyroxene granulite, amphibolite/hornblende granulite and pyroxenite, which occur as concordant as well as discordant bands, lenses, layers and enclaves both within charnockite as well as within gneisses of Migmatite Complex.

The Migmatite Complex is represented by biotite-hornblende gneiss (or hornblende-biotite gneiss) and quartzo-feldspathic gneiss/garnet-biotite gneiss with enclaves of garnet-sillimanite gneiss+graphite distributed mostly in the central and northeastern part. Pegmatite and quartz veins constitute the acid intrusives, whereas gabbro and dolerite are basic intrusives. Near the coast, isolated cappings of Neogene Warkalli sediments comprising grit and clay beds are noticed. Lateritisation is widespread, at places attaining a thickness of more than 10m. Extensive plateaus with laterite 'mesas' are common in the area. Angadipuram (west of Perinthalmanna), the type locality of laterite falls in this district. Quaternary unconsolidated sediments are restricted to the coastal plain. They have been classified into different morpho-stratigraphic units based on their lithic content and environment of formation.

(Source: District Survey Report of Minor Minerals, Malappuram District, Department of Mining and Geology, Government of Kerala, November 2016)

Kozhikode district can be divided into three geological belts viz., (i) a linear NW-SE trending gneissic belt, along the middle extending from north to south, (ii) a charnockite belt occupying areas in the northeast and south, extending to the adjacent districts and also occurring as pockets within the gneissic terrain and (iii) a narrow coastal belt.

Granite gneiss belonging to the Peninsular Gneissic Complex is the oldest unit of the area and occurs north of Alampore. Charnockite belonging to the Charnockite Group has a very wide distribution, especially in the northeast and south with variations like biotite-hypersthene gneiss, biotite-hornblende-hypersthene gneiss and hornblendehypersthene gneiss. Magnetite quartzite, another unit of this group, occurs as narrow linear bodies within charnockite. Hornblende-biotite gneiss of the Migmatite Complex extends from north to south and is well foliated. Garnetiferous quartzo-feldspathic gneiss, another member of Migmatite Complex, occurs as lenses within charnockite, in the east.

Pebble beds occur on the coast and along banks of the Beypore river. The pebble bed is associated with grit and clay and it is lateritised. It comprises well rounded pebbles of quartz, granite, quartzite and granulite. It is considered to be of Pleistocene origin. Sporadic laterite is recorded from the charnockite country to the southwest. Quaternary deposits are of marine and fluvial origin. Periyar Formation is a fluvial deposit comprising an admixture of sand, silt and clay. Guruvayur Formation is a strand line deposit of palaeo-marine origin and mostly comprises medium to fine sand. Kadappuram Formation represents contemporary marine deposits, constituting the present and barrier beach.

(Source: District Survey Report of Minor Minerals, Kozhikode District, Department of Mining and Geology, Government of Kerala, November 2016)

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)

As per the seismic zoning map of India, the project area of NW-3 falls in Zone III.

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 continued 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)

Thrissur district is characterized by wet type of climate and four types of seasons are identified. The hot summer season from March to May, the southwest monsoon season from June to September, the northeast monsoon season from October to December and a general cool and salubrious climate period during climate period during January and February.

The average annual rainfall ranges between 2310.1 and 3955.3 mm in the district with mean annual rainfall of 3198.133 mm. The maximum rainfall occurs during the period June to September (SW monsoon) and nearly 71.24% of the total rainfall is received during the season. 16.27% of the total rainfall is received during North East monsoon between October and December, 12.1% of the total rainfall is received during March to May and the balance 0.37% is accounted for during January and February months.

The maximum temperature ranges from 29.3 to 36.2^{0}C whereas the minimum from 22.1 to 24.9^{0}C. The average annual maximum temperature is 32.3^{0}C and minimum temperature 23.3^{0}C. Generally, March and April months are the hottest and November, December, January and February months are the coldest.

The humidity is higher during monsoon months from June to October and is around 93% during morning hours and 76% during evening hours.

(Source: District Survey Report of Minor Minerals, Thrissur District, Department of Mining and Geology, Government of Kerala, November 2016)

Malappuram district has more or less the same climatic conditions prevalent elsewhere in the State viz. dry season from December to February and hot season from March to May, the South-West monsoon from June to September and the North-East monsoon from October to December. The normal rainfall of the district is 2793.3 mm. Out of this, major rainfall contribution is from SW monsoon followed by the NE monsoon. The South West monsoon is usually very heavy and nearly 73.5% of the rainfall is received during this season. NE monsoon contributes nearly 16.4% and March to May summer rain contributes nearly 9.9% and the balance 0.2% is accounted for during January and February months.

The climate is generally hot and humid. March and April months are the hottest and January and February months are the coldest. The maximum temperatures range from 28.9 to 36.2°C and the minimum temperatures range from 17.0 to 23.4°C. The temperature starts rising from January and reaches the peak in the month of March and April and then decreases during the monsoon month and again rising from September onwards.

The relative humidity ranges from 84 to 94 % during morning hours. The humidity is more during the peak monsoon months from June to September.

(Source: District Survey Report of Minor Minerals, Malappuram District, Department of Mining and Geology, Government of Kerala, November 2016)

The climate of **Kozhikode district** is divided into four seasons – summer, South West Tropical Monsoon period, North East Tropical Monsoon period and winter. The SW and NE monsoons mainly contribute rainfall in the area with 82.77 % of the rainfall. The month of June experiences maximum rainfall. The months of July, August and October also receive heavy rainfall. The minimum temperature ranges between 22 and 25.8º C and the maximum between 28.2 and 32.9º C. The temperature reaches its peak in the month of April and attains minimum in January.

(Source: District Survey Report of Minor Minerals, Kozhikode District, Department of Mining and Geology, Government of Kerala, November 2016)

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 Thrissur District

The soils in Thrissur district have been classified in the following types, based on the morphological features and physiochemical properties.

The Laterite Soil

The predominant soil type observed is the lateritic soil, which covers almost the entire midland areas of the district. These soils are in general well drained, low in essential plant nutrients and organic matter. They exhibit very low cation exchange capacity and are generally acidic.

Brown hydromorphic soils

The second prominent soil type is the brown hydromorphic soil. These are confined to the valleys between undulating topography in the midlands and in the low lying areas of the coastal strip in the district. These have been formed as a result of transportation and sedimentations of materials from adjoining hill slopes and also by deposition from rivers. The soils are very deep and brownish in colour. The surface texture varies from sandy loam to clay.

Hydromorphic Saline Soils

Very small patches of hydromorphic saline soils are found in the coastal tracts of the district. They are brownish, deep and imperfectly drained, showing wide variation in texture. In the estuarine areas of the district, these soils are found with wide fluctuations in the intensity of salinity.

Coastal Alluvium

These soils are seen on the coastal tracts stretching from Kodungallur to Chettuvai. These have been developed from recent marine deposits with a texture dominated by partially sorted sand fraction. They are excessively drained with very rapid permeability. Water holding capacity of these soils is low.

Riverine Alluvium

These soils consist of moderately well drained and distributed mainly on the banks of rivers and their tributaries. They are light to medium textured with good physical properties and contain organic matter, nitrogen and potash moderately. They show wide variations in their physic-chemical properties. They are very deep soils with surface texture ranging from sandy loam to clayey loam, predominated by the fine sand fractions.

Forest Loamy Soil

These soils are found in the south-eastern hilly areas of the district, bordering Tamil Nadu. These are characterized by a surface layer very rich in organic matter. They are dark reddish brown to black with loam to silty loam texture. The soils are generally acidic.

(Source: District Survey Report of Minor Minerals, Thrissur District, Department of Mining and Geology, Government of Kerala, November 2016)

Soils of Malappuram 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 Malappuram district into four types viz. alluvial soil, lateritic soil, hydromorphic soil and forest loamy soil.

Alluvial Soil

Alluvial soil is mainly seen along the coastal plains and valleys. The soils range from exclusively drained to moderately/well drained sand to sandy clay in nature.

Laterite Soil

Lateritic soil is seen along the mid land portion of the district. These are deep to very deep, well drained, and gravelly to clayey.

Hydromorphic Soil

Hydromorphic soil comprises deep moderate, well drained and clayey soils with high gravel content. Erosion is moderate to severe. Hard laterites with rock out crops are present.

Forest Loamy Soil

Forest loamy soil is deep or very deep and well drained with loamy to clayey textures and having fairly high gravel content.

(Source: District Survey Report of Minor Minerals, Malappuram District, Department of Mining and Geology, Government of Kerala, November 2016)

Soils of Kozhikode District

The soils of Kozhikode district are alluvial soil, lateritic soil and forest loam.

Alluvial Soil

Alluvial soil is seen mostly along the coastal plain and valley. They are coastal alluvial soil and river alluvial soils. They are excessively drained to moderately drained and are of sandy to clayey textures. Majority of the area under riverine alluvium was once occupied by paddy cultivation. But those areas are now utilised for the cultivation of various crops especially plantain. The riverine alluvium contains moderate organic matter, nitrogen, phosphorous and potash.

Lateritic soil

Laterite soil is derived from the laterite under tropical climate with alternate wet and dry conditions. It is reddish in colour and well drained gravelly to clayey. They are found mostly along the midland portion of the district. The organic matter in the soil is very less with moderate nitrogen, phosphorous and potash. The pH of soil ranges between 5.5 and 6.5 and texture is clayey loam to silty loam with 5 to 20% coarse fragments. Laterites on high grounds are more compact when compared to the low-lying areas.

Forest Loamy Soil

Forest loam is deep or very deep and well drained loamy to clayey textures. They are rich in organic atter, nitrogen and humus. Forest loam is dark reddish brown in colour formed by weathering under forest cover with loamy to silty loam texture. The pH of the soil ranges between 5.3 and 6.3 and is slightly acidic in nature.

(Source: District Survey Report of Minor Minerals, Kozhikode District, Department of Mining and Geology, Government of Kerala, November 2016)

9.2.5 Land Use Pattern

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

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 Thrissur District

Major part of the district is covered by arable land which includes both irrigated and unirrigated land. In the valleys and low-lying areas paddy is cultivated while in the high ground coconut is the main crop. Next to arable land comes the forest land which is widespread in the eastern part. Natural forests in many places are replaced by plantations. Rubber and cashew are the major plantation crops of the area. There are some pockets of waste land with thick capping of hard laterite.

(Source: District Survey Report of Minor Minerals, Thrissur District, Department of Mining and Geology, Government of Kerala, November 2016)

The land use pattern in Thrissur district showing the classification of land in 15 categories as published by the Department of Economics and Statistics (DES), Government of Kerala, is given below in Table 9-1.

Table 9-1: CLASSIFICATION OF AREA ON THE BASIS OF LAND UTILISATION IN THRISSUR DISTRICT

S. No.	Particulars	Area (Ha)
1	Total Area	3029.19
2	Forest Area	1036.19
3	Land put to non-agricultural use	367.07
4	Barren and uncultivable land	2.47
5	Permanent pastures and grazing land	0.05
6	Land under miscellaneous tree crops	3.5
7	Cultivable waste	67.66
8	Fallow other than current fallow	63.64
9	Current Fallow	131.39
10	Marshy land	0.04
11	Still water	80.82
12	Water logged area	2.8
13	Social forestry	1.71
14	Net sown area	1271.85

S. No.	Particulars	Area (Ha)
15	Area sown more than once	340.31
16	Total cropped area	1612.16

Source: District Census Handbook, Thrissur, Part XII A, Series 33, Directorate of Census Operations, Kerala, Census of India, 2011.

Land Use in Malappuram District

Broadly, four types of land use can be seen in the district. A large part of the area, especially the coastal tract and the midland areas come under arable land, used for cultivation of different crops, both irrigated and non-irrigated. The coastal tracts are densely inhabited. Forests are seen along the east and north, forming part of tropical evergreen forest supporting a variety of plant and animal life. Cashew and rubber are the main commercial crops of the area. The thick laterite 'duricrust' capping the hillocks generally does not support any vegetation, hence such areas are demarcated as wasteland.

(Source: District Survey Report of Minor Minerals, Malappuram District, Department of Mining and Geology, Government of Kerala, November 2016)

As per the District Census Handbook, Malappuram, based on 2011 Census, data on the land use pattern of the District for the year 2010-11 shows that out of a total geographical area of 3554.46 sq km, forest occupies 1034.17 sq km constituting 29% and land under non-agricultural use is 12.50 per cent in 2010-11. The land use pattern in Malappuram district showing the classification of land in **15** categories as published by the Department of Economics and Statistics (DES), Government of Kerala, is given below in Table 9-2:

Table 9-2: CLASSIFICATION OF AREA ON THE BASIS OF LAND UTILISATION IN MALAPPURAM DISTRICT

Sl No.	Particulars	Area (Ha)
1	Total Area	3554.46
2	Forest Area	**1034.17**
3	Land put to non-agricultural use	**444.39**
4	Barren and uncultivable land	**12.40**
5	Permanent pastures and grazing land	**0.00**
6	Land under miscellaneous tree crops	**3.84**
7	Cultivable waste	**60.41**
8	Fallow other than current fallow	**62.75**
9	Current Fallow	**89.82**

Sl No.	Particulars	Area (Ha)
10	Marshy land	0.01
11	Still water	60.82
12	Water logged area	0.64
13	Social forestry	1.80
14	Net sown area	1783.41
15	Area sown more than once	591.33
	Total cropped area	2374.74

Source: District Census Handbook, Malappuram, Part XII A, Series 33, Directorate of Census Operations, Kerala, Census of India, 2011.

Land Use in Kozhikode District

The land use pattern in Kozhikode district showing the classification of land in 15 categories as published by the Department of Economics and Statistics (DES), Government of Kerala, is given below in Table 9-3:

Table 9-3: CLASSIFICATION OF AREA ON THE BASIS OF LAND UTILISATION IN KOZHIKODE DISTRICT

S. No.	Particulars	Area (Ha)
1	Total Area	234641
2	Forest Area	41386
3	Land put to non-agricultural use	26577
4	Barren and uncultivable land	788
5	Permanent pastures and grazing land	0
6	Land under miscellaneous tree crops	130
7	Cultivable waste	2232
8	Fallow other than current fallow	665
9	Current Fallow	2602
10	Marshy land	5
11	Still water	3879
12	Water logged area	382

13	Social forestry	35
14	Net sown area	155960
15	Area sown more than once	45901
	Total cropped area	201861

Source: District Census Handbook, Kozhikode, Part XII A, Series 33, 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-3 comprising residential use, agricultural land with paddy and coconut trees, fishing and ferry jetties, and transmission lines and towers. The chainage wise details of land use and land cover along the entire NW-3 stretch is provided in the hydrographic survey report prepared as part of the present DPR.

Detailed analysis of Land Use / Land cover in the project area is to be taken up as part of the EIA study to be carried out for the project by IWAI.

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 these vehicles are severe 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 2.5lakh 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)

Limited relevant secondary data on ambient air and noise quality is available for the project area.

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

Surface water quality analysis has been done at 18 sample locations in the project stretch as part of the hydrographic survey carried out for the present DPR study. The pH value for all the 18 locations has been found to be either close to or over 7, which indicates the alkaline nature of water in the NW-3 stretch under consideration.

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 insecticids 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 charecteristics of wells in Kerala are found to be affected by chemical and biological contaminants. The ground water quality problemas in the coastal areas are mainly because of the presence of excess chloride. The chloride concentration >250mb/l was detected in the well water samples of Azhicode, Kakkathuruthy, Edathinjil, Kadalundi, Chellanum, nallalam, Mankombu and Haripad.

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).

Primary data on water quality monitoring in the project area is to be collected as a 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 and 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)

Further analysis relating to susceptibility of the project area to natural hazards is to be taken up during the course of the EIA study to be carried out separately by IWAI.

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. Man made 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 Ministry of Environment, Forests and Climate Change, 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 notification imposes certain restrictions on the setting up and expansion of industries, operations or processes and the like in the CRZ.

The entire NW-3 project area falls under the tidal zone. Accordingly, the proposed project will require clearance under the CRZ Notification 2011.

9.2.10 Archaeological and Heritage Locations

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

The proposed stretch of NW-3 passes through three districts viz. Thrissur, Malappuram and Kozhikode. As per the information available on the website of the Department of Cultural Affairs, Government of Kerala, there are 50 State Protected Monuments in Thrissur district, nine (09) State Protected Monuments in Malppuram district and eight (08) State Protected Monuments in Kozhikode 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 three districts is provided in Table 9-5 to Table 9-7 below.

TABLE 9-5: STATE PROTECTED MONUMENTS LOCATED IN THRISSUR DISTRICT, KERALA

Sl. No.	Name of the Monument
1	Porkalam Dolmens
2	Images of nagaraja and nagayakshi under a Saptaparna tree in the Vadakkechira palace compound
3	Three Monuments in Palace Toppu (Vadakkechira Palace compound)
4	Palace site - Palace of the Chermaan Perumal portion around the state monument
5	Arryanur Temple
6	Nedudumkotta or Travancore line
7	Monolithic Monument
8	Western Gateway & Eastern Gateway, Vadakkechira Palace
9	Tipu's flag staff and land around it, Vadakkechira Palace
10	A Dolmen in Anapanthen, Kodassery Forest range
11	A Dolmen in Puthupara in Kothermuzhi
12	A Dolmen in South of Tram line in Puthupara

Sl. No.	Name of the Monument
13	One Muniyara with side rooms near Myldappan
14	An idol of Ganapathi at Elicode
15	A ruined temple deducted to Vishnu in Bharathamala in Thrikkur beat
16	An idol of Shiva & a circular well in Bharathamala
17	Munipara at Kodassery
18	Various Muniyara's at Chendrayi, Konnamkuzhinkara, Adirapilly, Vailathu thandu, Erappanpara, Velathumpara, Thoduikadu, Adukkalappara, Vettilapara, Vaniyampara road, Kapikad, Perumthumba, Thalikuzhi
19	Rock cut cave near Irumban, Nenmara
20	A dilapidated Shiva temple in the Athanad Hill
21	Site of Bana's fort and Shiva temple Panancheri
22	Two Muniyaras in Kudanthodu in assigned
23	One Shiva Temple in Elanad village
24	One Shiva temple in reserves in Chelakkara beat
25	Muniyaras in the reserves in Pullanparatha in Vazhani beat
26	Muniyaras on the ridge top in Mukkunnipara reserve in Kallampara beat
27	Muniyaras on the ridge top in Cheppara reserves in Kallampara beat
28	A dilapidated Sastha temple in Ayyappankunnu
29	Vattazhuthu inscriptions at Thazakkad Church, Kalletukara
30	Mukundapuram temple including the Fort ditches and foundations of ancient buildings within the area
31	Menhir
32	Prehistoric cave, Kottappuram
33	Megalithic Monument, Puzhakkal
34	Port hole cist, Karlom
35	Trikkur Rock Cut Mahadeva Temple
36	Kottappuram Fort
37	Irunilacode Rock Cut Siva Temple
38	Old Fortification, Vadakkechira
39	Megalithic Monument near the T.B. Hospital site
40	Sakthan Thamburan Palace
41	Ancient House of Arnos Pathiri Veloor St. Francis Xavier and Forance Church
42	Kothalikunnu Cave
43	Thalinedumprayoor Siva Kshetram & Kshetrkulam
44	Chettuvakotta, Chavakkad
45	Kodungalloor Valiya Thamburam Kovilakam Kottaram
46	St.Mary's Church, Kalparambu
47	Kollamcode Palace
48	The Birth house of Freedom fighter Muhammad Abdul Rahman Sahib
49	Chirakkal Palace
50	Erattachira Kovilakam

Source: http://www.keralaculture.org/keralaasi-protected-mounments/628

TABLE 9-6: STATE PROTECTED MONUMENTS LOCATED IN MALAPPURAM DISTRICT, KERALA

Sl. No.	Name of the Monument

1	Sri.Venkitta Thevar Temple (Siva Temple, Kottakkal)
2	Changanpally Kalari, Pazhukkamandapam, Nilapad Thara, Marunnara & Manikkinar at Thirunavaya
3	Eravimangalam Sri Subrahmanya Swami Kshethram
4	Tirurangadi Taluk Office Building
5	Willam John Dunckown Rawls Tomb
6	Sub Registrer Office Tirurangadi
7	Triprangode Maha Siva Kshesthram
8	Sri Karikkad Subramanya Swami Temple
9	Perumpadappu Valiya Kinar, Ponnani

Source: http://www.keralaculture.org/keralaasi-protected-mounments/628

TABLE 9-7: STATE PROTECTED MONUMENTS LOCATED IN KOZHIKODE DISTRICT, KERALA

Sl. No.	Name of the Monument
1	Monuments indicating the first arrival of Vascoda Gama at Kappad
2	Kottakal Kunjali Marakkar's House
3	Tipu Sultan Fort (Paramukku Kottastnalam)
4	Kalpathoor Paradevatha Temple
5	Kunjali Marakkar Juma Palli, Kottakal
6	Cave, Maniyoor
7	Lokanarkavu Bhagavathy Temple
8	Old Sub Registrar Office Building Kuttiady

Source: http://www.keralaculture.org/keralaasi-protected-mounments/628

Prohibited and Regulated Areas with respect to protected monuments 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 in the above mentioned website (http://keralaculture.org/protected-monuments-asi/627), 15 of the 27 Centrally Protected Monuments in Kerala are located in Thrissur district. None of the centrally protected monuments are located in Malappuram and Kozhikode districts.

The list of Centrally Protected monuments in Thrissur district is provided in Table 9-8 below.

TABLE 9-8: CENTRALLY PROTECTED MONUMENTS IN THRISSUR DISTRICT

Sl. No.	Name of the Monument
1	Chemmenthitta Siva Temple
2	Kadavallur Vishnu Temple
3	Peruvanam Siva Temple
4	Pallimana Siva Temple
5	Thiruvanchikulam Siva Temple
6	Vadakumnathan Temple
7	Triprayar Sree Rama Swami Temple
8	Ariyannur Umbrella Site, Kandanassery
9	Kudakkallu Parambu, Chermanangand
10	Burial Cave, Chowannur
11	Burial Cave, Eyyal
12	Burial Cave, Kattakampal
13	Burial Cave, Kakkad
14	Burial Cave, Kandanassery
15	Avittathur Siva Temple

Source: http://keralaculture.org/protected-monuments-asi/627

No project activities are proposed in either the prohibited or the regulated areas relating to the above mentioned centrally protected monuments located in Thrissur district. Therefore, no clearance requirement is envisaged with respect to these structures.

9.2.11 Flora and Fauna

Flora

The Western Ghats region, wherein the state is situated, is one of the 25 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 9-9 below gives the details of the representation of different plant groups in the flora of Kerala.

TABLE 9-9: TOTAL NUMBER OF PLANT TAXA BELONGING TO DIFFERENT GROUPS RECORDED FROM KERALA

Sl. 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 34 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 9-10: 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 9-11: FAUNA ENDEMIC TO WESTERN GHATS-FOUND IN KERALA

Group	Nos.
Amphibians	61
Reptiles	57
Birds	16

9.2.12 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 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 9-12 below.

TABLE 9-12: 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 biopspheres reserves fall in other adjoining States too. The parts of the biosphere reserves falling in Kerala are delineated in Table 9-13 below.

TABLE 9-13: BIOSPHERE RESERVES IN KERALA

S.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)

S.No.	Name of Biosphere Reserve	Extent (sq km)	Forest Areas falling in Kerala
			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 and one Community Reserve in the State spread across an area of 3213.24 sq km, out of which, two WLSs 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 list of National parks and Wildlife sanctuaries in the State has been provided in Table 9-14 below.

TABLE 9-14: PROTECTED AREAS IN KERALA

Sl. No.	Name of WLS/NPs	G.O. No. & Date	Year of Formation	Total Area (Sq. km)

Sl. No.	Name of WLS/NPs	G.O. No. & Date	Year of Formation	Total Area (Sq. km)
	National Parks			
1	Eravikulam National Park	G.O.(MS)142/78 dated 19-05-1978	1978	97.0000
2	Silent Valley National Park	GO-5462/FSA3/82/AD dated 15.11.84	1984	237.5200
3	Anamudi Shola National Park	G.O.12876/F2/2003/F&WLD dated 14-12-2003	2003	7.5000
4	Mathikettan Shola National Park	GO(MS)No.50/2003/F&WLD dated 10-10-2003	2003	12.8170
5	Pambadum Shola National Park	G.O.12875/F2/2003/F&WLD dated 14-12-2003	2003	1.3180
	Tiger Reserves			
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	643.6600
7	Periyar Wildlife Sanctuary (Tiger Reserve)	F1-2854/AD dated 11-08-1950 G-11025/34/FRY(PT) dated 29-08-1977	1950	925.0000
8	Neyyar WLS	GO(MS)871/58 dated 06..08..1958	1958	128.0000
9	Peechi-Vazhani WLS	GO(MS)871/58 dated 06..08..1958	1958	125.0000
10	Wayanad WLS	GO(MS)182/73/AD dated 30..05..1973	1973	344.4400
11	Idukki WLS	GO.7898/FM3/76/AD dated 09.02.76	1976	70.0000
12	Peppara WLS	GO(P)379/83/AD dated 21..12..1983	1983	53.0000
13	Thattekkad B.S	GO.35743/FM3/83/AD dated 27..08..83	1983	25.0000
14	Shendurney WLS	GO(P)258/84/AD dated 25..08..1984	1984	171.0000
15	Chinnar WLS	GO(P)229/84/AD dated 04..08..1984	1984	90.4400
16	Chimmony WLS	GO(P)259/84/AD dated 25..08..1984	1984	85.0000

Sl. No.	Name of WLS/NPs	G.O. No. & Date	Year of Formation	Total Area (Sq. km)
17	Aralam WLS	GO(P)300/84/AD dated 15..10..1984	1984	55.0000
18	Mangalavanam Bird Sanctuary	G.O(MS) No.42/04/F&WLD dated 31..08..2004	2004	0.0274
19	Kurinjimala Sanctuary	G.O.(P)36/2006/F&WLD dated 06-10-2006	2006	32.0000
20	Choolannur Pea Fowl Sanctuary	G.O.(P) 24/2007/F&WLD dated 15-05-2007	2007	3.4200
21	Malabar Sanctuary	G.O (P) 26/2009 / F&WLD dated 05-06-2009	2009	74.2150
22	Kottiyoor Wildlife Sanctuary	G.O (P) 17/2011 / F&WLD dated 01-03-2011	2011	30.3798
	Community Reserve			
23.	Kadalundi-Vallikunnu Community Reserve	G.O(MS)No.66/2007/F&WL dated 17-10-2007	2007	1.5000
	TOTAL			3213.2372

(Source: http://www.forest.kerala.gov.in/index.php/wildlife/2015-03-16-09-50-24/introduction)

The list of protected areas located in the three districts through which the proposed NW-3 passes is provided in Table 9-15 below. As can be seen from the information provided in Table 9-15, clearance from the National Board for Wildlife shall be required w.r.t Kadalundi Vallikunnu Community Reserve as the project is located at distance of 2.57 km from the boundary of the Community Reserve. The ESZ for this protected area has not been defined and therefore, as per the existing regulatory framework, a radial distance of 10 km from the boundary of the protected area shall have to be considered for clearance purposes.

Table 9-15: PROTECTED AREAS W.R.T NW-3

Sl. No.	Name of Wildlife Sanctuary (WLS)	Co-ordinates of WLS		Extent of ESZ	Whether NW-3 passes through the WLS or its ESZ) : Yes / NO	Shortest Distance of the project from the boundary of ESZ
		Lat	Long			
1	Peechi - Vazhani WLS	10^0 27' 58.3'' N to 10^0 40' 29.4'' N	76^0 17' 35.23'' E to 76^0 29' 34.78'' E	Up to 2.98 km around the boundary of the WLS	NO	22.40 Kms
2	Chimmony WLS	10^0 22' 37.1'' N to 10^0 29' 52.4'' N	76^0 23' 39.6'' E to 76^0 34' 19.2'' E	Up to 3.69 km around the boundary of the WLS	NO	26.5 Kms
3	Chulannur	10^0 42' 33.1'' N	76^0 27' 21.6'' E	Up to 1 km	NO	54.3 Kms

Sl. No.	Name of Wildlife Sanctuary (WLS)	Co-ordinates of WLS		Extent of ESZ	Whether NW-3 passes through the WLS or its ESZ) : Yes / NO	Shortest Distance of the project from the boundary of ESZ
		Lat	Long			
	Peafowl WLS	to 10^0 43' 57.9'' N	to 76^0 30' 0.20'' E	around the boundary of the WLS		
4	Malabar WLS	11^0 44' N	76^0 20' E to 75^0 38' E	Up to 1 km around the boundary of the WLS	NO	End Point of proposed NW 3 project is at "Kozikode Town". The edge of the WLS is about 44 Kms North of the town.
5	Kadalundi Vallikunnu Community Reserve	$11^0$07'48.79'' N	$75^0$50'06.96'' E	ESZ is not defined for this WLS	YES Since ESZ is not defined for this protected area, a radius of 10 km from the boundary of the Community Reserve is to be considered for clearance purposes from the National Borad for Wildlife.	2.57 Kms

9.2.13 Socio-economic Profile

The proposed NW-3 project is located in three districts of Kerala namely Thrissur, Malappuram and Kozhikode.

Thrissur District

Thrissur District is in the central region of Kerala State lying between 10º10' and 10º46' north latitude and 75º57' and 76º54' east longitudes. It has Ponnani taluk of Malappuram district and Ottappalam taluk of Palakkad district on the north and Devikulam taluk of Idukki district and Kunnathunad, Aluva and Paravur taluks of Ernakulam district on the south. Alathur taluk of Palakkad district and Pollachi taluk of Coimbatore district of Tamil Nadu are on its eastern boundary while the Lakshadweep sea is on the west.

The present Thrissur district is a part of erstwhile Cochin state. The then Cochin state comprised of 10 Kovilakathumvathukkals (or taluks) viz. Cochin, Kanayannur, Cranganore (Kodungallur), Mukundapuram, Kodasseri, Talappilly, Chelakkara, Enamakkal, Thrissur and Chittoor. In 1860 the number of taluks was reduced. With effect from the 1st July 1949 a new district named Thrissur was formed with 6 taluks of the erstwhile Cochin State viz.

Talappilly, Chittoor, Thrissur, Mukundapuram, Cranganore and Cochin-Kanayannur and taluks of erstwhile Travancore areas, namely, Kunnathunad and Parur.

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 Revenue division, Taluks and Villages. Under the local administrative set up, the district is divided into statutory towns and panchayats. For the implementation of developmental activities panchayats are grouped under community development blocks.

The district comprises of a single revenue division – Thrissur, consisting of 5 taluks and 254 villages. Some of the revenue villages lie partly in towns and the remaining part in rural areas. The 5 taluks in the district are Talappilly, Chavakkad, Thrissur, Kodungallur and Mukundapuram.

Panchayati Raj in Kerala works on the basis of the three- tier system and comprises of the Grama Panchayats, Block Panchayats and District Panchayats.In Kerala, there are 992 Grama Panchayats, 152 Block Panchayats and 14 District Panchayats.

The area of the district is 3032.00 sq km and it constitutes 7.8 percent of the total area of the state (38862.87 sq km). It ranks the 5th among the districts in area.

The population of the District has increased from 2,974,232 in 2001 to 3,121,200 in 2011 with 1,480,763 males and 1,640,437 females. The district with 7.80 per cent of the total geographical area of the State accommodates 9.34 per cent of the total population.

The population of the District is divided between the urban and the rural areas in the ratio of 2:1 in 2011. The rural-urban ratio was also 3:1 in 2001. This indicates that there is major urbanization in the district during the period from 2001 to 2011. The urban population has increased from 839,433 in 2001 to 2096,406 in 2011 with the simultaneous decrease of the rural population from 2,134,799 in 2001 to 1,024,794 in 2011. The urban population has increased from 28.22 per cent to 67.17per cent during the period 2001 to 2011.

The urban population of Thrissur District is distributed in 7 Statutory towns, 128 Census towns and one outgrowth. All the Statutory towns in the District have 20,000 and above population. All the Census Towns except 6 towns Madathumpady CT, Kurichikkara CT, Thangalur CT , Kizhakkumuri CT, Eravu CT, Muringur Vadakkumuri CT in the District have 5000 and above population. The average size of a town in the District works out to 15,529 (22,950).

The rural population of the District, accounting for 32.83 per cent of the total population, is distributed in 98 villages of 5 taluks.

The present growth rate of the District is 4.9 percent which is the lowest during the last 100 years.

The overall density of population per square kilometre in Thrissur District is 1031 persons in 2011.

The sex –ratio of the District in 2011 is 1108 and the District has fourth position among the Districts in respect of sex-ratio.

In 2011 Census, the total, male and female work participation rate have slightly increased to 35.1 per cent, 53.3 per cent and 18.7 per cent respectively. As far as the work participation rate of Thrissur District is concerned, the District has the 9th rank both in 2001 and 2011.

In 2011, the literacy rate of Thrissur District is 95.08 per cent. It is higher than the literacy rate of the State (94 per cent). The rural literacy rate of the District is 93.68 per cent while the urban literacy rate is 95.76 per cent.

In the District, the three important predominant religious groups are Hindus, Muslims and Christians. Other religious communities such as Sikhs, Buddhists and Jains are insignificant, as their percentage to total population is very negligible. In 2011 Census, 18.23 lakhs population of Thrissur district are Hindus, 5.33 lakhs are Muslims and 7.57 lakhs are Christians. Besides the above three major religious groups, there are 259 Sikhs, 278 Buddhists and 62 Jains. The number of persons who has not stated their religion due to reasons unknown are 6251. Hindus, Muslims and Christians constitute about 99.76 per cent of the total population. More than half of the population is Hindus (58.42 per cent). Muslims (17.07 per cent) and Christians (24.27 per cent) together account for 41.34 per cent of the total population.

According to 2011 Census, the population of the Scheduled Castes in the District was 324350 with 156480 males and 167870 females. This accounted for 10.67 per cent of the total Scheduled Caste population in the State. The five major Scheduled Castes in the district are Pulayan (Cheramar), Vettuvan, Kanakkan (Padanna), Paraiyan (Parayan, Sambavar) and Perumannan.

In 2011 Census the population of Scheduled Tribes in the District is 9430 with 4362 males and 5068 females. This accounted for 1.94 per cent of the Scheduled Tribe population of the State. The major tribes in the District are (Malayan, Nattu Malayan, Konga Malayan), (Kadar, Wayanad Kadar), (Ulladan, Ullatan), (Malai Arayan, Mala Arayan) and (Irular, Irulan).

The main cultivated crops of the district are coconut, rice, rubber, arecanut, tapioca, cashew, banana and pepper. Paddy is however the most widely cultivated crop. During 1990-91, 74038 hectares of area was under paddy. It had declined to 39215 hectares during 1998-99.

There is a decline of 47.03 per cent in the area under paddy cultivation during 1990-99. During 2009-10 it has further declined to 25439 ha. Kole cultivation in the water-logged areas of Thrissur, Mukundapuram and Chavakkad taluks is a speciality of the agricultural profile of the district.

Coconut is the main crop of the district in respect of area under cultivation. The coastal region and the lower slopes of the laterite hills of the interior parts of the district account for the major portion of area under cultivation of this crop.

Arecanut, another perennial crop grown in almost all taluks is intensively cultivated in Mukundapuram and Talappilly taluks, the major centres being Pazhanji, Wadakkancherry, Kunnamkulam, Irinjalakuda and Thrissur.

Rubber is planted in Talappilly, Thrissur and Mukundapuram taluks.

Cashew is grown in almost all parts of the district especially in dry lands, and lands not suited for any other crop.

Mango, Jack fruit, Banana, Pineapple etc. are some of the main fruit crops intensively grown in the district. Banana cultivation is done in almost all areas where irrigation facility is available. Pepper is also cultivated in the district. Spices like ginger, turmeric etc. are also grown in small areas in some places.

The livestock rearing which has a very long tradition in Kerala is assuming increasing importance as a subsidiary occupation along with agriculture.

Main fishing centres in the district are Chavakkad, Nattika and Kodungallur. Mechanised boats are also engaged for fishing in the District. Azhikode, Nattika, Vadanapally, Kadapuram, Chettuvai, Blangad and Puthankadapuram offer facilities for harbouring the mechanised. The district has 18 coastal fisheries villages and 8 inland fisheries villages. There is Shrimp Hatchery at Azhikode.

There are 68 large and medium scale industrial units in the district at present. The important among them are Sitaram Textiles Ltd. at Thrissur, Alagappa Textiles at Alagappanagar, Vanaja Textiles Ltd. at Kurchikara, Keltron Power Devices Ltd. at Mulamkunnathukavu, Appolo Tyres Ltd. at Perambra, Kodakara; Chalakudy Refractories Ltd. at Chalakudy, Kerala Solvent Extractions Ltd. at Irinjalakuda and Eddy Current Controls (India) Ltd. at Chalakudy, Kerala Chemicals and Proteins, Koratty, Microwave Products (India) Ltd., Puthenchira, Wood House Ltd., East Koraty, Steel and Industrial Forgings Ltd., Athani, Kerala Lakshmi Mills at Pullazhi, Rajagopal Textiles Ltd. at Athani, Jyothi Laboratories Pharmaceutical Co-operation at Kuttanellur, SDF Industries, Thrissur Cooperative Spinning Mill, etc.

There are two industrial development plots, one at Athani and the other at Kunnamkulam.

Manufacturing of bricks and tiles is one of the oldest industries in the district employing a very large number of workers. This industry is clustered in and around Ollur, Puthukkad, Karuvannur, Amballur, etc.

Kunnamkulam is well known for printing and binding industry.

The canning industry and oil mills absorb a good number of workers.

Traditional industries like handloom weaving, oil crushing, pottery, mat weaving, basket making, furniture manufacturing, toddy tapping, fish curing, bel metal, curing of arecanut etc. employ a large number of working force.

Kora grass mats are produced at Killimangalam in Talappily Taluk. Wood Carving at Cherpu, Metal Industry at Irinjalakuda and Nadavaramba area, Khus-khus mats and products at Valappad are other important cottage industries in the district.

There are also beedi making units and umbrella manufacturing centres in the district.

The manufacture of chappals, shoes, suitcases and hand bags out of leather is an important industry of the district.

Thrissur, Ollur and Puthukkad are the main centres of polishing of imitation stones.

Wood carving is an important handicraft of the district. Wood carvers of Cherpu, 7 miles away from Thrissur, are well known for the figures of elephants made by them. The carving of Kathakali dance dolls is also a special feature of this district.

Another important handicraft is the manufacturing of 'Alavattom' (Peacock feather fan).

Coir manufacturing is one of the important cottage industries of the district. The main centres of production are Chittattukara, Kottapuram and Kodungallur.

Thrissur District is well connected with almost all the major towns and cities of India. The district is covered by a network of National Highways, District roads and Village roads. The National Highway NH-47 in Thrissur District consists of the following two roads viz. Thrissur-Vaniampara road and Thrissur-Chalakudy road.

The National Highway NH-17 runs from Puthuponnani to Kottapuram in the district. Besides the two National Highways (NH-47 & NH-17), there are about 374 km of State Highways and 1292 km of Major District Roads under the control of Public Works Department.

The National Highway NH-17 runs from Puthuponnani to Kottapuram in the district. Besides the two National Highways (NH-47 & NH-17), there are about 374 kms. of State Highways and 1292 kms. of Major District Roads under the control of Public Works Department.

There are no airports in Thrissur District and the nearest airport is Cochin International Airport at Nedumbassery which is located at a distance of 50 km from the city. Calicut International Airport at Karipur in the Malappuram district, which is 80 km from the city and Coimbatore Airport, which is 114 kilometers from the city, are the other two airports in the vicinity.

(Source: District Census Handbook: Thrissur, Series 33, Part XII-A and Part XII-B, Directorate of Census operations, Kerala, Census of India, 2011)

Malappuram District

Malappuram district came into existence on June 16, 1969. Malappuram district is composed of portion of the erstwhile Palakkad and Kozhikode districts. It was carved out of Ernad taluk and portions of Tirur taluk of Kozhikode district and portions of Perinthalmannna and Ponnani taluks of Palakkad district.

Malappuram district is bounded on the north by Kozhikode taluk of Kozhikode district and Vythiri taluk of Wayanad district and on the south by Mannarkad and Ottappalam taluk of Palakkad district and Talappilly and Chavakkad taluks of Thrissur district and sandwiched between the Lakshadweep sea on the west and Gudalur and Oottaccamund taluks of Nilgiri district of Tamil Nadu on the east.

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 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 into community development blocks.

The district now comprises of two Revenue Divisions consisting of 6 taluks and 135 villages. The two Revenue Divisions are Tirur division comprising of Tirur, Tirurangadi and Ponnani taluks consisting of 59 villages and Perinthalmanna division comprising of Ernad, Nilambur and Perinthalmanna taluks consisting of 76 villages. Under the local selfgovernment system, the district is divided into 5 statutory towns and14 Development blocks consisting of 102 Panchayats.

Malappuram district has an area of about 3554 sq km. It accounts for 9.15 per cent of the total area of the State (38852 sq km). With regard to area, Malappuram district ranks 3rd in the state.

Panchayati Raj in Kerala works on the basis of the three- tier system and comprises of the Grama Panchayats, Block Panchayats and District Panchayats. In Kerala, there are 992 Grama Panchayats, 152 Block Panchayats and 14 District Panchayats.

The population of the district has increased from 36,25,471 in 2001 to 41,12,920 in 2011 with 1960328 males and 2152592 females. The district with 9.15 per cent of the total geographical area of the state accommodates 12.31 per cent of the population.

The district's population is divided between rural and urban areas in the ratio of 6:5 in 2011.

In 2011 census, urban area is present in all taluks and Tirurangadi (652326) is the most urbanized taluk followed by Tirur (452514). The urban population of the district is distributed in five municipalities, one outgrowth and thirty-nine Census Towns.

In 2011 census, the rural population of the district with 2295709 accounting for 55.81 per cent of the total population, is distributed in 83 villages of 6 taluks.

The overall density of population per square kilometer in Malappuram District is 1159 persons as per 2011 Census. Sex ratio of the district has increased from 1066 in 2001 to 1098 in 2011. The literacy rate of the district as per 2011 Census is 93.6 per cent.

In the district, the three predominant religious groups are Hindus, Christians and Muslims. Other religious communities such as Sikhs, Buddhists and Jains are insignificant, as their percentage to total population is very negligible. Hindus, Christians and Muslims constitute about 99.82 per cent of the total population of the district. More than two third of the population are Muslims (70.24 per cent). Hindus (27.60 per cent) and Christians (1.98 per cent) together account for 29.59 per cent of the total population.

According to 2011 census the population of SCs in the district is 3,08,266 consisting of 151557 males and 156709 females. This accounts for 10.14 percent of population of SC in the state. The major scheduled castes in the district are Kanakkan/Padanna/Padannan, Cheruman, Mannan/ Pathiyan/ Perumannan/ Vannan/ Velan, Kalladi and Pulayan/ Cheramar/ Pulaya/ Pulayar/ Cherama/ Cheraman/ Wayanad Pulayan/ Wayanadan Pulayan/ Matha/ Matha Pulayan.

The population of ST in the district in 2011 is 22990 consisting of 11272 males and 11718 females. This accounts for 4.74 per cent of ST population in the state. The major tribes in the district are Paniyan, Muthuvan/Mudugar/ Muduvan, Kattunayakan, Malapanickar and Kanikaran/Kanikkar.

The work participation rate for total workers is defined as the percentage of total workers to total population. 2001 census recorded 24.12 percent of district's population as workers. The main workers constituted 19.08 percent, marginal workers 5.04 percent and the remaining 75.88 percent were nonworkers. In comparison, during 2011 census there is a slight increase (1.7 per cent) in the work participation rate for total workers (25.8 per cent). In the case of main workers, the work participation rate for the district has increased to 20.72

percent in 2011. There is marginal increase in the work participation rate for marginal workers (5.11 per cent). The percentage of non-workers has decreased to 74.17 percent.

The main crops raised are paddy, coconut, tapioca, arecanut, cashew nut, banana, rubber, pulses, ginger and pepper.

Paddy is cultivated thrice in a year. The Viruppu (autumn crop), Mundakan (winter crop) and Puncha (summer crop) are the seasonal crops. Puncha cultivation depends mostly on the availability of irrigation water. The first two crops are mainly raised on the kayal lands or kole lands in the backwater areas of Ponnani taluk. Kole cultivation is mainly done in this vast land of Andathode and Ponnani development blocks. Paddy is largely produced in Wandoor, Perinthalmanna, Mankada, Ponnani, Manjeri, Kuttipuram, Kondotty etc.

The sea coast of the district extends to 70 km. and is rich marine wealth. Ponnani is the only port in this district. The majority of the people living in the coastal areas depends on fishing as their livelihood. Main fishing centres are Ponnani, Koottayi, Parappanangadi and Tanur. High sea fish catching operations with mechanised boats are centered in Ponnani and Parappanangadi. The important types of fish found in this district are Prawn, Oil Sardine, Silver belly, Shark, Catfish, Mackerel, Skate, Chemba, Soll fish, Seer fish and Ribbon fish.

Though Malappuram is rich in natural resources, the district is one of the industrially backward districts in the State due to lack of required infrastructure facilities viz. electricity, coal, petroleum, raw materials etc. During the last decade there has been a steady increase in the industrial activities of the district and the number of registered units has almost trebled due to various incentives given by the government.

An Electronics Techno Park is functioning near Calicut University. A rubber based common facility centre and industrial estate established at Payyanad at a cost of Rs.1 crore is fast growing. The estate has an area of 15.03 acres, in which 31 plots have been given to entrepreneurs for rubber-based units. At present a modern rubber processing unit spread over 20000 Sq feet has been established with mixing mills, extruders and calendaring machines manufacturing thread rubber and tyres.

There are 10629 industrial units registered under SSI/MSME.

The district has a good road network. Two National Highways pass through the district. The NH-17 enters the district at Chelembra in the north and runs through Calicut University, Kottakkal, Valancherry, Kuttipuram, Thavanur, Ponnani, Puduponnani, Veliyancode and proceeds to Trichur district in the south. It has a length of 72 kms in the district. The NH-213 connecting Palakkad to Kozhikode, passes through the district. There are 15 State Highways passing through Malappuram District. The important District Roads in the districts are Tirur – Kadalundy Road, ThrikkalangodeKalikavu Road, Kondotty-Areacode Road and Kondotty- Edavannappara Road.

There are two railway lines passing through the district. They are Mangalore-Madras (MangaloreTrivandrum) line which passes through Tirur taluk and the Shoranur-Nilambur line which passes through Perinthalmanna and Nilambur taluks. The first is through the coastal belt.

The Calicut International Airport, which is 26 km away from Malappuram and 28 km away from Kozhikode, is in Malappuram district.

The important places connected by waterways are Ponnani, Tirur and Thirurangadi. The water ways are used mostly for transporting timber. Besides the important rivers like Chaliyar river and Beypore river, Canoly canal passing through Ponnani and Tirur taluks is an important waterway in this district.

(Source: District Census Handbook: Malappuram, Series 33, Part XII-A and Part XII-B, Directorate of Census operations, Kerala, Census of India, 2011)

Kozhikode District

Kozhikode as a district came into existence on 1st January 1957. After the formation of Kerala state in 1956, when Malabar district was divided into three districts, the Central district with headquarters at Calicut (Kozhikode) was named as Kozhikode. The district, which initially had 5 taluks, had undergone several changes and the present district with 3 taluks was formed on 1st November 1980. The three taluks are namely Vadakara, Quilandy and Kozhikode.

Kozhikode district is situated on the southwest coast of India. The district is bounded on the north by Thalasserry taluk of Kannur district, on the east by Mananthavady and Vythiri taluks of Wayanaddistrict, on the south by Ernad and Tirur taluks of Malappuram district and on the west by Lakshadweep Sea. This district lies between north latitude 11°7’22" and 11°48’32" and east longitudes 75°30' and 76°8’20".

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 Revenue Division, Taluks and Villages. However, for local administration, the district is divided into statutory towns and panchayats. For the implementation of development activities, Panchayats are grouped into community development blocks.

The district comprises a single revenue division consisting of 3 taluks and 117 revenue villages. There are 12 development blocks and 78 panchayats. Out of 117 villages, 16 villages in Vadakara taluk, 17 villages in Quilandy taluk, 33 villages in Kozhikode taluk and a portion of a village in Quilandy taluk have been treated as urban. There are 3 statutory towns and 48 census towns in the district.

Panchayati Raj in Kerala works on the basis of the three- tier system and comprises of the Grama Panchayats, Block Panchayats and District Panchayats. In Kerala, there are 992 Grama Panchayats, 152 Block Panchayats and 14 District Panchayats.

Kozhikode District has an area of about 2345 sq km and ranks 9th in the state among the districts in area. It accounts for 6.04 percentage of the total area of the State (38852 sq km).

The present population of the district is 3086293. Its only 9.24 per cent of the total population of the state. In 2011 Census, the percentage of urban population to total population is 67.15 and the remaining 32.85 percent is rural.

In 2011, the rural and urban densities of the district are 724 and 2195 respectively. Both the rural and the urban density have decreased in 2011 and the urban area has registered a higher density than the rural area.

In 2011 census, the sex ratio of the district is 1098 females per 1000 males.

In 2011 census, the literacy rate of the district is 95.08 percent with a breakup of 94.47 percent for rural and 95.38 percent for urban.

Of the total population of Kozhikode district, 17.34 lakh population are Hindus, 12.11 lakhs are Muslims and 1.31 lakhs are Christians. Besides the above three major religious groups, there are 297 Sikhs, 235 Buddhists and 601 Jains. More than half of the population are Hindus (56.21%). Muslims (39.24%) and Christians (4.26%) together account for 43.5% of the total population.

According to 2011 Census the population of Scheduled caste in the district is 199191 consisting of 97279 males and 101912 females. This accounts for 6.55 percent of SC population in the State. The five major Scheduled castes in the district are Pulayan, Cheruman, Mannan, Valluvan and Bharathar (Paravan).

The population of Scheduled tribes in the district in 2011 is 15228 consisting of 7429 males and 7799 females. This accounts for 3.14 percent of ST population in the state. The major tribes in the district are Karimpalan, Paniyan, Kurichchan/Kurichiyan, Muthuvan, and Kurumans.

Total work participation rate has increased during 2001-2011. Quilandy taluk has highest work participation rate (32.38%) followed by Kozhikode Taluk (31.26) and vadakara taluk (27.73%). In the case of main workers, the work participation rate recorded in Kozhikode, Quilandy and Vadakara taluk in 2011 are 26.06, 23.4 and 21.59 per cent respectively.

Kozhikode district has a rich heritage in agriculture as it was a port city famous for pepper & species trade. Good soil, timely rainfall and abundance of water resources are the important factors which help agriculture in the district. Rubber is the main crop of the highland region. Coconut and paddy are the predominant crops of the low land region while pepper, coconut, arecanut and tapioca are the important crops of the midland region. Paddy is cultivated under varying conditions viz. Autumn, Winter and Summer crops. Heterogeneity in cultivation practices and diversity of cropping patterns are the important features of agriculture in the district. Over 90 per cent of the land holdings are less than one hectare.

Fish and fisheries play a crucial role in the economy of the district. Fishing is the main occupation of a large number of people in the coastal belt. Fishing industry makes sizeable contribution to the economy of the district. The number of estimated active fishermen in the district is around 20,589. The fish related economy is made up of three activities – production, marketing and consumption and these three activities are structured into 3 sectors – traditional, modern and ultra modern. While the inland fishery is confined to the first sector alone, the marine fisheries consist of all the three sectors. Fish is an important item of diet of more than 90 per cent of population.

With a coastline of about 80 kms. from Chaliyar to AzhIyoor, the district offers enormous natural resources for the development of fisheries. The district Kozhikode is abundant in brackish water and therefore, there is good scope for shrimp farming.

The major fish landing centres are Beypore, Vellayil, Puthiyappa, Koyilandy, Vadakara and Chombala and the average annual landing isstimated to about one lakh metric tonnes. About 29 major varieties of fish are obtained in the different coast. Among them most important are Oil Sardine, Mackerel, Shark, Ribbon fish, Prawn, Seer fish, Pomfret etc.

Kozhikode district represents one of the industrially advanced areas of the state, with many small-scale industries flourishing from early days.

The important large-scale industries are Timber industry, Textile mills, Saw mills, Match factories, Umbrella manufacturers, Soap industries, Bricks and Tile factories, Furniture etc. Kallai was one of the largest timber yards in the world.

Handloom is the largest cottage industry functioning under the co-operative and private sectors. Coir industry is carried on both as cottage industry and large-scale industry, while spinning of coir yarn is mainly of a cottage industry. A manufacturer of mats and mattings and ropes is generally done as a factory industry.

Metal industry has made notable progress in the district. Another major industry is the tile industry. The first tile factory went on steam as early as 1874 in Puthiyara, Kozhikode. The tile factories are mostly concentrated at Feroke-Cheruvannur area.

There is a ship breaking unit and a boat yard at Beypore in public sector. There is an Industrial Estate at Westhill, 2 mini-Industrial estates at Perambra and Kadalundi and 1 industrial park set up by SIDCO to promote industries in Kozhikode.

There are 21205 small-scale industrial units functioning in the district as on 31.3.2008 and 149 registered working factories as on 2007 and 34878 employees are working in these factories.

The major mode of transport of this district is by road. The district has fairly extensive road network. National Highways stretches to 77 km, state highways to 334 km and major district roads to 2034 km. Three National Highways are passing through the district. They are NH-17, NH-212 and NH-213. The NH-17 runs almost parallel to the coastal line linking the headquarters of the three taluks i.e. Kozhikode, Koyilandy and Vadakara. The NH-212 stretches from Kozhikode to Kollagal covering a distance of 250 km. The NH-213 stretches from Kozhikode to Palakkad covers a distance of 141 km. Besides the National Highway there are about 377.17 km of State Highway and 928.67 km of major district roads under the control of Public Works Department.

Kozhikode railway station is the major railway station in north Kerala. The railway line of Palakkad division enter Kozhikode district at Kadalundi and runs through the district covering Feroke, Kallai, Kozhikode, Vellayil, West Hill, Ealthur, Chemancheri, Panthalayani, Thikkodi, Payyoli, Iringal, Vadakara and Nadapuram road stations.

Though the Calicut International Airport is situated in Karippur, Malappuram district, it is only 26.5 km away from Kozhikode city.

The district has an intermediate port at Kozhikode (including Beypore) and a minor port at Vakakara. The port of Kozhikode, inclusive of Beypore, is 144.84 km north of Kochi. The coastline extends from Elathur Cape down to the South Bank of the Kadalundi river and treads roughly in a straight line. Beypore is situated at the mouth of the Beypore river and is approximately 10 km south of Kozhikode. Vadakara, another port of the district, is situated about 19.31 km south of Thalasserry. The ports of Kozhikode, Beypore and Vadakara are open to foreign trade.

(Source: District Census Handbook: Kozhikode, Series 33, Part XII-A and Part XII-B, Directorate of Census operations, Kerala, Census of India, 2011)

9.3 Potential Environmental and Social Impacts of the Project

Based on the traffic demand analysis, the present DPR is not in a position to recommend the implementation / development of NW-3.

In due course of time, if there is any increase in Cargo Volume, justifying the development, the same can be considered.

Potential Environmental and Social Impacts

The construction activities as proposed for development are as follows:

i. Construction of terminal buildings - Yes
ii. Construction of access roads - Yes
iii. Bank protection works - Yes
iv. Dredging of the river in the proposed waterway stretch – Yes
v. Installation of Navigational Lights - Yes

The proposed construction period is of Five years. In general, the construction phase will involve mobilization of manpower and equipment at site, movement of vehicles and use of existing water resources and use of DG sets for construction power.

The estimated quantity of dredged material is about 65.5 Lakhs Cu. M. All the dredged material is proposed to be disposed of in the banks of the Waterway. As such this dredged material is in heavy demand, in Kerala, which will enrich the area, as a whole by filling the low-lying area of the dwelling and this activity can be considered to be a boon for this area. Hence, there is no impact on the land environment due to the dredging.

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 commissioned for the project separately by IWAI.

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 riverbanks and by not allowing any debris to be thrown into the river during the construction and operation phases.

The project involves a sizeable quantity of Land Acquisition. The total land requirement for the project is estimated as 173.64 Ha comprising 173.10 Ha for fairway development and 0.49 Ha for terminal development within Bepore Port area. The 173.10 Ha of land required for fairway development comprises 127.20 Ha in Thrissur District, 19.95 Ha in Mallapuram District and 25.95 Ha in Kozhikode District. All land required for the project is to be acquired as per the provisions under Right to Fair Compensation and Transparency in Land Acqusition, Rehabilitation and Rsettlement (RFCTLARR) Act, 2013 of the Government of India, RFCTLARR Rules, 2015 of the Government of Kerala and the Direct Purchase of Land (Government of Kerala) Order, 2015.

The Kerala Conservation of Paddy Land and Wetland Act, 2008 and the Kerala Conservation of Paddy Land and Wetland (Amendment) Act, 2018 shall apply if the land to acquired or purchased for the project involves reclamation of any paddy land. The said Act also provides for exemption for reclamation for public purposes.

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

The positive impacts of the project will include improved waterway facilities and other allied infrastructure facilities for the local population. It will also generate some employment and small business opportunities for the local population.

Impacts on aquatic ecology due to dredging and disposal of the dredged material within the riverbanks need to be established as part of the EIA study to be commissioned for the project separately by IWAI.

Limited land use change will occur due to the construction of terminal facility for the operation of the proposed waterway. The land identified for terminal construction is located in Beypore Port area and is entirely secluded. No structures are present over the land identified for construction of terminal. Therefore, the project does not involve any dislocation of population on account of terminal construction. Dislocation of population, however, may be involved for fairway development along a length of 136 kms out of the total length of 169 km coming under the stretch of the proposed waterway. As has been stated above all land acquisition, rehabilitation and rsettlment shall be carried out in accordance with the regulatory framework at the National and the State levels.

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 riverbanks and by not allowing any debris to be thrown into the river during the construction and operation phases.

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

The positive impacts of the project will include improved waterway facilities and other allied infrastructure facilities for the local population. It will also generate some employment and small business opportunities for the local population.

9.4 EMP and Mitigation of Environmental Effects

As already stated, most of the potential impacts will be limited to the construction period.

The management measures required to mitigate the potential impacts of the project on the ambient air quality during construction period include suppression of fugitive dust by water sprinkling, transportation of construction debris in covered vehicles, maintaining the specified stack height of DG sets under use and ensuring that the vehicles and equipment used during the construction period are in well maintained condition.

To ensure that the ambient air quality remains within the prescribed standards by the Central Pollution Control Board (CPCB), periodic monitoring of ambient air quality should be undertaken through an accredited laboratory. Suitable corrective measures should be implemented if the ambient air quality is found to exceed the prescribed limits.

The measures to ensure that there is no adverse impact on the water quality on account of the project during the construction period would include setting up of labour camps at a safe distance from the riverbanks. 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 riverbanks 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 landowners, 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 relating to environmental aspects, as applicable to the project, are described below.

Consent to Establish and Consent to Operate

The project will require obtaining the Consent to Establish from the SPCB under the Air and Water Acts prior to commencement of construction. Prior to commencement of operation, it shall require obtaining the Consent to Operate from the SPCB under the same Acts.

CRZ Clearance

The entire project area falls under the tidal zone. As such the project shall require obtaining clearance under the CRZ Notification 2011.

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

The CRZ Notification 1991 was later amended, and a new Notification was issued in 2011 namely CRZ Notification 2011.

The CRZ Notification, 2011 declares the following areas as CRZ:

i. the land area from High Tide Line (HTL) to 500 mts on the landward side along the sea front. the land area between HTL to 100 mts or width of the creek whichever is less on the landward side along the tidal influenced water bodies that are connected to the sea and the distance up to which development along such tidal influenced water bodies is to be regulated shall be governed by the distance up to which the tidal effects are experienced which shall be determined based on salinity concentration of 5 parts per thousand (ppt) measured during the driest period of the year and distance up to which tidal effects are experienced shall be clearly identified and demarcated accordingly in the Coastal Zone Management Plans (hereinafter referred to as the CZMPs).

ii. Explanation - For the purposes of this sub-paragraph the expression tidal influenced water bodies mean the water bodies influenced by tidal effects from sea, in the bays, estuaries, rivers, creeks, backwaters, lagoons, ponds connected to the sea or creeks and the like.

iii. the land area falling between the hazard line and 500mts from HTL on the landward side, in case of seafront and between the hazard line and 100mts line in case of tidal influenced water body the word 'hazard line' denotes the line demarcated by Ministry of Environment, Forest and Climate Change (MoEFCC) through the Survey of India (SoI) taking into account tides, waves, sea level rise and shoreline changes.

iv. the land area between HTL and Low Tide Line (LTL) which will be termed as the intertidal zone.

v. the water and the bed area between the LTL to the territorial water limit (12 Nm) in case of sea and the water and the bed area between LTL at the bank to the LTL on the opposite side of the bank, of tidal influenced water bodies.

The coastal zone is categorized for the purposes of regulation in the following categories:

(i) CRZ-I,–

A. The areas that are ecologically sensitive and the geomorphological features which play a role in the maintaining the integrity of the coast,-

(a) Mangroves, in case mangrove area is more than 1000 sq mts, a buffer of 50meters along the mangroves shall be provided;

(b) Corals and coral reefs and associated biodiversity;

(c) Sand Dunes;

(d) Mudflats which are biologically active;

(e) National parks, marine parks, sanctuaries, reserve forests, wildlife habitats and other Protected areas under the provisions of Wild Life (Protection) Act, 1972 (53 of

1972), the Forest (Conservation) Act, 1980 (69 of 1980) or Environment (Protection)

Act, 1986 (29 of 1986); including Biosphere Reserves;

(f) Salt Marshes;

(g) Turtle nesting grounds;

(h) Horse shoe crabs habitats;

(i) Sea grass beds;

(j) Nesting grounds of birds;

(k) Areas or structures of archaeological importance and heritage sites.

B. The area between Low Tide Line and High Tide Line;

(ii) CRZ-II,-

The areas that have been developed upto or close to the shoreline.

Explanation.- For the purposes of the expression “developed area” is referred to as that area within the existing municipal limits or in other existing legally designated urban areas which are substantially built-up and has been provided with drainage and approach roads and other infrastructural facilities, such as water supply and sewerage mains;

(iii) CRZ-III,-

Areas that are relatively undisturbed and those do not belong to either CRZ-I or II which include coastal zone in the rural areas (developed and undeveloped) and also areas within municipal limits or in other legally designated urban areas, which are not substantially built up.

(iv.) CRZ-IV,-

A. the water area from the Low Tide Line to twelve nautical miles on the seaward side;

B. shall include the water area of the tidal influenced water body from the mouth of the water body at the sea upto the influence of tide which is measured as five parts per thousand during the driest season of the year.

(v) Areas requiring special consideration for the purpose of protecting the critical coastal environment and difficulties faced by local communities,-

A. (i) CRZ area falling within municipal limits of Greater Mumbai;

(ii) the CRZ areas of Kerala including the backwaters and backwater islands;

(iii) CRZ areas of Goa.

B. Critically Vulnerable Coastal Areas (CVCA) such as Sunderbans region of West Bengal and other ecologically sensitive areas identified as under Environment (Protection) Act, 1986 and managed with the involvement of coastal communities including fisherfolk.

The development or construction activities in different categories of CRZ are regulated by the concerned Coastal Zone Management Authority (CZMA) in accordance with the norms as defined under the CRZ Notification 2011.

Forest Clearance

The project does not involve diversion of forest land. Therefore, no Forest Clearance from the MoEF is required for development of the project.

Wildlife Clearance

Even though no part of the project falls either within the boundary of any of the protected areas or within their eco-sensitive zones, the project is located at a distance of 2.57 km from the boundary of Kadalundi Vallikunnu Community Reserve and the ESZ for this Community Reserve has not been defined; therefore, a radial distance of 10 km from its boundary shall have to be considered for clearance purposes. The wildlife clearance shall have to be obtained as per the provisions under Wildlife Protection Act, 1972 of the Government of India.

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 Environmental Clearances / Approvals / Permits Applicable to the Project

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

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 9-16 below.

TABLE 9-16: MAJOR ENVIRONMENTAL CLEARANCES / APPROVALS / PERMITS AND THEIR APPLICABILITY TO THE PROJECT

S. 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 development of NW-3 does not involve any diversion of forest land.
3.	Wildlife Clearance	Yes	Wildlife Protection Act, 1972	Even though no part of the project falls either within the boundary of any of the protected areas or within their eco-sensitive zones, the project is located at a distance of 2.57 km from the boundary of Kadalundi Vallikunnu Community Reserve and the ESZ for this Community Reserve has not been defined; therefore a radial distance of 10 km from its boundary shall have to be considered for clearance purposes.

S. No.	Clearance / Approval	Applicability to the Project	Applicable Legislation	Remarks
4.	CRZ Clearance	Yes	CRZ Notification 2011	The entire project falls in CRZ I.

9.5.3 Regulatory Framework for Land Acquistion, Rehabiltation and Resettlement

Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act (RFCTLARR), 2013

The RFCTLARR Act, 2013, provides for a transparent process and just and fair compensation to the affected families whose land is acquired or proposed to be acquired or are affected by such acquisition and provides for rehabilitation and resettlement of the affected families.

The RFCTLARR Act applies to acquisition of land for a public purpose, as defined in the Act. The Act provides for consultation with and involvement of local self-government in undertaking a Social Impact Assessment (SIA). The SIA is reviewed by an Expert Group to assess if the potential benefits of the project outweigh the social cost and adverse social impacts.

The Act provides for three methods of valuation and a solatium of 100% is payable on the market value of land multiplied by the factor and all immovable properties or assets, trees and plants.

The Kerala Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Rules 2015

The Rules framed and notified by the Government of Kerala for the RFCTLARRR Act, 2013 details the process of SIA, public hearing and SIA report and social impact management plan. The consent requirement in the format specified is to be obtained during the SIA. The rules also explain the process of preparing and publishing the rehabilitation and resettlement scheme. The State Rules do not deviate from the RFCTLARRR Act 2013 and only provides the specifics for its implementation.

Direct Purchase of Land (Kerala Government Order 2015)

In order to expedite and simplify the procedures of land acquisition for public purpose, Government of Kerala has passed Government Order GO (MS) No. 485/2015/RD dated 23/09/2015 for land acquisition for public purpose. The objective states that the Government aims to ensure the following relief to the land losers through this policy.

a. The land losers are provided with just and reasonable compensation for land acquired, relieving them from the burden of approaching judicial forums for enhancement of compensation.

b. Rehabilitation & Resettlement policy as provided in the Act along with additional packages including employment/ stake holdings in eligible cases according to the nature of the project.

c. Disbursement of compensation before taking possession of land and ensuring Rehabilitation and Resettlement packages including infrastructural amenities as provided in the third schedule of the Act within 18 months of the date of publication of DD.

d. Transparency in procedures and less negative impact ensuring the land losers that their socio-economic status does not fall below what it was before the acquisition.

The GO specifies that “The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 has been enacted with the objective of ensuring just and fair compensation and rehabilitation for the affected families due to compulsory acquisition of land for public purpose. This Act came into force w.e.f. 01/01 / 2014. The State Government as per G.O. mentioned above has approved the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (Kerala) Rules, 2015.

Section 108 of the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 provides for framing a state law/ policy which provides higher compensation than that calculated under this Act for the acquisition of land so that the affected person or his family or member of his family can opt to avail such a higher compensation under such state policy.

Therefore, in order to speed up and simplify the procedures of land acquisition for public purpose, Government are now pleased to approve a state policy for compensation in land acquisition as appended to this order. The important objective of this policy is to conduct negotiations with the land owners and reach consensus on compensation and rehabilitation by the District Level Fair compensation, rehabilitation and resettlement committee (DLFC) and approval of the same by the State Level Empowered Committee (SLEC).

State Resettlement and Rehabilitation Policy, 2017

The GO (Ms) No. 448/2017/RD, dated 29/12/2017 states that the Government of Kerala recognises the need to provide additional assistance to what is provided in the 2nd schedule of RFCTLAR&R Act 2013.It states that the R & R Policy is applicable all land acquisition in the State and by Direct/Negotiated purchase.

Conservation of Paddy Land and Wetland Act, 2008

As has been mentioned earlier in this report, the Kerala Conservation of Paddy Land and Wetland Act, 2008 and the Kerala Conservation of Paddy Land and Wetland (Amendment) Act, 2018 shall apply if the land to acquired or purchased for the project involves reclamation of any paddy land. The said Act also provides for exemption for reclamation for public purposes.

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 9-17: 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)	50	Lump-sum cost on intermittent basis
2.	Cost of one Time Baseline Data Generation at Pre-Construction Stage	6.40	To be done for one season **(Table – 9-18).**
3.	Public Consultation Meeting (PCM)	8	Lump-sum cost
4.	Reports / Document Printing	2	Lump-sum cost without break-up

5.	Travelling Cost for Site Visits (Bus, Taxi, Boat *etc.*)	6	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)	**82.40**	

In words: (i) *Rs. Eighty Two Lakhs Fourty 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 Table 9-18.

TABLE 9-18: 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	8	20,000	160,000
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	8	15,000	120,000
3.	Noise Quality monitoring	Day & Time time monitoring to be done at each location	24 Hourly sampling (Day & Night time) to be done	Per Sample with various parameters	8	10,000	80,000
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	8	10,000	80,000
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.	-	8	25,000	200,000
	Sub-Total (Baseline Environmental Data Generation Cost)						**640,000**
	In Words: *Rs. Six Lakh Fourty Thousand only…………………………..*						

Note: 1 monitoring station @ 25 Km/station = tentatively 8 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 9-19: 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	19.20	Shall be carried on yearly basis for entire construction period (**Table 9-20)**
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)	**44.20**	

TABLE 9-20: 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 parameters	8X3 = 24	20,000	480,000
2.	Water Quality monitoring	***Physical Properties:*** pH, Temp., DO, Conductivity, ***Chemical Properties:***	Surface and ground water to be monitored separately	Per sample with various parameters	8X3 = 24	15,000	360,000

Sl. No.	Env. Attributes	Parameters	Monitoring Frequency	Unit	No. of Tentative Locations (for 3 Years)	Unit Rate (Rs)	Amount (Rs)
		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 time monitoring to be done at each location	24 Hourly sampling (Day & Night time) to be done	Per sample socation with various parameters	8X3 = 24	10,000	240,000
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	8X3 = 24	10,000	240,000
5.	Aquatic Ecology	Trophic Status, Primary Productivity, Species diversity & densities of Phytoplankton, Zooplankton, Benthic Organism	One time study at this stage.		8X3 = 24	25,000	600,000

Sl. No.	Env. Attributes	Parameters	Monitoring Frequency	Unit	No. of Tentative Locations (for 3 Years)	Unit Rate (Rs)	Amount (Rs)
		(Benthos, Macro-benthos), Fish and Macrophytes, Shanon Weiner Diversity Index.					
Total (Rs)							**1920,000**

9.6.3 Estimated Cost at Operation Stage

Like preconstruction stage, the environmental monitoring and supervision to be done by the project proponent.

TABLE 9-21: 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.	6.40	Shall be carried for one season as per Table 9-17 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)	**16.40**	Per Year

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 9-22 given below:

TABLE 9-22: SUMMARY OF ESTIMATED ENVIRONMENTAL & SOCIAL COSTS FOR VARIOUS STAGES

Sl. No.	Project Stages	Cost (Rs. Lakhs)	Remark
1.	Pre-Construction Stage	82.40	Lump-sum
2.	Construction Stage	44.20	
3.	Operational Stage	16.40	
Total Estimated Budget (Except Statutory Fee & Land Acquisition & R&R Costs)		143.00	

In Words: Tentative estimated cost is Rs. 143.00 Lakhs.

The cost appears to be too meagre and hence a provision of total of 5% of project cost has been considered & recommened for Environment Management Plan as and when a decision for development of NW-3 shall be taken and the amount with respect to current project cost is about 124 Crores.

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 work and do all other acts necessary for the safety and convenience of shipping and navigation and improvement of the national waterways;

(d) control activities such as throwing rubbish, dumping or removal of material, in or from the bed of the national waterways and appurtenant land, in so far as they may affect safe and efficient, shipping and navigation, maintenance of navigable channels, river training and conservancy measures.

(e) remove or alter any obstruction or impediment in the national waterways and the appurtenant land which may impede the safe navigation or endanger safety of infrastructural facilities or conservancy measures where such obstruction or impediment has been lawfully made or has become lawful by reason of long continuance of such obstruction or impediment or otherwise, after making compensation to person suffering damage by such removal or alteration;

(f) provide for the regulation of navigation and traffic (including the rule of the road) on national waterways; (g) regulate the construction or alteration of structures on across or under the national waterways;

(h) disseminate navigational meteorological information about national waterways;

(i) ensure co-ordination of inland water transport on national waterways with other modes of transport; and (j) establish and maintain pilotage on national waterways;

(k) enter into joint ventures concerning inland shipping by way of equity participation.

14. (2) The Authority may also-

(a) advise the Central Government on matters relating to inland water transport;

(b) study the transport requirement with a view to co-coordinating inland water transport with other modes of transport;

(c) carry out hydrographic surveys and publish river charts;

(d) assist, on such terms and conditions as may be mutually agreed upon, any State Government in formulation and implementation of scheme for inland water transport development;

(e) develop consultancy services and provide such services, on such terms and conditions as may be mutually agreed upon, in India and abroad in relation to planning and development of waterways for shipping and navigation or any facility 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 Outsourcing the work along with supervision to different contractual agencies (Outsourcing the work to an agency and the Project Management to other agency).

10.2 Man Power Requirement

Outsourcing the work to a contractual agency is the best alternative.

As ascertained, IWAI is having an Institution Mechanism consisting of a Board along with Functional Manpower having the inverted conical organization pattern. The major functional aspects have already been segregated as Project; Planning; Survey; Marine; Traffic; Finance and Administration. Hence, dislocation of the existing system is not suggested. The present requirement within the study stretch should be unique, which should be amenable to the existing system in the office of Policy making with Control.

Accordingly, the Controlling office (at NOIDA) has been depicted in the pictorial form and will have 1 Chief Engineer to look after the Central part of the country (Hyderabad) to deal with the Waterways / National Waterways in the states of Maharashtra; Goa; Karnataka; Orissa; Telangana; Andhra Pradesh; Tamilnadu & Kerala (including NW 3). Refer the **Annexure 10.1**.

The present study stretches of Cluster 6 having 6 National Waterways will be looked after by a Directorate (suggested / recommended) with an office within the Geographical zone, preferably accessible to all the Waterways / National Waterways. The Organizational requirement has been depicted in **Annexure 10.2**. A skeleton staff requirement of 3 Nos. also has been projected as a support requirement in the Chief Engineer's office.

10.3 Training Requirement / Capacity Building

IWAI is having various disciplines within the organization viz., Civil Engineering; Mech. Marine Engineering; Hydrographic Survey; Traffic; Administration / Establishment; Finance etc.

It is suggested and recommended to that the Kochi facility is capable of providing such requirement in project implementation phase as well as operation stage.

10.4 Infrastructure

Separate Infrastructure is not needed at this stage as the proposed waterway is within the accessibility of Kochhi directorate headed by Director level officer and its subordinate office.

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 identified terminal locations, amenable with ease approach. Hence there is no suggestion / recommendation of Land / immovable asset under Institution.

10.4.2 Movable

Not Needed.

10.5 Cost Implications

The cost implication for institutional & infrastructure support is not considered.

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. The circulated data has been placed at Annexure 11.1. However, the same may not suffice the requirements in working out the cost / returns and hence some more assumptions have been considered appropriately, wherever required.

11.2 Basis of Costing

In general, the costing used to be worked out based on the quantity requirements along with rate per unit quantity. The quantities for the subject project have been arrived at based on the actual item wise requirements. The estimated costs have been worked out based on the relevant Schedule of Rates (SoR) -2021 of the Cpwd/ concerned region/ state. Rates for the non-available items have been proposed based on the Market Rates or based on the realistic budgetary quotations, to the extent possible.

11.3 Development Cost

The NW 3 (Extension) is having limited IWT mobility rather –Nil. The identified cargo is also very meager, while comparing the same with the huge investments having little visibility on revenue stream. Hence, it is not judicious for considering such large investments for such meagre cargo potential. If there is any confirmed cargo with positive growth development, in future, with any policy developments, the project can be considered for its longitudinal development of the fairway along the length of the waterway.

Rightnow the passenger ferry facility at three locatios have been identified and some small dredging quantity has been recommended at these locations acknowledging for a safe ferry movement with a one-time cost of 325 lakhs.

11.4 Capital Expenditure

As explained above, the Fairway related development cost has been worked out and placed herewith. Referring to the comments received from Kerala Government vide Letter No# A2/114/2018/CSIND dated 07/03/2020 for consideration of list of cross structure along with cost to be considered for modifications in the NW-3 DPR, two different project costs are considered i.e Option 1 and Option 2. Cost estimated in Option-1 involves only the fairway development along the ferry route at three locations for safe ferry operation.

Option-2 is based on the longitudinal fairway development along the length of the waterway which is clubbed with cost of modification of structures recommended vide letter received by Kerala Government stating that the modification of structures to be considered in the DPR. The referred letter is attached in **Annexure 2.1**.

TABLE 11-1: ABSTRACT OF COST FOR NW 3 FAIRWAY DEVELOPMENT

Abstract of Cost for NW 3 Fairway Development			
Sl No.	**Item Description**	**Option-I**	**Option-II**
		Amount (in Lakh Rs.)	**Amount (in Lakh Rs.)**
A.	**Fairway**		
1	Dredging		
(i)	General Soil in Longitudinal Development of Waterway	0.00	16259.34
(ii)	General Soil in crossing the water way at 03 location (Passenger Ferry)	292.86	0.00
(iii)	Hard Soil	0.00	0.00
2	Low-Cost River Structures	0.00	0.00
(i)	Bandaling	0.00	0.00
3	River Training Works		
(i)	Spurs		
(ii)	Bank Protection Works for river	0.00	71244.21
(iii)	Porcupine		
4	Night Navigation		
(i)	Channel Marking Buoy, Mooring Gear & Lighting Equipments	0.00	1187.30
(ii)	Shore Marking with Latiice Bridge & Lighting Equipments	0.00	0.00
5	Land Acquisition		
(i)	Land Acquisition for Lo-Lo	0.00	0.00

Abstract of Cost for NW 3 Fairway Development			
Sl No.	**Item Description**	**Option-I**	**Option-II**
		Amount (in Lakh Rs.)	**Amount (in Lakh Rs.)**
(ii)	Habitation / Structures for fairway along longitudinal waterway	0.00	10651.12
	Sub-total (A)	**292.86**	**99341.97**
B	**Modification of Structures**		
B1	**Modification of Structures (As Per Condition Assessment)**		
(i)	Bridges	0.00	8537.73
(ii)	Cables	0.00	27.00
(iii)	Dams	0.00	0.00
(iv)	Barrages	0.00	0.00
(v)	Locks (Construction at 7 locations)	0.00	8567.77
(vi)	Others	0.00	0.00
	Sub-total (B1)	**0.00**	**17132.49**
B2	**Modification of Structures (Kerla Govt. Letter No.A2/114/ 2018/CSIND dated 07.03.2020**		
(i)	Bridge	0.00	82000.00
(ii)	Foot Bridges	0.00	0.00
(iii)	Foot Bridge	0.00	3120.00
(iv)	HT Lines	0.00	510.00
(v)	LT Lines	0.00	32.00
(vi)	Bridge	0.00	22000.00
(vii)	Foot Bridges	0.00	2880.00
(viii)	Regulator Cum Bridge & Navigation Lock	0.00	7000.00
ixv)	Barrages	0.00	7000.00
(x)	Navigation Lock	0.00	7000.00
(xi)	Water Pipe -line	0.00	0.00
	Sub Total B2	**0.00**	**131542.00**
	Sub-total (B)	**0.00**	**148674.49**
C	**Communication System**		
(i)	RIS Centre	0.00	0.00
(ii)	AIS Base Station	0.00	0.00

Abstract of Cost for NW 3 Fairway Development			
Sl No.	**Item Description**	**Option-I**	**Option-II**
		Amount (in Lakh Rs.)	**Amount (in Lakh Rs.)**
(iii)	Vessels - Survey vessel & Other Vessel	0.00	0.00
(iv)	Buoys	0.00	0.00
	Sub-total (C)	**0.00**	**0.00**
D	**Institutional Requirement**		
(i)	Office Development Cost	0.00	0.00
	Sub-total (D)	**0.00**	**0.00**
	Sub-total (A)+(B)+(C)+(D)	**292.86**	**248016.46**
E	Enviornmental Management Plan Cost@5% of Prime cost	14.64	12400.82
F	Project Management & consultancy Charges @ 3% of Prime cost	8.79	7440.49
G	Contingencies and Unforeseen Items of Works @ 3% of Prime cost	8.79	7440.49
	Project Total Hard Cost	**325.07**	**275298.27**

The Lo-Lo facility has been dropped and not considered for development as the existing facility at Beypore and Ponnani may be advantageously used, if so needed. Also, the longitudinal development of the fairway has not been rcommended at this stage till the confirmations of the IWT traffic with critical observation. Investment on Development may be considered only with positive growth confirmations and visibility of revenue stream.

11.5 Operational and Maintenance Expenditure

The operation & Maintenance expenditure has been considered as at Annexure 11.1 and as per the industrial standards.

11.6 Phasing of Expenditure

As explained above, the project is proposed to be considered after having the cargo confirmations. Otherwise, the implementation is neither suggested nor recommended. If at all, the same is to be implemented, the period suggested is of 05 years as planned under option-II. The option-I may be implemented in 1-2 year period.

CHAPTER 12 IMPLEMENTATION SCHEDULE

12.1 Time Frame

The NW 3 (Extension) is having limited IWT mobility rather –Nil-. The identified cargo is also very meagre, while comparing the same with the huge investments. Hence, it is not judicious for considering such range of investments for such meagre cargo potential. If there is any confirmed cargo, in future, with any policy developments, the project can be considered.

The suggested development period is 05 Years (60 Months) as planned under Option-II.

12.2 Phasing

The longitudinal development along the length of waterway (169.55kms) and the Fairway development is to be considered only after having positive confirmations on the Cargo volumes, which is to be get confirmed. As above, the suggested time frame is of 60 months and no phasing is suggested once it is decided to develop the waterway.

12.3 Suggested Implementation Mechanism

The implementation will be considered for its implementation 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 as and when this is needed.

West Coast Canal (NW-3) development has been distinguished across two development modules. This is depicted in the following Table 13 1:

Table 13-1: NW 3 Development

Sub-sector	FY23	FY24	FY25	FY30	FY35	FY40
Fairway	Development					
		Operational				
Terminal		Operational (Using Existing Terminals)				

Source: Tractebel; Consultant

NW 3 has been proposed with prospects for handling passenger traffic river crossing at two different locations i.e Ponnani and Beypore. Both the locations are already operational for river crossing handling ro-pax traffic (passenger along with vehicles) with basic infrastructure. Local passengers travel across the river for daily necessity. Available infrastructure is sufficient to handle growing traffic, hence requirement of new terminal does not exist, usage of existing terminals is considered to accommodate projected passenger traffic. IWAI would improvise the fairway in-between identified routes (Beypore and Ponnani for river crossing) dedicatedly operation for passenger movement with minimal investment.

Construction period is considered for 2 years (FY23 & FY24) and IWT service will get operationalized from end of construction phase i.e FY24 onwards. IWAI prescribed tariffs (notified in 2011) have been assumed for fairway usage. The table below shows the revenue generating sources considered in this financial study.

Table 13-2: Revenue Sources for IWAI

Sr. No	Source	Tariff	Description
1	**Royalty from Tour Operators**		
	Boat Ride	INR 3 / Pax	20% of ticket fee charged by Operator (INR 15 per tourist)
2	Fairway Usage	INR 0.02 GRT-km	By IWAI
Source: IWAI and Consultant			

Royalty from tour operators would be the primary revenue source for IWAI. The boat operators carrying passengers for across the river ride would pay IWAI a Royalty of 20% from the boat tariffs. The selection of operators could be made using tendering process whereas 20% royalty sharing to be made as reserve price. Any operator bidding higher/highest revenue sharing to be awarded tourism project. IWAI would generate additional revenue from tariffs imposed from fairway uses which is bare minimum.

13.1 Input Sheet

The following table lists all the assumptions and input values used in the financial modeling of WCC (NW-3). This includes financial analysis for the navigation infrastructure (fairways), and terminal operations:

Table 13-3: Input Sheet for NW 3

Description	Unit	Fairway	Terminal
Loan Tenure	Years	10	10
Moratorium Period (Years Construction)	Years	2	2
Rate of Interest	Annual	11%	11%
Corporate Tax	Annual	25%	25%
Revenue Escalation	Annual	6%	6%
Administrative Cost	of Revenue	3%	2%
Manpower Cost Escalation	Annual	5%	5%
Dredging Costs Escalation	Annual	5%	
Other Costs Escalation	Annual		6%
Fairway Chainage	km	0.5	
Chainage (mouth of the river to Terminal)	Km		0.5
Operation & Maintenance			
Description	**Unit**	**Fairway**	**Terminal**
Civil Infrastructure	Cost		1%
Dredging		10%	
Machinery Infrastructure			5%
Insurance Cost	Capex	2%	2%

Assumptions for EIRR

Parameters	Unit	Value
Distance		
Road	Km	Ponnani - 17, Beypore - 11
IWT	Km	0.5 (river crossing)
Capacity		
Road	Pax. Per Bus	60
IWT	Pax. Per Vessel	40
Accidental Loss		
Road	Rs Lakhs/KM	7.6
IWT	Rs Lakhs/KM	0.15
Fuel price	Rs/Litre	94.0
Operating Cost (OC)		
Road	Rs/Pax.-km	1
IWT	Rs/Pax.-km	2.5
Emission		
Road	Rs/Trip	650
IWT	Rs/Trip	105.5

Source: Consultant, Market standards

All the necessary assumptions for financial modeling are either market driven or provided by IWAI. Fairway and terminal tariff have been taken from IWAI.

13.1.1 Revenue

Revenue for the cumulative stretch of WCC (NW-3) will be generated from the core operations, which include utilization of the fairways by the potential users and operation at the passenger terminal. Secondary revenues sources, labeled “Ancillary Revenue” i.e land leasing for commercial operations (tea-stall, coffee shops, inn, etc.) have not considered, as terminal construction is not proposed under WCC development for passenger IWT. The revenue break-up and total revenue for IWAI on WCC (NW-3) are presented in the table below:

Table 13-4: Revenue for NW-3 (INR Lakhs)

Description	FY23	FY24	FY25	FY30	FY35	FY40
Terminal	-	32.5	35.5	52.0	76.0	105.9
Fairway	-	0.1	0.1	0.2	0.3	0.4
Total	-	32.7	35.7	52.2	76.3	106.3

Source: Consultant

13.2 Costs

Table below shows the total capital cost required to develop the entire extended stretch of WCC (NW-3). Figures provided in the table below are estimation for IWAI reference in case they plan for further development. However, in this Financial chapter overall project cost of entire WCC extension is not considered for financial analysis as the waterway has not been recommended for any investment till the confirmations of the IWT traffic with critical observation. Investment on Development is suggested only with positive growth confirmations to develop the stretch of NW 3, which is unclear at this stage, however the cost has been compiled in the table below which also consists of suggestions of the Govt. of Kerala vide their letter L no. A2/224/2018/CSIND dated 07.03.2020 for inclusion of more structures having an additional financial impact of INR.1315.42 Crores in Nw-3 Extn. A five-year implementation schedule shall be needed for project of this magnitude, whenever it would be decided to commence with the project.

Table 13-5: Project Cost for Fairway Development of entire WCC Extension

Description	Total	Yr-1	Yr-2	Yr-3	Yr-4	Yr-5
Fairway (INR Crores)						
Fairway	993.4	198.7	198.7	198.7	198.7	198.7
Structure Modification	1,486.7	297.3	297.3	297.3	297.3	297.3
Environmental Management Plan Cost@5% of Prime cost	124.00	24.80	24.80	24.80	24.80	24.80

Description	Total	Yr-1	Yr-2	Yr-3	Yr-4	Yr-5
Project Management & consultancy Charges @ 3% of Prime cost	74.40	14.88	14.88	14.88	14.88	14.88
Contingencies and Unforeseen Items of Works@ 3% of Prime cost	74.40	14.88	14.88	14.88	14.88	14.88
Total Project Cost	**2752.9**	**550.56**	**550.56**	**550.56**	**550.56**	**550.56**

Traffic study has concluded to develop WCC for passengers moving across the river. Two routes are identified for this development and future traffic is projected accordingly. Fairway to be developed for river crossing is hardly 500m at two locations. Nominal investment for fairway improvisation is required. No terminal is proposed at the identified routes, as existing terminals would serve the purpose. Table below shows the project cost considered in this financial analysis for development of across the river IWT facility for passengers at two locations i.e Beypore and Ponnani.

Table 13-6: Project Cost

Description	Total	FY23	FY24
Fairway (INR Lakhs)			
Fairway	292.86	146.4	146.4
Environmental Management Plan Cost as per chapter-9 of the DPR	14.64	7.3	7.3
Project Management & consultancy Charges @ 3% of Prime cost	8.79	4.4	4.4
Contingencies and Unforeseen Items of Works@ 3% of Prime cost	8.79	4.4	4.4
Total Project Cost	325.07	162.5	162.5
Terminal – No new Terminal Construction is required			

As shown in the table below, capital cost investment is considered only for fairway that too just for minor improvisation. Capital investment for terminal building is not required, as existing terminal would be utilized to accommodate projected passenger traffic for river crossing.

It is understood by nature of investment and revenue generated that Fairway (Nominal investment – Negligible Revenue) and Terminal (No investment – Nominal Revenue) on standalone basis would not generate any returns. Terminals and fairway should be evaluated together to understand the financial viability of the WCC development. The traffic proposed for existing terminals would fall in the absence of developed fairway and it would render project unviable. Therefore, financial analysis for the project is undertaken as a whole (fairway + terminal), not fairway and terminal separately.

For operations, total 6 passenger vessels are required till FY40 to cater to the estimated passenger traffic at Ponnani and Beypore. The onus of vessel acquisitions lies with the private operator and not IWAI. Hence, these costs will not be factored in to development model for the Terminal.

13.3 Financial Analysis / FIRR

The financial indicators dictating FIRR for individual ventures, viz. fairways development and terminal construction have been presented in the tables below. These indicators help measure the financial return on investment, which will enable IWAI in taking an informed decision regarding implementing the project. However, before presenting FIRR for the project, some major components such as Depreciation, and P&L statement are provided in the following four tables, respectively:

Table 13-7: Depreciation (Using SLM Method) (INR Lakh)

Depreciation & Amortization	FY23	FY24	FY25	FY30	FY35	FY40
Gross Block	162.5	325.1	325.1	325.1	325.1	325.1
Depreciation & Amortization	0.0	25.0	25.0	18.5	18.5	0.0
Cumulative Depreciation & Amortization	0.0	25.0	50.0	162.0	254.7	325.1
Net Block	162.5	300.1	275.1	163.1	70.4	0.0

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 13-8: P&L Statement (INR Lakh)

Parameter	FY23	FY24	FY25	FY30	FY35	FY40
Revenue	**0.0**	**32.7**	**35.7**	**52.2**	**76.3**	**106.3**
O&M Cost	14.6	31.4	33.0	42.3	54.1	69.2
PBDIT	-14.6	1.3	2.7	9.9	22.2	37.1
Depreciation	0.0	25.0	25.0	18.5	18.5	0.0
Interest	11.6	23.2	20.5	6.8	0.0	0.0
PBT	-26.3	-47.0	-42.8	-15.4	3.7	37.1
Tax	0.0	0.0	0.0	0.0	0.9	9.3
PAT	**-26.3**	**-47.0**	**-42.8**	**-15.4**	**2.8**	**27.8**

Source: Consultant

Project starts showing positive returns in last 7 years i.e FY34 onwards. The following table is the ultimate financial assessment of the WCC viability:

Table 13-9: FIRR for NW 3 (INR Lakh)

Parameter	FY23	FY24	FY25	FY30	FY35	FY40
Project Cashflow (Pre-tax)	-177.2	-161.3	2.7	9.9	22.2	37.1
Project IRR (Pre-tax)	**-1.9%**					
Project Cashflow (Post-tax)	-177.2	-161.3	2.7	9.9	21.3	27.8
Project IRR (Post-tax)	**-2.6%**					

Source: Consultant

13.4 Economic Analysis / EIRR

Economic Internal Rate of Return (EIRR) includes all the financial benefits of a project as well as the non-financial benefits of that project. Non-financial benefits would include reduction in CO2 emission, decreased health care interventions, reduced traffic, and other quantified benefits that a project can have on a region considered for a project. The EIRR looks at any investment decision from the perspective of improving the welfare of the society in general. The table below shows the estimated EIRR for each of these sub-sectors is presented in the table below:

Table 13-10: Project EIRR (INR Crores)

Parameters	FY22	FY23	FY25	FY30	FY35	FY40
Economic Cash Outflow	-1.8	-2.4	-0.8	-0.9	-1.1	-1.2
Net Cash Flow to Project	-1.0	1.8	2.9	3.3	3.7	4.1
Project EIRR	**210.4%**					

Source: Consultant

Project shows positive economic IRR, this is based on the huge difference between road connectivity and IWT. Developing IWT on WCC for passenger moving across the river generates economic benefits to the society.

13.5 Sensitivity Analysis

Variations in tariff rates and project cost (+/- 10%) have been applied to measure the overall impact these could have on the project's earnings and profitability. Sensitivity Analysis for each of the sub-sectors is shown in the table below:

Table 13-11: Sensitivity Analysis (+10% Revenue, +10% Project Cost)

Revenue Source (Lakhs)	FY23	FY25	FY30	FY35	FY40
Revenue	0.0	39.2	57.4	83.9	116.9
PAT	-28.9	-47.1	-16.9	3.0	30.5
Project IRR (Pre tax)	**-1.9%**				
Project IRR (Post tax)	**-2.6%**				

Source: Consultant

Table 13-12: Sensitivity Analysis (+10% Revenue, -10% Project Cost)

Revenue Source (Lakhs)	FY23	FY25	FY30	FY35	FY40
Revenue	0.0	39.2	57.4	83.9	116.9
PAT	-23.6	-31.6	-3.6	13.7	40.6
Project IRR (Pre tax)	**3.8%**				
Project IRR (Post tax)	**2.7%**				

Source: Consultant

Table 13-13: Sensitivity Analysis (-10% Revenue, +10% Project Cost)

Revenue Source (Lakhs)	FY23	FY25	FY30	FY35	FY40
Revenue	0.0	32.1	47.0	68.7	95.7
PAT	-28.9	-54.1	-27.1	-10.9	15.0
Project IRR (Pre tax)	**-9.3%**				
Project IRR (Post tax)	**-9.7%**				

Source: Consultant

Table 13-14: Sensitivity Analysis (-10% Revenue, -10% Project Cost)

Revenue Source (Lakhs)	FY23	FY25	FY30	FY35	FY40
Revenue	0.0	32.1	47.0	68.7	95.7
PAT	-23.6	-38.5	-13.8	2.5	25.1
Project IRR (Pre tax)	**-1.8%**				
Project IRR (Post tax)	**-2.6%**				

Source: Consultant

Under 2nd scenario i.e +10% revenue and -10% project cost the entire project shows positive returns. Apart from this, under no scenario fairway generates any IRR and this primarily because of revenue generated for IWAI is too low to show any positive return.

13.6 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.

Project investment cost considered for development of WCC (NW-3) for passenger river crossing is nominal. No terminal cost is considered as constructing new one is not required. Slight improvisation of fairway for river crossing which is less than 500 m is needed, for which nominal investment of 3.25 crore is considered.

Application of VGF on such small investment is irrelevant and does not create any huge difference on commercial viability of the project development.

13.7 Conclusion

The following table gives a snapshot of the project cost and viability indicators for all the sub-sector developments for NW 3 under different scenarios:

Table 13-15 Critical indicators for the NW 3

Sl No.	Factors	Section	Unit	Outcome
1	Project Cost	Fairway	Cr.	3.25
		Terminals	Cr.	-
2	Tariff	Royalty	INR / Pax.	3 (20% of Ticket Fare)
		Fairway Usage	INR GRT-Km	0.02
2	Traffic	Passengers	In numbers (FY40)	1,310,598
3	Revenue	Fairway (FY40)	Cr.	0.004
		Terminals (FY40)	Cr.	1.06
4	FIRR	Entire Project	-	-2.6%
5	EIRR	Entire Project	-	210.4%

Source: Consultant

As shown in the table above, development of WCC for passenger movement for across the river shows negative return on commercial front, this is because of the insignificant revenue generation. However, the project shows healthy economic IRR i.e 210.4%, this depicts that project has huge benefits in social front. It is recommended to develop WCC for passenger movement for river crossing with nominal investment in improvising the fairway.

CHAPTER 14 CONCLUSIONS AND RECOMMENDATIONS

The study of Second Stage Detailed Project Report (DPR) for Development of NW 3 (Extension) consisting of 169.794 kms from Kottappuram (Lat 10° 11' 38.32" N, Long 76° 12' 04.39" E) to Kozhikkode (Lat 11° 13' 38.83" N, Long 75° 46' 43.90" E) has been carried out as per the Terms of Reference (ToR) and the details of the study are given in the preceding chapters.

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

- Detailed Hydrographic Survey has been carried out and based on the Survey carried out / Site data collected / subsequent to the Hydrological analysis etc., the required developments in the Fairway along with interrelated activities have been identified. The study stretch is traversing parallel to the West Coast in Kerala. Since it is traversing through a canal system, as such there is no major Regime disturbance in the study stretch.
- It takes the alignment which passes/crosses through Periyar River, Karuvannur River, Beeyam Kayal River, Bharathapuzha River, Kadalundipuzha River, Kadalundi River, Chaliyar River and Mampuzha River. The integrating points of canal and the said rivers are in the vicinities of Arabian Sea mouths at eight different locations including start and the end of the canal.
- The National Waterway 3 (Extension) is having a depth lesser than – 0.3 m (w. r. to the Chart Datum) in the majority of the stretch. In most of the places, the width is not adequate for navigation even to the level of Class I of the NW Standards. Further, majority of the study stretch is in the Tidal reach. The Non-Tidal reach is only of 12 Kms (Ch. 118.53 km to Ch. 130.67 km). NW 3 (Extension) has been considered for the study as Class III waterway in line with the requirement of connectivity for mobility through the existing NW 3. There is no observed cargo mobility in the stretch.
- The present waterway of the study stretch of NW 3 (Extension) is having connectivity with the existing NW 3 i.e., with Kottappuram and Kollam including the Kochi area and ICTT, Kochi. In the study stretch, the Waterway is traversing through two Non Major Ports viz., Ponnani and Beypore.
- However, there is no IWT cargo identified through the study stretch, except a meagre volume of Steel scrap of 0.4 MTPA. This volume is not justifying the development. The possibility of IWT mobility is a remote possibility.

- No development is suggested till a critical and micro level analysis with observation of positive growth trend amenable for investment. If the cargo is confirmed / justified for the investment, the period of development is suggested as 5 years for this magnitude of development.
- As a part of development, in order to provide a class III safe navigable fairway, dredging of 67.56 Lakhs Cu. M; 136 kms of Bank Protection at 30 identified locations; 330 Nos. of Buoy / Lights; Reconstruction of 7 Nos. Locks and 209 Hectares of Land Acquisition have been projected with an assumption that the existing port facility at Beypore and Ponnani may be advantageously used for any possible mobility.
- The estimated quantity of the dredging corresponds to longitudinal development of the waterway along its length of 169.794kms.
- A tentative Land requirement has been worked out and arrived at with 5041 Sq. M approx. at Beypore Port vicinity. Land Survey was considered accordingly. Land Details of the location has been firmed up and the same is in the Beypore Village; Beypore Taluka; Kozhikkode District of Kerala state. The IWT Terminal at these locations have not been suggested for any development, due to the non-availability of IWT cargo.
- No Terminal Infrastructure has been suggested.
- The existing ferry services at three locations do provide facility for crossing across the waterway, which has been identified at Beypore & Ponnani area for its strengthening for safe navigability of passenger mobility, thus three kms of dredging may be needed to support the passenger ferry vessel movement and the quantity of dredging may be in the range of (67.56*3/169.56) cum = 1,19,533 cum. Hence the dredging quantity for crossing over development has been considered as 1.19 Lakh cum.
- Any passenger ferry with less than 1.5m draft is suitable for navigating in the defined stretch, as targeted depth of NW-3 waterway is 2.2 m. The recommended specification of passenger ferry that can be deployed in NW-3 for tourism and passenger movement is as follows.
  - For steel boat
    - i. Size (L x B x D) – 15m x 1.9m x 0.7m, 25pax
    - ii. Engine - 1 Marine Diesel Outboard Engine of 120 hp each (approx).
  - For FRP boat
    - iii. Size (L x B x D) – 15m x 1.9m x 0.4m, 30pax
    - iv. Engine - 1 Marine Diesel Outboard Engine of 90 hp each (approx).
- The deployment of passenger vessel for ferry services shall be through 3rd party tour operators.

- The Cost Estimates have been worked out for longitudinal development, which is 2752.98 Crores inclusive of INR.1315.42 Crores as suggested by Govt. of Kerala letter vide their L no. A2/224/2018/CSIND dated 07.03.2020 for inclusion of additional structures in NW-3 waterway. However, the FIRR and EIRR have not been worked out since the waterway has not been recommended for its development in absence of cargo hence commercial & financial viability does not exist as there is no revenue stream to support such large investment.
- Facilitating crossing of the waterway at three locations has been mooted with suggested dredging at these three locations for safe navigation of the passenger vessels at a nominal cost of 3.25 Crores. The costing and FIRR and EIRR have been calculated and the critical indicators are placed.
- Facilitating crossing of the waterway at three locations has been mooted with suggested dredging at these three locations for safe navigation of the passenger vessels at a nominal cost of 3.25 Crores. The costing and FIRR and EIRR have been calculated and the critical indicators are placed.

Parameter	Section	Unit	Outcome
Project Cost	Fairway	Cr.	3.25
	Terminals	Cr.	-
Revenue	Fairway (FY40)	Cr.	0.004
	Terminals (FY40)	Cr.	1.06
FIRR	Entire Project	-	-2.6%
EIRR	Entire Project	-	210.4%

- Not recommended any investment for longitudinal development along the waterway till the confirmations of the IWT traffic with critical observation. Investment on Development is suggested only with positive growth confirmations to develop the stretch of NW 3 (Extension) for about 169 Kms with Class III Canal system of the NW standards.

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	✓		The project is located within 10 km from the boundary of Kadalundi Vallikunnu Community Reserve.
c) Tiger or Elephant Reserve		✓	
d) Biosphere Reserve		✓	
e) Reserved / Protected Forest		✓	
f) Wetland		✓	
g) Important Bird Areas		✓	
h) Mangroves Areas		✓	
i) Estuary with Mangroves		✓	
j) Areas used by protected, important or sensitive species of fauna for breeding, nesting, foraging, resting, over wintering, migration		✓	
k) World Heritage Sites		✓	
l) Archeological monuments/ sites (under ASI"s Central / State list)		✓	
2. Is the project located in whole or part in / near any Critically Polluted Areas identified by CPCB?		✓	
3. Is, there any defense installations near the project site?		✓	
4. Whether there is any Government Order/ Policy relevan / relating to the site?	✓		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 have been discussed in Section 9.3 of the DPR.
7. Is the project area susceptible to natural hazard (*earthquakes, subsidence, erosion,*	✓		

Screening Question	Yes	No	Details / Remarks
flooding, cyclone or extreme or adverse climatic conditions)			
8. Is the project located in whole or part within the Coastal Regulation Zone?	✓		The entire project falls in CRZ I.
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?			To be ascertained by IWAI through separate SIA/ R&R study.
12. Is the proposed project activity affect schedule tribe/ caste communities?			---Do---

Sl. No.	Result of Screening Exercise	(Yes / No)
1.	Environment Impact Assessment is Required	Yes
2.	CRZ Clearance is Required	Yes
3.	Environmental Clearance is Required	No
4.	Forest Clearance is required	No
5.	Wildlife Clearance is required	Yes
6.	NOC from SPCB is required	Yes
7.	Social Impact Assessment is Required	Yes
8.	Abbreviated RAP is required	No
9.	Full RAP is required	Yes
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 - West Coast Canal is bounded by Kozhikode district on the North, Malappuram district in the East, Thrissur district on the South-East, and Arabian Sea on the West. These districts have a combined coastal belt of 195 km on the Western side from Kozhikode till Kottapuram in Thrissur.
- Catchment area – The primary hinterland of West Coast Canal includes the areas, which are located within 25 km from the river. The proposed waterway on West Coast Canal covers Kozhikode, Malappuram, Pallakad & Thrissur districts of Kerala
- Population – As per census 2011, total population residing in above mentioned districts is approx. 10 millions
- Economic activities – The economy of Kerala has high dependence on foreign remittance
- Major industries - The industrial development of hinterland has been very limited. No large scale industries exists, although some Medium industries (in the form of steel plants) are located in Kozhikode district and small industries are operational in Malappuram & Thrissur
- Connectivity

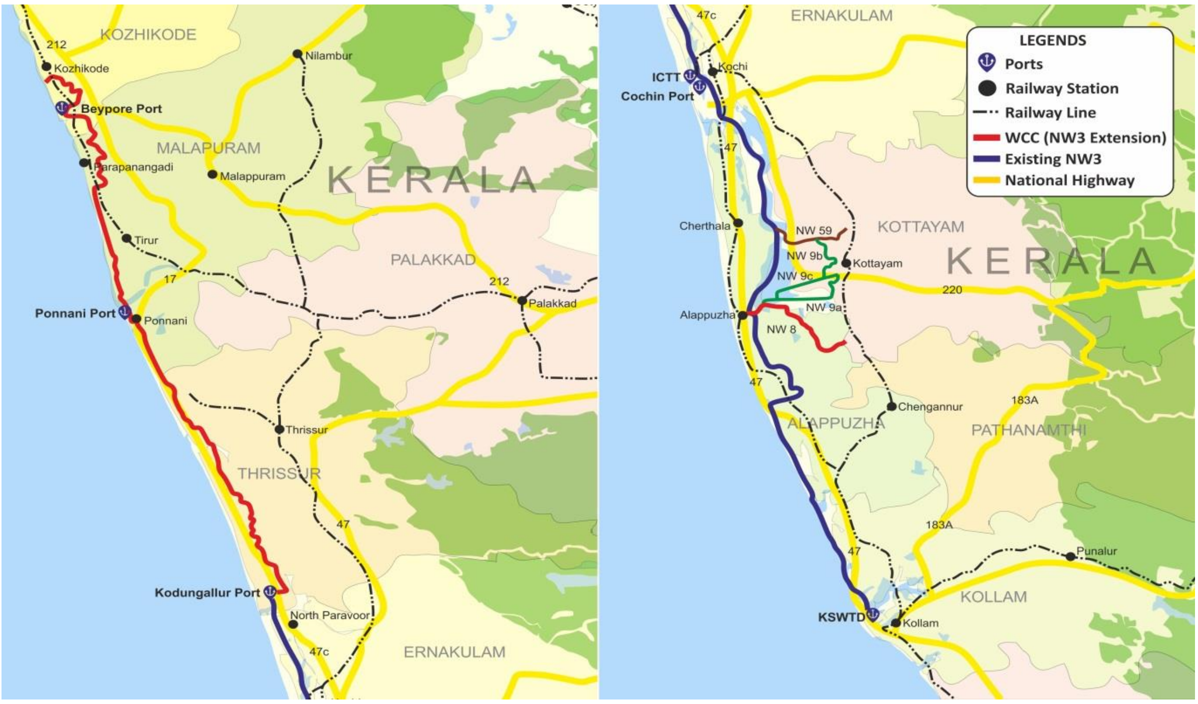
  ✓ Major roads - National Highway-17 moves along the waterway from Kottapuram to Kozhikode. Various other State Highways that bisect the waterway are SH-20, SH-69 connecting the waterway with Thrissur, NH-213 connects the waterway with Malappuram, and NH-17 & SH-28 connect the waterway with Kozhikode city.

  ✓ Major railway – The Thiruvananthapuram and Palakkad division of Southern Railways passes through the catchment of West Coast Canal. There is no direct rail connectivity available for Malappuram city. The nearest railway station from Malappuram is Angadipuram, which is located at a distance of around 21 km

- Specific Developments

Ponnani is a fishing harbour in the catchment area of WCC. Ponnani is going to be developed through public-private participation (PPP) model. The port would be a non-major port for handling cargo and it would be designed to handle vessels of up to 50,000 DWT.

- Catchment area Map



15.2.2 Navigation Baseline

- Existing Waterway Usage

No utility of Waterway noted.

15.2.3 Market Baseline

- Potential Market

✓ Steel Scraps

Commodity	Source	Reasoning
Coal	Kochi Port	There is no thermal power plant near catchment area and steel plants do not use coal as per interaction with industry.
Steel Scraps	Kochi Port	It is used by Steel casting plants. Around 0.4 mn tonnes steel scrap is required for these plants.
Cement Clinker	Cement Industries at Kochi & Kochi Port	Industries are not ready to use waterways for transportation. Water transport is not possible because the distribution area (destination) is scattered in a region and not located in a particular area. It is not possible to develop terminals in various places in that region for distribution. Roadway is the preferred mode of transportation for these companies.
Cement	Cement Industries at Kochi &	Cement Companies at Kozhikode are not willing to use waterways. Maximum dealers are located at Kozhikode. JSW Cement has a manufacturing unit in neighboring state, Andhra

Commodity	Source	Reasoning
	Kochi Port	Pradesh. Road route is preferred by these industries. Ambuja Cement, Ultra tech cement & Zuari are also not willing to use the waterway.
Sand	Catchment of WCC	Sand mining is illegal and there is ban on sand mining. Also dredged sand from Kochi Port could not be diverted to waterway because construction sites, which are the major consumers of dredged sand are scattered in the region. Unloading sand through waterway would be difficult.
Minerals	Extracted from mines	Some mineral reserves are located in the catchment area, but they are not fully operational till now.
Food Grains	Produced in catchment area	Locally consumed and distribution is done via roadways.
Fertilizer	Allotted in catchment area, used in agriculture	Maximum Fertiliser dealers are ready to shift to waterways as roadway is preferred as time saving mode. Roadways take around 5-6 hrs. to reach the destination, whereas waterway would take longer time.

15.2.4 Forecasting Years

Name of the waterway: West Coast Canal														
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**
Proposed Terminal Opportunity for IWAI														
1	Steel Scraps	Break Bulk	Kochi Port	Kochi Port	Beypore Port	Beypore Port		Mn Tonnes	0.4	0.4	0.4	0.4	0.4	0.4

15.2.5 Presentation of Forecast

Sr. No	Name of Cargo	Type of Cargo	Origin	Final Destination	Unit p.a	FY 16	FY 20	FY 25	FY 30	FY 35	FY 40
1	Steel Scraps	Break Bulk	Kochi Port	Beypore Port	mnT- KM	67.2	67.2	67.2	67.2	67.2	67.2

15.2.6 Market Success Factors

The Market success factor for development of NW 3 (Extension) is the Geographical location with its connectivity with the existing NW 3; Cochin Port; ICTT, Kochi; Beypore Port; Ponnani Port and the hinterland spread of the entire Kerala. The diversion to IWT may reduce the road density considerably in Kerala.

15.2.7 Forecasting Methodology

- ✓ Peekay Rolling Mills Ltd., which has showed willingness to use Beypore Port after its development for the transportation of its raw material, i.e. shredded steel scrap. This cargo is handled at Kochi Port at present. The consultant has assumed that from Kochi Port, cargo would be further moved to Beypore Port using IWT. This cargo traffic movement is considered for traffic projection of WCC.
- ✓ The future projection is based on interaction with prospective stakeholder, Peekay Rolling Mills Ltd.
- ✓ Consultant has assumed zero growth rate during cargo projection. As industry is not having any expansion plan.
- ✓ Cargo traffic is proposed based on the assumption that IWAI would widen the identified stretch of the canal, meeting minimum class requirement of vessels. At present, West Coast Canal has very less width for a very long stretch of the river.

15.3 Project Costing Template

Cost type	Cost categories	Components to be itemized
Capital costs	Waterway Infrastructure	***Applicable for Longitudinal development of the waterway along its length of 169.794kms (Not Recommendeded however cost has been computed).*** ☐ Land, compensation and resettlement: 106.51 cr ☐ Capital dredging: 66.36 lakhs cu.m –162.59 cr ☐ River training/bank protection: 712.44 cr ☐ Locks: 7 Nos ☐ Barrages: No ☐ Channel markings: 330 Nos ☐ Night navigation : 11.87 cr ☐ Other: Communication system – NIL ***Applicable for Crossing the waterway for passenger mobility at three locations (Suggested Development).*** **Capital Cost**: INR 3.25 crore
Terminal Infrastructure		None
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 type	Cost categories	Components to be itemized
		□ (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 expressed in year 2021 price levels.
Value engineering		Not all investments will be necessary in all projects. Value engineering should be applied to project scoping and specification to avoid "gold-plating" of costs and undermining viability of project: --
Cost verification		Costs that are estimated on a "bottom-up" basis should be verified or tested for reasonableness against actual costs for such activities evidenced in the market place: Considered as per standard

15.4 Economic Evaluation Template

Item	Requirements
Objective	To assess economic internal rates of return (EIRR) on a consistent basis between different river projects.
Economic evaluation approach	Economic evaluation of each river upgrading project may include: **Capital Cost**: INR 3.25 crore Savings in transport resource costs between IWT and rail and/or road transport **Saving on Fuel**: INR 0.6 crore **Saving on Vehicle Operating Cost**: INR 2.67 crore **Savings in road accident costs**: INR 0.1 crore **Saving in carbon emissions**: INR 1.1 crore
Standard values	To ensure consistency between evaluations of different waterways the following has been used: Vehicle operating Cost • Road: INR 2.57/tons-km • IWT: INR. 1.06/tons-km • Road accident Loss: INR 7.73 Lakhs/km

Item	Requirements
	• 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 2019 price level as equivalent to resource costs for the purposes of the economic evaluation.
Evaluation period	Initial construction period has been adopted as 2 years for Navigation infrastructure. The sector will be developed in single phase only. Construction will be from FY23 to FY24. A total 17 years for operation period have been taken into account entire operation.
EIRR	The EIRR for project development is 210.4% Development of West Coast Canal as an alternate mode for transportation for river crossing 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 West Coast Canal is also likely to generate overall benefits to the project.
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 West Coast Canal NW-3 Extension i.e., the study stretch, starts from Kottapuram 10°11'38.32"N, 076°12'04.39"E and ends at Kozhikode 11°13'38.83"N, 075°46'43.90"E.
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. No longitudinal development of waterway along 169.794 kms proposed. Only fairway development at three locations for passenger ferry mobility is considered for crossing the waterway. **Returns for proposed development are:** Total Revenue: INR 1.06 cr. in FY40 O&M Cost: INR 0.69 cr. in FY40 Tax: 0.09 cr. FY40 (@ 30% on EBITDA) EBIDA: INR 0.37 cr. In FY40 Project Capital Cost (with escalation): INR 3.25 cr. Net Cash Flow: INR 0.28 cr. In FY40
Disaggregation	Cash flow streams and FIRRs have been attached as annexures in Financial Evaluation chapter-13 for Navigation Structure and terminals combined. It is considered as a whole. Payback is also considered as a whole for all 2 facilities. **Returns for proposed development are:** Total Revenue: INR 1.06 cr. in FY40 O&M Cost: INR 0.69 cr. in FY40 Tax: 0.09 cr. FY40 (@ 30% on EBITDA) EBIDA: INR 0.37 cr. In FY40 Project Capital Cost (with escalation): INR 3.25 cr. Net Cash Flow: INR 0.28 cr. In FY40.
Evaluation period	Construction period has been adopted as 2 years for all the sub-segment projects. For fairway & terminal, a total 16 years for operation period has been taken into account for the entire operation (FY24 – FY40).
FIRR and payback period	Estimate FIRR and overall sector payback period, the latter being the year in which the sector flow still shows negative return: Described in financial evaluation
Ramp-up period	Unless good reasons otherwise, assume 4 years ramp-up period from first operational year to long-term trend levels of traffic: 5 years ramp up period considered

Item	Requirements
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 West Coast 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 away 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. Traffic for private operators should generate decent revenue to eventually recover costs of fairway development in the long run. Passengers are already using existing ro-pax service at both the identified routes i.e Beypore and Ponnani. If in future the terminal operator charges higher tariff for proposed passenger facilities, then chances are high that increasing will keep using existing service.
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.

<u>An inception report has to be prepared which would consist of the findings based on the analysis of the existing data and reconnaissance surveys.</u>

1.1.3 Feasibility Report

The Consultant has to prepare Feasibility Report for the proposed waterways based on the available data and reconnaissance survey. It must include the following prospects:

1. **Introductory considerations:**
   The Consultant shall provide an introduction, describing the scope of the assignment, its methodology in fulfilling the assignment and the expected outcome of the assignment.

2. **Analysis of present state of affairs:**
   The Consultant shall provide a quantitative and qualitative description of the current utilization of proposed inland waterways. In addition, the Consultant shall describe the status of goods transport, including utilization of road and transport, as well as river facilities.

3. **Market Analysis:**
   The consultant shall analyze the market and potential usage of proposed Inland Waterways. This analysis shall examine both the existing market and the potential future market. Contractor has to collect the details of available Industries along the waterway, type of production in these industries, ferry services, type of crop along the waterway, previous history of movement of cargo in the waterway etc. Above is to be collected after discussion with local village people while conducting reconnaissance survey etc. and also after interaction with State Govt. Officials, Irrigation / Water Resources departments.

4. **Reconnaissance Survey:**
   Analysis of the data collected in the reconnaissance survey should reflect the possibility of year round flow in the proposed Inland Waterways to achieve the commercial navigation. It should also consist the map of proposed Inland Waterways indicating existing cross structures viz. bridges, dams etc. Navigability of the waterway (for the periods) is to correlate with CWC/Irrigation water level data.

The Consultant has to submit the Feasibility Report for proposed Inland Waterways. Consultant also has to emphasize that which stretches of proposed inland waterways has potential of possible navigation. Only for those stretches of proposed inland waterways, which have potential of possible navigation, Stage 2 has to be carried out.

After obtaining approval from IWAI for identified stretches, Consultant may proceed for Stage - 2. Based on the feasibility report, IWAI will accord the approval for Stage-II, and stretch for DPR will be based on feasibility study.

1.2 STAGE-2

For Stage-2, Consultant has to carry out detailed hydrographic survey, topographic survey, traffic survey and selection of terminal locations.

Stage-2 would consist of the following activities:

1A. Hydrographic Survey & hydro-morphological survey

1B. Traffic Survey & Techno economic feasibility

1C. Preparation of Detailed Project Report

1.2.1 HYDROGRAPHIC SURVEY & HYDROMORPHOLOGICAL SURVEY

Based on the recommendation after reconnaissance survey of proposed Inland Waterways, Hydrographic survey may be carried out as per the International Standards including the following for finding the potential of proposed Inland Waterways for inland navigation:-

(i) The detailed hydrographic survey is to be carried out in WGS'84 datum.

(ii) The horizontal control is to be made using DGPS with minimum 24 hours observations at some platform/base.

The vertical control is to be established with respect to the chart datum / sounding datum from the following methods:-

i. Chart datum/ sounding datum already established by Port Authorities (Chart Datum), Central Water Commission (Average of last six years minimum Water Level) / State Irrigation Department (Full Supply Level (FSL)) and at their gauge stations along the river/canal. Secrecy undertaking forms etc. will be provided by IWAI for collection of CWC data. Introductory letter will be issued to the successful Consultant for collection of other required information from State Departments.

ii. Standard method shall be adopted for transfer of datum in rivers/canals. For tidal reaches standard transfer of datum as per Admiralty Manual shall be adopted.

iii. **By erection of tide gauges – at every 10km interval and also at upstream and downstream of Locks, Sluice gates, Barrages, Dams etc.**

Other Terms of Reference for the survey work shall be as given below: -

1.2.1.1 BENCH MARK PILLARS

a. Construct Bench Mark Pillars of dimension 0.3m x 0.3m x 1.5m (0.6m above GL) RCC pillar with 6mm thick 50mm dia GI pipe inserted (as per construction drawing of Survey Pillar in the tender document), at every 10km interval. Detailed description of the bench mark along with its position and value to be given in the report for future recovery.

1.2.1.2 WATER LEVEL GAUGES

i. Water level gauges are to be erected at every 10 km interval along the canal/river **and also at upstream and downstream of Locks, Sluice gates, Barrages, Dams etc. simultaneously.** Readings are to be taken at 1 hr interval for 12 hours (6 AM to 6 PM) or for the entire period of survey. The gauges are to be connected to a nearest Bench Mark by leveling and its datum value shall be established w.r.to MSL & CD. Water level gauges are to be installed temporarily during the survey period.

ii. At least 2 gauges (one U/s and one D/s at 10 Km apart) shall be read simultaneously and soundings to be carried out within the gauge stations. Soundings are to be reduced for datum of a gauge for 5km length of the canal/river on both side of a gauge.

1.2.1.3 BATHYMETRIC AND TOPOGRAPHICAL SURVEY

Sl. No.	Name of the River / Canal	Description of Inland Waterway
CLUSTER-2		
1	DHANSIRI / CHATHE	110 km length of the river from Bridge near Morongi T.E. village Lat 26°24'40.65"N, Lon 93°53'46.75"E to Numaligarh Lat 26°42'1.20"N, Lon 93°35'15.42"E
2	LOHIT RIVER	100 km length of the river from Parasuram Kund Lat 27°52'40.06"N, Lon 96°21'39.70"E to Saikhowa Ghat, Sadiya Lat 27°47'49.14"N, Lon 95°38'13.84"E

3	SUBANSIRI RIVER	111 km length of the river from Gerukamukh Lat 27°27'3.14"N, Lon 94°15'16.12"E to Brahmaputra confluence at Lat 26°52'24.93"N, Lon 93°54'31.26"E
4	TIZU and ZUNGKI RIVERS	42 km length of the river from Longmatra at Lat 25°46'11.98"N, Lon 94°44'35.04"E to Avanghku at Myanmar border Lat 25°35'2.94"N, Lon 94°53'6.12"E and in Zungki river from bridge at Lat 25°48'26.10"N, Lon 94°46'35.96"E to confluence of Zungki and Tizu rivers at Lat 25°46'58.03"N, Lon 94°45'20.51"E
	CLUSTER-3	
1	BIDYA RIVER	55 km length of the river from Lot No. 124 at Lat 21°54'42.88"N, Lon 88°41'8.48"E to near Uttar Danga at Lat 22°11'47.93"N, Lon 88°51'54.93"E
2	CHHOTA KALAGACHI (CHHOTO KALERGACHI) RIVER	15 km length of the river from near Rajani ferry ghat Lat 22°19'57.49"N, Lon 88°54'21.40"E to near Nazat at Lat 22°26'5.40"N, Lon 88°50'11.69"E
3	DVC CANAL	130 km length of the canal from Durgapur Barrage Lat 23°28'47.36"N, Lon 87°18'19.04"E to Confluence point of DVC canal with Hooghly river near Tribeni Lat 23° 0'30.95"N, Lon 88°24'54.72"E
4	GOMAR RIVER	7 km length of the river from near Ramkrishnapur Lat 22°11'53.35"N, Lon 88°44'41.97"E to near Gosaba Kheya ghat at Lat 22°10'5.44"N, Lon 88°47'37.17"E
5	HARIBHANGA RIVER	16 km length of the river from Bangladesh Border Lat 21°53'18.81"N, Lon 89° 1'23.61"E to confluence with Jhila river at Lat 21°58'17.66"N, Lon 88°55'8.38"E
6	HOGLA (HOGAL)-PATHANKHALI RIVER	37 km length of the river from near Parandar Lat 22°12'22.05"N, Lon 88°40'42.77"E to near Sandeshkhai Ferry Ghat at Lat 22°21'12.26"N, Lon 88°52'47.99"E
7	KALINDI (KALANDI) RIVER	8 km length of the river from Bangladesh Border at Hingalganj Lat 22°28'8.48"N, Lon 88°59'46.19"E to Bangladesh Border near Khosbash at Lat 22°24'41.40"N, Lon 88°58'20.68"E
8	KATAKHALI RIVER	23 km length of the river from Bangladesh Border near Barunhat Lat 22°30'31.44"N, Lon 88°58'24.53"E to Lebukhali ferry at Lat 22°21'45.36"N, Lon 88°57'30.27"E
9	MATLA RIVER	98 km length of the river from Bay of Bengal at Lat 21°33'4.13"N, Lon 88°38'25.65"E to Canning ferry ghat at Lat 22°18'38.87"N, Lon 88°40'42.65"E
10	MURI GANGA (BARATALA) RIVER	27 km length of the river from Bay of Bengal near Bisalakshmipur Lat 21°37'51.94"N, Lon 88°10'0.24"E to near Kakdwip at Lat 21°52'17.39"N, Lon 88° 9'7.52"E
11	RAIMANGAL RIVER	52 km length of the river from Hemnagar at Lat 22°11'40.58"N, Lon 88°58'1.08"E to Rajnagar at Lat 22°33'56.95"N, Lon 88°56'16.64"E
12	SAHIBKHALI (SAHEBKHALI) RIVER	14 km length of the river from near Ramapur Lat 22°17'52.04"N, Lon 88°56'34.78"E to Bangladesh Border near Khosbash at Lat 22°24'41.40"N, Lon 88°58'20.68"E
13	SAPTAMUKHI RIVER	37 km length of the river from Bay of Bengal at Henry Island Lat 21°34'57.35"N, Lon 88°19'8.47"E to near Chintamanipur at Lat 21°51'14.01"N, Lon 88°18'40.50"E
14	THAKURRAN RIVER	64 km length of the river from Bay of Bengal at Lat 21°33'31.95"N, Lon 88°27'45.40"E to Madhabpur at Lat 22° 2'52.19"N, Lon 88°33'27.96"E
	CLUSTER-4	
1	BAITARNI RIVER:	49 kms length of the river from Dattapur village at Lat 20°51'44.61"N, Long 86°33'30.45"E to confluence with Dhamra river near Laxmiprasad Dia at Lat 20°45'13.32"N, Long 86°49'15.36"E

2	BIRUPA / BADI GENGUTI / BRAHMANI RIVER SYSTEM:	102 kms length of the river from Birupa Barrage at Choudwar at Lat 20°30'49.00"N, Long 85°55'20.17"E to confluence of Birupa & Brahmani rivers near Upperkai Pada village at Lat 20°37'36.25"N, Long 86°24'19.13"E including alternative route of 25 kms from Samaspur village at Lat 20°35'40.59"N, Long 86° 6'31.50"E to near Kharagpur village at Lat 20°38'27.77"N, Long 86°17'31.81"E and additional 54 kms length of Brahmani river from confluence of Birupa & Brahmani rivers near Upperkai Pada village at Lat 20°37'36.25"N, Long 86°24'19.13"E to Brahmani river at Katana Lat 20°39'26.28"N, Long 86°44'52.86"E
3	BUDHA BALANGA:	56 kms length of the river from Barrage (approx 300m from Patalipura village) at Lat 21°38'12.96"N, Long 86°50'53.17"E to confluence of Budha Balanga river with Bay of Bengal at Chandipur Fishing Port Lat 21°28'12.14"N, Long 87° 4'11.60"E
4	MAHANADI RIVER:	425 kms length of the river from Sambalpur Barrage at Lat 21°27'34.33"N, Long 83°57'49.80"E to Paradip at Lat 20°19'38.12"N, Long 86°40'16.96"E
	CLUSTER-5	
1	PENNAR RIVER:	29 kms length of the river from Penna Barrage, Pothireddypalem at Lat 14°28'8.38"N, Long 79°59'9.31"E to confluence with Bay of Bengal near Kudithipalem at Lat 14°35'36.75"N, Long 80°11'30.61"E
2	KAVERI / KOLLIDAM RIVER:	364 kms length of the river from Uratchikottai Barrage at Lat 11°29'3.09"N, Long 77°42'13.68"E to confluence with Bay of Bengal at Pazhaiyar Lat 11°21'37.97"N, Long 79°49'53.23"E
3	PALAR RIVER:	141 kms length of the river from rail bridge at Virudampattu, Vellore Lat 12°56'14.07"N, Long 79° 7'29.70"E to confluence with Bay of Bengal at Sadurangapattinam Lat 12°27'52.16"N, Long 80° 9'13.47"E
4	PAZHYAR RIVER:	20 kms length of the river from Bridge near Veeranarayana Mangalam village at Lat 8°13'48.97"N, Long 77°26'27.34"E to confluence with Arabian Sea at Manakudi at Lat 8° 5'15.01"N, Long 77°29'7.61"E
5	PONNIYAR RIVER	125 km length of the river from Sathanur Dam at Lat 12°11'0.06"N, Lon 78°51'1.25"E to Cuddalore at confluence of Bay of Bengal at Lat 11°46'21.76"N, Lon 79°47'41.70"E
6	TAMARAPARANI RIVER:	64 kms length of the river from Sulochana Mudalir bridge, Tirunelveli at Lat 8°43'43.17"N, Long 77°42'53.94"E to confluence with Bay of Bengal near Punnaikayal at Lat 8°38'24.90"N, Long 78° 7'37.85"E
	CLUSTER-6	
1	West Coast Canal	160 kms length of the canal as extension of NW-3 towards north of Kottapuram - from Kottapuram at Lat 10°11'38.32"N, Long 76°12'4.39"E to Kozhikode at Lat 11°13'38.83"N, Long 75°46'43.90"E
2	ALAPPUZHA-CHANGANASSERY CANAL	28 km from Boat jetty, Alappuzha at Lat 9°30'2.85"N, Lon 76°20'37.05"E to Changanassery Jetty at Lat 9°26'41.61"N, Lon 76°31'41.76"E
3	ALAPPUZHA- KOTTAYAM – ATHIRAMPUZHA CANAL	38 km from Boat jetty, Alappuzha at Lat 9°30'2.85"N, Lon 76°20'37.05"E to Athirampuzha market Lat 9°40'04"N, Lon 76°31'54"E
4	KOTTAYAM-VAIKOM CANAL	28 km from Kottayam, near Kodimatha at Lat 9°34'38.67"N, Lon 76°31'7.67"E to Vechoor joining National Waterway no. 3 at Lat 9°40'0.19"N, Lon 76°24'10.65"E
5	GURUPUR RIVER	10 km length of the river from confluence of Netravathi river at Lat 12°50'44.04"N, Lon 74°49'44.51"E to confluence of Mangalore Port Bridge at Lat 12°55'34.81"N, Lon 74°49'37.34"E

6	KABINI RIVER	23 km length of the river from Kabini Dam Lat 11°58'24.52"N, Lon 76°21'9.69"E to Beeramballi at Lat 11°56'9.55"N, Lon 76°14'17.58"E
7	KALI RIVER	54 km length of the river from Kodasalli Dam Lat 14°55'8.24"N, Lon 74°32'6.90"E to confluence of Kali river with Arabian Sea near Sadashivgad bridge at Lat 14°50'30.95"N, Lon 74° 7'21.32"E
8	NETRAVATHI RIVER	78 km length of the river from Netravathi Dam, Dharmsthala Lat 12°57'55.23"N, Lon 75°22'10.19"E to confluence with Arabian sea at Bengre Lat 12°50'42.73"N, Lon 74°49'28.86"E
9	PANCHAGANGAVALI (PANCHAGANGOLI) RIVER	23 km length of the river from Gangoli Port at Lat 13°38'1.30"N, Lon 74°40'8.43"E to Bridge at Badakere at Lat 13°44'50.01"N, Lon 74°39'15.13"E
10	SHARAVATI RIVER	29 km length of the river from Honnavar Port Sea Mouth at Lat 14°17'56.23"N, Lon 74°25'27.04"E to link at highway at Gersoppa Lat 14°14'14.73"N, Lon 74°39'6.15"E
11	UDAYAVARA RIVER	16 km length of the river from Arabian Sea Mouth at Malpe Lat 13°20'57.24"N, Lon 74°41'28.22"E to Bridge near Manipura Lat 13°17'32.70"N, Lon 74°46'25.56"E
	CLUSTER-7	
1	CHAPORA RIVER	33 kms length of the river from Bridge at State highway # 124 (1Km from Maneri village) Lat 15°42'47.31"N, Long 73°57'23.38"E to Confluence of Chapora river with Arabian Sea at Morjim Lat 15°36'33.27"N, Long 73°44'0.93"E
2	MAPUSA / MOIDE RIVER	27 kms length of the river (including Moide river) from bridge on NH17 at Mapusa Lat 15°35'20.79"N, Long 73°49'17.20"E to confluence point of Mapuca & Mandovi rivers at Porvorim Lat 15°30'20.01"N, Long 73°50'42.09"E
3	SAL RIVER	14 kms length of the river from Orlim Deusa Bridge at Lat 15°13'11.41"N, Long 73°57'29.77"E to confluence with Arabian Sea at Mobor Lat 15° 8'31.93"N, Long 73°56'59.89"E
4	AMBA RIVER	45 kms length of the river from Arabian Sea, Dharamtaar creek near village Revas at Lat 18°50'15.14"N, Long 72°56'31.22"E to a Bridge near Nagothane ST Stand at Lat 18°32'19.82"N, Long 73° 8'0.29"E
5	DABHOL CREEK/VASHISHTI RIVER	45 km length of the river from Arabian Sea at Dabhol Lat 17°34'51.33"N, Lon 73° 9'17.83"E to bridge at Pedhe Lat 17°32'39.45"N, Lon 73°30'35.56"E
6	KALYAN-THANE-MUMBAI WATERWAY, VASAI CREEK AND ULHAS RIVER	145 km length of the waterway from Arabian Sea at Navi Mumbai Lat 18°55'49.78"N, Lon 72°53'21.67"E via Ulhas river to bridge on State Highway No.76 near Malegaon T. Waredi Lat 19° 2'38.20"N, Lon 73°19'53.79"E Bridge on Kalyan-Badlapur road near Kalyan railway yard at Kalyan Lat 19°14'6.39"N, Lon 73° 8'49.13"E to Kalyan Lat 19°15'35.03"N, Lon 73° 9'27.77"E Vasai Creek from Lat 19°18'53.50"N to Lon 72°47'30.18"E to Kasheli at Lat 19°13'22.84"N, Lon 73° 0'21.44"E
7	RAJPURI CREEK	31 km length of the river from Arabian Sea at Rajpuri Lat 18°18'3.15"N, Lon 72°56'42.94"E to Mhasala at Lat 18° 8'15.37"N, Lon 73° 6'45.35"E
8	REVADANDA CREEK / KUNDALIKA RIVER	31 km length of the river from Arabian Sea at Revadanda Lat 18°32'19.85"N, Lon 72°55'32.80"E to bridge on Roha-Astami Road near Roha Nagar Lat 18°26'31.50"N, Lon 73° 7'10.74"E
9	SAVITRI RIVER (BANKOT CREEK)	44 kms length of the river from Bridge near Sape at Lat 18° 5'54.11"N, Long 73°20'8.81"E to Arabian Sea at Harihareswar Lat 17°58'47.10"N, Long 73° 2'15.01"E
10	SHASTRI RIVER / JAIGAD CREEK	52 kms length of the river from Sangmeshwar at Lat 17°11'15.83"N, Long 73°33'2.57"E to confluence with Arabian Sea at Jaigad Lat 17°19'11.92"N, Long 73°12'39.30"E

CLUSTER-8		
1	MAHI RIVER:	248 kms length of the river from Kadana Dam at Lat 23°18'22.35"N, Long 73°49'37.45"E to confluence with Gulf of Khambhat near Kavi railway station at Lat 22°10'34.71"N, Long 72°30'36.31"E
2	NARMADA RIVER	227 km length of the river from Pandhariya at Lat 21°57'10.37"N, Lon 74° 8'27.46"E to confluence of Narmada with Arabian Sea at Gulf of Khambhat Lat 21°38'26.81"N, Lon 72°33'28.24"E
3	SABARMATI RIVER:	212 kms length of the river from Barrage near Sadoliya at Lat 23°26'49.66"N, Long 72°48'34.85"E to confluence with Gulf of Khambhat near Khambhat at Lat 22° 9'17.99"N, Long 72°27'27.81"E
4	TAPI RIVER:	436 kms length of the river from Hatnur Dam near Mangalwadi at Lat 21° 4'21.99"N, Long 75°56'44.88"E to confluence with Gulf of Khambhat (Arabian Sea) at Lat 21° 2'15.51"N, Long 72°39'29.63"E

#	River/Canal	State	Length (km)	Spacing (m)	Ave. width (m)
	CLUSTER-2				
1	Dhansiri / Chathe	Assam	110	150	150
2	Lohit	Assam & Arunachal Pradesh	100	200	1000
3	Subansiri	Assam	111	200	1000
4	Tizu and Zungki	Nagaland	42	50	100
			363		
	CLUSTER-3				
1	BIDYA RIVER	West Bengal	55	200	1500
2	CHHOTA KALAGACHI (CHHOTO KALERGACHI) RIVER	West Bengal	15	200	500
3	DVC CANAL	West Bengal	130	100	100
4	GOMAR RIVER	West Bengal	7	200	400
5	HARIBHANGA RIVER	West Bengal	16	200	2000
6	HOGLA (HOGAL)-PATHANKHALI RIVER	West Bengal	37	200	300
7	KALINDI (KALANDI) RIVER	West Bengal	8	200	500
8	KATAKHALI RIVER	West Bengal	23	200	200
9	MATLA RIVER	West Bengal	98	200	2000
10	MURI GANGA (BARATALA) RIVER	West Bengal	27	200	3000
11	RAIMANGAL RIVER	West Bengal	52	200	800
12	SAHIBKHALI (SAHEBKHALI) RIVER	West Bengal	14	200	300
13	SAPTAMUKHI RIVER	West Bengal	37	200	700
14	THAKURRAN RIVER	West Bengal	64	200	1000
			583		
	CLUSTER-4				
1	Baitarni	Odisha	49	100	100
2	Birupa / Badi Genguti / Brahmani	Odisha	156	100	200
3	Budha Balanga	Odisha	56	100	100
4	Mahanadi	Odisha	425	200	500
			686		

		CLUSTER-5			
1	Pennar	Andhra Pradesh	29	100	400
2	Kaveri / Kollidam	Tamil Nadu	364	200	400
3	Palar	Tamil Nadu	141	200	500
4	Pazhyar	Tamil Nadu	20	50	100
5	PONNIYAR	Tamil Nadu	125	200	300
6	Tamaraparani	Tamil Nadu	64	150	300
			743		
		CLUSTER-6			
1	West Coast Canal	Kerala	160	50	100
2	ALAPPUZHA- CHANGANASSERY CANAL	Kerala	28	50	100
3	ALAPPUZHA- KOTTAYAM – ATHIRAMPUZHA CANAL	Kerala	38	50	100
4	KOTTAYAM-VAIKOM CANAL	Kerala	28	50	100
5	GURUPUR RIVER	Karnataka	10	100	400
6	KABINI RIVER	Karnataka	23	200	500
7	Kali	Karnataka	54	150	450
8	Netravathi	Karnataka	78	100	300
9	PANCHAGANGAVALI (PANCHAGANGOLI) RIVER	Karnataka	23	150	600
10	SHARAVATI RIVER	Karnataka	29	150	400
11	UDAYAVARA RIVER	Karnataka	16	100	250
			487		
		CLUSTER-7			
1	CHAPORA RIVER	Goa	33	100	250
2	MAPUSA / MOIDE RIVER	Goa	27	50	100
3	SAL RIVER	Goa	14	50	100
4	AMBA RIVER	Maharashtra	45	150	300
5	DABHOL CREEK/VASHISHTI RIVER	Maharashtra	45	150	400
6	KALYAN-THANE-MUMBAI WATERWAY, VASAI CREEK AND ULHAS RIVER	Maharashtra	145	150	350
7	RAJPURI CREEK	Maharashtra	31	150	1000
8	REVADANDA CREEK / KUNDALIKA RIVER	Maharashtra	31	150	400
9	SAVITRI RIVER (BANKOT CREEK)	Maharashtra	46	150	400
10	SHASTRI RIVER / JAIGAD CREEK	Maharashtra	52	150	300
			469		
		CLUSTER-8			
1	MAHI RIVER	Gujarat	248	200	400
2	NARMADA RIVER	Maharashtra & Gujarat	227	200	500
3	SABARMATI RIVER	Gujarat	212	200	150
4	TAPI RIVER	Maharashtra & Gujarat	436	200	350
			1123		

Note:- Bathymetric and Topographical survey of specified Waterways is to be conducted for average width specified in above table. Average width of the Waterways is the average of narrow and wider portions of the river. For reservoir / ponding areas, only bathymetric survey of maximum 500m width in the deepest channel is to be carried out. Minimum 100m wide corridor is to be surveyed (only for rivers / canals having less than

60m water width). 100m wide corridor includes width of proposed Waterways. Bathymetric and topographic survey is to be carried out for 50m width on both side from the centre line of the channel.

a. Bathymetric and Topographical survey of proposed Inland Waterways is to be conducted for width specified in above table. Minimum 100m wide corridor is to be surveyed to assess the extent of land acquisition required for 100m wide corridor (100m wide corridor includes width of proposed Inland Waterways).
b. Cross-section sounding lines / leveling are to be run from bank to bank at spacing specified in above table, to identify the navigable channel.
c. Continuous soundings are to be taken by running the sounding boat at constant speed on the cross-section so as to get smooth contours. Intermediate line is to be run at bends, if the line spacing is more than the specified above.
d. For cross-sectional bathymetric survey more than 60m in proposed Inland Waterways, spot levels at line spacing x 20m length grid, on both banks should be taken. If Island or sandchur exist in the middle of the waterway, spot levels on the same spacing should also be taken and indicated in the charts along the same cross-section line.
e. If bathymetry cross-section is limited up to 60 mts width in waterway, then Consultant has to cover 100m corridor including spot levels in line spacing x 20m length grid on both banks.
f. If bathymetry cross-sectional is limited up to 20 mts width in waterway, then Consultant has to run three (03) nos. longitudinal lines. One in centre and one each at equal interval (near the edges of water).
g. If bathymetry cross-sectional is limited up to 10 mts width in waterway, then Consultant has to run one (01) no. longitudinal line at centre only.
h. If Island or sandchur exist in the middle of the river, spot levels on the same spacing should also be taken and indicated in the charts along the same cross-section line.
i. Surveys in non-approachable areas are to be informed by the Consultant and joint inspection (Consultant's representative & Engineer-In-Charge or his representative) will be held to confirm the non-approachable areas.
j. The survey area may consist of canal sections, rivers, sea openings of different dimensions. Hence, Consultant has to inspect the area to be surveyed and satisfy themselves with respect to site conditions before submission of bid. However, variation in quantity will be considered only for length of the river/canal (longitudinal length).
k. The soundings are to be reduced to the chart datum/ sounding datum established at every gauge stations.

1.2.1.4 CURRENT VELOCITY AND DISCHARGE MEASUREMENT

a. The current velocity and discharge at every 10 km interval shall be observed once in a day during the survey period. Current velocity and discharge at every 10 km interval are to be measured only once at different depths while carrying out survey in that region.
b. Current meter measurement should be taken at 1m below water surface or 0.5d (if depth is less than 1m), where d is measured depth of water & values indicated in the report along with position.
c. Measurements at different depths may be taken by single equipment over three different time spans.
d. Measurement of current velocity at different depth is to be measured for at least 15

minutes or as per listed calibration period of the equipment, under use for this project.

e. Current velocity and discharge can also be measured with the help of ADCP during survey, at every 10km interval. Discharge can be measured either by ADCP or standard formulas.

1.2.1.5 WATER AND BOTTOM SAMPLES

a. Water and bottom samples are to be collected from the deepest route at every 10 km interval and are to be tested and the results/characteristics of the soil and the water are to be incorporated in the report. Soil sample can be collected by a grab and water sample at 0.5d (d-measured depth of water) by any approved systems. The following tests are to be carried out for Bottom samples:-

i) Grain size distribution
ii) Specific gravity,
iii) PH value
iv) Cu, Cc
v) Clay silt%
and Sediment concentration for Water Samples.

1.2.1.5 COLLECTION OF TOPOGRAPHICAL FEATURES

a. Photographs of the prominent features are to be taken and included in the report along with its position.
b. Permanent structures located within this corridor are also required to be indicated on the report & charts.
c. All prominent shore features (locks, bridges, aqueducts, survey pillars if available etc) and other conspicuous objects are to be fixed and indicated on the chart and included in the report.
d. Identify cross structures which are obstructing navigation.
e. Details (horizontal and vertical clearances above High Flood Level in non-tidal area and High Tide Level in tidal area) of bridges, aqueducts, electric lines, telephone lines, pipe lines, cables en-route are to be collected and indicated on the chart and also included in the report along with their co-ordinates and location.
f. Details of water intake/ structures are to be collected and shown on the charts and include in the report.
g. Availability of berthing place, existing jetty, ferry ghats, approach roads etc. are to be indicated on the charts and include in the report.
h. During the survey, conditions of the banks are also required to be collected. It is to be noted that banks are pitched (protected) or not protected. Estimate the length of bank protection, where banks erosion is taking place.
i. Positions and levels of corners of permanent structures within the corridor are to be physically surveyed and marked on survey charts.
j. Approachable roads / rails / places outside the corridor may be incorporated from Toposheets/Google Map/Google Earth.

1.2.1.6 SURVEY CHART PREPARATION

a. The survey chart is to be prepared on a scale of 1:1,000 for Waterways width less than 100m. On a scale of 1:2,000 for Waterways width between 100m to 300m. On a scale of 1:5,000 for Waterways width between 300m to 500m and On a scale of 1:10,000 for Waterways width more than 500m.

b. Contours of 0m, 1m, 2m, 3 m, 5m and 10 m are to be indicated on the charts with respect to Chart Datum / Sounding Datum.
c. Reduced spot levels w.r.to MSL to be indicted on the charts. Spot level values are to be given w.r.t. Mean Sea Level (MSL) & Soundings w.r.t. Chart Datum / Sounding Datum. A separate file (xyz) (soft copy only) is also to be created for spot levels w.r.t. Chart Datum / Sounding Datum for dredging calculation purpose.
d. On completion of the cross-sections, dredge channel is to be identified/ established by linking deepest soundings on the cross-sections. Dredging quantity is to be estimated for developing a navigational channel of
   i. dimension of 32m x 1.8m, with side slope of 1:5, w.r.t. chart datum/sounding datum (if channel width is less than or equal to 100m).
   ii. dimension of 45m x 2.0m, with side slope of 1:5, w.r.t. chart datum/sounding datum (if channel width is more than 100m).
e. Dredging quantity is to be indicated in the report for per km length of the waterway.
f. Minimum & maximum reduced depth and length of shoal for per km length of the waterway is also to be indicated in the report.
g. Current meter measurement values shall be indicated in the report along with position.
h. The results/characteristics of the soil and the water are to be incorporated in the report.
i. Shallow patches /shoal and submerged sand-chur having less than 1.0 m depth, rocky outcrops, rapids and other navigational impediments are to be indicated on the charts.
j. A brief write up on condition of the locks, Sluice gates, Barrages, Dams etc. (if available) are also to be included in the report. Brief write up based on visual observation, photographs and information from State Irrigation Deptt. and local sources.
k. The chart shall also be suitably updated with prominent land features from the Topo-sheets/site. Available Survey of India (SOI) Topographic sheet will be shared with successful Consultant on receipt of Undertaking. Satellite imageries are not available with IWAI for the designated area. Route map and survey plan will be provided by IWAI to the successful Consultant.
l. All raw data and processed data of Automatic Hydrographic Survey System are required to be submitted. Standard procedure is to be adopted for data processing. All RAW, EDIT, SORT and field data are required to be submitted by the Contractor.
m. All surveyed field data including leveling data (csv file) are required to be submitted.
n. All position data of ground features, waterway structures are to be submitted in both hard copies and soft copies.

1.2.2 TRAFFIC SURVEY & TECHNO ECONOMIC FEASIBILITY

This is a detailed study to make a forecast of the traffic prospects to facilitate the projection of the most promising route for waterway transport and to assess the quantum of traffic of vessels/cargo on that route. This survey is to be under-taken in conjunction with Reconnaissance and Hydrographic surveys so that the Techno Economic feasibility and costs of the alternative proposals can be taken into account while formulating the recommendations.

Modality of conducting traffic survey shall be based on industrial surveys and a traffic projection for a horizon period (say 5, 10, 15 and 20 years) has to be forecasted based on standard methods. Divertible traffic to IWT is also to be assessed.

1.2.3 DETAILED PROJECT REPORT

The scope of works is as follows:

a. Assessment of the morphological, hydrological, hydrographical conditions, and operation and maintenance requirements of the proposed waterways to identify works in sufficient details that are required in respect of:
   - River conservancy including river training, bank protection, dredging etc. needed for shipping and navigation.
   - Navigational aids and communication facilities.
   - Improvements with reference to horizontal and vertical clearances required on the existing or proposed cross structures such as bridges, power cables, locks etc.

b. Geo-tech investigation will be carried out by the consultant as per standard guidelines of Geological Survey of India, Government of India.

c. To conduct necessary investigations for the preliminary design, to ensure a coordinated development to cover waterways engineering works and structures, waterway crossing, navigational structures, riverine ports and terminals, land and rail access.

d. Prepare preliminary engineering designs, drawings and estimates for the optimum structure of river training and bank protection measures and navigational aids to develop and maintain a navigable channel for the waterway system in an EPC mode.

e. For preliminary engineering designs, the data about soil characteristics shall be collected from the local sources based on the structures constructed nearby. In case of critical structures, consultant can suggest that detailed soil investigation including borehole tests etc.

f. River training/bank protection works particularly for those stretches where either the channel is narrow and needs to be widened by dredging or where it is anticipated that the bank can erode due to continuous movement of barges.

g. Identify the location and carry out preliminary designs of cargo terminals and river ports to handle the anticipated cargo as duly updated.

h. Prepare a realistic construction schedule for the whole project indicating the priority of different components of the project. The phasing of expenditure is also to be worked. Also suggest phased programs of construction including riverine terminals and ports which shall be fully integrated with the existing and planned irrigation and hydropower facilities.

i. Prepare cost estimate for various possible alternatives for the entire proposed infrastructure, handling, and other allied facilities. While comparing the different alternatives, the cost and economy factors shall also be evaluated. The most suitable alternative recommended shall have detailed costing for all the components of the project. The Consultant is to propose the River conservancy including river training, bank protection, dredging etc. needed for shipping and navigation. Alternate possible methods for water augmentation are also to be suggested in detail. FIRR, EIRR, NPV and SWOT analysis are also to be carried out by the Consultant.

j. Assess the environmental impacts due to these development works and suggest suitable environmental management plan (EMP) to mitigate the adverse impacts, if any, including its cost. Flood Plain specialist will be responsible to assess the Environmental Impact and preparation of EMP. Consultant has to identify the Authorities who will give the clearances for EIA/EMP. Consultant will not be required to take clearances from these identified Authorities.

k. Suggest horizontal and vertical clearances to be provided on cross structure such as bridges, power cables, locks etc. for commercial viable navigation in present as well as in future. For this, IWAI guidelines Section-IV, may also be referred to.

2.0 PERIOD OF SERVICES

Consultant may associate with sub Consultant(s) to enhance their expertise. The applicant shall submit a Memorandum of Understanding (MOU) with the Sub Consultant regarding the role and responsibilities of the Associate Company along with the proposal.

2.1 TIME SCHEDULE/SUBMISSION OF REPORTS:

(a) The time of completion of various sub-stages of the assignment will be as given below:

			Cluster -2	Cluster -3	Cluster -4	Cluster -5	Cluster -6	Cluster -7	Cluster -8
	Sl. No	**Activity**	**Time in weeks****						
Stage-I	a)	Mobilization of the Team and submission of Inception Report (2 copies)	6	9	10	11	8	8	15
	b)	Submission of Draft Feasibility Report (3 copies)	9	12	13	14	11	11	18
	c)	Comments from IWAI	11	14	15	16	13	13	20
	d)	Presentation and Submission of Final Pre-feasibility Report (3 copies)	13	16	17	18	15	15	22
Stage-II	a)	Acceptance of Stage-I report and go ahead for Stage-II by IWAI	15	18	19	20	17	17	24
	b)	Submission of Hydrographic Survey Charts and report (3 copies)	23	30	29	31	24	26	38
	c)	Submission of Draft Detailed Project Report (3 copies)	31	38	37	39	32	34	46
	d)	Receipt of comments of IWAI on Draft DPR.	33	40	39	41	34	36	48
	e)	Submission of Final Detailed Project Report (10 copies) after incorporating final comments of IWAI.	39	46	45	47	40	42	54
****reckoned from the date of signing of Contract or 15 days from the date of issuance of work order, whichever is earlier.**									

NOTE: - The consultants are required to submit the following outputs in Stage-II for all the clusters in the enclosed standard templates:-

vi) Traffic Template: at Annex-IV
vii) Project Costing Template: at Annex-V
viii) Financial Evaluation Template: at Annex-VI
ix) Economic Evaluation Template: at Annex-VII
x) Environmental & Social Screening Template: at Annex-VIII

3.0 Minimum Qualification of Key Professionals

Sl. No	Key Professionals	Qualification Criteria
1.	**Waterway Expert (Team Leader)**	**Educational Qualification:** • Should be Graduate in Civil Engineering. Higher professional qualification in Port and Harbor Engineering/Structural Engineering/Geo-technical Engineering will be preferred. **Professional Qualification:** • Minimum 15 years' experience in planning, design, construction, preparing Feasibility Report/Detailed Project Report for various waterway/port/river front development/river training works, terminals, trade facilitations and other infrastructures in different natural and operational conditions with at least 5 years in a reputed firm of consultants.
2.	**Port planning & Infrastructure Specialist**	**Educational Qualification:** • Should be Graduate in Civil Engineering. Postgraduate training/ studies in Port & Harbor Engineering will be preferred. **Professional Qualification:** • Minimum 10 years' experience in Port planning, Port infrastructure Planning and development of physical facilities for port operations. Should be well conversant with different types of port structures and other physical facilities required for the provision of various port services efficiently. Should preferably have experience/ exposure of constructing several modern ports.
3.	**Remote Sensing/GIS Expert**	**Educational Qualification:** • Should be Graduate in Engineering/Geology. Higher professional qualification in Remote Sensing/ Geoinformatics will be preferred. **Professional Qualification:** • Minimum 10 years' experience in waterway/port/river mapping and a demonstrated proficiency in using the GIS software. Working knowledge of spatial data formats and related metadata issues. Working knowledge of web mapping applications, such as Google Earth/Bhuvan.
4.	**Floodplain Specialist**	**Educational Qualification:** • Should be Graduate in Civil/Environmental Engineering. Higher professional qualification in Floodplain Management/ Hydrology/Water Resource Engineering will be preferred. **Professional Qualification:** • Minimum 10 years' experience in Floodplain Management. Working

Sl. No	Key Professionals	Qualification Criteria
		knowledge of water and/or wastewater modeling is desirable.
5.	**Hydrographic Expert**	**Educational Qualification:** • Should be ITI in Survey/Diploma in Civil Engineering. Higher qualification in relevant field will be preferred. **Professional Qualification:** • Minimum 8 years' experience in conducting hydrographic surveys, investigations and measurements, bathymetric surveys/Topographic Survey in a variety of geographical locations and natural.
6.	**Soil Engineer/ Foundation Engineer**	**Educational Qualification:** • Should be Graduate in Civil/Environmental Engineering. Higher qualification in Marine Structure/Geotechnical Engineering will be preferred. **Professional Qualification:** • Minimum 10 years' experience in related field. He should have experience of the soil investigation, reclamation work, soil improvement and will be associated in foundation design. He will also be responsible for preparation of cost estimates/BOQ.
7.	**Traffic Surveyor**	**Educational Qualification:** • Should be Graduate in Engineering. Higher qualification in relevant field will be preferred. **Professional Qualification:** • Minimum 10 years' experience in related field. He should have experience of traffic survey of waterways/river/canal or similar facilities.
8.	**Transport Economist**	**Educational Qualification:** • Should be Graduate in transport planning management, transport economics, transport/road/rail/Civil engineering/MBA or equivalent qualifications. Higher qualification in relevant field will be preferred. **Professional Qualification:** • Minimum 10 years' experience in related field. He should have experience of estimating transport investments and implementing transport programs.

NOTE 1:- If the Key Personnel proposed in the CV does not fulfill the minimum academic qualification, the overall score of his CV will be evaluated as zero. All such Key Personnel (whose CV scores less than 75% or who does not fulfill the minimum qualification) will have to be replaced by the firm. H-1 firm will be intimated for replacement of such personnel and work will be awarded after receipt of CV's fulfilling the tender criteria.

Note 2:- IWAI may call each key personnel of the preferred Consultant at the time of award of work, at the cost of Consultant.

Note 3: - In case during interaction with the key personnel, it is found that the key personnel proposed is un-suitable for the assignment position, his replacement by equivalent or better shall be provided by the consultant. The key personnel with such un-suitable CV shall not be considered in any future bids for that position for two years. No deduction for such replacement, who are not found suitable during interaction shall be made.

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

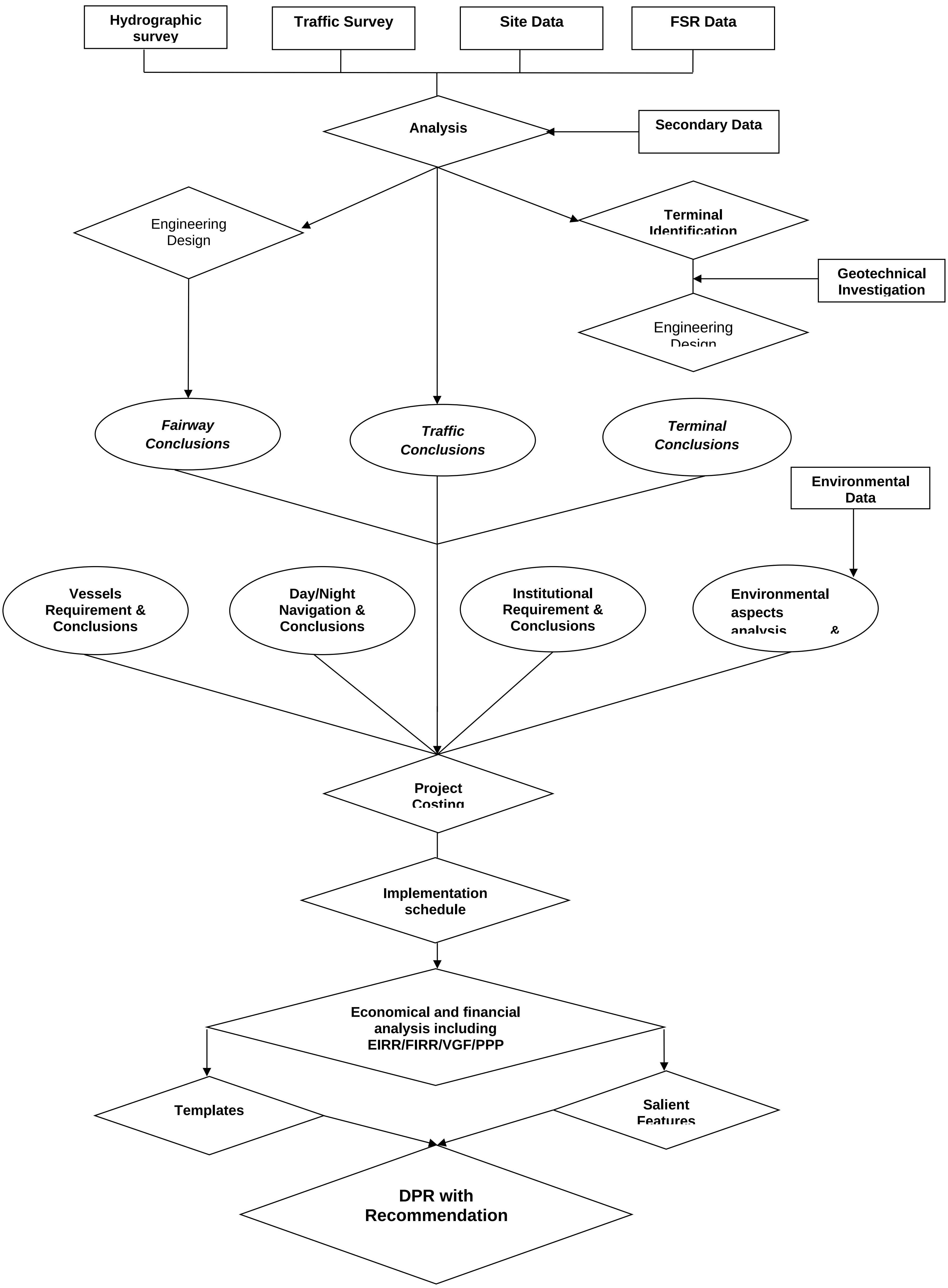
Note 5:- Role and responsibilities of the Key Professional shall be as per the requirement of the project and Terms of Reference of the tender document and the same has to be access by prospective bidder.

ANNEXURE 1.2 – COMPLIANCE ON TOR OF THE AGREEMENT

COMPLIANCE ON THE TERMS OF REFERENCE
WEST COAST CANAL NW 3 (EXTENSION)

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



ANNEXURE 2.1 – LETTER FROM KERALA GOVERNMENT ON MODIFICATION OF 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	9B	9C				
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				
1	Foot bridges	26	3	-	9	-	3		41	49.20

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				
1	HT Lines	17	-					Nil	17	5.10
2	LT Lines	32	50	25	52	14	25	Nil	198	1.98

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. <u>Cross structures under Kerala Water Authority</u>

The proposed estimate is given by KWA is Rs. 0.187 Cr.

Sl. No.	Name of Structures / obstructions	NW-3 (Kottappuram – Kozhikkode)	NW – 8 (Alappuzha -Changanassery Canal)	NW-9 (Alappuzha - Kottayam)			NW-59 – (Vechoor – Athiramapuzha)	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. <u>Now 15 bridges</u> are proposed to reconstruct by PWD and <u>1 Navigation lock</u> 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 3.1 LAND REQUIREMENT ON NW 3 - EXTENSION (CHAINAGE WISE / DISTRICT WISE) {ONLY FOR LAND}

LAND ACQUISITION REQUIREMENT ON NW 3 - EXTENSION (CHAINAGE WISE / DISTRICT WISE) {ONLY FOR LAND}

Chainage from	Chainage to	Stretch Length (in m)	Observed channel width (in m)	LA in Left (in m)	LA in Right (in m)	Area in Left (in Sq. m)	Area in Right (in Sq. m)	Total Area (in Sq. m)	Cumulative Area (in Sq.	Unit Rate in INR	Amount in INR	Amount in Lakhs INR	Amount in Crores INR	Name of the District
15.6	17.65	2050	40	5	5	10250	10250	20500	20500					
17.7	18.5	800	40	5	5	4000	4000	8000	28500					
18.5	18.65	150	30	10	10	1500	1500	3000	31500					
18.65	19.45	800	30	10	10	8000	8000	16000	47500					
19.45	20.75	1300	20	15	15	19500	19500	39000	86500					
20.75	22.7	1950	20	15	15	29250	29250	58500	145000					
22.7	30.3	7600	20	15	15	114000	114000	228000	373000					
32.45	33	550	40	5	5	2750	2750	5500	378500					
33	33.15	150	40	5	5	750	750	1500	380000					
53.5	55.85	2350	40	5	5	11750	11750	23500	403500					
56	56.7	700	30	10	10	7000	7000	14000	417500					
56.7	57.1	400	10	20	20	8000	8000	16000	433500					
57.1	57.35	250	40	5	5	1250	1250	2500	436000					
57.35	60.15	2800	20	10	10	28000	28000	56000	492000					
60.15	60.4	250	10	20	20	5000	5000	10000	502000					

60.4	62.7	2300	40	5	5	11500	11500	23000	525000					
62.7	64.4	1700	30	10	10	17000	17000	34000	559000					
65.2	65.7	500	40	5	5	2500	2500	5000	564000					
65.7	66.1	400	20	15	15	6000	6000	12000	576000					
66.1	66.25	150	10	20	20	3000	3000	6000	582000					
66.25	74.8	8550	20	15	15	128250	128250	256500	838500					
74.8	77.8	3000	10	20	20	60000	60000	120000	958500					
77.8	82.25	4450	20	15	15	66750	66750	133500	1092000					
83.35	87.85	4500	10	20	20	90000	90000	180000	1272000	555.975	707200200	7072.002	70.72002	THRISSUR DISTRICT
97	100.55	3550	20	15	15	53250	53250	106500	106500					
100.55	100.95	400	30	10	10	4000	4000	8000	114500					
100.95	107.5	6550	20	15	15	98250	98250	196500	311000					
107.5	109.45	1950	30	10	10	19500	19500	39000	350000					
109.45	114.8	5350	20	15	15	80250	80250	160500	510500					
140.45	142.9	2450	30	10	10	24500	24500	49000	559500	375	209812500	2098.125	20.98125	MALAPPURAM DISTRICT
156.05	162.7	6650	20	15	15	99750	99750	199500	199500					
162.7	165.3	2600	30	10	10	26000	26000	52000	251500					
165.3	165.7	400	30	10	10	4000	4000	8000	259500	750	194625000	1946.25	19.4625	KOZHIKKODE DISTRICT
		77550				1045500	1045500	2091	2091			1111	111.1	

								00 0	00 0			6. 38	63 8			
		9650														
		67900														
BP L	67900	0	67900													
BP R	67900	0	67900													
			135800													
			136 kms													

ANNEXURE 3.2 LAND ACQUISITION REQUIREMENT ON NW 3 - EXTENSION (CHAINAGE WISE / DISTRICT WISE) {ONLY FOR HABITATION}

Chainage from	Chainage to	Stretch Length (in m)	LA in Left (in m)	LA in Right (in m)	Area in Left (in Sq. m)	Area in Right (in Sq. m)	Total Area (in Sq. m)	Cumulative Area (in Sq. m)	Unit Rate with Habitation	Unit Rate only Land	Unit Rate only Habitation	Amount in INR	Amount in Lakhs INR	Amount in Crores INR
19.1	19.15	50	10	10	500	500	1000	1000						
19.25	19.3	50	10	10	500	500	1000	2000						
19.45	19.7	250	15	15	3750	3750	7500	9500						
19.7	20.1	400	15	0	6000	0	6000	15500						
21.05	21.45	400	0	15	0	6000	6000	21500						
22.7	22.75	50	0	15	0	750	750	22250						
22.8	22.85	50	0	15	0	750	750	23000						
22.9	22.95	50	0	15	0	750	750	23750						
22.95	23.3	350	0	15	0	5250	5250	29000						
23.25	23.45	200	15	0	3000	0	3000	32000						
23.45	23.75	300	15	15	4500	4500	9000	41000						
25.45	25.65	200	15	0	3000	0	3000	44000						
25.95	26.05	100	15	0	1500	0	1500	45500						
26.35	26.45	100	15	0	1500	0	1500	47000						
26.75	26.9	150	0	15	0	2250	2250	49250						
27.1	27.25	150	0	15	0	2250	2250	51500						
27.4	27.45	50	15	0	750	0	750	52250						
27.45	27.65	200	0	15	0	3000	3000	55250						
27.75	27.85	100	15	15	1500	1500	3000	58250						
28.1	28.2	100	15	0	1500	0	1500	59750						
28.15	28.35	200	0	15	0	3000	3000	62750						
28.35	28.4	50	15	0	750	0	750	63500						
28.4	28.5	100	0	15	0	1500	1500	65000						
28.65	29.05	400	15	15	6000	6000	12000	77000						
29.2	29.8	600	15	15	9000	9000	18000	95000						
29.9	30.15	250	15	15	3750	3750	7500	102500						
30.15	30.3	150	15	0	2250	0	2250	104750						
32.9	33.15	250	20	0	5000	0	5000	109750						
53.6	54.2	600	0	10	0	6000	6000	115750						
54.5	54.55	50	10	0	500	0	500	116250						
56.7	57.1	400	20	20	8000	8000	16000	132250						
57.85	58.1	250	0	15	0	3750	3750	136000						
58.05	58.3	250	15	0	3750	0	3750	139750						
58.45	58.75	300	15	0	4500	0	4500	144250						
58.55	58.65	100	0	15	0	1500	1500	145750						
58.9	59.05	150	15	0	2250	0	2250	148000						

59.2	59.25	50	15	0	750	0	750	148750						
59.6	60	400	15	0	6000	0	6000	154750						
66.4	66.45	50	15	0	750	0	750	155500						
67.6	67.7	100	15	15	1500	1500	3000	158500						
69.5	69.7	200	0	15	0	3000	3000	161500						
70.35	70.45	100	0	15	0	1500	1500	163000						
70.6	70.8	200	15	15	3000	3000	6000	169000						
74.8	74.95	150	20	20	3000	3000	6000	175000						
75.5	76.45	950	0	20	0	19000	19000	194000						
76.45	76.8	350	20	0	7000	0	7000	201000						
77.25	77.4	150	20	20	3000	3000	6000	207000						
78.35	78.65	300	15	0	4500	0	4500	211500						
79.5	79.7	200	15	0	3000	0	3000	214500						
79.85	80.1	250	15	15	3750	3750	7500	222000						
80.25	80.7	450	0	15	0	6750	6750	228750						
80.55	80.75	200	15	0	3000	0	3000	231750						
80.9	80.95	50	15	15	750	750	1500	233250						
81.5	81.65	150	15	15	2250	2250	4500	237750						
81.75	81.85	100	0	15	0	1500	1500	239250						
82.05	82.2	150	15	0	2250	0	2250	241500						
83.35	86.85	3500	20	20	70000	70000	140000	381500						
86.85	86.95	100	20	0	2000	0	2000	383500						
86.95	87.85	900	20	0	18000	0	18000	401500	2268	555.975	1712.025	687378038	6873.78	68.7378
97.3	97.4	100	15	0	1500	0	1500	1500						
97.5	97.6	100	15	15	1500	1500	3000	4500						
99.5	99.8	300	0	15	0	4500	4500	9000						
100.2	100.55	350	0	15	0	5250	5250	14250						
101.4	101.9	500	0	15	0	7500	7500	21750						
101.7	101.8	100	15	0	1500	0	1500	23250						
102.3	102.4	100	15	15	1500	1500	3000	26250						
102.95	103.1	150	0	15	0	2250	2250	28500						
105.55	106.1	550	15	0	8250	0	8250	36750						
108.6	108.85	250	35	0	8750	0	8750	45500						
110.2	110.25	50	0	15	0	750	750	46250						
110.5	111.45	950	0	15	0	14250	14250	60500						
111.1	111.15	50	15	0	750	0	750	61250						
111.3	111.6	300	15	0	4500	0	4500	65750						
111.6	112.4	800	15	15	12000	12000	24000	89750						
112.6	112.7	100	0	15	0	1500	1500	91250						
112.7	113.05	350	15	0	5250	0	5250	96500						
112.9	113	100	0	15	0	1500	1500	98000						

113.2	113.8	600	10	15	6000	9000	15000	113000	2250	375	1875	211875000	2118.75	21.1875
140.5	140.85	350	10	10	3500	3500	7000	7000						
141.05	141.25	200	10	0	2000	0	2000	9000						
141.5	141.55	50	10	0	500	0	500	9500						
141.6	141.85	250	10	10	2500	2500	5000	14500						
141.9	142.9	1000	10	10	10000	10000	20000	34500	5557.5	750	4807.5	165858750	1658.588	16.58588
156.05	162.7	6650	15	15	99750	99750	199500	199500					10651.12	106.5112
162.7	165.3	2600	10	10	26000	26000	52000	251500						
165.3	165.7	400	10	10	4000	4000	8000	259500						
							808500	808500						

8.09 Lakhs Sq. m or say 8.1 Lakhs Sq. m. Also can be taken as 81 Hectares.

ANNEXURE 3.3 – MODIFICATION OF BRIDGES

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	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
								Hz	Vt	
1	0	Road Bridge	RCC	10	10x31.5	31.5	7.5	No	No	0.00
2	1.83	Road Bridge	RCC	10	9x31.5	31.5	7.5	No	No	0.00
3	3.8	Road Bridge	RCC	10	6x35.6	35.6	5.2	No	Yes	50,21,500.00
4	6.1	Road Bridge	RCC	8	10x25.8	25.8	6	No	No	0.00
5	13.6	Road Bridge	RCC	8	8x37	37	8.5	No	No	0.00
6	15.97	Road Bridge	RCC	8	3x36	36	5.5	No	Yes	50,21,500.00
7	17.23	Foot Bridge	RCC	2	5x9	9	5	Yes	Yes	71,50,000.00
8	20.08	Foot Bridge	Iron	2	1x38	38	5	No	Yes	38,50,000.00
9	20.75	Road Bridge	RCC	8	3x26	26	5.3	No	Yes	50,21,500.00
10	25.95	Road Bridge	RCC	1.8	5x6	6	3	Yes	Yes	82,50,000.00
11	27.76	Foot Bridge	RCC	1.8	3x15.5	15.5	4	No	Yes	38,50,000.00
12	28.94	Road Bridge	RCC	1.8	4x6	6	4	Yes	Yes	82,50,000.00
13	28.95	Road Bridge	RCC	1	3x11.5	11.5	5	Yes	Yes	82,50,000.00
14	29.25	Road Bridge	RCC	8	3x11.5	11.5	6.6	Yes	No	82,50,000.00
15	30.06	Foot Bridge	RCC	1.2	3x11.5	11.5	5.5	Yes	Yes	38,50,000.00
16	35.75	Road Bridge	RCC	7.5	7x14.3	14.3	4	No	Yes	55,00,000.00
17	37.1	Hanging Bridge	Iron	1.2	1x110	110	6	No	No	0.00
18	39.52	Road Bridge	RCC	10	7x32.7	32.7	7	No	No	0.00
19	42.93	Road Bridge	RCC	6	7x14	14	3.6	No	Yes	55,00,000.00
20	50.35	Road Bridge	RCC	8	7x37.8	37.8	5	No	Yes	50,21,500.00
21	53.35	Road Bridge	RCC	10	13x20	20	6	No	No	0.00
22	54.07	Lock	RCC			6	6	Yes	No	0.00
23	54.12	Lock	RCC			6	6	Yes	No	0.00
24	54.42	Road Bridge	RCC	7.5	3x16.5	16.5	6.2	No	No	0.00
25	55.27	Road Bridge	RCC	2	1x28	28	5	No	Yes	50,21,500.00
26	56.62	Road Bridge	Iron	4	1x30	30	4	No	Yes	55,00,000.00
27	57.96	Moving Bridge	Iron	4	1x10	10	2.7	Yes	Yes	71,50,000.00

Sl. No.	Chainage	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
								Hz	Vt	
28	58.55	Foot Bridge	Iron	1.8	1x20	20	4	No	Yes	38,50,000.00
29	60.29	Road Bridge	RCC	7.5	3x9.3	9.3	5.8	Yes	Yes	82,50,000.00
30	60.38	Road Bridge	RCC	3	5x5.5	5.5	3.6	Yes	Yes	82,50,000.00
31	61.32	Moving Bridge	Iron	3.5	1x10	10	3.2	Yes	Yes	71,50,000.00
32	62.26	Foot Bridge	RCC	2	3x8.4	8.4	5.3	Yes	Yes	71,50,000.00
33	62.78	Moving Bridge	Iron	3.5	1x10.5	10.5	3.5	Yes	Yes	71,50,000.00
34	65.3	Moving Bridge	Iron	3.5	1x10	10	2.1	Yes	Yes	71,50,000.00
35	66.1	Road Bridge	RCC	7.5	1x15	15	5.5	No	Yes	50,21,500.00
36	66.14	Foot Bridge	RCC	1	1x10	10	3	Yes	Yes	71,50,000.00
37	67.56	Foot Bridge	RCC	1.2	1x6.75	6.75	3.6	Yes	Yes	71,50,000.00
38	67.63	Moving Bridge	Iron	3.5	1x10.5	10.5	3	Yes	Yes	71,50,000.00
39	68.65	Foot Bridge	RCC	1.2	1x8.5	8.5	3.6	Yes	Yes	71,50,000.00
40	68.65	Moving Bridge	Iron	3.5	1x8.5	8.5	2.7	Yes	Yes	71,50,000.00
41	69.64	Temporary Bridge	Wooden	1.2		2.2	2.3	Yes	Yes	71,50,000.00
42	70.65	Foot Bridge	RCC	1.2	5x8.5	8.5	5.7	Yes	Yes	71,50,000.00
43	71.4	Road Bridge	RCC	4	1x10	10	5.5	Yes	Yes	82,50,000.00
44	72.55	Foot Bridge	RCC	1	1x8	8	4.6	Yes	Yes	71,50,000.00
45	72.56	Moving Bridge	Iron	3.5	1x8.5	8.5	3	Yes	Yes	71,50,000.00
46	73.6	Moving Bridge	Iron	3.5	1x8	8	2	Yes	Yes	71,50,000.00
47	74.86	Moving Bridge	Iron	3.5	1x16	16	4	No	Yes	38,50,000.00
48	74.86	Temporary Bridge	Wooden	1				Yes	Yes	71,50,000.00
49	76	Road Bridge	RCC	7.5	1x16	16	4	No	Yes	55,00,000.00
50	76.47	Temporary Bridge	Iron	7.5	1x18	18	6.3	No	No	38,50,000.00
51	77.32	Temporary Bridge	Wooden	1.2			1	Yes	Yes	71,50,000.00
52	78.12	Moving Bridge	Iron	4	1x16	16	4	No	Yes	38,50,000.00
53	79.32	Temporary Bridge	Wooden	1.2			1	Yes	Yes	71,50,000.00
54	80.05	Foot Bridge	Iron	2	1x15	15	4	No	Yes	38,50,000.00
55	72.92	Lock	RCC					Yes	Yes	0.00
56	82.01	Lock	RCC					Yes	Yes	0.00
57	82.18	Foot Bridge	Wooden	1.2			1	Yes	Yes	71,50,000.00

Sl. No.	Chainage	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
								Hz	Vt	
58	83.77	Moving Bridge	Iron	3.5	1x15	15	5	No	Yes	38,50,000.00
59	84.62	Foot Bridge	Iron	1.5	1x14	14	6.3	No	No	0.00
60	85.68	Road Bridge	RCC	10	1x15	15	7	No	No	0.00
61	85.9	Foot Bridge	RCC	1.5	1x5	5	1.5	Yes	Yes	71,50,000.00
62	85.91	Road Bridge	RCC	6	3x8.4	8	4	Yes	Yes	82,50,000.00
63	86.6	Foot Bridge	RCC	2	3x8.4	8	4	Yes	Yes	71,50,000.00
64	87.24	Foot Bridge	RCC	2.5	3x8.4	8	4	Yes	Yes	71,50,000.00
65	87.53	Foot Bridge	RCC	1.5	2x8	8	2	Yes	Yes	71,50,000.00
66	87.53	Road Bridge	RCC	4	1x8	8	2	Yes	Yes	82,50,000.00
67	94.69	Hanging Bridge	RCC	1.8	1x185	185	7	No	No	0.00
68	95.91	Road Bridge	RCC	4.5	16x6	6	6	Yes	No	82,50,000.00
69	97.37	Foot Bridge	RCC	2.5	4x10	10	4.5	Yes	Yes	71,50,000.00
70	98.3	Temporary Bridge	Wooden	1	12x3	3	2	Yes	Yes	71,50,000.00
71	99.5	Foot Bridge	Iron	2	4x10.4	10.4	6	Yes	No	71,50,000.00
72	100.5	Road Bridge	RCC	3	3x12	12	5.1	Yes	Yes	82,50,000.00
73	101.83	Road Bridge	RCC	7.5	3X18	18	7	No	No	0.00
74	103.5	Road Bridge	RCC	7.5	1X16.5	16.5	6.5	No	No	0.00
75	103.75	Road Bridge	RCC	2.5	3x8.4	8	4.6	Yes	Yes	82,50,000.00
76	105	Road Bridge	RCC	6.5	3X18	18	5	No	Yes	50,21,500.00
77	105.68	Temporary Bridge	Iron					Yes	Yes	71,50,000.00
78	106.27	Temporary Bridge	RCC					Yes	Yes	71,50,000.00
79	107.2	Foot Bridge	Iron	1.5	3X11.5	11.5	4.6	Yes	Yes	71,50,000.00
80	107.51	Foot Bridge	Iron	1.5	3X12	12	4.6	Yes	Yes	71,50,000.00
81	107.82	Foot Bridge	RCC	1.5			1.5	Yes	Yes	71,50,000.00
82	108.85	Foot Bridge	RCC	1.5	3X10	10	4.5	Yes	Yes	71,50,000.00
83	109.72	Temporary Bridge	Wooden	0.8				Yes	Yes	71,50,000.00
84	110.16	Foot Bridge	RCC	1.5	3X10.2	10.2	8	Yes	No	71,50,000.00
85	110.87	Foot Bridge	RCC	2	3X10.2	10.2	4.2	Yes	Yes	71,50,000.00
86	111.62	Road Bridge	RCC	4	1X10	10	3.5	Yes	Yes	82,50,000.00
87	112.32	Road Bridge	RCC	6	1X12	12	5	Yes	Yes	82,50,000.00
88	113	Foot Bridge	RCC	2	3X10	10	2	Yes	Yes	71,50,000.00
89	113.52	Temporary Bridge	Wooden	1				Yes	Yes	71,50,000.00

Sl. No.	Chainage	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
								Hz	Vt	
90	114.27	Temporary Bridge	Bamboo		12X2	2	2.5	Yes	Yes	71,50,000.00
91	114.65	Foot Bridge	RCC	1.5	1X6.5	6.5	1	Yes	Yes	71,50,000.00
92	114.67	Lock	RCC					Yes	Yes	0.00
93	116.91	Road Bridge	RCC	8.5	7X16	16	5	No	Yes	50,21,500.00
94	117.05	Railway Bridge	RCC	5	5X17	17	6	No	No	0.00
95	117.05	Railway Bridge	RCC	5	5X17	17	7	No	No	0.00
96	118.53	Barrage & Bridge	RCC	1.8	10X4.5	4.5		Yes	Yes	0.00
97	119.26	Road Bridge	RCC	8	7X11	11	5.5	Yes	Yes	82,50,000.00
98	121.03	Lock	RCC	4	7X7	7	5.5	Yes	Yes	0.00
99	121.44	Road Bridge	RCC	7.5	7X9.7	9.7	5	Yes	Yes	82,50,000.00
100	124.15	Road Bridge	RCC	7.5	5X17.5	17.5	7	No	No	0.00
101	128.38	Road Bridge	RCC	7.5	5X15	15	5	No	Yes	50,21,500.00
102	130.67	Lock	RCC	1.8	10X4.5	4.5	8.5	Yes	No	0.00
103	132.1	Road Bridge	RCC	7.5	5X23	23	4	No	Yes	55,00,000.00
104	133.2	Road Bridge	RCC	7.5	4X20	20	4	No	Yes	55,00,000.00
105	138.85	Road Bridge	RCC	4	6X18	18	4	No	Yes	55,00,000.00
106	140.87	Lock	RCC	4	2X7.5	7.5	6	Yes	No	0.00
107	142.3	Foot Bridge	RCC	2.5	2X7.5	7.5	5	Yes	Yes	71,50,000.00
108	142.66	Foot Bridge	RCC	4	3X9.0	9	2.5	Yes	Yes	71,50,000.00
109	146.61	Road Bridge	RCC	5	3x15.5	15	3	No	Yes	55,00,000.00
110	143.61	Road Bridge	RCC	10	5X21.2	21.2	3.6	No	Yes	55,00,000.00
111	145.97	Railway Bridge	RCC	5	4X16.5	16.5	3	No	Yes	1,32,00,000.00
112	145.98	Railway Bridge	RCC	5	4X16.5	16.5	3	No	Yes	1,32,00,000.00
113	147.71	Road Bridge	RCC	7.5	7X18	18	7	No	No	0.00
114	152.13	Railway Bridge	RCC	10	7X29	29	4	No	Yes	1,32,00,000.00
115	152.16	Railway Bridge	RCC	8	6X37	37	4.75	No	Yes	1,32,00,000.00
116	153.03	Road Bridge	RCC	10	8X27	27	5.5	No	Yes	50,21,500.00
117	156.87	Road Bridge	RCC	5	1X15	15	3.5	No	Yes	55,00,000.00
118	157.63	Road Bridge	RCC	2	3X10	10	3.5	Yes	Yes	82,50,000.00
119	158.95	Temporary Bridge	Bamboo					Yes	Yes	71,50,000.00
120	160.05	Foot Bridge	RCC	2	3x8.4	8	3	Yes	Yes	71,50,000.00
121	161	Road Bridge	RCC	8	3X11.5	11	5.5	Yes	Yes	82,50,000.00

Sl. No.	Chainage	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
								Hz	Vt	
122	161.93	Foot Bridge	RCC	2	2X10	10	2	Yes	Yes	71,50,000.00
123	164.61	Road Bridge	RCC	7	4X10	10	4	Yes	Yes	82,50,000.00
124	165.78	Foot Bridge	RCC	2	6X13	13	3.5	Yes	Yes	71,50,000.00
125	165.99	Road Bridge	RCC	10	5X16	16	4	No	Yes	55,00,000.00
126	167.99	Road Bridge	RCC	10	2X25	25	5	No	Yes	50,21,500.00
127	168	Railway Bridge	RCC	12	3X25	25	5	No	Yes	1,32,00,000.00
128	169.27	Road Bridge	RCC	8	7X18	18	5	No	Yes	50,21,500.00

Total Cost **Rs. 70,70,58,000.00**

(Adding 15% overhead cost) & 5% increase in cost per annum **Rs. 85,37,72,535.00**

NOTES :

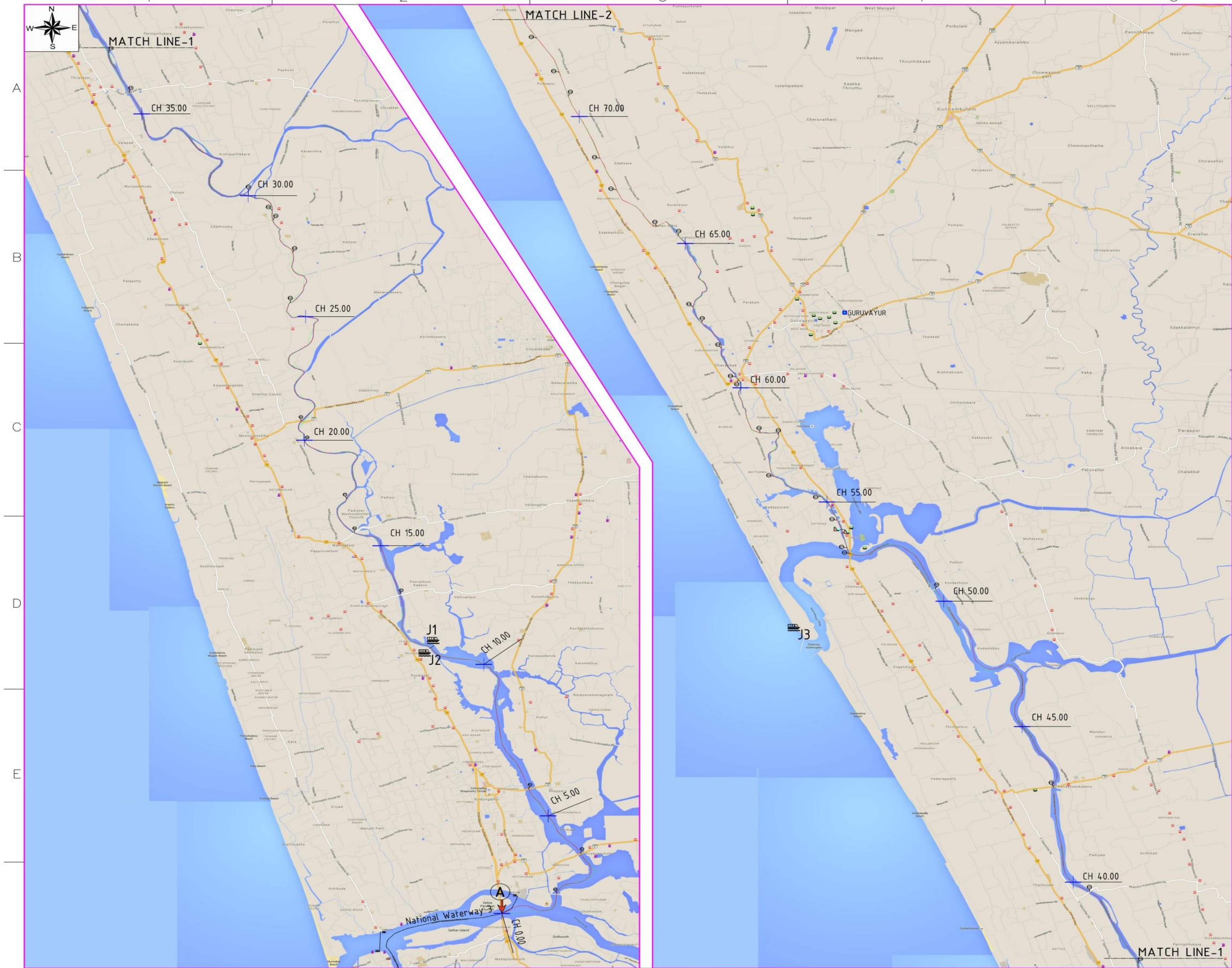
NOTE 1	For Railway & Road bridges modification is possible in two ways.
NOTE 2	When the bridge has adequate span but inadequate height. In that case, strengthening of existing substructure and foundation is proposed by increasing the height as required.
NOTE 3	When the span becomes inadequate, entire bridge needs to be dismantled and reconstruction is required.
NOTE 4	Foot Over Bridges which require modification have adequate span but inadequate vertical clearance.
NOTE 5	Foot Over Bridges may be modified / replaced according to condition of bridge at site.
NOTE 6	Temporary /Wooden/Bamboo Bridges and moving bridges may be modified / replaced according to condition of bridge at site.
NOTE 7	Barrages and Locks are computed separately.
NOTE 8	The cost of modification may have to be updated before construction at Detailed Engineering Stage.
NOTE 9	While considering entire new construction, many factors like soil condition, hydrology analysis etc will come to play. As a result, the cost may vary at Detailed Engineering Stage.

ANNEXURE 3.4 – LOCATION OF BANK PROTECTION DETAILS (PILE AND SLABS)

Length of Bank Protection (Pile & Slab) On NW 3 - Extension (Chainage Wise)				
Sl No.	**Chainage from (km)**	**Chainage to (km)**	**Length of Prposed Bank Protection (in m)**	**Observed channel width (in m)**
1	15.60	17.65	2050	40
2	17.70	18.50	800	40
3	18.50	18.65	150	30
4	18.65	19.45	800	30
5	19.45	20.75	1300	20
6	20.75	22.70	1950	20
7	22.70	30.30	7600	20
8	32.45	33.00	550	40
9	33.00	33.15	150	40
10	53.50	55.85	2350	40
11	56.00	56.70	700	30
12	56.70	57.10	400	10
13	57.10	57.35	250	40
14	57.35	60.15	2800	20
15	60.15	60.40	250	10
16	60.40	62.70	2300	40
17	62.70	64.40	1700	30
18	65.20	65.70	500	40
19	65.70	66.10	400	20
20	66.10	66.25	150	10
21	66.25	74.80	8550	20
22	74.80	77.80	3000	10
23	77.80	82.25	4450	20
24	83.35	87.85	4500	10
25	97.00	100.55	3550	20
26	100.55	100.95	400	30
27	100.95	107.50	6550	20
28	107.50	109.45	1950	30
29	109.45	114.80	5350	20
30	140.45	142.90	2450	30
			67900	
	Left Bank Protection (m)	67900		
	Right Bank Protection (m)	67900		
	Total Bank Protection (m)	135800		
	Say,	136 kms		

ANNEXURE 4.1 – LAYOUT MAP SHOWING EXISTING INDUSTRIES IN THE VICINITY OF NW-3

ANNEXURE 4.1



LEGEND

BUS STOP	HISTORICAL PLACE
JETTY	FUEL STATION/PUMP
PORT	INDUSTRY
RESORT	RAILWAY STATION
FERRY LINE	RAILWAY LINE
DAM / BARRAGE / LOCK	ROAD
NATIONAL/STATE HIGHWAY (Hwy)	
ROUTE PROVIDED BY IWAI	
SURVEY (VESSEL TRACK)/THALWEG	

(A) START POINT FROM NORTH OF KOTTAPURAM AT
LAT. 10°11'38.32" N
LON. 76°12'4.39" E

(B) MID POINT NEAR PALAPPETTY
LAT. 10°42'18.18" N
LON. 75°57'43.16" E

PROPOSED WATERWAY LENGTH 160.0Km (AS PER TENDER)
TOTAL WATERWAY LENGTH FROM POINT 'A' TO POINT 'C' 168.93Km

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

LIST OF PORTS & JETTIES

SL.	DESCRIPTION	SYMB.
1	VALLIVATTOM JETTY	J1
2	KADAVU JETTY	J2
3	CHETTVA PORT	J3

CLIENT

INLAND WATERWAYS AUTHORITY OF INDIA
MINISTRY OF SHIPPING
A-13, Sector-1, Noida

SURVEYED BY

Rev.	Y M D	Modifications	Status	Drawn	Checked	Approved	Validated
-	-	-	-	-	-	-	-

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

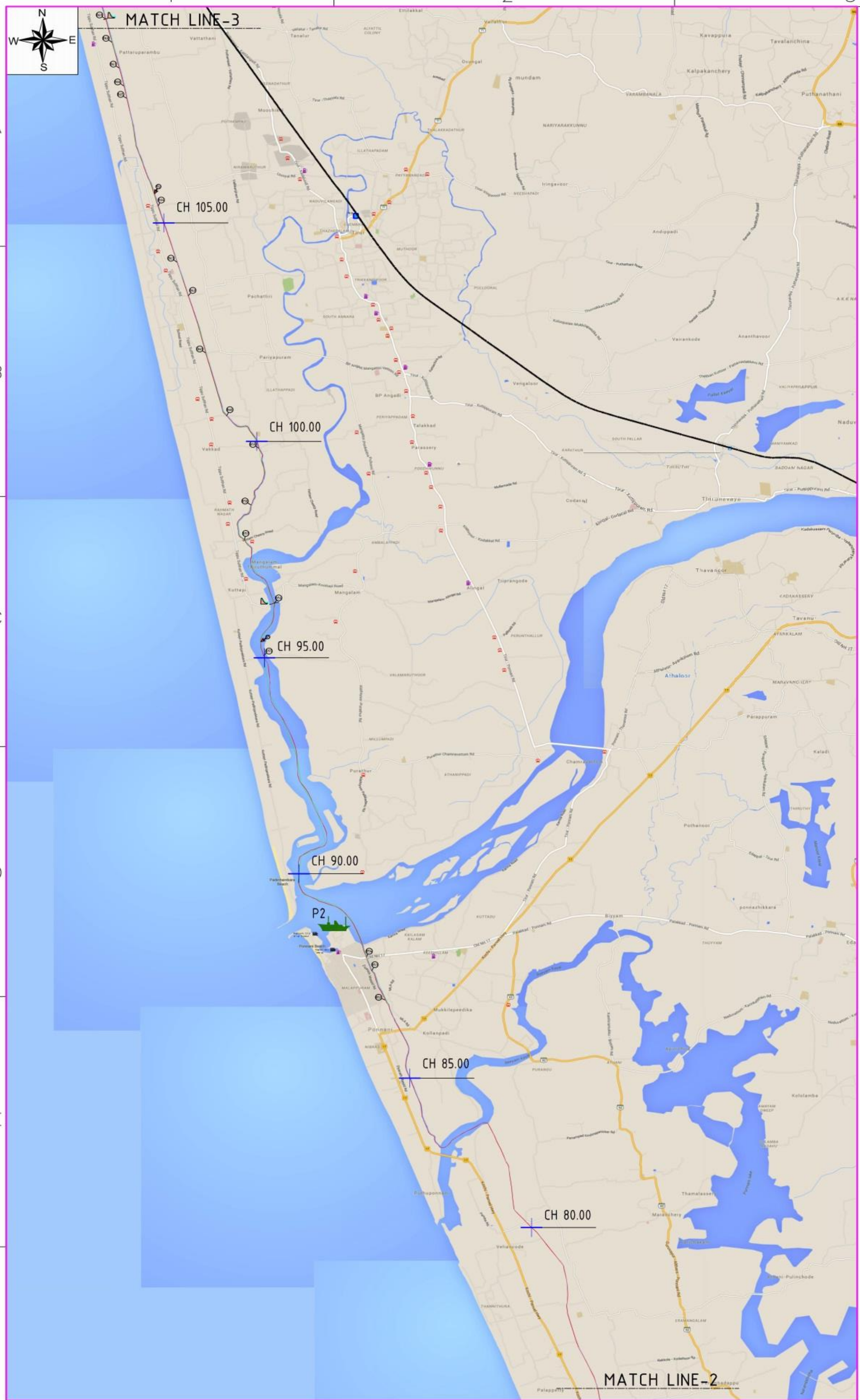
Subject
LAYOUT MAP SHOWING EXISTING JETTIES & INDUSTRIES IN VICINITY OF WEST COAST CANAL NW-3 (KERALA)

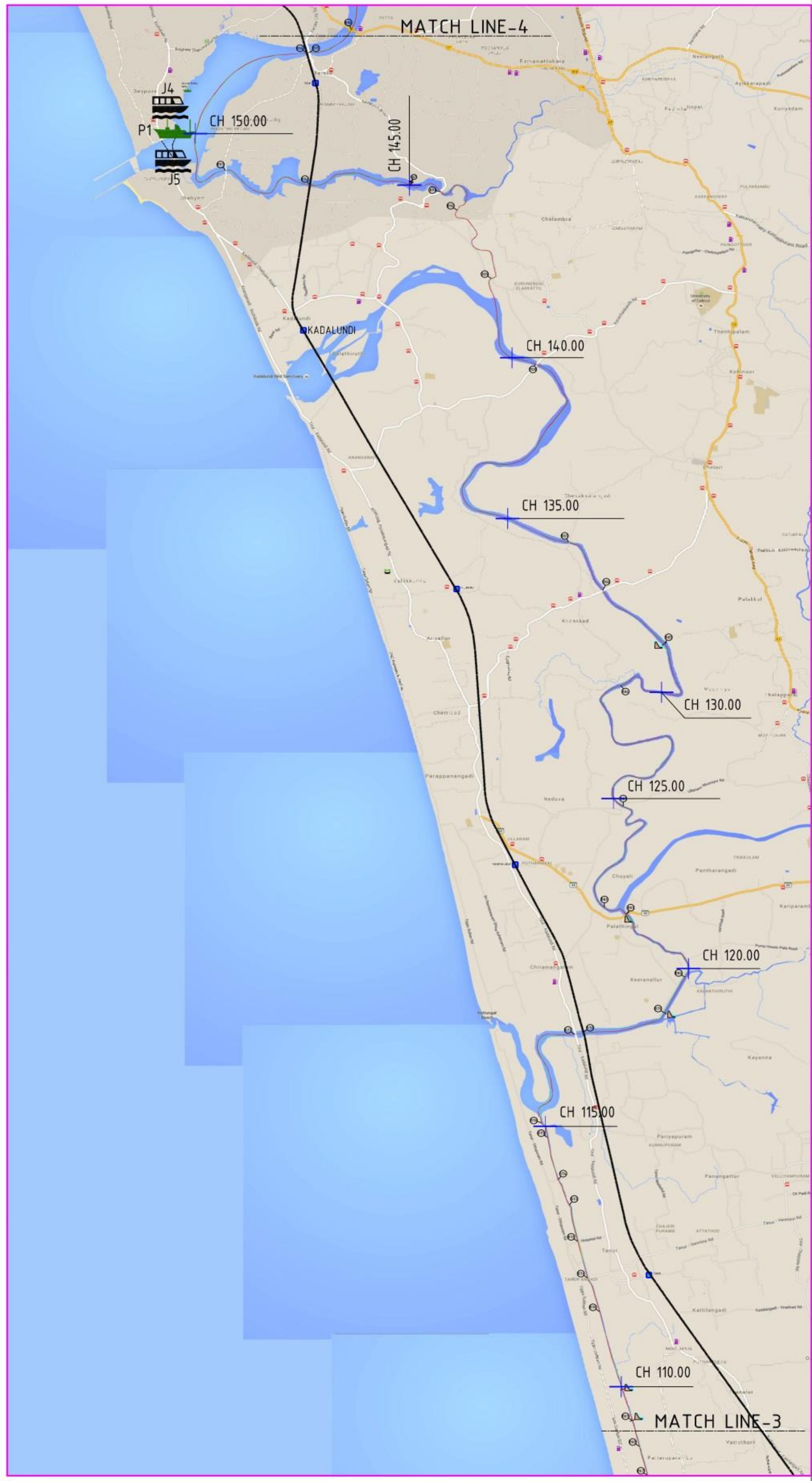
CONSULTANT

TRACTEBEL ENGIE

TRACTEBEL ENGINEERING PVT. LTD.
Intec House, 37
Institutional Area, Sector 44
122002 Gurgaon-INDIA

Status Of Drawing: ISSUED FOR DPR
Scale: 1:50000
Size: A1
DRG N°: ANNEXURE 4.1
Rev.: -
Sheet: 1 Of 3





ANNEXURE 4.1

LEGEND

	BUS STOP		HISTORICAL PLACE
	JETTY		FUEL STATION/PUMP
	PORT		INDUSTRY
	RESORT		RAILWAY STATION
	FERRY LINE		RAILWAY LINE
	DAM / BARRAGE / LOCK		ROAD
	NATIONAL/STATE HIGHWAY (Hwy)		
	ROUTE PROVIDED BY IWAI		
	SURVEY (VESSEL TRACK)/THALWEG		

(A) START POINT FROM NORTH OF KOTTAPURAM AT
LAT. 10°11'38.32" N
LON. 76°12'4.39" E

(B) MID POINT NEAR PALAPPETTY
LAT. 10°42'18.18" N
LON. 75°57'43.16" E

PROPOSED WATERWAY LENGTH 160.0Km (AS PER TENDER)
TOTAL WATERWAY LENGTH FROM POINT 'A' TO POINT 'C' 168.93Km

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

LIST OF PORTS & JETTIES

SL.	DESCRIPTION	SYMB.
1	BEYPORE PORT	P1
2	PONNANI PORT	P2
3	BEYPORE JETTY	J4
4	CHALIYAM JETTY	J5

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INLAND WATERWAYS AUTHORITY OF INDIA
MINISTRY OF SHIPPING
A-13, Sector-1, Noida

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Rev.	Y M D	Modifications	Status	Drawn	Checked	Approved	Validated
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CONSULTANCY SERVICES FOR PREPARATION OF SECOND STAGE DPR OF CLUSTER -6 (KERALA) OF NATIONAL WATERWAYS

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DRG N°: ANNEXURE 4.1 Rev.: - Sheet: 2 Of 3

ANNEXURE 4.1

INDUSTRY		
INDUSTRIES SHOWN IN MAP		
SL.	DESCRIPTION	SYMB.
1	ROLLING INDUSTRIES	I1
2	VIJAYPRAKASH INDUSTRIES	I2
3	VEEKESY RUBBER	I3
4	SAIL-SCL KERALA	I4
5	KESB DISEL POWER PLAN	I5
6	PK STEEL CASTING	I6
7	PK ROLLING MILL	I7
8	THIRUVANNUR COTTON MILL	I8
9	SOUTH INDIAN INDUSTRIES	I9
10	UNIROYAL MARINE EXPORTS	I10

LEGEND

BUS STOP	HISTORICAL PLACE
JETTY	FUEL STATION/PUMP
PORT	INDUSTRY
RESORT	RAILWAY STATION
FERRY LINE	RAILWAY LINE
DAM / BARRAGE / LOCK	ROAD

NATIONAL/STATE HIGHWAY (Hwy)

ROUTE PROVIDED BY IWAI

SURVEY (VESSEL TRACK)/THALWEG

(A) START POINT FROM NORTH OF KOTTAPURAM AT
LAT. 10°11'38.32" N
LON. 76°12'4.39" E

(C) END POINT AT KOZHIKODE
LAT. 11°13'38.83" N
LON. 75°46'43.90" E

PROPOSED WATERWAY LENGTH 160.0Km (AS PER TENDER)
TOTAL WATERWAY LENGTH FROM POINT 'A' TO POINT 'C' 168.93Km

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

CLIENT

INLAND WATERWAYS AUTHORITY OF INDIA
MINISTRY OF SHIPPING
A-13, Sector-1, Noida

SURVEYED BY

Rev.	Y	M	D	Modifications	Status	Drawn	Checked	Approved	Validated
-	-		-		-	-	-	-	-

Project

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

Subject

LAYOUT MAP SHOWING EXISTING JETTIES & INDUSTRIES IN VICINITY OF WEST COAST CANAL NW-3 (KERALA)

CONSULTANT

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Status Of Drawing: ISSUED FOR DPR
Scale: 1:50000
Size: A1
DRG N°: ANNEXURE 4.1
Rev.: -
Sheet: 3 Of 3

ANNEXURE 5.1– CALCULATION OF SAFE BEARING CAPACITY

Although no development has been suggested however the computation of safe bearing capacity at both the locations of Beypore & Ponnani is marked as Annexures for reference only.

Calculation of Safe Bearing capacity as per IS 6403 - 1981

Width of Footing/Raft (B)	=	**3.00**	m	
Length of Footing/Raft (L)	=	**3.00**	m	
Cohesion (C)	=	**0.0**	KN/m^3	For BH-NW3B
Angle of Internal Friction (ϕ)	=	**27.0**	degree	For BH-NW3B
Bulk Unit weight (γ)	=	**17.87**	KN/m^3	For BH-NW3B
Unit weight of water (γ_w)	=	**10**	KN/m^3	
Submerged Unit Weight	=	**7.87**	KN/m^3	
Type of Failure	=	**Local Shear Failure**		
Depth of foundation (Df)	=	**3.0**	m	
Factor of Safety	=	**2.5**		
Shape of Footing / Raft	=	Rectangle		
L/B	=	1		
Shape factor (sc)	=	1.2	(Table 2 of IS 6403)	
Shape factor (sq)	=	1.2	(Table 2 of IS 6403)	
Shape factor (sγ)	=	0.6	(Table 2 of IS 6403)	
Nϕ	=	2.663424	(cl. 3 of IS 6403)	
Depth factor (dc)	=	1.326	(cl. 5.1.2.2 of IS 6403)	
Depth factor (dq)	=	1.163	(cl. 5.1.2.2 of IS 6403)	
Depth factor (dγ)	=	1.163	(cl. 5.1.2.2 of IS 6403)	
Inclination of load to vertical (α)	=	**0**	degree	
Inclination factors (ic)	=	1	(cl. 5.1.2.3 of IS 6403)	
Inclination factors (iq)	=	1	(cl. 5.1.2.3 of IS 6403)	
Inclination factors (iγ)	=	1	(cl. 5.1.2.3 of IS 6403)	
From Table 1 of IS 6403				
ϕ' for local shear failure (Φ'=Φ*2/3)	=	18.762	degree	
Bearing capacity factor (Nc')	=	**13.88**	For Local shear failure	
Bearing capacity factor (Nq')	=	**5.78**	For Local shear failure	
Bearing capacity factor (Nγ')	=	**4.72**	For Local shear failure	

q = Effective surcharge at the base level of foundation = γ*Df

qa = Net pressure for a specified settlement of 50 mm

R = Relative density of soil

W' = Correction factor for Water Table = **0.50** (cl. 5.1.2.4 of IS 6403)

Qu' (Local shear failure) = 1/F(2/3*c* Nc' *sc*dc*ic + γ*Df*(Nq' -1) *sq*dq*iq + 0.5*γ*B*Nγ' *sγ*dγ*iγ*W')

81.00 KN/m^2

As per Figure 9 of IS 8009 (Part I) 1986		
Average SPT Value =	16	
Settlement at a load of 1 kg/cm^2 (100 kN/m^2) =	17	mm (For Width = 1.5 m)
Water Table Correction for Settlement =	0.5	
Correction Factor for Depth of foundation =	0.78	
Correction Factor for Rigidity of Foundation =	0.8	
Settlement after Water Table Correction =	21.216	mm

Load at 50 mm Settlement = 236.00 kN/m^2

Safe Bearing Capacity = 81.00 kN/m^2

Calculation of Safe Bearing capacity as per IS 6403 - 1981

Width of Footing/Raft (B)	=	3.00	m	
Length of Footing/Raft (L)	=	3.00	m	
Cohesion (C)	=	35.2	KN/m^3	For BH-3P
Angle of Internal Friction (ϕ)	=	12.0	degree	For BH-3P
Bulk Unit weight (γ)	=	17.58	KN/m^3	For BH-3P
Unit weight of water (γ_w)	=	10	KN/m^3	
Submerged Unit Weight	=	7.58	KN/m^3	
Type of Failure	=	**Local Shear Failure**		
Depth of foundation (Df)	=	3.0	m	
Factor of Safety	=	2.5		
Shape of Footing / Raft	=	Rectangle		
L/B	=	1		
Shape factor (sc)	=	1.2	(Table 2 of IS 6403)	
Shape factor (sq)	=	1.2	(Table 2 of IS 6403)	
Shape factor (sγ)	=	0.6	(Table 2 of IS 6403)	
Nϕ	=	1.525225	(cl. 3 of IS 6403)	
Depth factor (dc)	=	1.247	(cl. 5.1.2.2 of IS 6403)	
Depth factor (dq)	=	1.124	(cl. 5.1.2.2 of IS 6403)	
Depth factor (dγ)	=	1.124	(cl. 5.1.2.2 of IS 6403)	
Inclination of load to vertical (α)	=	0	degree	
Inclination factors (ic)	=	1	(cl. 5.1.2.3 of IS 6403)	
Inclination factors (iq)	=	1	(cl. 5.1.2.3 of IS 6403)	
Inclination factors (iγ)	=	1	(cl. 5.1.2.3 of IS 6403)	
From Table 1 of IS 6403				
ϕ' for local shear failure ($\Phi' = \Phi * 2/3$)	=	8.065	degree	
Bearing capacity factor (Nc')	=	7.62	For Local shear failure	
Bearing capacity factor (Nq')	=	2.12	For Local shear failure	
Bearing capacity factor (Nγ')	=	0.91	For Local shear failure	

q = Effective surcharge at the base level of foundation = γ*Df

qa = Net pressure for a specified settlement of 50 mm

R = Relative density of soil

W' = Correction factor for Water Table = 0.50 (cl. 5.1.2.4 of IS 6403)

Qu' (Local shear failure) = 1/F(2/3*c* Nc' *sc*dc*ic + γ*Df*(Nq' -1) *sq*dq*iq + 0.5*γ*B*Nγ' *sγ*dγ*iγ*W')

124.00 KN/m^2

As per Figure 9 of IS 8009 (Part I) 1986

Average SPT Value =	12	
Settlement at a load of 1 kg/cm^2 (100 kN/m^2) =	25	mm (For Width = 1.5 m)
Water Table Correction for Settlement =	0.5	
Correction Factor for Depth of foundation =	0.78	
Correction Factor for Rigidity of Foundation =	0.8	
Settlement after Water Table Correction =	31.2	mm

Load at 50 mm Settlement = 160.00 kN/m^2

Safe Bearing Capacity = 124.00 kN/m^2

ANNEXURE 5.2– CALCULATION OF PILE CAPACITY

Although no development has been suggested however the computation of Pile Capacity for bored cast-in-situ piles is marked as Annexures for reference only.

TRACTEBEL
ENGIE

Working Pile - Vertical Capacity in Soil (Both Friction and End Bearing as per IS 2911-1-2 : 2010) i.e. Bored Cast in situ Pile of NW 3 P

Dia of Pile (D) =	1.40	m			0 to 3.5 m	3.5 to 7.5 m	7.5 to 12.9 m
Average Ground Level =	2.0	m	Saturated Unit Weight (kN/m^3) =		7.00	8.00	7.26
Pile Cutoff Level =	2.5	m		12.9 to 16.5 m	16.5 to 18 m	18 to 20 m	20 to 25.6 m
Maximum Scour Level	-3.95	m		7.75	8.15	8.2	8.68
FoS (Bearing and Friction)	2.5		Ultimate Shaft Resistance = S ((Ks*Pdi*tanδ)*Asi + a*C(As))				
Effective Length of Pile = 15D =	21	m	Ki = Earth Pressure Coefficient		**Value**	**ϕ (Degree)**	**Factor**
Length of Pile below Ground level =	36	m			1	30	
Unit Weight of Reinforced Concrete	25	kN/m^3			1.5	40	0.05

Depth below NSL (m)	**EL (m)**	**Friction angle (ϕ) as per Fig-1 (IS 6403)**	**Cohesion (C) kN/m^2**	**Wall Friction Angle δ (Degree)**	**Earth Pressure Coefficient (Ki)**	**Adhesion Factor (α)**	**Overburden Pressure at bottom of the**	**al Area of Pile Shaft (Asi) (m^2)**	**Ultimate Shaft Friction (kN)**
0	2.0	0	0	0	0	0	0	0	0
1.5	0.5	30	0.00	30	1.00	0.00	10.5	6.60	0.0
3.5	-1.5	30	0.00	30	1.00	0.00	24.5	8.80	0.0
4.5	-2.5	12	35.20	12	1.00	1.00	32.5	4.40	0.0
5.95	-3.95	12	35.20	12	1.00	1.00	44.1	6.38	0.0
7.5	-5.5	12	35.20	12	1.00	1.00	56.5	6.82	312.9
9	-7	2	54.30	2	1.00	0.80	67.39	6.60	300.9
10.5	-8.5	2	54.30	2	1.00	0.80	78.28	6.60	303.4
12	-10	2	54.30	2	1.00	0.80	89.17	6.60	305.9
12.9	-10.9	2	54.30	2	1.00	0.80	95.704	3.96	184.7
15	-13	30	0.00	30	1.00	0.00	111.979	9.24	553.7
16.5	-14.5	30	0.00	30	1.00	0.00	123.604	6.60	448.7
18	-16	31	0.00	31	1.05	0.00	135.829	6.60	539.9
19	-17	31	0.00	31	1.05	0.00	143.979	4.40	388.2
20	-18	32	0.00	32	1.10	0.00	152.129	4.40	447.6
21.5	-19.5	31	0.00	31	1.05	0.00	164.354	6.60	658.6
23	-21	31	0.00	31	1.05	0.00	164.354	6.60	659.7
24.5	-22.5	31	0.00	31	1.05	0.00	164.354	6.60	659.7
25.6	-23.6	31	0.00	31	1.05	0.00	164.354	4.84	483.8
27	-25	31	0.00	31	1.05	1.00	164.354	6.16	615.8
28.5	-26.5	31	0.00	31	1.05	2.00	164.354	6.60	659.7
30	-28	31	0.00	31	1.05	3.00	164.354	6.60	659.7
31.5	-29.5	31	0.00	31	1.05	4.00	164.354	6.60	659.7
33	-31	31	0.00	31	1.05	5.00	164.354	6.60	659.7
34.5	-32.5	31	0.00	31	1.05	6.00	164.354	6.60	659.7
36	-34	31	0.00	31	1.05	7.00	164.354	6.60	659.7
					Total Ultimate Skin Friction Resistance, Qst (kN) =				10821.99
					Total Allowable Skin Friction Resistance, Qst (kN) =				**4328.80**

Note : Effective Length of Pile = 15D. Effective Overburden pressure will not increase after effective length of Pile.

End Bearing (T) = Ap*(Nc*Cp+0.5*D*γ*Nγ+Pd*Nq)

Cohesion (C) =	0.00	kN/m^2
Depth of Pile Tip (Pile Bottom) from Ground Level =	25.6	m
Effective Overburden Pressure at Pile Tip =	164.35	kN/m^2
Angle of Internal Friction at Pile Tip (ϕ) =	31	degree
Bearing Capacity Factor (Nc)	0	
Bearing Capacity Factor (Nq)	25.000	(As per IS 2911Part-1 Sec-2 -2010)
Bearing Capacity Factor (Nγ)	27.530	(As per IS 6403 -1981)

End Bearing (T) =	6532.74	kN
Allowable End Bearing Capacity of Pile =	**2613.10**	**kN**
Self Weight of Pile =	1404.68	kN
Net Bearing Capacity of Pile =	**5537.0**	**kN**

Uplift Capacity of Pile

Safe Uplift Capacity of Pile = 2/3*Frictional Resistance =	2885.87	
Safe Uplift Capacity (Including Weight of Pile)=	**4291.0**	**kN**

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.

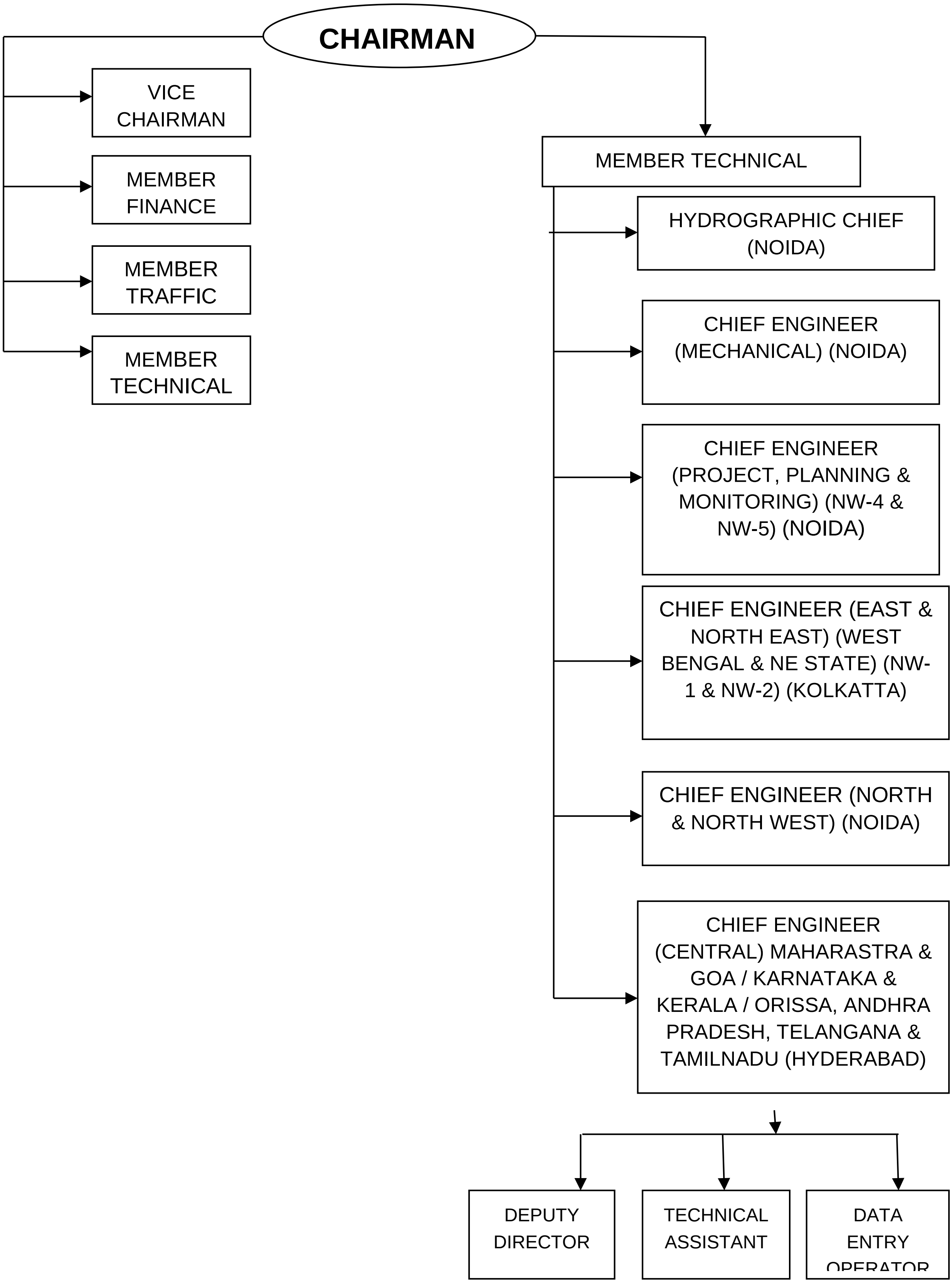
xxviii. The Vessels shall comply the emission norms prescribed from time to time.

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.

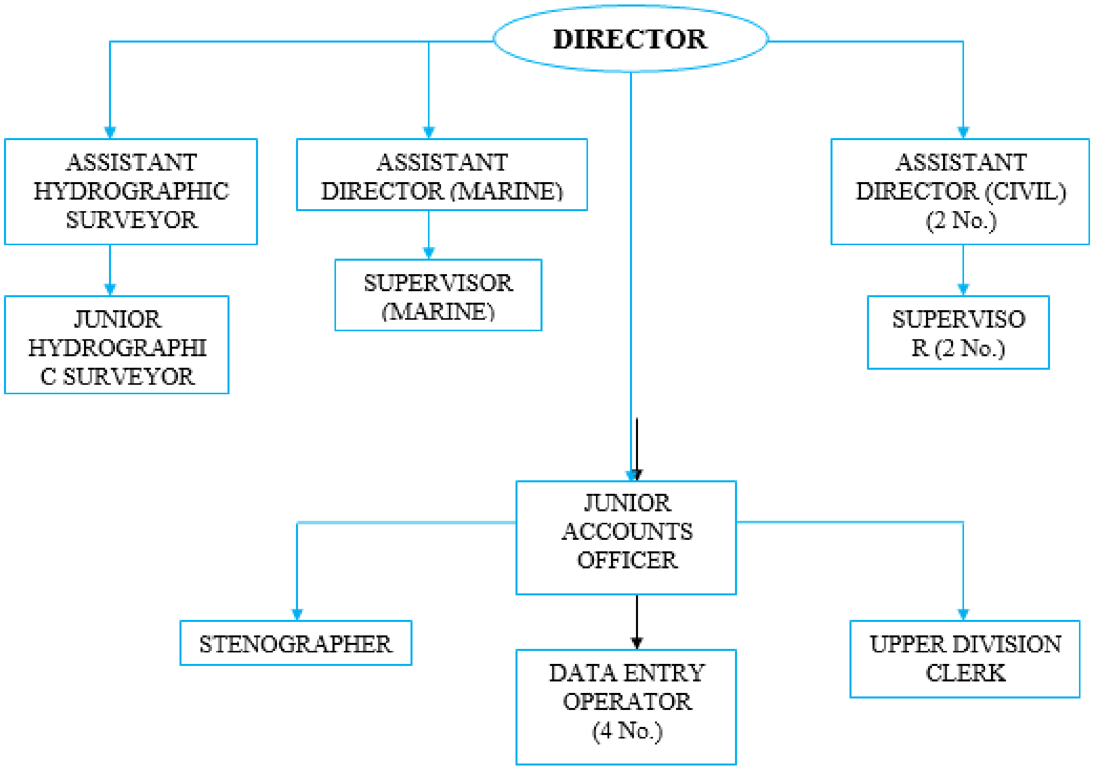
21/12/17

Sharath Kumar Pallerla
Director

ANNEXURE 10.1– INSTITUTIONAL REQUIREMENT HEAD OFFICE COMPONENTS



ANNEXURE 10.2– INSTITUTIONAL REQUIREMENT IN KARNATAKA AND KERALA



ANNEXURE 11.1 – COSTING/FINANCIAL ASSUMPTIONS

Note: *The present organizational system at IWAI Kochi will look after the NW-3 Extension development with due modifications at the time of implementation activities.*

FINANCIAL ANALYSIS

Broad Assumptions

Based on Financial Analysis as per DPR of NW5

Abstract

Broadly identified assumptions in order to facilitate financial analysis of Category II shortlisted waterways development

Inland Waterways Authority of India

FINANCIAL ANALYSIS BROAD ASSUMPTIONS[1]:

Capital Expenditure:

Elements to be covered (based on planned infrastructure requirement for respective rivers)

Suitable assumptions with relevant justification shall be made for any missing items.

CAPEX HEAD	TOTAL COST (INR CRORE)
Land Acquisition	Cost initially to be considered for acquisition of land for land side development of floating jetty
Dredging	**Normal Condition** Standard dredging rate of Rs. 200/cum to be considered. Suitable adjustments shall be made (with proper justification) for change in quality of dredge material/any special requirement for disposal of dredge material
Barrages with Navigational Locks	Based on requirement standard charges as per Planned Infrastructure of respective rivers.
Raising Banks	
Protection Measures	
Environmental Monitoring	
Navigational Aids	
Bridges	
Cross Drainage Works	
Facilities to Local People	
Terminals	Initially while calculating CAPEX terminal cost shall include cost for development of required numbers of floating jetty along respective waterways, cost of equipment, manpower required for terminal operation
Total Capital Expenditure	**Sum of all parameters mentioned above**
DC, PMC, IE Services, Loan Fees	10% of Total CAPEX
Overall Contingency	3% of Total CAPEX
Escalation	1.5% of Total CAPEX
Total Hard Capex	
Interest During Construction	
Total Project Cost	

Operations & Maintenance Expenditure:

(Pick up the cost items relevant to your study and planned infrastructure components)

Suitable assumptions with relevant justification shall be made for any missing items.

Annual Escalation shall be assumed @ 5.0%.

[1] These assumptions are to facilitate consultants in giving a sense of direction in which they shall move to make the reporting of final outcome consistent. Any missing information shall be assumed suitably (with valid justification) by the consultants in order to provide desired end result.

Cost Items	% of CAPEX
Dredging	5%
Cross Drainage	2%
Locks	2%
Bridges	1%
Terminals	2%
Navigation Aids	2%
Protection Measures	2%
Raising Banks	2%
Facility to Local People for Ferry Services	2%
Environmental Monitoring	2%
Cost of Barrages with Navigation Locks	2%
Total Waterway O&M Costs	

Revenue Estimation:

For estimating the revenue, the tariff structure proposed by IWAI (Levy & Collection of fees and charges) Regulations, 2011 shall be used as a reference.

Existing Tariff Structure & Charges by IWAI (Shall be verified from the latest published Tariffs)

Suitable assumptions with relevant justification shall be made for any missing items.

Tariff Heads	Charge unit	Charges (INR)
(A) Usage Charges		
Movement of Vessels	GRT/km	0.02
(B) Vessel related charges		
Berthing charges	Vessel	1000.00
Towage	Vessel/hour	600.00
Pilotage	Day	750.00
(C) Cargo related charges		
(i) Terminal Charges		
Dry Cargo	Ton (or part thereof)	1.00
Liquid Cargo	Ton (or part thereof)	1.00
Containerised Cargo	TEU	50.00
(ii) Transit shed charges		
First 3 days	MT per day	
First 7 days	MT per day	
7-21 days	MT per day	5.00
22-35 days	MT per day	10.00
After 35 days	MT per day	40.00
(iii) Open storage charges		
Hard Stand		
First 3 days	MT per day	
First 7 days	MT per day	0.00
7-21 days	MT per day	2.00
22-35 days	MT per day	4.00
After 35 days	MT per day	16.00
On Open Area		
First 3 days	MT per day	

Tariff Heads	Charge unit	Charges (INR)
First 7 days	MT per day	0.00
7-21 days	MT per day	1.00
22-35 days	MT per day	2.00
After 35 days	MT per day	8.00
(D) Composite Charges		
Movement of Over Dimensional Cargo	Per MT per km	1.50
Customs clearance convenience charges	Per MT	40.00
(E) Miscellaneous charges		
Crane, fork lift, bunkering of fuel, water supply, etc.	Of total revenue	
Crane (including Pontoon crane)		
5 MT capacity Crane	Per shift of 8 hrs	800.00
20 MT capacity Crane	Per shift of 8 hrs	2000.00
>20 MT capacity Crane	Per shift of 8 hrs	2500.00
Container Crane	Per hr	1100.00
Fork Lift (3MT capacity)	Per shift of 8 hrs	600.00
Electricity supply to Vessels		As per Electricity Board
Bunkering of fuel/ Petroleum Oil Lubricants		As per Market Rates
Water Supply	Per km	300.00
Sewage Disposal	Per km	100.00
Weighing scale	Per MT	5.00

In order to estimate the effective charge that the end users are expected to face, it is assumed that the margin charged by barge operators is Rs. 1.20 per MT per km.

FINANCING

The financing parameters considered for the study are as follows:

Suitable assumptions with relevant justification shall be made for any missing items.

Item	Unit	Value
Leverage Ratio	% Debt	70%
Moratorium	Quarters	2
Door-to-door Tenor	Years	15
Interest Rate	%	8%
Debt Drawal Start Quarter	No.	1
Debt Repayment Start Quarter	No.	22
Debt Repayment End Quarter	No.	60
Discount Rate (For NPV calculations)	%	16%

OTHER ASSUMPTIONS

Suitable assumptions with relevant justification shall be made for any missing items.

Tax Rate Assumptions

Type of Tax	Rate
Corporate Income Tax Rate	34.61%
Minimum Alternate Tax Rate	21.34%

Final IRR Reporting:

The consultant shall report the Project FIRR & EIRR considering different scenarios. Broadly the sensitivity shall include (but not limited to) following parameters as variable:

- Traffic (15-20% ± of projected divertible cargo, as at this stage the divertible cargo potential)
- Development Cost (15-20% ± of planned cost)
- Leverage Ratio (70:30 in base case, 10-15% ± in optimistic & pessimistic scenarios)

ANNEXURE 11.2 –ABSTRACT OF COST FOR NW 3 FAIRWAY DEVELOPMENT

Abstract of Cost for NW 3 Fairway Development			
S.No.	Item Description	Option-I	Option-II
		Amount (in Lakh Rs.)	Amount (in Lakh Rs.)
A.	**Fairway**		
1	Dredging		
(i)	General Soil in Longitudinal Development of Waterway	0.00	16259.34
(ii)	General Soil in crossing the water way at 03 location (Passenger Ferry)	292.86	0.00
(iii)	Hard Soil	0.00	0.00
2	Low Cost River Structures	0.00	0.00
(i)	Bandaling	0.00	0.00
3	River Training Works		
(i)	Spurs		
(ii)	Bank Protection Works for river	0.00	71244.21
(iii)	Porcupine		
4	Night Navigation		
(i)	Channel Marking Buoy, Mooring Gear & Lighting Equipments	0.00	1187.30
(ii)	Shore Marking with Latiice Bridge & Lighting Equipments	0.00	0.00
5	Land Acquisition		
(i)	Land Acquisition for Lo-Lo	0.00	0.00
(ii)	Habitation / Structures for fairway along longitudinal waterway	0.00	10651.12
	Sub-total (A)	**292.86**	**99341.97**
B	**Modification of Structures**		
B1	**Modification of Structures (As Per Condition Assessment)**		
(i)	Bridges	0.00	8537.73
(ii)	Cables	0.00	27.00
(iii)	Dams	0.00	0.00
(iv)	Barrages	0.00	0.00

(v)	Locks (Construction at 7 locations)	0.00	8567.77
(vi)	Others	0.00	0.00
	Sub-total (B1)	**0.00**	**17132.49**
B2	**Modification of Structures (Kerla Govt. Letter No.A2/114/ 2018/CSIND dated 07.03.2020**		
(i)	Bridge	0.00	82000.00
(ii)	Foot Bridges	0.00	0.00
(iii)	Foot Bridge	0.00	3120.00
(iv)	HT Lines	0.00	510.00
(v)	LT Lines	0.00	32.00
(vi)	Bridge	0.00	22000.00
(vii)	Foot Bridges	0.00	2880.00
(viii)	Regulator Cum Bridge & Navigation Lock	0.00	7000.00
ixv)	Barrages	0.00	7000.00
(x)	Navigation Lock	0.00	7000.00
(xi)	Water Pipe -line	0.00	0.00
	Sub Total B2	**0.00**	**131542.00**
	Sub-total (B)	**0.00**	**148674.49**
C	**Communication System**		
(i)	RIS Centre	0.00	0.00
(ii)	AIS Base Station	0.00	0.00
(iii)	Vessels - Survey vessel & Other Vessel	0.00	0.00
(iv)	Buoys	0.00	0.00
	Sub-total (C)	**0.00**	**0.00**
D	**Institutional Requirement**		
(i)	Office Development Cost	0.00	0.00
	Sub-total (D)	**0.00**	**0.00**

	Sub-total (A)+(B)+(C)+(D)	**292.86**	**248016.46**
E	Enviornmental Management Plan Cost@5% of Prime cost	14.64	12400.82
F	Project Management & consultancy Charges @ 3% of Prime cost	8.79	7440.49
G	Contingencies and Unforeseen Items of Works @ 3% of Prime cost	8.79	7440.49
	Project Total Hard Cost	**325.07**	**275298.27**

ANNEXURE 11.3 –COST OF DREDGING

SL No.	Item Description	Unit	Estimated Quantity (Cum)	Rate (in Rs.)	Amount (in Lakh Rs.)
1	Dredging in General Soil (Longitudinal Development along the length of waterway)	Cum	66,36,467.00	245	16259.34
2	Dredging in General Soil (Cross over Development across the waterway at 03 locations)	Cum	1,19,533.00	245	292.86
3	Dredging in Hard Soil	Cum	0	963	0.00
	Total Cost of Dredging		**6756000.00**		**16552.20**

ANNEXURE 11.4 –COST OF BANK PROTECTION WORKS AT RIVER

Cost of Bank Protection Works at NW-3

Cost of Bank Protection Works at Canal (with Pile & Slab)

Sl No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
1	BORING - Boring of suitable diameter of bore hole for 400mm size RCC pile as specified through gravel, sand, silt clay and all soils other than boulders or rock to a depth below ground level (N<100) in all boreholes	m	5	1949.7	0.10
2	CONCRETE - Reinforced Cement Concrete of specified Grade M40 in different structural members i.e. Slab	Cum	1.10	8882.45	0.10
3	REINFORCEMENT - High yield strength deformed bars Reinforcement Grade Fe500 in reinforcing cage including ring bars as detailed on the drawings	MT	0.275	83150	0.23
4	ANCHOR ROD - 32mm dia anchor rods of 3 m length at every 2 m center to center distance including fittings as shown in the sketch	m	LS	LS	0.05
5	Filter wrapped in Geotextile	Cum	LS	LS	0.05
					0.52
	Cost of Bank Protection Works for 1 m				0.52
	Cost of Bank Protection Works for 136000 m				**71,244**

ANNEXURE 11.5 –NIGHT NAVIGATION

Cost of Night Navigation Works (Buoy & Lights) (Option-2)

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	No.	330	3,59,788	1187.30
	Cost of of Night Navigation Works				**1187.30**

ANNEXURE 11.6 – COST OF LAND ACQUISITION

Cost of Land - NW-3 Extn. Waterway									
KM From	**KM To**	**KM To**	**Length**			**Left Bank Area**	**Right Bank Area**	**Total Area**	**Cumulative Area (Sq-m)**
15.6	17.65	2050	40	5	5	10250	10250	20500	20500
17.7	18.5	800	40	5	5	4000	4000	8000	28500
18.5	18.65	150	30	10	10	1500	1500	3000	31500
18.65	19.45	800	30	10	10	8000	8000	16000	47500
19.45	20.75	1300	20	15	15	19500	19500	39000	86500
20.75	22.7	1950	20	15	15	29250	29250	58500	145000
22.7	30.3	7600	20	15	15	114000	114000	228000	373000
32.45	33	550	40	5	5	2750	2750	5500	378500
33	33.15	150	40	5	5	750	750	1500	380000
53.5	55.85	2350	40	5	5	11750	11750	23500	403500
56	56.7	700	30	10	10	7000	7000	14000	417500
56.7	57.1	400	10	20	20	8000	8000	16000	433500
57.1	57.35	250	40	5	5	1250	1250	2500	436000
57.35	60.15	2800	20	10	10	28000	28000	56000	492000
60.15	60.4	250	10	20	20	5000	5000	10000	502000
60.4	62.7	2300	40	5	5	11500	11500	23000	525000
62.7	64.4	1700	30	10	10	17000	17000	34000	559000
65.2	65.7	500	40	5	5	2500	2500	5000	564000
65.7	66.1	400	20	15	15	6000	6000	12000	576000
66.1	66.25	150	10	20	20	3000	3000	6000	582000
66.25	74.8	8550	20	15	15	128250	128250	256500	838500
74.8	77.8	3000	10	20	20	60000	60000	120000	958500
77.8	82.25	4450	20	15	15	66750	66750	133500	1092000
83.35	87.85	4500	10	20	20	90000	90000	180000	1272000
97	100.55	3550	20	15	15	53250	53250	106500	106500
100.55	100.95	400	30	10	10	4000	4000	8000	114500
100.95	107.5	6550	20	15	15	98250	98250	196500	311000
107.5	109.45	1950	30	10	10	19500	19500	39000	350000
109.45	114.8	5350	20	15	15	80250	80250	160500	510500
140.45	142.9	2450	30	10	10	24500	24500	49000	559500
156.05	162.7	6650	20	15	15	99750	99750	199500	199500
162.7	165.3	2600	30	10	10	26000	26000	52000	251500
165.3	165.7	400	30	10	10	4000	4000	8000	259500
		77550				1045500	1045500	2091000	2091000
Total Land Area in Thrissur District			1272000						
555.975		7072.002	70.72	THRISSUR DISTRICT					
707200200									
Total Land Area in Malappuram District			199500						

375		2098.125	20.98	MALAPPURAM DISTRICT					
209812500									
Total Land Area in Kozhikkode District			259500						
750		1946.25	19.46	KOZHIKKODE DISTRICT					
194625000									
Total Cost		11116.38	111.16						
		9650							
		67900							
BP L	67900	0	67900						
BP R	67900	0	67900						
			135800						
			136 kms						

ANNEXURE 11.7 –COST OF LAND FOR NW3-HABITATION

NW-3 Extn. Waterway Habitation

		0			0	0	0	0
19.1	19.15	50	10	10	500	500	1000	1000
19.25	19.3	50	10	10	500	500	1000	2000
19.45	19.7	250	15	15	3750	3750	7500	9500
19.7	20.1	400	15	0	6000	0	6000	15500
21.05	21.45	400	0	15	0	6000	6000	21500
22.7	22.75	50	0	15	0	750	750	22250
22.8	22.85	50	0	15	0	750	750	23000
22.9	22.95	50	0	15	0	750	750	23750
22.95	23.3	350	0	15	0	5250	5250	29000
23.25	23.45	200	15	0	3000	0	3000	32000
23.45	23.75	300	15	15	4500	4500	9000	41000
25.45	25.65	200	15	0	3000	0	3000	44000
25.95	26.05	100	15	0	1500	0	1500	45500
26.35	26.45	100	15	0	1500	0	1500	47000
26.75	26.9	150	0	15	0	2250	2250	49250
27.1	27.25	150	0	15	0	2250	2250	51500
27.4	27.45	50	15	0	750	0	750	52250
27.45	27.65	200	0	15	0	3000	3000	55250
27.75	27.85	100	15	15	1500	1500	3000	58250
28.1	28.2	100	15	0	1500	0	1500	59750
28.15	28.35	200	0	15	0	3000	3000	62750
28.35	28.4	50	15	0	750	0	750	63500
28.4	28.5	100	0	15	0	1500	1500	65000
28.65	29.05	400	15	15	6000	6000	12000	77000
29.2	29.8	600	15	15	9000	9000	18000	95000
29.9	30.15	250	15	15	3750	3750	7500	102500
30.15	30.3	150	15	0	2250	0	2250	104750
32.9	33.15	250	20	0	5000	0	5000	109750
53.6	54.2	600	0	10	0	6000	6000	115750
54.5	54.55	50	10	0	500	0	500	116250
56.7	57.1	400	20	20	8000	8000	16000	132250
57.85	58.1	250	0	15	0	3750	3750	136000
58.05	58.3	250	15	0	3750	0	3750	139750
58.45	58.75	300	15	0	4500	0	4500	144250
58.55	58.65	100	0	15	0	1500	1500	145750
58.9	59.05	150	15	0	2250	0	2250	148000
59.2	59.25	50	15	0	750	0	750	148750
59.6	60	400	15	0	6000	0	6000	154750
66.4	66.45	50	15	0	750	0	750	155500
67.6	67.7	100	15	15	1500	1500	3000	158500
69.5	69.7	200	0	15	0	3000	3000	161500
70.35	70.45	100	0	15	0	1500	1500	163000
70.6	70.8	200	15	15	3000	3000	6000	169000

74.8	74.95	150	20	20	3000	3000	6000	175000
75.5	76.45	950	0	20	0	19000	19000	194000
76.45	76.8	350	20	0	7000	0	7000	201000
77.25	77.4	150	20	20	3000	3000	6000	207000
78.35	78.65	300	15	0	4500	0	4500	211500
79.5	79.7	200	15	0	3000	0	3000	214500
79.85	80.1	250	15	15	3750	3750	7500	222000
80.25	80.7	450	0	15	0	6750	6750	228750
80.55	80.75	200	15	0	3000	0	3000	231750
80.9	80.95	50	15	15	750	750	1500	233250
81.5	81.65	150	15	15	2250	2250	4500	237750
81.75	81.85	100	0	15	0	1500	1500	239250
82.05	82.2	150	15	0	2250	0	2250	241500
83.35	86.85	3500	20	20	70000	70000	140000	381500
86.85	86.95	100	20	0	2000	0	2000	383500
86.95	**87.85**	**900**	**20**	**0**	**18000**	**0**	**18000**	**401500**
97.3	97.4	100	15	0	1500	0	1500	1500
97.5	97.6	100	15	15	1500	1500	3000	4500
99.5	99.8	300	0	15	0	4500	4500	9000
100.2	100.55	350	0	15	0	5250	5250	14250
101.4	101.9	500	0	15	0	7500	7500	21750
101.7	101.8	100	15	0	1500	0	1500	23250
102.3	102.4	100	15	15	1500	1500	3000	26250
102.95	103.1	150	0	15	0	2250	2250	28500
105.55	106.1	550	15	0	8250	0	8250	36750
108.6	108.85	250	35	0	8750	0	8750	45500
110.2	110.25	50	0	15	0	750	750	46250
110.5	111.45	950	0	15	0	14250	14250	60500
111.1	111.15	50	15	0	750	0	750	61250
111.3	111.6	300	15	0	4500	0	4500	65750
111.6	112.4	800	15	15	12000	12000	24000	89750
112.6	112.7	100	0	15	0	1500	1500	91250
112.7	113.05	350	15	0	5250	0	5250	96500
112.9	113	100	0	15	0	1500	1500	98000
113.2	113.8	600	10	15	6000	9000	15000	113000
140.5	140.85	350	10	10	3500	3500	7000	7000
141.05	141.25	200	10	0	2000	0	2000	9000
141.5	141.55	50	10	0	500	0	500	9500
141.6	141.85	250	10	10	2500	2500	5000	14500
141.9	142.9	1000	10	10	10000	10000	20000	34500
156.05	162.7	6650	15	15	99750	99750	199500	199500
162.7	165.3	2600	10	10	26000	26000	52000	251500
165.3	165.7	400	10	10	4000	4000	8000	259500
							808500	808500

8.09 Lakhs Sq. m or say 8.1 Lakhs Sq. m. Also can be taken as 81 Hectares.

Total Land Area in								

Thrissur District									
2268	**555.975**	**1712.025**	**687378038**	**6873.78**	**68.7378**				
Total Land Area in Malappuram District									
2250	**375**	**1875**	**211875000**	**2118.75**	**21.1875**				
Total Land Area in Kozhikkode District									
5557.5	**750**	**4807.5**	**165858750**	**1658.588**	**16.58588**				
				10651.12	**106.5112**				

ANNEXURE 11.8 – COST OF MODIFICATION OF BRIDGES

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	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
								Hz	Vt	
1	0	Road Bridge	RCC	10	10x31.5	31.5	7.5	No	No	0.00
2	1.83	Road Bridge	RCC	10	9x31.5	31.5	7.5	No	No	0.00
3	3.8	Road Bridge	RCC	10	6x35.6	35.6	5.2	No	Yes	50,21,500.00
4	6.1	Road Bridge	RCC	8	10x25.8	25.8	6	No	No	0.00
5	13.6	Road Bridge	RCC	8	8x37	37	8.5	No	No	0.00
6	15.97	Road Bridge	RCC	8	3x36	36	5.5	No	Yes	50,21,500.00
7	17.23	Foot Bridge	RCC	2	5x9	9	5	Yes	Yes	71,50,000.00
8	20.08	Foot Bridge	Iron	2	1x38	38	5	No	Yes	38,50,000.00
9	20.75	Road Bridge	RCC	8	3x26	26	5.3	No	Yes	50,21,500.00
10	25.95	Road Bridge	RCC	1.8	5x6	6	3	Yes	Yes	82,50,000.00
11	27.76	Foot Bridge	RCC	1.8	3x15.5	15.5	4	No	Yes	38,50,000.00
12	28.94	Road Bridge	RCC	1.8	4x6	6	4	Yes	Yes	82,50,000.00
13	28.95	Road Bridge	RCC	1	3x11.5	11.5	5	Yes	Yes	82,50,000.00
14	29.25	Road Bridge	RCC	8	3x11.5	11.5	6.6	Yes	No	82,50,000.00
15	30.06	Foot Bridge	RCC	1.2	3x11.5	11.5	5.5	Yes	Yes	38,50,000.00

16	35.75	Road Bridge	RCC	7.5	7x14.3	14.3	4	No	Yes	55,00,000.00
17	37.1	Hanging Bridge	Iron	1.2	1x110	110	6	No	No	0.00
18	39.52	Road Bridge	RCC	10	7x32.7	32.7	7	No	No	0.00
19	42.93	Road Bridge	RCC	6	7x14	14	3.6	No	Yes	55,00,000.00
20	50.35	Road Bridge	RCC	8	7x37.8	37.8	5	No	Yes	50,21,500.00
21	53.35	Road Bridge	RCC	10	13x20	20	6	No	No	0.00
22	54.07	Lock	RCC			6	6	Yes	No	0.00
23	54.12	Lock	RCC			6	6	Yes	No	0.00
24	54.42	Road Bridge	RCC	7.5	3x16.5	16.5	6.2	No	No	0.00
25	55.27	Road Bridge	RCC	2	1x28	28	5	No	Yes	50,21,500.00
26	56.62	Road Bridge	Iron	4	1x30	30	4	No	Yes	55,00,000.00
27	57.96	Moving Bridge	Iron	4	1x10	10	2.7	Yes	Yes	71,50,000.00
28	58.55	Foot Bridge	Iron	1.8	1x20	20	4	No	Yes	38,50,000.00
29	60.29	Road Bridge	RCC	7.5	3x9.3	9.3	5.8	Yes	Yes	82,50,000.00
30	60.38	Road Bridge	RCC	3	5x5.5	5.5	3.6	Yes	Yes	82,50,000.00
31	61.32	Moving Bridge	Iron	3.5	1x10	10	3.2	Yes	Yes	71,50,000.00
32	62.26	Foot Bridge	RCC	2	3x8.4	8.4	5.3	Yes	Yes	71,50,000.00
33	62.78	Moving Bridge	Iron	3.5	1x10.5	10.5	3.5	Yes	Yes	71,50,000.00
34	65.3	Moving Bridge	Iron	3.5	1x10	10	2.1	Yes	Yes	71,50,000.00
35	66.1	Road Bridge	RCC	7.5	1x15	15	5.5	No	Yes	50,21,500.00
36	66.14	Foot Bridge	RCC	1	1x10	10	3	Yes	Yes	71,50,000.00
37	67.56	Foot Bridge	RCC	1.2	1x6.75	6.75	3.6	Yes	Yes	71,50,000.00
38	67.63	Moving Bridge	Iron	3.5	1x10.5	10.5	3	Yes	Yes	71,50,000.00
39	68.65	Foot Bridge	RCC	1.2	1x8.5	8.5	3.6	Yes	Yes	71,50,000.00
40	68.65	Moving Bridge	Iron	3.5	1x8.5	8.5	2.7	Yes	Yes	71,50,000.00
41	69.64	Temporary Bridge	Wooden	1.2		2.2	2.3	Yes	Yes	71,50,000.00
42	70.65	Foot Bridge	RCC	1.2	5x8.5	8.5	5.7	Yes	Yes	71,50,000.00
43	71.4	Road Bridge	RCC	4	1x10	10	5.5	Yes	Yes	82,50,000.00

44	72.55	Foot Bridge	RCC	1	1x8	8	4.6	Yes	Yes	71,50,000.00
45	72.56	Moving Bridge	Iron	3.5	1x8.5	8.5	3	Yes	Yes	71,50,000.00
46	73.6	Moving Bridge	Iron	3.5	1x8	8	2	Yes	Yes	71,50,000.00
47	74.86	Moving Bridge	Iron	3.5	1x16	16	4	No	Yes	38,50,000.00
48	74.86	Temporary Bridge	Wooden	1				Yes	Yes	71,50,000.00
49	76	Road Bridge	RCC	7.5	1x16	16	4	No	Yes	55,00,000.00
50	76.47	Temporary Bridge	Iron	7.5	1x18	18	6.3	No	No	38,50,000.00
51	77.32	Temporary Bridge	Wooden	1.2			1	Yes	Yes	71,50,000.00
52	78.12	Moving Bridge	Iron	4	1x16	16	4	No	Yes	38,50,000.00
53	79.32	Temporary Bridge	Wooden	1.2			1	Yes	Yes	71,50,000.00
54	80.05	Foot Bridge	Iron	2	1x15	15	4	No	Yes	38,50,000.00
55	72.92	Lock	RCC					Yes	Yes	0.00
56	82.01	Lock	RCC					Yes	Yes	0.00
57	82.18	Foot Bridge	Wooden	1.2			1	Yes	Yes	71,50,000.00
58	83.77	Moving Bridge	Iron	3.5	1x15	15	5	No	Yes	38,50,000.00
59	84.62	Foot Bridge	Iron	1.5	1x14	14	6.3	No	No	0.00
60	85.68	Road Bridge	RCC	10	1x15	15	7	No	No	0.00
61	85.9	Foot Bridge	RCC	1.5	1x5	5	1.5	Yes	Yes	71,50,000.00
62	85.91	Road Bridge	RCC	6	3x8.4	8	4	Yes	Yes	82,50,000.00
63	86.6	Foot Bridge	RCC	2	3x8.4	8	4	Yes	Yes	71,50,000.00
64	87.24	Foot Bridge	RCC	2.5	3x8.4	8	4	Yes	Yes	71,50,000.00
65	87.53	Foot Bridge	RCC	1.5	2x8	8	2	Yes	Yes	71,50,000.00
66	87.53	Road Bridge	RCC	4	1x8	8	2	Yes	Yes	82,50,000.00
67	94.69	Hanging Bridge	RCC	1.8	1x185	185	7	No	No	0.00
68	95.91	Road Bridge	RCC	4.5	16x6	6	6	Yes	No	82,50,000.00

69	97.37	Foot Bridge	RCC	2.5	4x10	10	4.5	Yes	Yes	71,50,000.00
70	98.3	Temporary Bridge	Wooden	1	12x3	3	2	Yes	Yes	71,50,000.00
71	99.5	Foot Bridge	Iron	2	4x10.4	10.4	6	Yes	No	71,50,000.00
72	100.5	Road Bridge	RCC	3	3x12	12	5.1	Yes	Yes	82,50,000.00
73	101.83	Road Bridge	RCC	7.5	3X18	18	7	No	No	0.00
74	103.5	Road Bridge	RCC	7.5	1X16.5	16.5	6.5	No	No	0.00
75	103.75	Road Bridge	RCC	2.5	3x8.4	8	4.6	Yes	Yes	82,50,000.00
76	105	Road Bridge	RCC	6.5	3X18	18	5	No	Yes	50,21,500.00
77	105.68	Temporary Bridge	Iron					Yes	Yes	71,50,000.00
78	106.27	Temporary Bridge	RCC					Yes	Yes	71,50,000.00
79	107.2	Foot Bridge	Iron	1.5	3X11.5	11.5	4.6	Yes	Yes	71,50,000.00
80	107.51	Foot Bridge	Iron	1.5	3X12	12	4.6	Yes	Yes	71,50,000.00
81	107.82	Foot Bridge	RCC	1.5			1.5	Yes	Yes	71,50,000.00
82	108.85	Foot Bridge	RCC	1.5	3X10	10	4.5	Yes	Yes	71,50,000.00
83	109.72	Temporary Bridge	Wooden	0.8				Yes	Yes	71,50,000.00
84	110.16	Foot Bridge	RCC	1.5	3X10.2	10.2	8	Yes	No	71,50,000.00
85	110.87	Foot Bridge	RCC	2	3X10.2	10.2	4.2	Yes	Yes	71,50,000.00
86	111.62	Road Bridge	RCC	4	1X10	10	3.5	Yes	Yes	82,50,000.00
87	112.32	Road Bridge	RCC	6	1X12	12	5	Yes	Yes	82,50,000.00
88	113	Foot Bridge	RCC	2	3X10	10	2	Yes	Yes	71,50,000.00
89	113.52	Temporary Bridge	Wooden	1				Yes	Yes	71,50,000.00
90	114.27	Temporary Bridge	Bamboo		12X2	2	2.5	Yes	Yes	71,50,000.00
91	114.65	Foot Bridge	RCC	1.5	1X6.5	6.5	1	Yes	Yes	71,50,000.00
92	114.67	Lock	RCC					Yes	Yes	0.00

93	116.91	Road Bridge	RCC	8.5	7X16	16	5	No	Yes	50,21,500.00
94	117.05	Railway Bridge	RCC	5	5X17	17	6	No	No	0.00
95	117.05	Railway Bridge	RCC	5	5X17	17	7	No	No	0.00
96	118.53	Barrage & Bridge	RCC	1.8	10X4.5	4.5		Yes	Yes	0.00
97	119.26	Road Bridge	RCC	8	7X11	11	5.5	Yes	Yes	82,50,000.00
98	121.03	Lock	RCC	4	7X7	7	5.5	Yes	Yes	0.00
99	121.44	Road Bridge	RCC	7.5	7X9.7	9.7	5	Yes	Yes	82,50,000.00
100	124.15	Road Bridge	RCC	7.5	5X17.5	17.5	7	No	No	0.00
101	128.38	Road Bridge	RCC	7.5	5X15	15	5	No	Yes	50,21,500.00
102	130.67	Lock	RCC	1.8	10X4.5	4.5	8.5	Yes	No	0.00
103	132.1	Road Bridge	RCC	7.5	5X23	23	4	No	Yes	55,00,000.00
104	133.2	Road Bridge	RCC	7.5	4X20	20	4	No	Yes	55,00,000.00
105	138.85	Road Bridge	RCC	4	6X18	18	4	No	Yes	55,00,000.00
106	140.87	Lock	RCC	4	2X7.5	7.5	6	Yes	No	0.00
107	142.3	Foot Bridge	RCC	2.5	2X7.5	7.5	5	Yes	Yes	71,50,000.00
108	142.66	Foot Bridge	RCC	4	3X9.0	9	2.5	Yes	Yes	71,50,000.00
109	146.61	Road Bridge	RCC	5	3x15.5	15	3	No	Yes	55,00,000.00
110	143.61	Road Bridge	RCC	10	5X21.2	21.2	3.6	No	Yes	55,00,000.00
111	145.97	Railway Bridge	RCC	5	4X16.5	16.5	3	No	Yes	1,32,00,000.00
112	145.98	Railway Bridge	RCC	5	4X16.5	16.5	3	No	Yes	1,32,00,000.00
113	147.71	Road Bridge	RCC	7.5	7X18	18	7	No	No	0.00
114	152.13	Railway Bridge	RCC	10	7X29	29	4	No	Yes	1,32,00,000.00
115	152.16	Railway Bridge	RCC	8	6X37	37	4.75	No	Yes	1,32,00,000.00
116	153.03	Road Bridge	RCC	10	8X27	27	5.5	No	Yes	50,21,500.00
117	156.87	Road Bridge	RCC	5	1X15	15	3.5	No	Yes	55,00,000.00
118	157.63	Road Bridge	RCC	2	3X10	10	3.5	Yes	Yes	82,50,000.00
119	158.95	Temporary Bridge	Bamboo					Yes	Yes	71,50,000.00

120	160.05	Foot Bridge	RCC	2	3x8.4	8	3	Yes	Yes	71,50,000.00
121	161	Road Bridge	RCC	8	3X11.5	11	5.5	Yes	Yes	82,50,000.00
122	161.93	Foot Bridge	RCC	2	2X10	10	2	Yes	Yes	71,50,000.00
123	164.61	Road Bridge	RCC	7	4X10	10	4	Yes	Yes	82,50,000.00
124	165.78	Foot Bridge	RCC	2	6X13	13	3.5	Yes	Yes	71,50,000.00
125	165.99	Road Bridge	RCC	10	5X16	16	4	No	Yes	55,00,000.00
126	167.99	Road Bridge	RCC	10	2X25	25	5	No	Yes	50,21,500.00
127	168	Railway Bridge	RCC	12	3X25	25	5	No	Yes	1,32,00,000.00
128	169.27	Road Bridge	RCC	8	7X18	18	5	No	Yes	50,21,500.00
									Total	**70,70,58,000.00**
					(Adding 15% overhead cost) & 5% increase in cost per annum.					**85,37,72,535.00**

NOTES :

NOTE 1	For Railway & Road bridges modification is possible in two ways.
NOTE 2	When the bridge has adequate span but inadequate height. In that case, strengthening of existing substructure and foundation is proposed by increasing the height as required.
NOTE 3	When the span becomes inadequate, entire bridge needs to be dismantled and rconstruction is required.
NOTE 4	Foot Over Bridges which require modification have adequate span but inadequate vertical clearance.
NOTE 5	Foot Over Bridges may be modified / replaced according to condition of bridge at site.
NOTE 6	Temporary /Wooden/Bamboo Bridges and movig bridges may be modified / replaced according to condition of bridge at site.
NOTE 7	Barrages and Locks are computed separately.
NOTE 8	The cost of modification may have to be updated before construction at Detailed Engineering Stage.
NOTE 9	While considering entire new construction, many factors like soil condition, hydrology analysis etc will come to play. As a result, the cost may vary at Detailed Engineering Stage.

ANNEXURE 11.9 –COST OF MODIFICATION OF LOCKS

NW-3 Extn. Waterway (Quantity for 1 Lock In)					
Sl No.	**Item Description**	**Unit**	**Estimated Quantity**	**Rate (in Rs.)**	**Amount (in Lakh Rs.)**
1.0	**Land Acquisition**				
		sqm	4985.00		
		sqm	**4985.00**	555.98	27.72
2.0	**Jungle Clearance**				
2.1	Clearing jungle including uprooting of rank vegetation, grass, brush wood, trees and saplings of girth upto 30 cm measured at a height of 1m above ground level and removal of rubbish upto a distance of 50 m outside the periphery of the area cleared.				
		sqm	4725.00		
		sqm	**4725.00**	12.64	0.60
3.0	**Site Preparations including bunding**				
				L.S.	2.00
4.0	**Excavation**				
4.1	Earthwork in excavation for foundation trenches of walls, retaining walls of Lock structure				
		cum	33075.00		
		cum	**33075.00**	543.40	179.73
5.0	**RCC Concrete Works**				
	CONCRETE - Reinforced Cement Concrete of specified Grade M40 in different structural members below bed level				
5.1	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying but excluding the cost of centering, shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-in-charge. 5.33.1 All works upto plinth level 5.34.3 Providing M-40 grade concrete instead of M-25 grade BMC /RMC.(Note : Cement content considered in M-40 is @ 360 kg/ cum)				
	3m Wide retaining Wall	Cu.m	405		
	1m wide retaining wall	Cu.m	135		
	Total Concrete	**Cu.m**	**540.00**	8364.20	45.17
	CONCRETE - Reinforced Cement Concrete of specified Grade M25 above 1 m of depth				

5.2	Providing and laying in position ready mixed M-25 grade concrete for reinforced cement concrete work, using cement content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer -in - charge. (Note :- Cement content considered in this item is @ 330 kg/cum. Excess/ less cement used as per design mix is payable/recoverable separately).				
	3m Wide retaining Wall	Cu.m	3,014		
	1m wide retaining wall	Cu.m	1,005		
	Total Concrete	**Cu.m**	**4018.00**	8364.20	336.07
6.0	**Steel Reinforcement**				
6.1	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. 5.22.4 Hot rolled deformed bars				
		MT	683.70		
	Total Reinforcement	**MT**	**684**	83150.00	568.50
7.0	**Fenders**				
		Nos	30.00	6553.98	1.97
8.0	**Bollards**				
	Market Rate with Quotation and DSR , 4.1.2 Supplying and fixing the "Cleat Bollard" of high quality Spheroidal Graphite (SG) Cast Iron material grade 65-45-12for a capacity of 10 T to 15 T of M/s Trelleborg with an overall size of 410 mm x 220 mm x 165 mm of standard make confirming to the BS 5950:2000 / BS 6349: 1-4 (2013): Part 4 / AS 3990:1993 with the material specifications of Ductile cast Iron (Spheroidal graphite Iron) BS eN 1563 ASTM A 536 / cast Steel ASTM A148 IS 1030 / Anchor Bolts (galvanized) ISo 898 BS 3692 ASTM / Blasting (standard) Blasting (high performance) SSPc-SP10 NAcS no. 2 / Paint (standard) Paint (high performance) BS 3416 ISo 12944 and Bolts to be embedded into the Cement concrete block of 0.5 m x 0.3 m x 0.4 m of mix 1: 1 1/2 : 3	Nos	8.00	57148	4.57
9.0	**Security Room 3mx3m each**				
		sqm	9.00	4862.03	0.44
10.0	**Lock operating room 3mx7m**				
		sqm	21.00	4862.03	1.02
11.0	**Electric Power supply room 3mx4m**				
		sqm	12.00	6077.53	0.73
12.0	**DG room 5mx3m**				
		sqm	15.00	4862.03	0.73
13.0	**Store room 5mx8m**				
		sqm	40.00	4862.03	1.94
14.0	**Wash room 6mx4m**				
		sqm	24.00	4862.03	1.17
15.0	**High Mast light**				
		Nos.	1.00	36822.76	0.37
16.0	**Fencing**				
		m	200.00	607.75	1.22

17.0	**Instrumentation**				
		LS		LS	4.00
18.0	**Gate**				
				LS	2.00
19.0	**DG SET**				
		LS		LS	12.00
20.0	**Lock Gates (Miter Gates with Stoplog and hoisting arrangements)**		30458.00	91465.00	32.04
	Total for 1 Lock on NW 3 Extension (In Lakhs)				**1223.97**
	Total Cost for 07 Lock on NW 3 Extension (In Lakhs)				**8567.77**
Note:	**DSR rate2021.**				

ANNEXURE 12.1 –IMPLEMENTATION SCHEDULE (OPTION-I)

Option-I: NW -3 (Extension) - Across Development Along the Ferry Route at Three Locations (@ 1.0kms at each route -Total 3.0 kms dredging)

Sl. No.	Items	Implementation Schedule (24 Months)																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
A	**Passenger Ferry Dredging**																								
	1.a) Dredging																								
	Ordinary Soils / Hard Soils (Approval & Tendering)																								
	Ordinary Soils (1.19 Lakhs Cu. M)																								
	Environmental Management Plan																								

Development is suggested along the ferry line for fairway development for safe navigability. Tthe above schedule is for 24 months.

ANNEXURE 12.2 –IMPLEMENTATION SCHEDULE (OPTION-II)

Option-II: NW -3 (Extension) - Longitudinal Development Along the Length of River (169.55 kms.)

Sl. No.	Items	Implementation Schedule (60 Months)																																																										
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
A	**Fairway**																																																												
	1.a) Dredging																																																												
	Ordinary Soils / Hard Soils (Approval & Tendering)																																																												
	Ordinary Soils (66.36 Lakhs Cu. M)																																																												
	2. Low Cost Riverine Structures (NIL)																																																												
	3. River Training Works/ Bank Protection (136 kms)																																																												
	4. Night Navigation																																																												
	Buoy / Lights (Approval & Tendering)																																																												
	Buoy / Lights (330 Nos)																																																												
	5. Land Acquisition (209 Hectares for Fairway) @																																																												
	LA is a continuous process and works are to be segregated accoringly.																																																												
B	**Modification of Structures**																																																												
C	**Communication System**																																																												
D	**Institutional Requirement (Along with Cl 6 development)**																																																												
	Office / Manpower (Establishment & Recruittment)																																																												
	Office / Manpower (Deployment)																																																												
E	**Environmental Management Plan**																																																												

Development is not suggested. If the cargo is confirmed at later stage, the above schedule can be considered. Development is to be segregated according to the LA. Implementation will be in 60 months.

LIST OF DRAWINGS

S. No.	DRAWING NAME	DRAWING NUMBER	SHEETS
1	WEST COAST CANAL (KERALA) NW3 LAYOUT PLAN	P.010256-W-20301-A01	18
2	WEST COAST CANAL(KERALA)NW-3 RIVER PROTECTION TYPICAL SECTION	P.010256-W-20303-X01	1
3	WEST COAST CANAL (KERALA) NW3 LOCATION OF BORE HOLE AT PONNANI & BEYPORE	P.010256-W-20351-X01	2

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