Preface

India is the largest peninsula in the world with a coastline of about 7517 km with 12 major ports and 185 non major / intermediate ports with a very impressive water network consisting of rivers, lakes, creeks and canals.

An efficient transport sector is vital for development of the economy to stimulate optimum competitive business environment. Indian transport system comprises various modes, viz. Railways, Roadways, Inland Waterways, Coastal Shipping and Airways. Integrated development of waterways can generate waterway grid that may in future help shift cargo traffic from road transport to the cheaper and eco-friendly inland waterways.

The first national waterways were established in India in mid 1980s & 1993 with a combined length of 2,716 km:

NW 1 (1620 km): Ganga - Bhagirathi- Hooghly river system between Haldia & Allahabad declared as National waterway in 1986

NW 2 (891 Km): Brahmaputra River between Bangladesh Border and Sadiya declared as National waterway in 1988

NW 3 (205 km): West coast canal (168 km) - Udyogmandal canal (23 km) - Champakara canal (14 km) declared as National waterway in 1993

The government also declared the following two inland waterways as national waterways during 2008:

NW 4 (1078 km): Kakinada-Pondicherry canal - Godavari and Krishna rivers

NW 5 (588 km): East Coast Canal - Brahmani River and Mahanadi delta

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

Accordingly, to make provisions for existing national waterways and to provide for the declaration of certain inland waterways to be national waterways and also to provide for the regulation and development of the said waterways for the purposes of shipping and navigation, National waterway act, 2016 has received the assent of the President on the 25th March, 2016 declaring a total of 111 National Waterways.

IWAI, a statutory body under MoS, Govt. of India, has entrusted WAPCOS with the responsibility for preparation of two stages DPR of six waterways in Tamilnadu and Andhra Pradesh: **National waterway No's 55 (Kaveri Kollidam), 75 (Palar), 77 (Pazhyar), 79 (Pennar), 80 (Ponniyar) and 99 (Tamaraparani)** for a total length of 763 km.

This Final Feasibility report (Stage-I) covers the review of data, reconnaissance survey, preliminary traffic and market analysis and navigation development feasibility for Ponniyar river. The consultant team has physically visited the 125 km river stretch and gathered all requisite information.

Acknowledgement

This Final Feasibility report (Stage 1) is the outcome of review of existing infrastructure along the Ponniyar River, present state of affairs and the probability of development as Inland waterway. This vision is shared jointly by IWAI and WAPCOS Limited.

This report gives the present status of water ways assets, topographic features, climatic variability, land use / land cover pattern, details of all cross structures, socio-economic information of the waterways and the feasibility of its development for navigation as per classification by Govt. of India (Gazette Notification).

We, WAPCOS project team acknowledge Cdr. P. K. Srivastava, Hydrographic Chief, Inland Waterways Authority of India; Sh Rajiv Singhal, AHS for constant encouragement and guidance, technical discussions and for evincing keen interest in the project and this report.

WAPCOS Team

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List of Abbreviations

ATT	Admiralty Tide Table
BM	Bench Mark / Local Reference Level
CH	Chainage
CM	Central Meridian
CRZ	Coastal Regulation Zone
CWC	Central Water Commission
CVT	Calibration, Verification & Test
DF	Dual Frequency
DGPS	Differential Global Positioning System
DPR	Daily Progress Report
GPS	Global Positioning System
HFL	Highest Flood Level
HC	Horizontal Clearance
HSE	Health, Safety and Environment
kHz	kilohertz
km	kilometer
m	meter
MHWS	Mean High Water Spring
mmtpa	million metric tons per annum
MN	million
m/s	meter per second
ms	milliseconds
MSL	Mean Sea Level
PWD	Public Works Department
QA/QC	Quality Assurance / Quality Control
QMS	Quality Management System
Rev	Revision
Rep.	Representative
SBES	Single Beam Echo sounder
SD	Standard Deviation
Sr	Senior
UTM	Universal Transverse Mercator
VC	Vertical Clearance
WGS	World Geodetic System

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The tidal variation is about 1 m.

(Source : Tide data at Pondicherry Port Admiralty tide table ATT Volume 3)</td></tr>
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<tr><td>> 2.0</td><td>0.24</td><td>2.91</td><td>1.46</td><td>1.44</td><td>6.27</td><td>2.80</td><td>15.12</td></tr>
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</td></tr>
<tr><td>c)</td><td>Cross structures
i) Dams, weirs, barrages etc. (total number; with navigation locks or not)
ii) Bridges, Power Cables etc. (total</td><td>There are six dams namely, Marudadu Dam, Sornavur Dam, Ellis Dam, Thirukovillur Dam, Pickup Dam and Sathanur Dam in the present study stretch. The present study stretch starts from D/S of Sathanur Dam.

22 bridges crosses Ponniyar river in this stretch.
VC for bridges varies from 0.5 m to 5.0 m.
HC for bridges varies from 4m to 35m.

26 HT and electric lines cross Ponniyar River in this stretch.
VC for Power Cables varies from 0.5 m to 11m.</td></tr>
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<table>
<tr><td></td><td>number; range of horizontal and vertical clearances)</td><td>HC for Power Cables varies from 50m to 300m.</td></tr>
<tr><td>d)</td><td>Avg discharge & no. of days</td><td>No of Gauge Stations: Two. One at Vazhavachanur and other at Villupuram

Vazhavachanur
➔ June to September - 0 to 2 m^3/s
➔ October to December - 20 to 30 m^3/s or less
➔ January to May - 2 to 5 m^3/s or less
Villupuram
➔ June to September : 0 to 2 m^3/s
➔ October to December : 20 to 30 m^3/s or less
➔ January to May : 2 to 5 m^3/s or less</td></tr>
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<tr><td>Villupuram RBL 42.125 m</td><td>Mouth RBL 0.0 m</td><td>42.125 m</td><td>39.65 km</td><td>1/941</td></tr>
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</td></tr>
<tr><td>f)</td><td>Consultant’s inference</td><td>CH 0.0 – 4.0 km
This reach can be developed as class II/ Class III waterway for whole year (365 days) with little dredging. The detailed dredging quantity can be estimated after detailed survey in Stage II.

CH 4.0 – 22.6 km
Marudadu weir exists at Ch 9.8 km. It is an old structure which is in very bad shape. Reconstruction of this weir may lead to some water depths in this reach which can be seen after detailed cross-sectional survey in Stage II.

Ch 22.6 km to 47.3 km
Reconstruction/modification of Sornavur weir at ch 22.6 and Ellis weir at 47.3 may lead to storage of some water during monsoon season. This may create some water depths. The details of water depth and duration will require cross-section</td></tr>
</table>

		survey of river and mathematical modelling studies which can be taken up in 2nd stage. ***Ch 47.3 to 65.9 km*** This stretch starts from d/s of Thirukoilur anicut at Ch 65.9 up to Ellis weir at ch 47.3km. At present 4 canals off take form Thirukoilur anicut. During the survey patches of water were observed in this stretch. Modification of Ellis weir will lead to raising the water levels at upstream. Thirukoilur anicut can also be modified to maintain discharges and to make water available at downstream. Detailed mathematical model studies and Cross-section survey of river (Stage II) is required to firmly assess the feasibility of this stretch for Inland navigation. ***Ch 65.9 km to 117.2 km*** A pickup weir was observed at the start of this stretch. Thirukoilur anicut is a weir where gates are provided for offtaking canals (04 in No's). It exists at downstream end of this stretch. Shallow water was observed in this stretch. Modification of Thirukoilur anicut will create water storage and additional water depths. Modification of pickup weir may add to more discharges in the reach. For feasibility for navigation, details of water depth will require cross-section survey of river and mathematical modelling studies which can be taken up in 2nd stage. ***Ch 117.2 km to 125.5 km*** Sathnur dam is a large reservoir and a well developed recreational spot. It is also used for Power generation. Navigation can be developed in a stretch from 1 km d/s of Sathnur dam to pick up weir at ch 117.2km. Modification of Pickup weir will lead to additional water depth in this stretch. Details can only work out after Stage II studies.
5.	<u>Traffic Potential</u>	
a)	Present IWT operations, ferry services, tourism, cargo, if any	**Cargo** Due to a lack of round the year availability of water, there is no existing cargo movement in the Ponniyar River **Ferry services** There are no passenger ferry services around the Ponniyar River. **Tourism** A lot of temples, tourist sites including Rangnath temple, Abhirameshwarar temple, Kalyana Mahal, Auroville etc. are situated nearby Ponniyar River.
b)	Important Industries within	Cuddalore, Villupuram and Tiruvannamalai have several industries. Out of these, the leading industries in terms of total production are stone & wood carving,

	50 km	handloom, silk weaving and rice mills.
c)	Distance of Rail & Road from industry	Various Industries at Cuddalore, Villupuram and Tiruvannamalai are located at a distance of about 40 km to 100 km from the river.
6.	Consultant's recommendation for going ahead with Stage-II (DPR preparation)	As depths of about 1 m are available without dredging for 6-7 months, **we recommend Stage II studies (Detailed studies and investigations) to examine the possibility of various alternative methods (Like raising the height of existing weirs, construction of locks, etc.) to make the waterway feasible all round the year for class I and Class II navigation for Tourism, ferry and cargo development.**
7.	Any other information/ comment	-----

1. About the Studies

M/s Inland Waterways Authority of India (IWAI), a statutory body under ministry of shipping, Govt. of India, has entrusted WAPCOS with the responsibility for preparation of two stage DPR for 6 national waterways of rivers Pennar, Kaveri Kollidam, Palar, Pazhyar, Ponniyar, Tamaraparani in Tamilnadu and Andhra Pradesh. The approximate lengths of all six national waterways are given in the table below:

Sl. No.	Name of the River / Canal	Description of Inland Waterway	From:	Upto:
1.	Pennar River, Andhra Pradesh	29 km length of the river from Penna Barrage, Pothireddypalem to confluence with Bay of Bengal near Kudithipalem (NATIONAL WATERWAY 79)	14°28'8.38"N, 79°59'9.31"E	14°35'36.75"N, 80°11'30.61"E
2.	Palar River, Tamilnadu	141 km length of the river from rail bridge at Virudampattu, Vellore to confluence with Bay of Bengal at Sadurangapattinam (NATIONAL WATERWAY 75)	12°56'14.07"N 79° 7'29.70"E	12°27'52.16"N, 80° 9'13.47"E
3.	**Ponniyar River, Tamilnadu**	**125 km length of the river from Sathanur Dam to Cuddalore at confluence of Bay of Bengal (NATIONAL WATERWAY 80)**	**12°11'0.06"N, 78°51'1.25"E**	**11°46'21.76"N, 79°47'41.70"E**
4.	Kaveri / Kollidam, Tamilnadu	364 km length of the river from Uratchikottai Barrage to confluence with Bay of Bengal at Pazhaiyar (NATIONAL WATERWAY 55)	11°29'3.09"N 77°42'13.68"E	11°21'37.97"N79°49'53.23"E
5.	Tamaraparani River, Tamilnadu	64 km length of the river from Sulochana Mudalir bridge, Tirunelveli to confluence with Bay of Bengal near Punnaikayal (NATIONAL WATERWAY 99)	8°43'43.17"N, 77°42'53.94"E	8°38'24.90"N, 78° 7'37.85"E
6.	Pazhyar River, Tamilnadu	20 km length of the river from Bridge near Veeranarayana Mangalam village to confluence with Arabian Sea at Manakudi (NATIONAL WATERWAY 77)	8°13'48.97"N 77°26'27.34"E	8°5'15.01"N 77°29'7.61"E

Table 1: National Waterways in Tamilnadu and Andhra Pradesh

The Google Map showing all river stretches is enclosed as **Figure 1**.

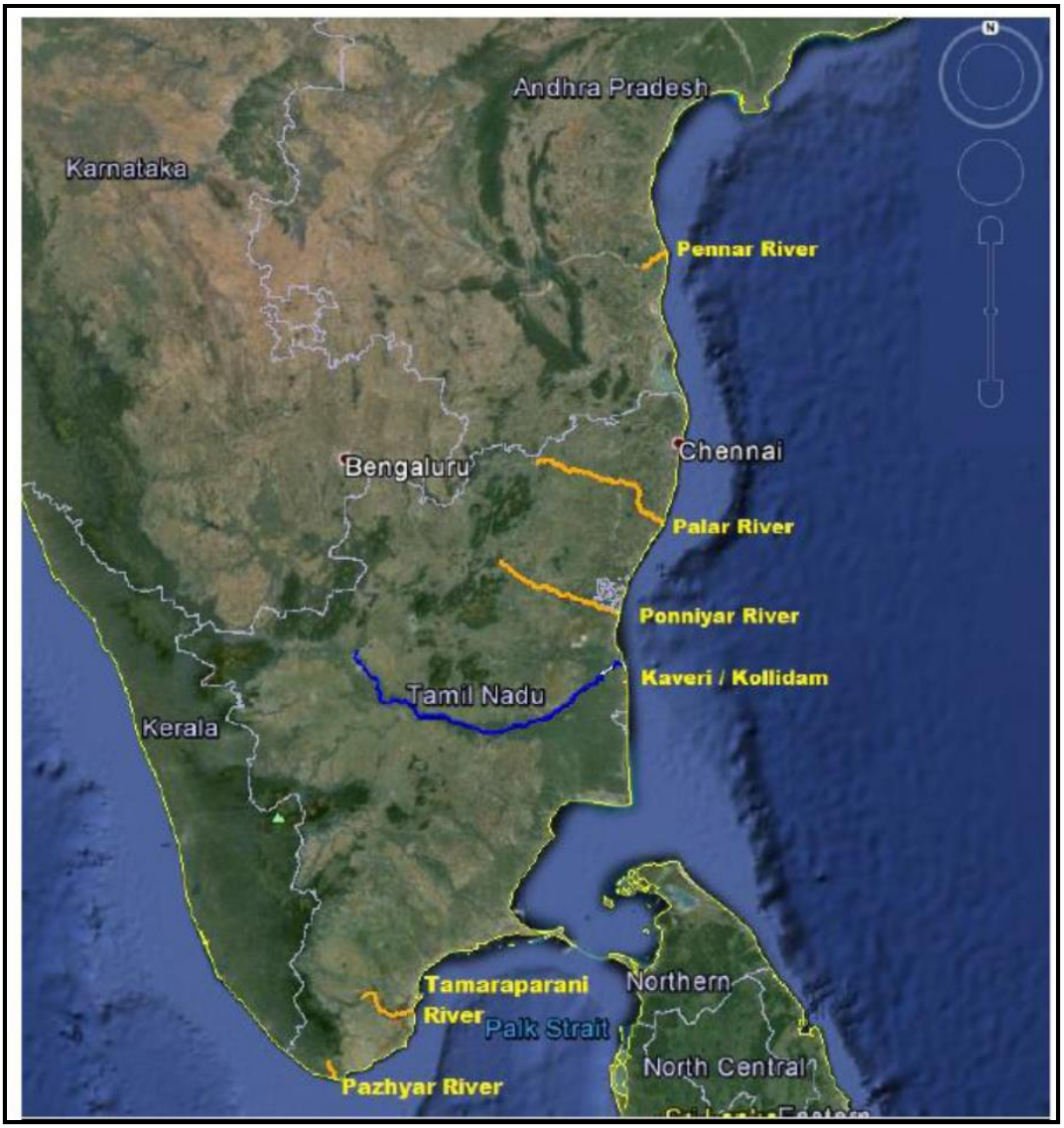


Figure 1: Google Map showing six rivers in Andhra Pradesh & Tamilnadu

Accordingly, WAPCOS Ltd. has undertaken the studies for 6 national waterways (Pennar, Kaveri Kollidam, Palar, Pazhyar, Ponniyar and Tamaraparani) in Tamilnadu and Andhra Pradesh. The brief scope of work is depicted as under:

Stage-1

A. Reconnaissance Survey

B. Collection and Review of available data

C. Feasibility Report

Stage-2

A. Hydrographic Survey & Hydro-morphological survey

B. Traffic Survey & Techno economic feasibility

C. Preparation of Detailed Project Report

The present studies are limited to establish the feasibility of waterways for Inland navigation i.e. up to Stage 1 only**.**

The present **Final Feasibility Report** covers the review of data, reconnaissance survey, present state of affairs, traffic analysis, and possible navigable stretches for Ponniyar River as detailed below:

- ✓ **Introductory Considerations**
- ✓ **Classification of waterways**
- ✓ **Details of existing structures**
- ✓ **Reconnaissance survey & site visit**
- ✓ **Single Line Longitudinal Survey**
- ✓ **Bed Profile**
- ✓ **Soil Texture**
- ✓ **Hydrological Data collection and analysis**
- ✓ **Preliminary Traffic studies and Market analysis**
- ✓ **Results and feasibility of waterways**

2. Introductory Considerations

As discussed in previous chapter, Cluster 5 consists of six rivers in the states of Tamilnadu and Andhra Pradesh. This chapter covers the introductory considerations, origin, hydrological parameters like altitude, length, catchment area, Annual rainfall, major dams, and barrages along the river, tributaries, and major cities along their bank, historical and religious places for Ponniyar River.

2.1 Name of River: Ponniyar

2.2 Length of River

Ponniyar River is declared as National Waterway 80 for 125 km length as per the Gazette Notification published on 26 March 2016. The total length of the river from origin to its outfall in the Bay of Bengal is 400 km. The length under present studies is detailed below:

125 Km length from Sathanur Dam to Cuddalore at confluence of Bay of Bengal (National Waterway 80)	**From: 12°11'0.06"N, 78°51'1.25"E**	**Upto: 11°46'21.76"N, 79°47'41.70"E**

2.3 State, District through which river passes

The river Ponniyar traverses through Kolar, Bangalore, Dharmapuri, Vellore, Tiruvannamali, Villupur and Cuddalore districts before it conjugates to Bay of Bengal in the East.

The main towns in the vicinity of Ponniyar River are Cuddalore, Panruti, Vilupuram, Ullundurprttai, Tirukkoyilur, Sankarapuram, Thandrampet and Tiruvannamalai in its 125 km stretch.

2.4 Maps

A Map showing entire Ponniyar basin (Source: CWC) and Present study stretch is attached as **Figure 2** & **Figure 3** respectively.

2.5 River Characteristics

2.5.1 River Course

The Ponniyar or the Dakshina Pinakini River rises near Hongashenhalli village at an elevation of about 900 m above MSL at North latitude 13º 25' and East longitude 77º 58' in the Kolar district of Karnataka state. From its origin, the river Ponniyar generally flows in the Southern direction for a length of 79 km. through Kolar and Bangalore districts of Karnataka before entering the Dharmapuri district of Tamil Nadu. The river flows another 247 km generally in the South-Easterly direction in the districts of Dharmapuri, Vellore, Tiruvannamalai, Cuddalore and Villupuram. The river then flows in Easterly direction below the Tirukoyilur anicut for another 70 km before finding its way into Bay of Bengal.

2.5.2 River Basin (Catchment Area)

It drains a total area of 16,019 sq km throughout the flow out of which 77% of the drainage is in Tamil Nadu alone. The river is extensively dammed for irrigation, especially in Tamil Nadu. There are also reservoirs at Krishnagiri and Sathanur.

Name of State	Drainage area (sq km)	% of total area
Karnataka	3530	22
Andhra Pradesh	210	1
Tamilnadu	12279	77
Total	16019	100

Table 2: Ponniyar River Catchment

2.5.3 Tributaries

Ponniyar flows in generally southern direction through the kolar and Bangalore districts to enter the Salem district of Tamil Nadu. The Gadilam and the Varaha join the Ponniyar just before its outfall into the Bay of Bengal, from left and right respectively. A Map showing Ponniyar Sub basin (Source: CWC) and Present study stretch is attached as *Figure 2* & *Figure 3* respectively.

2.5.4 Topography

The Ponniyar River rises at an elevation of about 900 m in the kolar district in Mysore and flows in southern direction through the kolar and Bangalore districts for a total distance of 291 km to enter the Salem district of Tamil Nadu.

2.5.5 Climate, Temperature & Humidity

Winter, summer, South-East monsoon and North-East monsoon season occurs in the river Basin. The south-west monsoon arrives in first week of June and ends by the end of September. The western part of the basin receives the major part of this rainfall. The north-east monsoon occurs from October to December.

2.5.6 Rainfall

The rainfall in the basin varies from region to region, the coastal districts in the basin gets heavier rainfall then the western parts. The rainfall decreases from 1270 mm at the eastern extremity of the basin to 762 mm at the western extremity.

2.5.7 Land Use

Three crop seasons viz. kharif, rabi and summer are mainly observed in the basin. The kharif crops are paddy, bajra, ragi, jowar, millets, cotton etc. The main summer crop for this area is paddy. The rabi crops are cholam (Jowar), millets, gram, other pulses, etc.

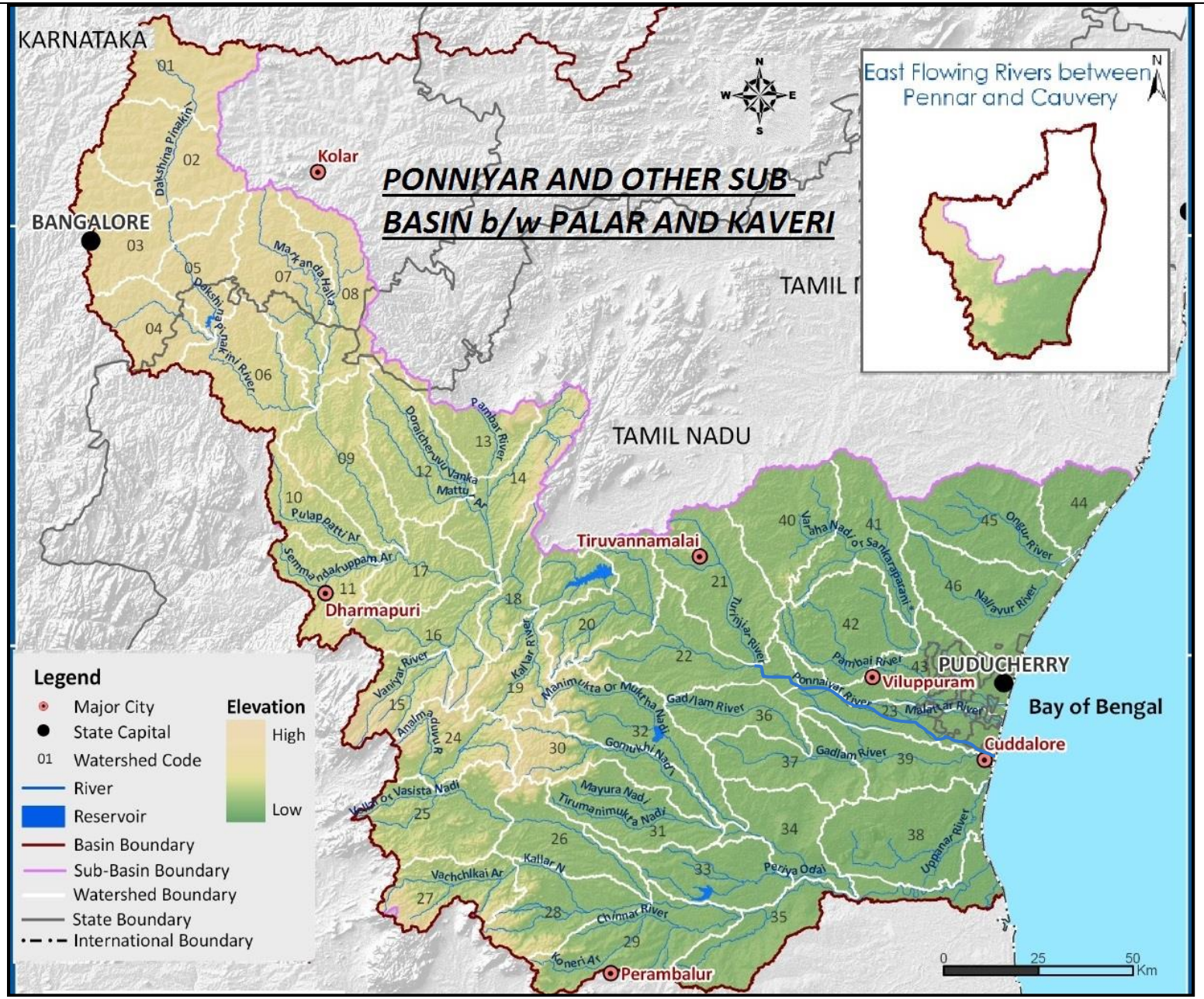


Figure 2: Ponniyar and other sub basin b/w Palar and Kaveri

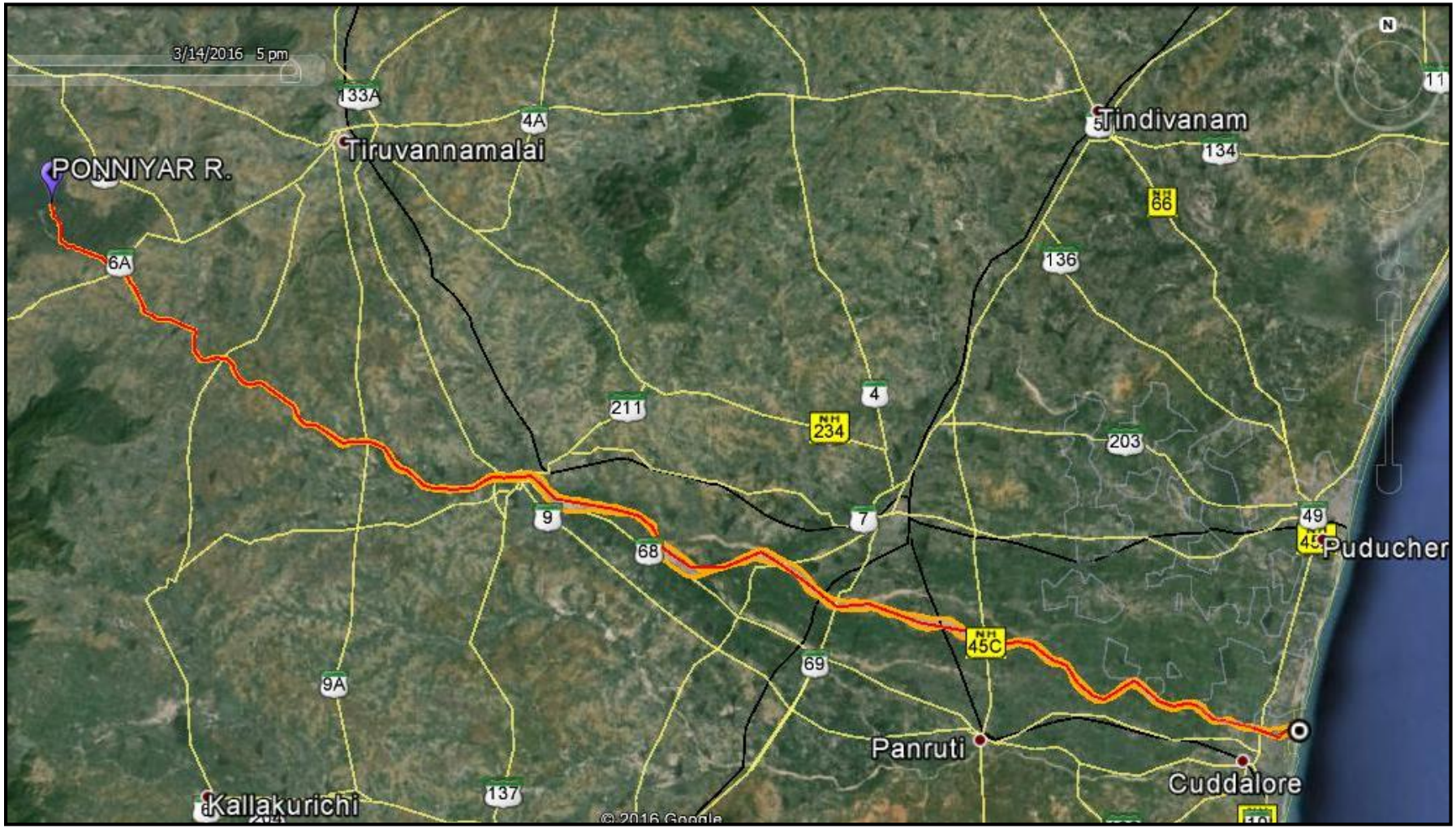


Figure 3: Google image showing Ponniyar river stretch under present studies

2.5.8 Soil

The Ponniyar basin is covered by the Archaean rocks such as Pyroxene granulites, Quartzite, Ferruginous Quartzite, Amphibolites, Gneiss and Hornblende biotite gneiss with younger intrusive of Pegmatite and Dolerite in the central and western parts . The eastern part is covered by the cretaceous formation of argillaceous, calcareous sandstone with clay and limestone. The tertiary formation is of Cuddalore sandstones and the recent formation of river alluvium and coastal alluvium

2.5.9 Demography

The main towns are Cuddalore, Viluppuram and Tiruvannamalai having population of 26 Lakhs, 34.60 Lakhs and 24.64 Lakhs respectively.

2.5.10 Dams, Barrages/ Weirs/ Anicut

Wellington Reservoir (Earthen type) is situated in Titagudi Taluk in Cuddalore District with a capacity of 73.40 Mcum.

Sathanur Power House is associated with Sathanur Hydroelectric Project having 1 unit of 7.5 MW total installed capacities.

Sathanur Reservoir Project is one of the major multipurpose projects in South Arcot district. Due to the difficult nature of the terrain, no canal takes off directly from the dam. A pick up weir across the river, 7.25 km below the dam site has been constructed. The power generation capacity of this dam is around 7.5 MW.

2.5.11 Tourism

Sathanur Dam is also developed as a tourism attraction and is a very good picnic and recreational spot.

2.6 Methodology and Data collection

2.6.1 Importance of Hydrological and Topographical data

Navigability of a natural river channel or tidal creek primarily depends upon hydraulic parameters like water discharge, flow depth, velocity, sediment load and width of river channel. These parameters are function of topography/bathymetry of river bed and discharge in river during different seasons. Apart from these important parameters, there are other natural factors such as tidal range and length of tidal reach, type/nature of river bed (rocky, sandy, silty, clayey), bends in river course and stability of alignment of deep channel of river over long period. Apart from above natural factors, information on other factors such as various structures across (Dams/weirs/barrages/bridges) and along the river bank (river training and bank protection works) is also required.

2.6.2 Data Requirement

The following data was required for Stage-1 feasibility report:

1. Type of crops (in different seasons) and industries along the waterway
2. Availability of passenger ferry services. Prominent towns / City along the waterway.
3. Historical and tourist places.
4. Existing water sport and recreational activities and future probability.
5. Details of cross-structures (bridges, aqueducts, electric lines, telephone lines, pipe lines, cables) and their clearances. Salient features of Dams / Barrages / Weirs.
6. Availability of water in different seasons. Also to correlate this with CWC / Irrigation datum's.
7. Ponding level and limit of Dams / Barrages / Weirs.
8. Encroachment in the waterway, width of the waterway, sharp bends.
9. Environmental impacts. CRZ or wildlife clearances.
10. Local/pronounced name of the rivers in different stretches.
11. Any Border issue with other country.
12. Incorporation of topographical features (outside survey limits) from Google Earth imageries.
13. Obstructions to the navigation and un-approachable areas.
14. Photographs of all cross-structures, gauges, obstructions - annotated with location & chainage. In report with lat/long, easting/northing, chainage details
15. Permanent structures located within this corridor.
16. All prominent shore features (locks, bridges, aqueducts, survey pillars if available etc) and other conspicuous objects shall be fixed and indicated on the chart and included in the report.
17. Details of water intake/ structures shall be collected and shown on the charts and include in the report.
18. Availability of berthing place, existing jetty, ferry ghats, approach roads etc. in the area shall be indicated on the charts and include in the report.
19. During the survey, condition of the banks shall also be collected, whether that banks are pitched (protected) or not protected. The length of bank protection, where banks erosion is taking place shall also be estimated.
20. Positions and levels of corners of permanent structures within the corridor shall be physically surveyed and marked on survey charts.

2.6.3 Primary Data- Sources

A. Survey of India (SOI) Dehradun, during February & March 2016

Toposheets and satellite imageries are useful to obtain information such as extent of tidal reach, HTL & LTL, width of river and deep channel, important places, nature of river bed and bank along reach, channel bends, slope of river channel, and locations of various structures across and along river course and tendency of shifting of deep channel (general morphology of the deep channel of the river course).

As the coastal zone falls under restricted category, the restricted and non-restricted Toposheets of Survey of India /hydrographic charts and satellite imageries has been collected after taking approval from **Ministry of Water Resources, Govt. of India**. A total of 43 toposheets were procured from Survey of India (SOI) (39 no.'s toposheets of 1: 50000 scale and 04 No's toposheets of 1:25000 scale) for all six rivers and analyzed to study various aspects mentioned above. The satellite imageries of different years from Google are also analyzed. The details of toposheets for Ponniyar River as collected from SOI are given as under:

Ponniyar River	**57 L/16, 58 M/1, 58 M/5, 58 M/9, 58 M/13, 58 M**

Table 3: SOI Toposheets

B. Data from Site Visit and Reconnaissance survey during March & April 2016

The site visit and reconnaissance survey was carried out in March and April 2016.

The details of existing cross-structures, Weirs, Barrages, Anicut, Dams, HT/ LT line, Type of Crops, Soils, shore protection along the waterway, Historical and tourist places, existing ferry services were collected. The details and photographs have been detailed in Chapter 3. The collected Data for all dams, barrages, and anicut is attached as **Annexure 2.**

The details of existing industries, major commodities, production were also collected from various industries located around main industrial clusters, important towns in the vicinity of waterways and important ports near river mouth. These details have been presented in Chapter 5.

2.6.4 Secondary Data- Sources

A. Central Water Commission (CWC), Govt of India and Water Resource Division (WRD), Chennai during February, March and April 2016

These data give most vital information on water availability in river reach and sediment concentration in river water.

Gauge- discharge, sediment and river cross section data (at gauging site) was collected from CWC for two gauging stations on Ponniyar River. Following Table gives details of gauging stations and data collected.

River	Gauging station	Data type	From	To	Frequency
Ponniyar	Vazhavachanur, Tiruvannamalai, TN 12^0 03′ 57” N 78^0 58′ 41” E	Gauge- discharge	1978	2013	daily
		Sediment	2001	2013	daily
		Cross-section	1999	2012	2 days/year
	Villupuram, TN 11^0 52′ 14” N 79^0 27′ 34” E	Gauge- discharge	1971	2012	daily
		Sediment	-	-	daily
		Cross-section	1999	2012	2 days/year

Table 4: Gauge Discharge Sediment data collected from CWC

2.6.5 Methodology

The studies are being carried out as detailed below:

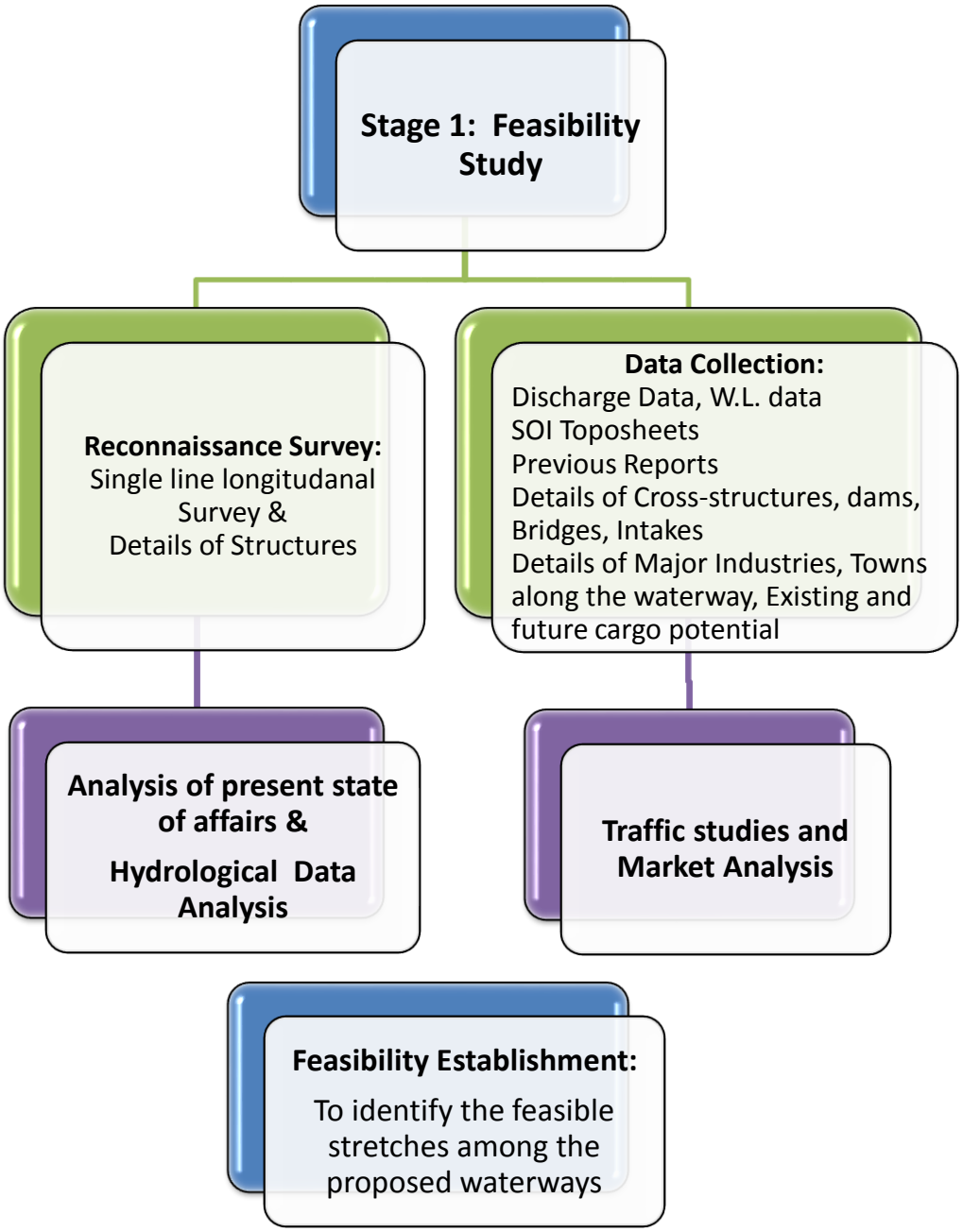


Figure 4: Feasibility Studies (Stage 1)

The detail methodology for reconnaissance survey, Hydrological data analysis and Traffic studies is given in their respective chapters. The feasibility of waterways is established after hydrological and traffic studies and analysis. Based on hydraulic conditions (depth, width, curvatures etc.) of the navigation channel, the class of the waterway is established in

accordance with the classification notified by the Inland Waterways Authority of India (IWAI) vides Gazette Notification dated 26 January 2007. The same has been detailed below:

2.6.6 Classification of Waterways

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

The classification of waterways is discussed below.

- ***Classification of Inland waterways for Rivers***

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

Table 5: Inland Waterway classification for Rivers

- ***Classification of Inland waterways for Canals***

Class of Waterway	Canals				
	Minimum Depth	Bottom Width	Bend Radius	Vertical Clearance	Horizontal Clearance
I.	1.5 m	20 m	300 m	4 m	20 m
II.	1.8 m	30 m	500 m	5 m	30 m
III.	2.2 m	40 m	700 m	7 m	40 m
IV.	2.5 m	50 m	800 m	10 m	50 m
V.	-	-	-	-	-
VI.	3.50 m	60 m	900 m	10 m	60 m
VII.	-	-	-	-	-

Table 6: Inland Waterway classification for Canals

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

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

- ***Vertical Clearance for Power Cables / Telephone Lines for all Classes***
- Telephone lines and Low Voltage lines 16.5 m
- High Voltage Transmission lines not exceeding 110 KV – 19 m
- High Voltage Transmission lines exceeding 110 KV – 19 m + 1 cm per each KV

In case of underground pipe / power lines and other cables norms to be decided as per conditions and navigational requirement

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

- ***Type of vessels to be used in different class waterways***

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

Table 7: Type of vessels to be used in different class of waterways

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

Wapcos has carried out hydrological studies to establish the feasibility of development of river stretches as national waterways. In cases where minimum depth (of 1.2m as per Govt. of India notification) is not available round the year, the no. of days of availability and available depth is calculated and presented in chapter 4. The project authorities may review the waterway classification. The feasibility of these stretches may be established for some part of the year after detailed studies in stage 2 after the approval. Measures to improve the depth are also stressed upon.

3. Analysis of present state of affairs

This chapter identifies the existing cross-structures viz. Dams, Weirs, Barrages, Locks, Bridges, Crossings, pipelines, cables, HT/LT line, National and State highways including railway lines in the river stretch collected during the site visit and reconnaissance survey. The details of all structures are tabulated in **Annexure 4**.

3.1 Existing Dams, Weir, Barrage, Anicuts and Locks

None of these existing Check Dams /Anicut /Barrages /Dams have navigational lock due to which through navigation in the river is not possible without constructing new lock.

Sl No	Structure Name	Chainage (km)	Location	Position (Above survey track)			
				WGS84 Datum; UTM Projection: CM 081°E , Zone 44N			
				Latitude(N)	Longitude(E)	Easting(m)	Northing(m)
1	Marudadu Dam	9.3	Marudadu	11° 47' 41.50"	79° 42' 55.40"	360042	1304190
2	Sornavur Dam	21.1	SornavoorMelpathy	11°49'31.69"	79°37'04.42"	349435	1307626
3	Ellis Dam	48.8	Enathimangalam	11°54'12.47”	79°23'56.06"	325623	1316381
4	Thirukovillur Dam	65.9	Thirukovillur	11°57'07.35"	79°15'08.17"	309682	1321851
5	Pickup Dam	118.2	Keelamanjanoor	12° 08' 19.91"	78°53'28.80"	270523	1342797
6	Sathanur Dam	125.0	Sathanur	12°10'59.7"	78°51'01.8"	266116	1347743

Table 8: Details of existing Dams, Weir, Barrage and Anicuts

3.2 Existing Bridges and Crossing Over River

Sl No	Structure Name	Chainage (km)	Location	Position (Above survey track)				Vertical clearance above H.F.L. (m)	Horizontal Clearance (m)
				WGS84 Datum; UTM Projection: CM 081°E , Zone 44N					
				Latitude [N]	Longitude [E]	Easting [m]	Northing [m]		
1	Bridge	1.9	Poonthendral Nagar	11°46'00.20"	79°46'42.98"	366917	1301047	2.0	20
2	Puducherry Bridge (SH-49)	3.5	Chinnakanganankuppam	11°46'26.47"	79°45'51.18"	365353	1301861	4.5	20

Sl No	Structure Name	Chainage (km)	Location	Position (Above survey track)				Vertical clearance above H.F.L. (m)	Horizontal Clearance (m)
				WGS84 Datum; UTM Projection: CM 081°E , Zone 44N					
				Latitude [N]	Longitude [E]	Easting [m]	Northing [m]		
3	Kumandanmedu Ground Bridge cum Causeway	4.4	KumandanMedu	11°46'29.23”	79°45'23.74"	364522	1301950	Causeway	
4	Chavadi Bridge	6.8	UnnamalaichettyChavadi	11°46'46.21"	79°44'09.83"	362287	1302481	5.0	20
5	Erandaravillagam Ground Bridge	10.9	Erandaravillagam	11°47'30.01"	79°42'16.40"	358860	1303843	0.5	4
6	Mananadu Bridge	14.4	Mananadu	11°48'18.58"	79°40'37.03"	355859	1305349	3.0	15
7	Kalinjikuppam Bridge	19.7	Kalinjikuppam	11°48'09.22"	79°37'58.62"	351063	1305084	2.0	15
8	Kalinjikuppam Damaged Bridge	19.7	Kalinjikuppam	11°48'04.70"	79°37'54.42"	350935	1304946	Damaged Bridge	
9	Panrutti to Cuddalore Bridge (NH-45C)	29.0	Kallipattu	11°50'39.12"	79°33'17.74"	342585	1309733	1.5	18
10	Railway Bridge	32.8	Kuchipalaiyam	11°51'25.62"	79°31'19.16"	339004	1311180	2.5	35
11	Villupuram to Thindavanam Bridge (NH-45)	41.7	Keelamangalam	11°52'16.96"	79°26'27.64"	330190	1312806	1.5	18
12	Villupuram to Thindavanam Bridge (NH-45)	41.7	Keelamangalam	11°52'16.89"	79°26'26.75"	330163	1312804	1.5	18
13	Railway Bridge	42.9	Keelamangalam	11°52'43.92"	79°25'53.88"	329173	131364	1.0	18
14	Thiruannamalai	47	Enathimangalam	11°54'20.70"	79°24'20.61"	326367	1316630	0.5	15

Sl No	Structure Name	Chainage (km)	Location	Position (Above survey track)				Vertical clearance above H.F.L. (m)	Horizontal Clearance (m)
				WGS84 Datum; UTM Projection: CM 081°E , Zone 44N					
				Latitude [N]	Longitude [E]	Easting [m]	Northing [m]		
	Bridge (SH-69)								
15	Enathimangalam (causeway)	50.2	Marangiyur	11°54'22.99"	79°22'31.93"	323079	1316719	Causeway	
16	Paiyur Bridge cum causeway	53.0	Sirumadurai	11°53'59.29"	79°21'03.75"	320407	1316007	Causeway	
17	Thirukovillur bridge cum Causeway	70.9	Thirukovillur	11°58'31.75"	79°12'51.82"	305574	1324471	Causeway	
18	ThirukovillurThiruannamalai Bridge (SH-9)	71.7	Thirukovillur	11°58'35.23"	79°12'21.00"	304642	1324584	1.0	20
19	Malanurpet to Dhuravam Road Bridge (SH-9A)	86.3	Kallippadi	12°00'09.47"	79°05'19.10"	291897	1327566	1	5
20	Vazhavachanur to Moongalthuraipattu Bridge	101.2	Unnamalaipalyam	12°03'53.07"	78°58'44.02"	279995	1334523	2	8
21	Raindapuram to Allapannur Bridge	108.7	Royandapuram	12°05'39.38"	78°55'57.08"	274969	1337829	1	8
22	Kolamanjanur Bridge (SH-6A)	115.4	Keelamajanoor	12°08'01.72"	78°53'57.25"	271379	1342231	1	18

Table 9: Details of existing Bridges and Crossings

Note: Unless specified, all are road bridges.

Note: Vertical clearance is measured above H.F.L. The HFL for tidal reach is MHWS as per ATT- Vol 3 and HFL at gauge site is calculated as maximum water level in last twenty years Gauge Discharge Data as collected from CWC.

3.3 Pipelines and cables

Veeranam Water Pipeline (CH 29.2km) is located at Lat. 11° 50' 41.71" N, Long. 79° 33' 11.86" E with vertical clearance (VC) of 6m and horizontal clearance (HC) of 20m.

3.4 Details of High Tension and Electric Lines across Ponniyar River

Sl No	Cross-Structure Name	CH (km)	Location	Position (Above Survey track)				Vertical clearance above H.F.L. (m)	Horizontal Clearance (m)
				WGS84 Datum; UTM Projection: CM 081°E , Zone 44N					
				Latitude [N]	Longitude [E]	Easting [m]	Northing [m]		
1	HT Line	15.5	Perichchambakkam	11° 48' 33.06"	79° 40' 06.33"	354932	1305798	0.5	150
2	HT Line	21.7	SornavoorMelpathy	11°48'59.95”	79°37'15.70"	349772	1306649	10	100
3	Electric Line	22.3	SornavoorMelpathy	11°49'19.08"	79°37'09.23"	349579	1307238	11	50
4	HT Line	28.3	Kallipattu	11° 50' 26.80"	79° 33' 38.60"	343214	1309351	8.5	250
5	HT Line	36.8	Dalavanur	11°51'56.65"	79°29'12.45"	335174	1312154	8.5	300
6	Electric Line	41.4	Near to NH-45	11°52'18.79"	79°26'41.25"	330602	1312860	1.0	100
7	Cable Wire	45.2	Sathanur	11°53'37.73"	79°24'59.14"	327526	1315303	1.5	60
8	HT Line	46.8	Enathimangalam	11°54'14.25"	79°24'19.76"	326341	1316432	2.0	120
9	Electric Line	47.5	Enathimangalam	11°54'19.27"	79°23'56.27"	325631	1316590	0.5	120
10	HT Line	49.1	Marangiyur	11° 54' 39.08"	79° 23' 08.49"	324188	1317207	1.5	200
11	Electric pole	50.2	Marangiyur	11° 54' 29.56"	79° 22' 33.06"	323115	1316921	0.5	60

12	Electric Line	61.2	Veeracholapuram	11°56'27.83"	79°17'39.40"	314251	1320608	4.0	200
13	Electric Line	71.0	Thirukoilure	11°58'26.38"	79°12'45.08"	305369	1324308	1.0	100
14	HT Line	73.2	Beside SH-9	11°58'22.59"	79°11'36.67"	303298	1324205	3.0	250
15	Electric Line	73.3	Beside SH-9	11°58'21.60"	79°11'32.97"	303186	1324175	1.0	150
16	HT Line	73.4	Beside SH-9	11°58'24.72"	79°11'28.93"	303064	1324272	5.0	250
17	Electric Line	76.5	-	11°57'57.34"	79°09'53.53"	300172	1323449	3.5	100
18	HT Line	81.8	Melaripattu	11°58'41.45"	79°07'14.61"	295373	1324837	2.5	150
19	HT Line	87.0	Kallipadi	12°00'06.18"	79°04'55.12"	291171	1327470	3.5	200
20	Electric Line	95.2	Suthamalai	12°02'13.04"	79°01'16.53"	284586	1331416	5.0	150
21	Electric Line	100.6	-	12°03'48.15"	78°59'02.00"	280537	1334368	4.75	150
22	Electric Line	101.6	Beside Kallakurichi-Tiruvannamalai Road	12°03'56.23"	78°58'33.24"	279669	1334623	4.0	120
23	HT Line	103.7	-	12°04'08.00"	78°57'31.31"	277799	1334999	No wire	120
24	Cable Wire	105.5	Thondamanur	12°05'04.17"	78°57'30.58"	277789	1336725	0.5	50
25	Electric Line	108.8	Royandapuram	12°05'41.12"	78°55'54.80"	274901	1337883	2.0	120
26	Cable Wire	111.1	Edathanur	12°06'30.70"	78°55'05.50"	273421	1339418	1.0	100

Table 10: Details of High Tension and Electric Lines

Note: Vertical clearance is measured above H.F.L. The HFL for tidal reach is MHWS as per ATT- Vol 3 and HFL at gauge site is calculated as maximum water level in last twenty years Gauge Discharge Data as collected from CWC.

3.5 Hindrances in conducting the reconnaissance survey

Stretch from Chainage 117.5 to 125 km is crocodile prone area. Further this area was located in reserved forest zone and

approach to river was really difficult. Survey team has tried from various different routes and has been able to cover some part. The details are attached as **Annexure 3**. Rocky starata was also observed from chainage 76 to 125.5 km.

3.6 Encroachment to the waterway

There is no encroachment in the waterway.

3.7 Details of Protected Area, Wildlife, Defense

Ponnaiyar Reserved Forest is situated at Ch 117 km to 125 km (Sathanur Dam) along both banks of Ponniyar River.

3.8 NH/SH/MDR along and/or in Vicinity

NH-45, NH-45A, NH-45C, SH-6A (Thanipadi Road), SH-6 (Kallakurichi-Tiruvannamalai Road), SH-7, SH-9, SH-9A, SH-49, SH-68, SH-69, SH-137, SH-69, Tiruvannamalai-Tirukkovilur Road, Thiruvarangam Road, MDR 1014, Tirukkovilur-Asanur Road, Cuddalore-Sankarapuram Road, Villupuram-Mambalapattu-Tirukkovilur Road exists along Ponniyar river.

3.9 Railway Line and stations in the vicinity

Tandarai, Andampallam, Adichanallur, Thirukovilur, Aayandhur, Mambalapattu, Teli, Venkatesapuram, Villupuram, Valavanur, Thiruvennainallur, Thiruthuraiyur, Panruti, Tirupadripulyur, Cuddalore Port railway stations exists along the river.

4. Reconnaissance Survey

This chapter gives the stretch wise description (125 km stretch) of Ponniyar River and presents the observed water level during survey. This chapter also covers the Hydrological analysis of the collected data viz. Minimum and maximum water levels, discharges, average 10 daily discharges, change in cross-section over the years and establishment of sounding datum in river. The route map of Ponniyar River is given below:

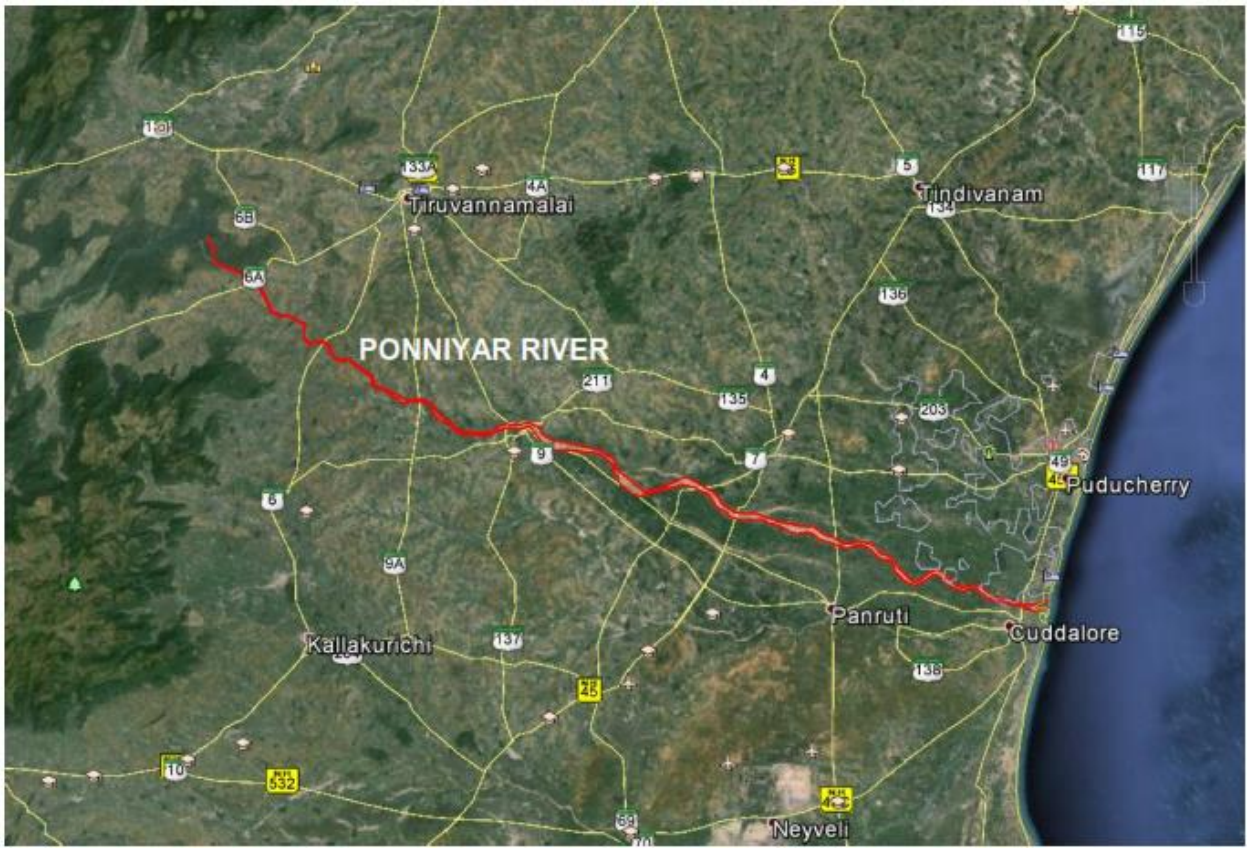


Figure 5: Route map of Ponniyar River

4.1 Resources, Equipment used and Methodology adopted

4.1.1 Resources & Equipment used

Personnel Name	Function
Santosh Nag	Surveyor , Fugro Limited
Ponlogesh	Asst. Surveyor, Fugro Limited

Table 11: Survey Personnel

Following equipment and systems were mobilized for the data acquisition.

Equipment / System	Description / Make / Model/Resolution /Accuracy
Software / Navigation	Starfix.Seis V. 10.1 PC based data acquisition and survey vessel navigation package and accessories
Positioning	12 Channel Single frequency (L1 & L2) DGPS System and accessories
Echo Sounder	ODOM Hydrotrac single Frequency Echo sounder, 210KHz Transducer and accessories
Soil sample collection	Grab Sampler with accessories
Trimble Total station with accessories & Laser Distometer	

Table 12: Equipments for data acquisition

Survey Vessel

Locally Hired boat 'Pratap' was used for carrying out the bathymetry survey.

4.1.2 Detailed methodology adopted for survey

a) Specifications for survey: Survey Geodesy

The survey was conducted in WGS84 datum; UTM Projection (Zone 44 N, CM 081° E). The geodetic parameters used during the survey are as follows:

Global Positioning System Geodetic Parameters	
Datum:	World Geodetic System 1984
Spheroid:	World Geodetic System 1984
Semi major axis:	a = 6 378 137.000 m
Inverse Flattening:	1/f = 298.257 223 563
Map Projection:	Universal Transverse Mercator
Grid System:	UTM Zone 44 N;
Central Meridian:	081° 00' 00" East
Latitude of Origin:	0° 00' 00" North
False Easting:	500 000 m
False Northing:	0 m
Scale factor on Central Meridian:	0.9996
Units:	Meter

Table 13: Global Positioning System Geodetic Parameters

b) Field Calibrations & Verifications

All survey equipments used for the survey were calibrated and bench tested prior to their mobilisation for this task. After installation on the survey vessel, field verification and tests were carried out as per standard survey methods. On completion of successful Mobilization, Calibration, Verification and Testing of all equipment as per the relevant work practices, the survey task was commenced.

c) DGPS Calibrations

In order to ensure fault free operations, the performance of the GPS Receivers deployed on this job were bench tested against a known point, prior to mobilisation to site, and

found to be satisfactory. The integrity of satellite based Starfix DGPS system was monitored round the clock at workshop, to ensure continuous differential corrections are transmitted to the mobile DGPS receivers at work sites.

d) Single Beam Echo Sounder (SBES)

Odom Hydrotrac single frequency (210 kHz) echo sounder was used for measuring water depths. The echo sounder system was bench calibrated at workshop prior to mobilization for the survey. The echo sounder transducer was side mounted on the survey vessel and its draft below the water-line was measured and recorded. Thereafter, the echo-sounder was calibrated by the standard bar-check method at site, prior to deployment on the survey job. The echo sounder system was interfaced with the Starfix.Seis navigation and survey system for navigation and data logging.

e) Data Acquisition & Survey Run-Line Logs

The Navigation and depth data from the Starfix.HP DGPS was logged continuously and monitored using the Starfix.Seis navigation suite. A survey run-line log book was maintained where the quality of data was noted. Details such as horizontal and vertical clearances above high flood level of bridges, aqueducts, electric lines, telephone lines, pipe lines, cables enroute were assessed on the spot and recorded, and their coordinates and location were plotted on the chart and included in the report. Photographs of important structures along the route are included as part of this report.

f) Soil Sampling and Visual Analysis

Soil samples were collected from the river bed along the surveyed route at about 10 km intervals, and the nature and texture of the samples collected were visually analyzed and reported.

g) On-line Quality Control of Data Logged

Real Time Graphs and QC Plots as provided by the Starfix survey software suite were used by experienced surveyors to monitor and control the quality of sensor data on-line, before they are logged. Time stamping on all the data was done by means of Starfix Timing Module through Navigation network synchronized with the GPS (high precision) 1PPS time signal. The data / record obtained from each survey sensor such as Navigation, Heading, SBES and Motion Sensor etc. were quality checked and an extract of the same were made available for verification and confirmation to proceed further.

h) Survey of Data Processing and interpretation methods

The survey data was logged in Binary Format (BF), and processed using the Starfix.Proc software. Heading, motion and position data were processed and checked to ensure good data quality.

The measured offsets for all survey sensors was entered into the navigation system and processed using Starfix.Proc to enable track charts was plotted and 'corrected' navigation files was integrated with other sensor data at a later stage. These included:

- GPS position absolute of the primary & secondary positioning systems.
- Common Reference Point.
- Single beam echo sounder.

i) Bathymetry Data Analysis and Presentation

Starfix.Proc and Starfix. Workbench was used to import and process the navigation, bathymetry, tides and sound velocity data. The data was filtered, cleaned, and combined to create geographically positioned bathymetric data set that has been corrected for tides and sound speed.

j) Equipment Layout Diagram

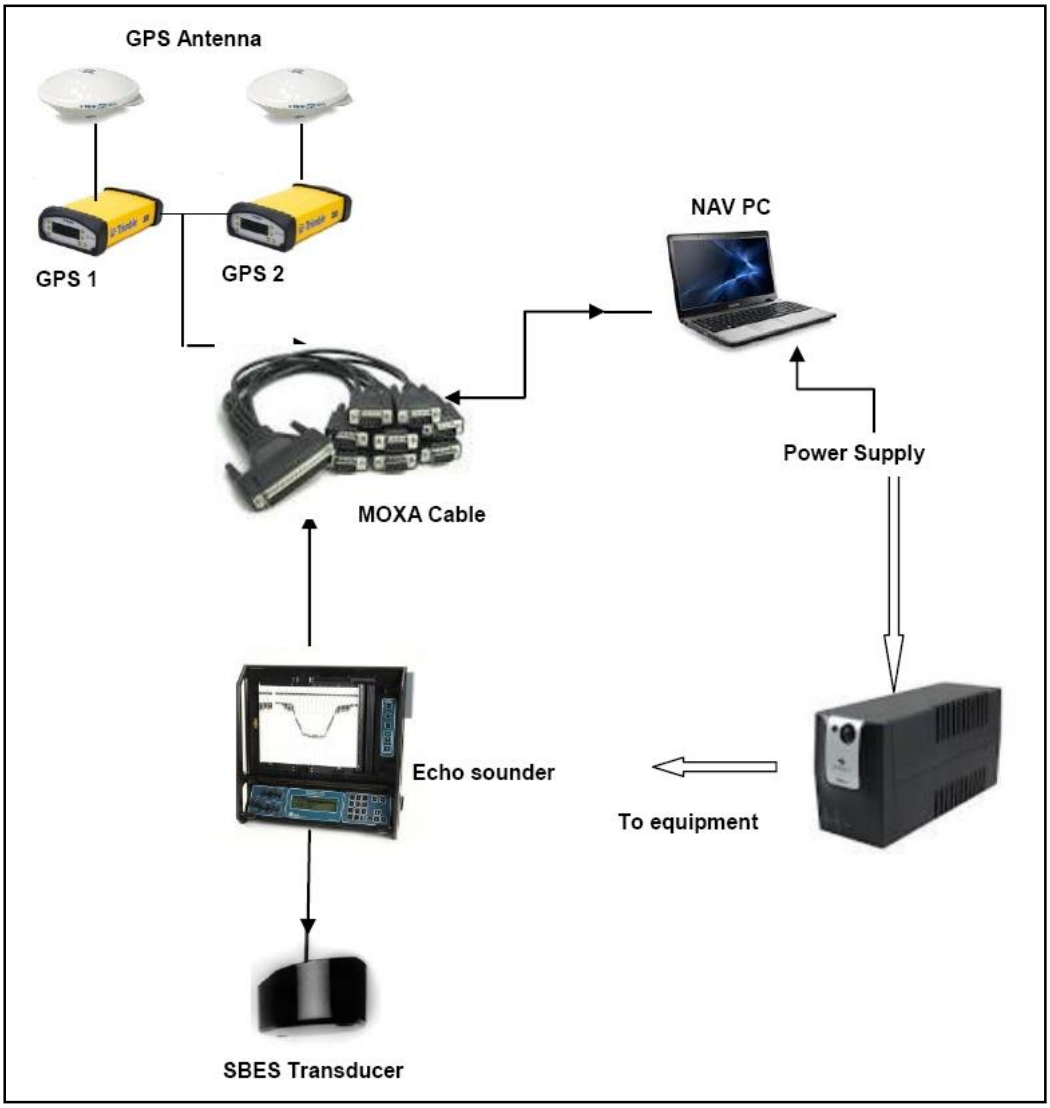


Figure 6: Equipment layout diagram

4.2 Description of bench marks (B.M.)/ Authentic reference level used

A CWC Musto Type bench mark was successfully recovered on the river stretch at the Vazhavachanur Township, which was 142.01 m above the MSL. All the heights of the riverbed in this report are referenced to this BM for obtaining their height above the MSL.

Brief Narrative on the Recovery of the Station

a) What is the Source of Station Description Data;	CWC Site Office, Valavachanur
b) Was the station recovered successfully?	Yes
c) What were the differences in Coordinates after verification using Starfix.HP?	No earlier coordinates available
d) Give Link to Starfix Mean Posn/Final Fix Report.	GPS observation could not be carried out on top of the MTBM view obstructions. However, position derived by the range & bearing from the observed TBM position. Ellipsoidal height is derived by the levelling from the TBM.

Final Coordinates in WGS84 Datum after verification using Starfix.HP

GEOGRAPHICAL COORDINATES:			UTM COORDINATES:	Zone No: 44	CM: 081 °E
LATITUDE :	12° 04' 02.2997"	N	EASTING:	260 021.77 m	(+/-0.30 m)
LONGITUDE :	78° 58' 44.6356"	E	NORTHING:	1 334 807.45 m	(+/- 0.30 m)
ELLIPSOIDAL HEIGHT :	50.771	m	Ht above MSL/CD	142.01 m	

Describe the General Location & Access to the Station :	The station is situated on a stone inside a concrete well (1.10m x 1.10m x 0.57m). The well is filled with sand. The well is situated inside village Atangra. The station is 100 mtrs from the Northern bank of the river Ponniyar, 50 mtrs from the temple SANETHA KOLLIYAMAEN and 50 mtrs west of the TIRUNMALAI-KALLAKKURUCHI ROAD (SH6) at VALAVACHANUR. The station is easily accessible by walk from the Valavachanur bus stop. Nearest City Tirunmalai is 25 Kms on Northern side and Sankarapuram on southern side is also 25 Kms. CWC site office is situated 50 mtrs & 100 mtrs east of the SH-6 and MTBM respectively.
Describe how the Stn is marked on the Ground	The station is marked by a stone on ground.
Expected durability of the Station (in Years) :	10

DETAILED DIAGRAM :

Figure 7: Details of CWC MTBM at Vazhavachanur

Brief description on the Survey execution									
1. Purpose of Establishing the station	To find the ellipsoidal height and coordinates of CWC MTBM, Valavachanur								
2. Equipment / Method used	Trimble SPS 461, Static Observation								
3. Give Link to Starfix Mean Posn/Final Fix Report.	Mean Position Report_TBM_VALAVACHANUR_PONNIYAR.pdf								
Final Coordinates in WGS84 Datum									
GEOGRAPHICAL COORDINATES:				**UTM COORDINATES:**	Zone No:	44	CM:	081	°E
LATITUDE :	12° 04' 00.5966"	N		EASTING:	260 029.46	m	(+/-0.03 m)		
LONGITUDE :	78° 56' 45.1032"	E		NORTHING:	1 334 755.11	m	(+/- 0.02 m)		
ELLIPSOIDAL HEIGHT :	50.11	m		Ht above MSL/GD	141.349	m			
Describe the General Location & Access to the Station :	The station is established on the western railing post of the steps leading to the temple SANETHA KOLLIYAMAEN from the North. The temple is situated on the northern bank of the river Ponniyar, village Atangra. The TBM is 50 mtrs South of the CWC MTBM and 50 mtrs west of the TIRUNMALAI-KALLAKKURUCHI ROAD (SH6) at VALAVACHANUR. The station is easily accessible by walk from the Valavachanur bus stop. Nearest City Tirunmalai is 25 Kms on Northern side and Sankarapuram on southern side is also 25 Kms. CWC site office is situated 50 mtrs & 100 mtrs east of the SH-6 and TBM respectively.								
Describe how the Stn is marked on the Ground	The station is marked by a dot and circle in red colour.								
Expected durability of the Station (In Years) :	2								

DETAILED DIAGRAM :

Figure 8: TBM established by survey team at Vazhavachanur

Starfix Mean Position Report v5.02.24

Vessel

Vessel Name	
Project Name	RIVER RECCEE SURVEY
Project Number	J_MAR_16_020
Offset Name	MainVessel_CRP
Sampling Started	24-Apr-2016 14:25:54 (UTC+05:30)
Sampling Ended	24-Apr-2016 14:35:55 (UTC+05:30)
Comment	TBM WAS SET ON THE RAILING PILLAR OF THE STEPS OF THE TEMPLE N END W SIDE OF RIVER BRIDGE

Results

	Mean	Standard Deviation
Local Latitude	12°04'00.5988"N	
Local Longitude	78°58'45.1032"E	
Ellipsoidal Height	50.81 m	
Local Easting	280029.48 m	0.03 m
Local Northing	1334755.11 m	0.02 m
Orthometric Height	50.81 m	0.05 m
WGS84 Latitude	12°04'00.5988"N	
WGS84 Longitude	78°58'45.1032"E	
Ellipsoidal Height	50.81 m	
Quality	1.22	0.04 m
Depth	0.00 m	0.00 m
Heading	0.42°G	0.00°

Line Navigation Data		Point Navigation Data	
Line Name	N/A	Point Name	N/A
Chainage	N/A	Easting	N/A
Cross Track	N/A	Northing	N/A
		Range	N/A
		Bearing TO	N/A
		FROM	N/A

Observations
Used 183 out of 183

Geodetic Parameters

Geodetic Datum	WGS84		
Ellipsoid	WGS84		
Semi-Major Axis	6378137.000		
Inverse Flattening	298.2572235630		
Eccentricity^2	0.006694379990141		
DX	0.0000m	RX	0.0000 arc seconds
DY	0.0000m	RY	0.0000 arc seconds
DZ	0.0000m	RZ	0.0000 arc seconds
D Scale	0.0000ppm		
Rotation Convention	+RZ=-RLongitude		
Projection	Transverse Mercator (UTM) Zone: 44		
Latitude of Origin	0°00'00.0000"N		
Longitude of Origin	81°00'00.0000"E		
False Easting	500000.000m		
False Northing	0.000m		
Convergence	- 0°25'21.4505"		
Calculation Mode	Grid		

Mean Position Report_TBM_FOR CWC MTBM_VALAVACHANUR_PONNIYAR_3 115 14 37 15.pdf 14:37 April 24, 2016

Figure 9: Mean position report CWC MTBM - Fugro

SL	RIVER	POINT	DESCRIPTION	WGS 84 COORDINATES			LOCAL COORDINATES (UTM ZONE 44)		OTHER INFORMATION	REMARKS
				LATITUDE (N)	LONGITUDE (E)	ELLIPSOIDAL HEIGHT (M)	EASTING (M)	NORTHING (M)		
1	PONNIYAR	CWC MTBM, VALAVACHANUR	MTBM IS ESTABLISHED BY CWC AND SITUATED INSIDE VILLAGE ATANGRA. 100 MTRS NORTH OF RIVER PONNIYAR AND 50 MTRS WEST OF THE TIRUNMALAI-KALLAKKURUCHI ROAD (SH6) AT VALAVACHANUR	12° 04' 02.2997"	78° 58' 44.8356"	50.771	280 021.77	1 334 807.45	VALUE OF MTBM IS 142.010 MTRS ABOVE MSL (PROVIDED BY THE CWC SITE OFFICE, VALAVACHANUR)	POSITION DERIVED BY RANGE&BEARING FROM TBM. ELLIPSOIDAL HEIGHT DERIVED BY THE LEVELLING FROM THE TBM ESTABLISHED BY FSINPVT.
2	PONNIYAR	TBM, VALAVACHANUR	TBM WAS ESTABLISHED ON THE WESTERN RALING POST OF THE STEPS LEADING TO SANETHA KOLLIYAMAEN TEMPLE FROM THE NORTH SIDE, VILLAGE ATANGRA,	12° 04' 00.5988"	78° 58' 45.1032"	50.11	280 029.48	1 334 755.11	VALUE OF TBM IS 141.349 MTRS ABOVE MSL (DERIVED BY LEVELLING FROM THE MTBM)	DERIVED BY STARFIX MEAN POSITION. ANTENNA HEIGHT (0.70 M) IS REDUCED TO THE OBSERVED ELLIPSOIDAL HEIGHT.

Figure 10: Details of CWC MTBM and Established TBM at Valavachanur

MTBM TO TBM LEVELLING RECORD

Job No :	J-MAR-16-020		Client Name :	WAPCOS LTD.	
Location:	VALAVACHANUR, TAMILNADU		Equipment & Sl. No.	Leica No. 5 Dumpy/ 432992	
Benchmark Locatio	MTBM IS ESTABLISHED BY CWC AND SITUATED INSIDE VILLAGE ATANGRA. 100 MTRS NORTH OF RIVER PONNIYAR AND 50 MTRS WEST OF THE TIRUNMALAI-KALLAKKURUCHI ROAD (SH6) AT VALAVACHANUR				
TBM Location:	TBM WAS ESTABLISHED ON THE WESTERN RALING POST OF THE STEPS LEADING TO SANETHA KOLLIYAMAEN TEMPLE FROM THE NORTH SIDE, VILLAGE ATANGRA, VALAVACHANUR				
Date of Observatio	25-Apr-16	Observer's Name:	Bhanu Prakash	Staff Holder's Name :	Abhijeet Kulkarni

MTBM Value (RI	**142.010**	**TBM VALUE**	141.349
MTBM Reference (CD/MSL)	**MSL**	**Tachy Staff to TBM**	**0.000**

MTBM TO TBM

Point No	Back Sight	Fore Sight	Reduced Level	Rise (+) Fall (-)	Instrument Height
1	0.564	1.225	141.349	-0.661	142.574
2			141.349	0.000	141.349
3			141.349	0.000	141.349
4			141.349	0.000	141.349
5			141.349	0.000	141.349
6			141.349	0.000	141.349
7			141.349	0.000	141.349
8			141.349	0.000	141.349
9			141.349	0.000	141.349
10			141.349	0.000	141.349
11			141.349	0.000	141.349
12			141.349	0.000	141.349
13			141.349	0.000	141.349
14			141.349	0.000	141.349
15			141.349	0.000	141.349
16			141.349	0.000	141.349
17			141.349	0.000	141.349
18			141.349	0.000	141.349
19			141.349	0.000	141.349
20			141.349	0.000	141.349
21			141.349	0.000	141.349
22			141.349	0.000	141.349
23			141.349	0.000	141.349
24			141.349	0.000	141.349
25			141.349	0.000	141.349
26			141.349	0.000	141.349
27			141.349	0.000	141.349
28			141.349	0.000	141.349
29			141.349	0.000	141.349
30			141.349	0.000	141.349
31			141.349	0.000	141.349
32			141.349	0.000	141.349
33			141.349	0.000	141.349
34			141.349	0.000	141.349

TBM TO MTBM

Point No	Back Sight	Fore Sight	Reduced Level	Rise (+) Fall (-)	Instrument Height
1	1.222	0.561	142.010	0.661	142.571
2			142.010	0.000	142.010
3			142.010	0.000	142.010
4			142.010	0.000	142.010
5			142.010	0.000	142.010
6			142.010	0.000	142.010
7			142.010	0.000	142.010
8			142.010	0.000	142.010
9			142.010	0.000	142.010
10			142.010	0.000	142.010
11			142.010	0.000	142.010
12			142.010	0.000	142.010
13			142.010	0.000	142.010
14			142.010	0.000	142.010
15			142.010	0.000	142.010
16			142.010	0.000	142.010
17			142.010	0.000	142.010
18			142.010	0.000	142.010
19			142.010	0.000	142.010
20			142.010	0.000	142.010
21			142.010	0.000	142.010
22			142.010	0.000	142.010
23			142.010	0.000	142.010
24			142.010	0.000	142.010
25			142.010	0.000	142.010
26			142.010	0.000	142.010
27			142.010	0.000	142.010
28			142.010	0.000	142.010
29			142.010	0.000	142.010
30			142.010	0.000	142.010
31			142.010	0.000	142.010
32			142.010	0.000	142.010
33			142.010	0.000	142.010
34			142.010	0.000	142.010

Misclosure =	0.000	meters	
Adjusted Tide Gauge Height =	141.349	meters	
Hence, the Zero of Tide Gauge is	141.349m	metres Above	MSL

Checked by:	
Surveyor's Name:	Bhanu Prakash
Date:	25-Apr-16

Figure 11: MTBM to TBM leveling record

Brief Narrative on the Recovery of the Station	
a) What is the Source of Station Description Data;	CWC Site Office, Viluppuram
b) Was the station recovered successfully?	Yes
c) What were the differences in Coordinates after verification using Starfix.HP?	No earlier coordinates available
d) Give Link to Starfix Mean Posn/Final Fix Report.	GPS observation could not be carried out on top of the MTBM. However, position derived by the range & bearing from the observed TBM position. Ellipsoidal height is derived by the levelling from the TBM.

Final Coordinates in WGS84 Datum after verification using Starfix.HP								
GEOGRAPHICAL COORDINATES:			**UTM COORDINATES:**	Zone No:	44	CM:	081	°E
LATITUDE :	11°52'05.7556"	N	EASTING:	332 405.41	m	(+/-0.30 m)		
LONGITUDE :	79°27'40.8697"	E	NORTHING:	1 312 449.64	m	(+/- 0.30 m)		
ELLIPSOIDAL HEIGHT :	-46.767	m	Ht above MSL/CD	44.315	m			
Describe the General Location & Access to the Station :	The station is situated on a stone inside a concrete well (*1.33m x 1.33m x 0.60m*). The well is filled with sand. The well is situated inside the premises of the CWC site office in front of CWC staff quarters at village Paithambadi, Viluppuram. The station is accessible by autorickshaw from the Viluppuram. Nearest City Viluppuram is about 15 Kms on Northern side.							
Describe how the Stn is marked on the Ground	The station is marked by a stone on ground.							
Expected durability of the Station (In Years) :								10

Figure 12: Details of CWC MTBM at Paithambadi, Villupuram

Brief description on the Survey execution									
1. Purpose of Establishing the station	To find the ellipsoidal height and coordinates of CWC MTBM, Viluppuram								
2. Equipment / Method used	Trimble SPS 461, Static Observation								
3. Give Link to Starfix Mean Posn/Final Fix Report.	Mean Position Report_TBM_VILUPPURAM_PONNIYAR.pdf								
Final Coordinates in WGS84 Datum									
GEOGRAPHICAL COORDINATES:				**UTM COORDINATES:**		Zone No:	44	CM:	081 °E
LATITUDE :	11°52'06.2310"	N		EASTING:	332 407.50	m		(+/-0.02 m)	
LONGITUDE :	79°27'40.9563"	E		NORTHING:	1 312 464.24	m		(+/- 0.02 m)	
ELLIPSOIDAL HEIGHT :	-46.45	m		Ht above MSL/GB	44.632	m			
Describe the General Location & Access to the Station :	TBM was established on the Northern fencing boundary wall of the CWC site office compound, Palthamwadi village, Viluppuram. The station is 1.25 mtrs from the Direction Indicator Pillar, 4.6 mtrs from the Max Min Temperature Box base and 7.5 mtrs from the Anemometer Pillar. The station 22 mtr north of MTBM. The station is accessible by autorickshaw from the Viluppuram. Nearest City Viluppuram is about 15 Kms on Northern side.								
Describe how the Stn is marked on the Ground	The station is marked by a dot and circle in red colour.								
Expected durability of the Station (In Years) :	2								

DETAILED DIAGRAM :

Figure 13: TBM established at Villupuram

Starfix Mean Position Report v5.02.24

Vessel

Vessel Name	
Project Name	RIVER RECCEE SURVEY
Project Number	J_MAR_16_020
Offset Name	MainVessel_CRP
Sampling Started	26-Apr-2016 12:12:43 (UTC+05:30)
Sampling Ended	26-Apr-2016 12:22:43 (UTC+05:30)
Comment	CWC MTBM IS SITUATED INSIDE A CONCRETE WELL, PAITH AMWADI,CUDDALORE DISTT.

Results

	Mean	Standard Deviation
Local Latitude	11°52'06.2310"N	
Local Longitude	79°27'40.9563"E	
Ellipsoidal Height	-44.87 m	
Local Easting	332407.50 m	0.02 m
Local Northing	1312464.24 m	0.02 m
Orthometric Height	-44.87 m	0.05 m
WGS84 Latitude	11°52'06.2310"N	
WGS84 Longitude	79°27'40.9563"E	
Ellipsoidal Height	-44.87 m	
Quality	0.94	0.08 m
Depth	0.00 m	0.00 m
Heading	0.32°G	0.00°

Line Navigation Data		Point Navigation Data	
Line Name	N/A	Point Name	N/A
Chainage	N/A	Easting	N/A
Cross Track	N/A	Northing	N/A
		Range	N/A
		Bearing TO	N/A
		FROM	N/A

Observations
Used 206 out of 206

Geodetic Parameters

Geodetic Datum	WGS84		
Ellipsoid	WGS84		
Semi-Major Axis	6378137.000		
Inverse Flattening	298.2572235630		
Eccentricity^2	0.006694379990141		
DX	0.0000m	RX	0.0000 arc seconds
DY	0.0000m	RY	0.0000 arc seconds
DZ	0.0000m	RZ	0.0000 arc seconds
D Scale	0.0000ppm		
Rotation Convention	+RZ=-RLongitude		
Projection	Transverse Mercator (UTM) Zone: 44		
Latitude of Origin	0°00'00.0000"N		
Longitude of Origin	81°00'00.0000"E		
False Easting	500000.000m		
False Northing	0.000m		
Convergence	- 0°18'59.4518"		
Calculation Mode	Grid		

Mean Position Report_MTBM_CWC_VILUPPURAM_3 117 12 26 39.pdf 12:26 April 26, 2016

Figure 14: Mean Position Report of CWC MTBM

SL	RIVER	POINT	DESCRIPTION	WGS 84 COORDINATES			LOCAL COORDINATES (UTM ZONE 44)		OTHER INFORMATION	REMARKS
				LATITUDE (N)	LONGITUDE (E)	ELLIPSOIDAL HEIGHT (M)	EASTING (M)	NORTHING (M)		
1	PONNIYAR	CWC MTBM, VILUPPURAM	MTBM IS ESTABLISHED BY CWC AND SITUATED INSIDE THE PREMISES OF CWC OFFICE, VILLAGE PAITHAMBADI, PANRUTI TALUK, NEAR VILUPPURAM	11°52'05.7556"	79°27'40.8897"	-46.767	332 405.41	1 312 449.64	VALUE OF MTBM IS 44.315 MTRS ABOVE MSL (PROVIDED BY THE CWC SITE OFFICE, VILUPPURAM)	POSITION DERIVED BY RANGE&BEARING FROM TBM. ELLIPSOIDAL HEIGHT DERIVED BY THE LEVELLING FROM THE TBM ESTABLISHED BY FSINPVT.
2	PONNIYAR	TBM, VILUPPURAM	TBM WAS ESTABLISHED ON THE NORTHERN FENCING BOUNDARY WALL OF THE CWC OFFICE COMPOUND. THE STATION IS 1.28 M FROM THE DIRECTION INDICATOR PILLAR, 4.6 M FROM THE MAX MIN TEMPERATURE BOX BASE AND 7.8 M FROM THE ANEMOMETER PILLAR.	11°52'06.2310"	79°27'40.9563"	-46.45	332 407.50	1 312 464.24	VALUE OF TBM IS 44.632 MTRS ABOVE MSL (DERIVED BY LEVELLING FROM THE MTBM)	DERIVED BY STARFIX MEAN POSITION. ANTENNA HEIGHT (1.58 M) IS REDUCED TO THE OBSERVED ELLIPSOIDAL HEIGHT.

Figure 15: CWC MTBM and Established TBM details

4.3 Tidal Influence Zone and Tidal Variation in different stretches

From the analysis of Survey of India topo sheets for the coastal zone, it was found that the tidal reach of the river is upto 4 km. During reconnaissance survey, the tidal effect was predominant upto 3.33 km.

The Nearest Port is Cuddalore. The tidal variation is about 1 m.

(Source : Tide data at Pondicherry Port Admiralty tide table ATT Volume 3)

4.4 Chart datum / Sounding datum and reduction details

4.4.1 Horizontal control

Worldwide Starfix.HP DGPS was used for positioning the survey vessel during this survey. The accuracy of the x, y, z position data obtained from the Starfix.HP DGPS system is +/- 10 cms at 95% assurance levels. Starfix software suite was used for navigation, data logging, and online quality control of the survey data logged.

4.4.2 Vertical control

a) Chart Datum at the River Estuary

From KP 0.0 to KP 3.3 which have tidal influence, the soundings were reduced to Chart Datum using real time tidal observations and applying MSL~CD value of 0.899 m for the nearest port Pondichery, obtained from Admiralty Tide Table (ATT) Vol-3 (ATT does not have values for Cuddalore which is nearer to Ponniyar River Mouth as compared to Puducherry, hence values for Puducherry has been adopted). The coordinates of Chart Datum (CD) used is given below:

Sr. No.	Location	Latitude	Longitude	Z0 (m)
1	Pondicherry	11° 56' 00'' N	79° 50' 00'' E	0.899

Table 14: Details of Chart Datum Used for Reduction of Soundings

Z0: The Value of Z0 is taken below M.S.L.

b) *Chart Datum for the upstream part of the River*

The CD value at the two gauge stations on this Ponniyar River are tabulated below. No other gauge station data for this river was available. As directed by the IWAI, the average height of last six years Minimum Water Levels at this gauge station is taken as the Chart Datum. This is detailed in Para 4.18.

Gauging station	Latitude	Longitude	Elevation of CD from MSL (m)
Vazhavachanur	12^0 03' 57" N	78^0 58' 41" E	133.637 m
Villupuram	11^0 52' 14" N	79^0 27' 34" E	42.635 m

Table 15: Chart Datum Details for the Gauge Stations

4.5 Hydrographic/Topographic Survey

4.5.1 Hydrographic Survey

a) *Length of stretch for which bathymetry survey has been carried out*

The bathymetry survey has been carried out in the stretch of 3.3 km from Ponniyar river mouth.

b) *Minimum and Maximum Depths*

River Stretch (From CH 0.0 to CH 3.3)

3.3 km length of the river is the Estuary portion of the river where it meets the Bay of Bengal, and hence influenced by the tidal variations. Depths shown in the diagram up to CH 3.3 are reduced to Chart Datum which is 0.89 m below the MSL. In general, agricultural land use was seen on either side of the river bank. In the upstream areas, the reduced depth with reference to the Chart Datum levels are shown (+ve depths are below CD). In this portion (0-3.3 km), the minimum reduced depth measured is -0.1 m (CH 1.11) and the maximum is 2.9 m (CH 1.55) wrt CD.

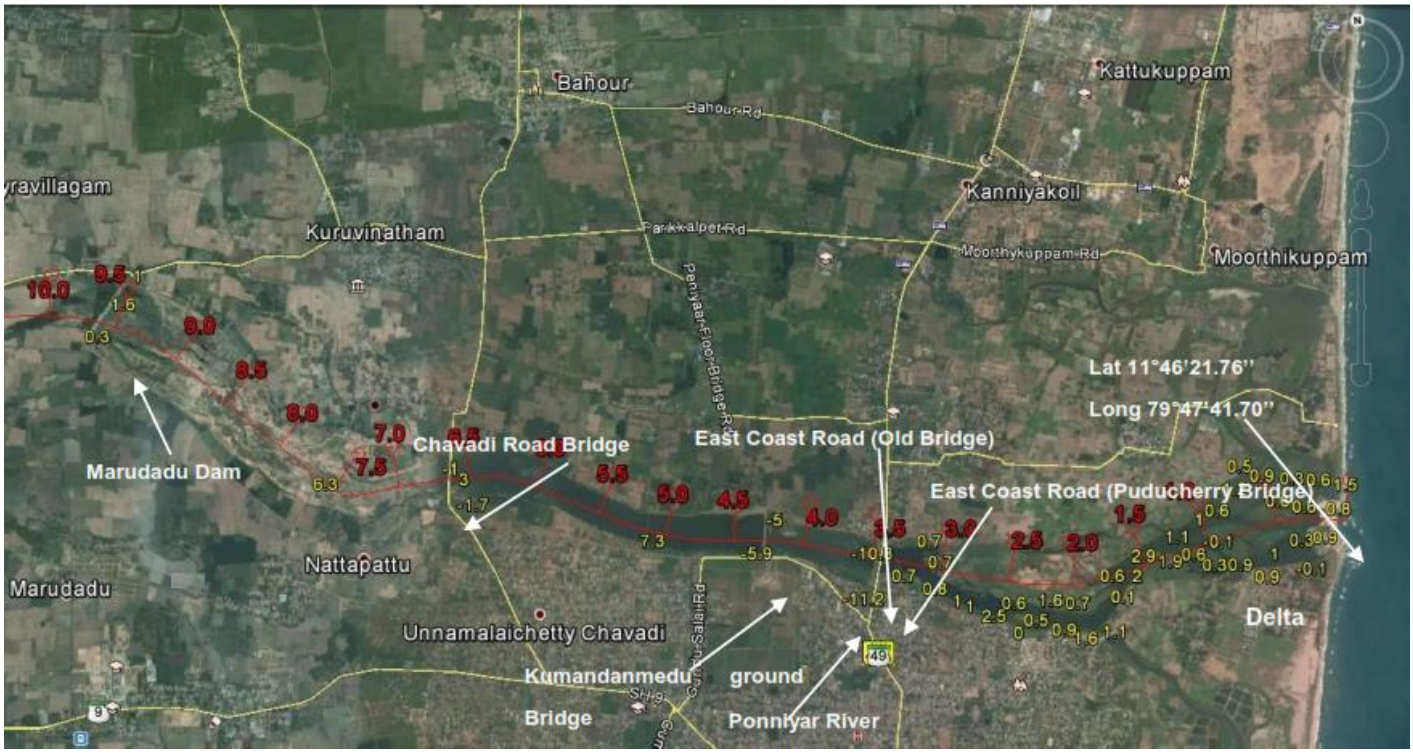


Figure 16: Ponniyar River from CH 0.0 to CH 3.3

Chainage (km)		Reduced depth (m) w.r.t. Chart Datum	
From	To	Minimum	Maximum
0.0	3.3	-0.1	2.9

c) *Water levels Bathymetric Survey*

Chainage (Km) A	Easting B	Northing C	Raw Depth D	Tide E	Reduced Depth w.r.t. CD (m) F = D-E
0.17	368569.30	1301905.42	2.52	1.00	1.5
0.20	368503.44	1301737.29	1.78	1.00	0.8
0.23	368472.75	1301949.06	1.61	0.99	0.6
0.30	368402.15	1301701.78	1.85	0.99	0.9
0.33	368374.01	1301967.89	1.25	0.98	0.3
0.34	368369.90	1301583.43	1.47	0.97	0.5
0.34	368369.37	1301480.02	0.85	0.97	-0.1
0.42	368279.82	1301934.27	1.54	0.96	0.6
0.43	368268.07	1301976.51	1.54	0.96	0.6
0.50	368160.46	1302007.71	1.83	0.95	0.9
0.53	368211.85	1301539.82	1.28	0.94	0.3
0.56	368094.30	1302040.63	1.53	0.93	0.6
0.63	368105.00	1301529.75	1.97	0.92	1.0

Chainage (Km) A	Easting B	Northing C	Raw Depth D	Tide E	Reduced Depth w.r.t. CD (m) F = D-E
0.63	368007.19	1302089.81	1.44	0.92	0.5
0.73	368041.71	1301451.12	1.85	0.91	0.9
0.75	367875.11	1302029.38	1.23	0.91	0.3
0.82	367940.02	1301467.63	1.83	0.90	0.9
0.87	367770.21	1301946.38	2.12	0.89	1.2
0.90	367844.51	1301498.84	1.05	0.88	0.2
0.96	367706.19	1301866.86	1.29	0.87	0.4
0.97	367765.02	1301559.68	1.14	0.86	0.3
1.02	367696.87	1301632.88	0.94	0.85	0.1
1.05	367630.39	1301803.97	1.40	0.84	0.6
1.11	367601.02	1301663.64	0.68	0.83	-0.1
1.14	367547.36	1301747.27	1.78	0.82	1.0
1.25	367446.25	1301665.29	1.45	0.81	0.6
1.27	367422.68	1301713.00	1.91	0.80	1.1
1.34	367358.76	1301674.77	2.46	0.79	1.7
1.44	367267.36	1301631.77	2.69	0.78	1.9
1.55	367164.15	1301599.38	3.66	0.77	2.9
1.55	367167.16	1301555.37	1.29	0.76	0.5
1.63	367108.21	1301472.23	1.71	0.75	1.0
1.65	367068.76	1301556.20	3.37	0.74	2.6
1.70	367056.93	1301386.22	2.78	0.74	2.0
1.72	367011.33	1301471.10	1.31	0.73	0.6
1.76	366996.63	1301305.48	2.18	0.72	1.5
1.86	366907.08	1301207.31	2.07	0.72	1.3
1.87	366887.75	1301252.38	0.81	0.71	0.1
1.89	366881.25	1301152.58	2.02	0.70	1.3
1.95	366814.06	1301170.04	1.76	0.69	1.1
1.99	366781.54	1301129.73	2.02	0.68	1.3
2.07	366650.80	1301180.18	2.05	0.68	1.4
2.11	366602.08	1301142.97	2.30	0.67	1.6
2.17	366556.83	1301237.03	1.36	0.66	0.7
2.26	366457.75	1301214.54	1.59	0.65	0.9
2.34	366363.05	1301275.49	2.29	0.64	1.6
2.43	366254.17	1301211.13	0.68	0.64	0.0
2.43	366265.79	1301300.37	1.16	0.63	0.5
2.52	366171.47	1301267.82	0.95	0.62	0.3
2.53	366165.88	1301313.78	1.39	0.62	0.8
2.58	366102.85	1301277.60	1.18	0.61	0.6
2.61	366087.19	1301322.95	1.58	0.60	1.0
2.73	365969.35	1301356.59	3.10	0.59	2.5

Chainage (Km) A	Easting B	Northing C	Raw Depth D	Tide E	Reduced Depth w.r.t. CD (m) F = D-E
2.81	365887.55	1301391.93	2.10	0.58	1.5
2.85	365857.65	1301435.30	1.61	0.58	1.0
2.91	365795.16	1301437.40	2.41	0.57	1.8
2.95	365769.55	1301483.49	1.53	0.56	1.0
3.05	365680.54	1301529.31	1.75	0.55	1.2
3.07	365721.89	1301754.08	1.30	0.55	0.7
3.09	365654.84	1301579.18	1.32	0.54	0.8
3.15	365627.54	1301714.22	0.93	0.53	0.4
3.16	365611.78	1301670.14	1.04	0.53	0.5
3.18	365623.09	1301772.26	1.17	0.52	0.7
3.24	365532.53	1301682.29	1.17	0.51	0.7
3.32	365470.84	1301762.27	1.56	0.51	1.0

Table 16: Bathymetry Water levels (Observed, Reduction factor and Reduced)

4.5.2 Topographic Survey

a) Length of stretch for which topographic survey has been carried out

Since the water depths are shallow for chainage above 3.3 km from river mouth and bathymetry survey was not possible, therefore the topography survey has been carried out from chainage 3.3 km to 125.0 km from Ponniyar river mouth.

b) Minimum and Maximum Depths

As per IWAI suggestion, following sign convention is adopted

(+) : Riverbed below CD
(-) : Riverbed above CD
(+) : Water Depth below CD
(-) : Water Depth above CD

River Stretch (From CH 3.3 to CH 10)

Depths shown in the diagram up to CH 10 are reduced to Chart Datum. The East Coast Road (S. H. No. 49) crosses the river at CH 3.43. In general, agricultural land use was seen on either side of the river bank. The heights of the river bed with reference to the Chart Datum levels are shown (+ve heights are below CD). In this portion (3.3-10 km), the minimum reduced depth measured is -1.2 m and the maximum is 3.1 m wrt CD.

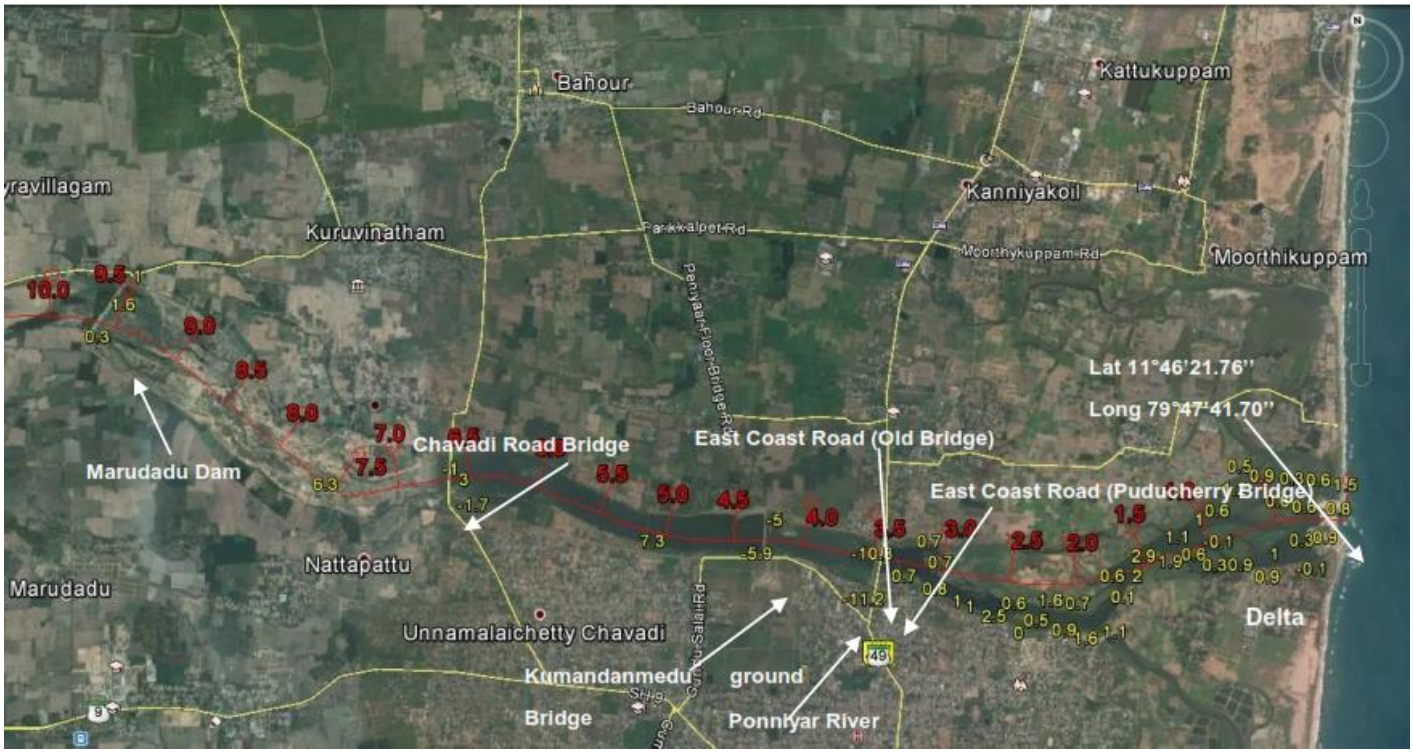
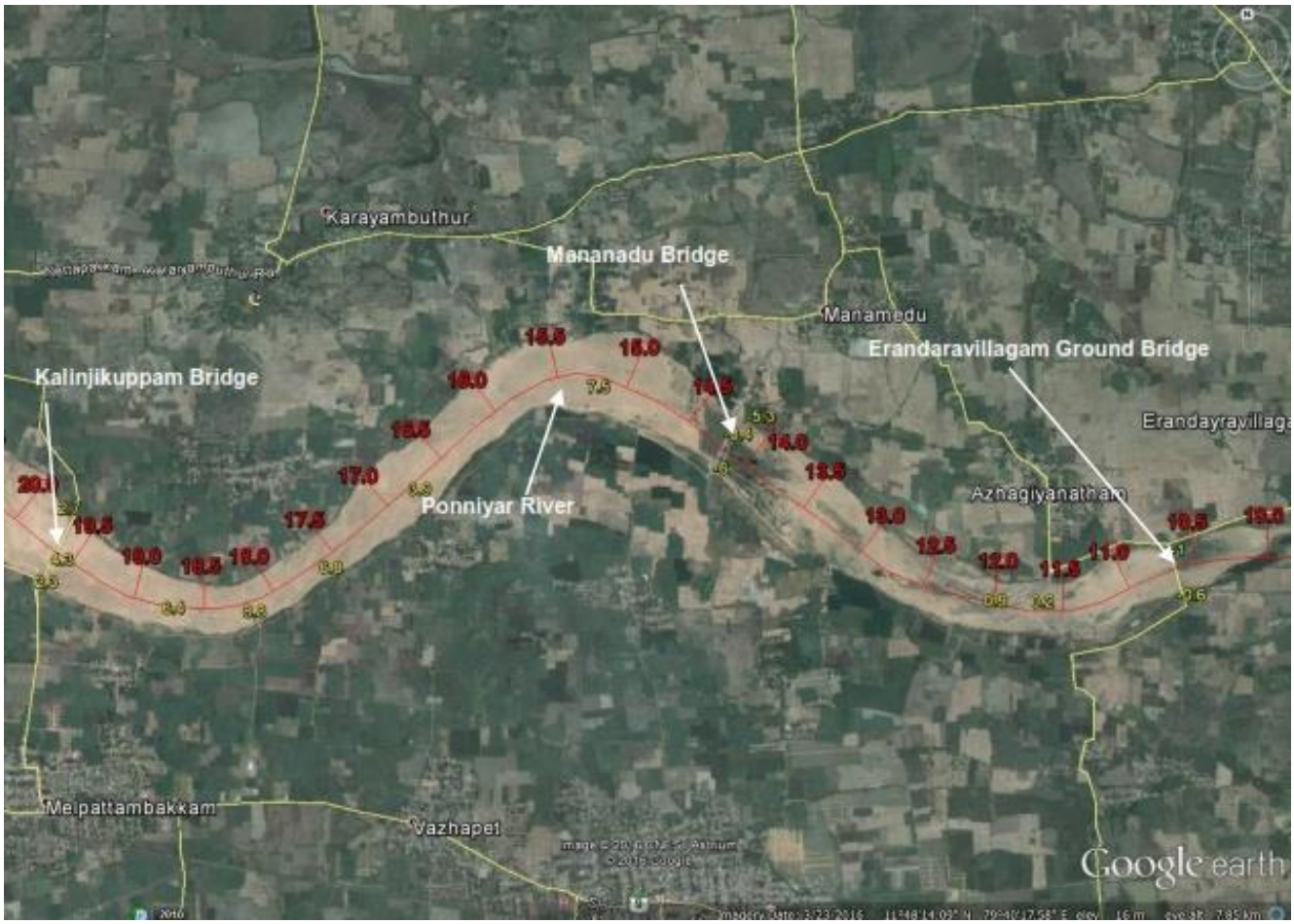


Figure 17: Ponniyar River from CH 3.3 to CH 10.0

Chainage (km)		Reduced Depth (m) w.r.t. Chart Datum	
From	To	Minimum	Maximum
3.3	10	-1.2	3.1

River Stretch (From CH 10.0 to CH 20.0)

In this section, the banks of the river are mostly covered with vegetation and agriculture fields. This section of the river is crossed over by three (03) prominent bridges at CH 10.6, CH 14.3 and CH 19.7 km. The Minimum height of river bed recorded in this section is -5.3 m (CH 14.0) and the maximum height is 8.8 m (CH 18.0) w.r.t. CD.



Chainage (km)		Reduced Depth (m) w.r.t. Chart Datum	
From	To	Minimum	Maximum
10.0	20.0	-5.3	8.8

River Stretch (From CH 20.0 to CH 30.0)

In this section, the banks of the river are mostly covered with vegetation and agriculture fields. One (01) high tension line and one (01) electric wire cross the river at CH 21.64 and CH 22.25. This section of the river is crossed over by one (01) Road Bridge at CH 30.1 and Sornavur Dam at CH 22.5. The minimum and maximum height of river bed here was -4.4 m (CH 30.0) and 6.0 m (CH 21.5) with respect to chart datum.

Chainage (km)		Reduced Depth (m) w.r.t. Chart Datum	
From	**To**	**Minimum**	**Maximum**
20.0	30.0	-4.4	6.0

River Stretch (From CH 30.0 to CH 40.0)

In this section, the banks of the river are mostly covered with vegetation and agriculture fields. Two (02) high tension wires cross the river at CH 29.38 and CH 38.06. This section of the river is crossed over by one (01) Railway Bridge (CH 34.07). The minimum and maximum height of river bed was -3.1 m (CH 35.0) and 6.0 m (CH 35.5) with respect to CD.

Chainage (km)		Reduced Depth (m) w.r.t. Chart Datum	
From	**To**	**Minimum**	**Maximum**
30.0	40.0	-3.1	6.0

River Stretch (From CH 40.0 to CH 50.0)

In this section, the banks of the river are mostly covered with vegetation and agriculture fields. This section of the river is crossed over by one (01) Railway Bridge at CH 44.4 and two (02) Road Bridges at CH 43.0 & CH 48.6. There are fields seen on both side and vegetation cover in the middle of the river. The minimum and maximum height of river bed was -14.7 m (CH 43.0) and 6.7 m (CH 40.0) with respect to chart datum.

Chainage (km)		Reduced Depth (m) w.r.t. Chart Datum	
From	To	Minimum	Maximum
40.0	50.0	-14.7	6.7

River Stretch (From CH 50.0 to CH 60.0)

In this section, the banks of the river are mostly covered with vegetation and agriculture fields. This section of the river is crossed over by one (01) Road Bridge at CH 54.6. The minimum and maximum height of river bed was -0.4 m (CH 64.3) and 11.5 m (CH 73.8) with respect to chart datum.

Chainage (km)		Reduced Depth (m) w.r.t. Chart Datum	
From	To	Minimum	Maximum
50.0	60.0	-14.8	8.5

River Stretch (From CH 60.0 to CH 70.0)

In this section, the banks of the river are mostly covered with vegetation and agriculture fields. The Thirukovillur dam is located at CH 67.75. One (01) electric lines cross the river at CH 63.0. Minimum height of river bed recorded in this section is -3.3 m (CH 64.2) and the maximum is 8.5 m (CH 65.54) w.r.t. CD.

Chainage (km)		Reduced Depth (m) w.r.t. Chart Datum	
From	To	Minimum	Maximum
60.0	70.0	-3.3	8.5

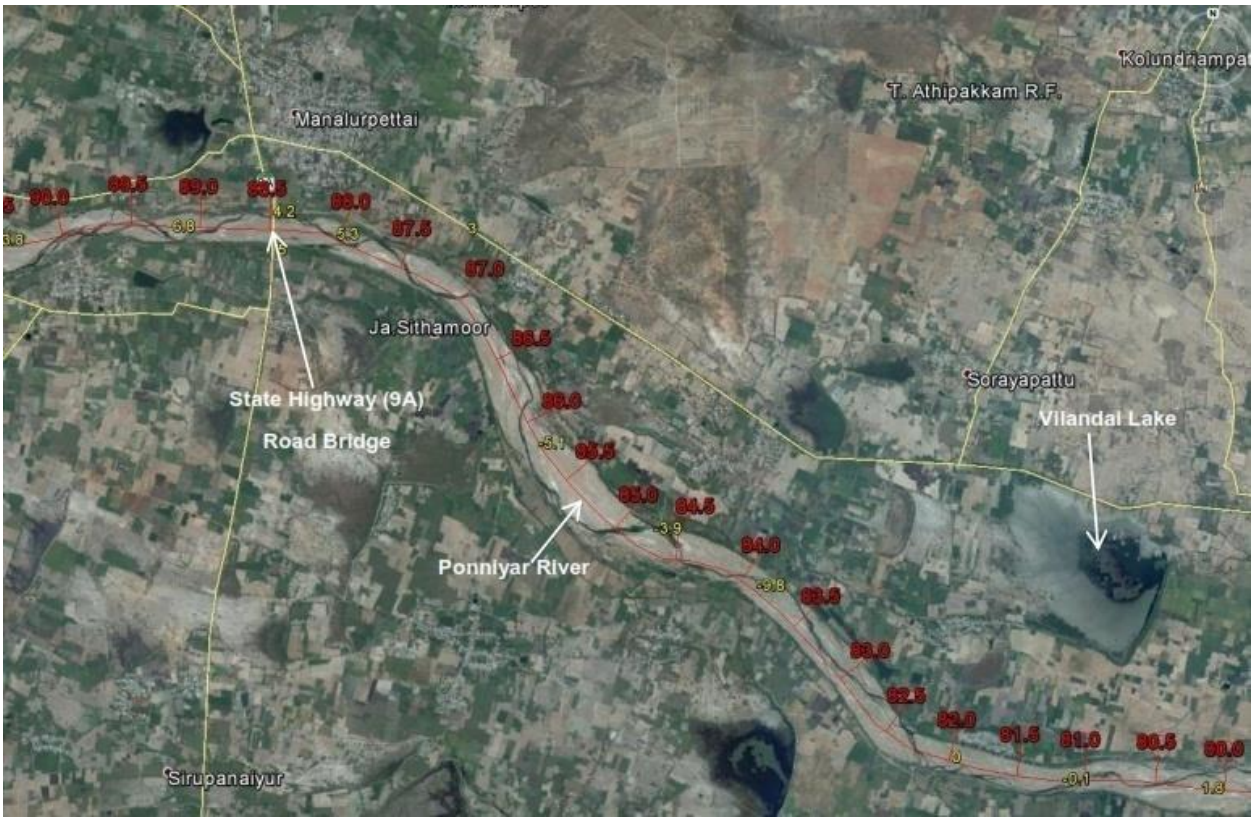
River Stretch (From CH 70.0 to CH 80.0)

In this section, the banks of the river are mostly covered with vegetation and agriculture fields. This section of the river is crossed over by three (03) Road Bridges at CH 73.0, CH 73.8 & CH 76.05. Four high tension lines and one (01) electric lines cross the river at CH 73.11. Minimum height of river bed recorded in this section is -13.6 m (CH 73.78) and the maximum is 9.5 m (CH 75.4) w.r.t. CD.

Chainage (km)		Reduced Depth (m) w.r.t. Chart Datum	
From	To	Minimum	Maximum
70.0	80.0	-13.6	9.5

River Stretch (From CH 80.0 to CH 90.0)

State Highway (9A) Road Bridge crosses the river at CH 88.4. In this section, the banks of the river are mostly covered with vegetation and agriculture fields. Minimum height of river bed recorded in this section is -9.8 m (CH 83.9) and the maximum is 6.8 m (CH 89.2) w.r.t. CD.



Chainage (km)		Reduced Depth (m) w.r.t. Chart Datum	
From	**To**	**Minimum**	**Maximum**
80.0	90.0	-9.8	6.8

River Stretch (From CH 90.0 to CH 100.0)

In this section, the banks of the river are mostly covered with agriculture fields. One (01) electric wire line crosses the river at CH 97.60. Minimum height of river bed recorded in this section is -11.3 m (CH 93.6) and the maximum is 12.6 m (CH 95.8) w.r.t. CD.

Chainage (km)		Reduced Depth (m) w.r.t. Chart Datum	
From	**To**	**Minimum**	**Maximum**
90.0	100.0	-11.3	12.6

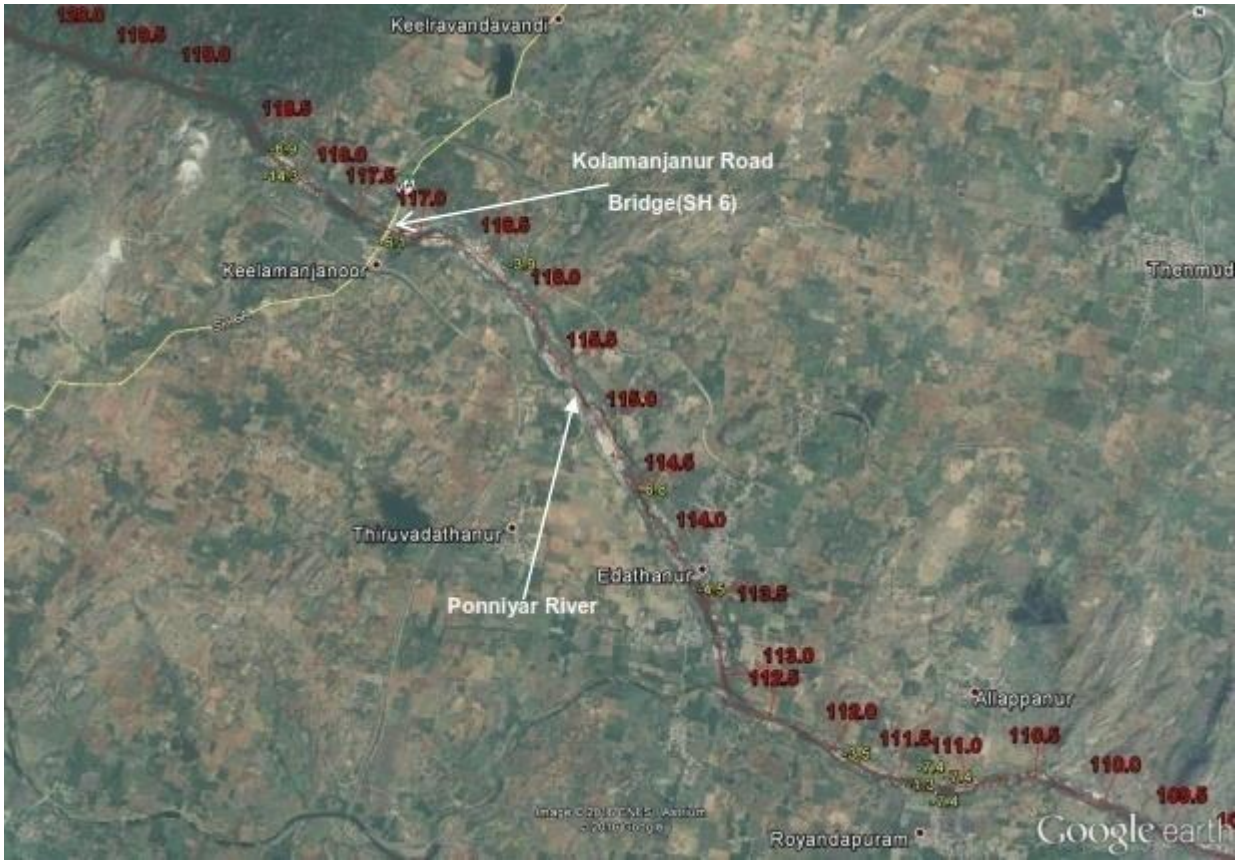
River Stretch (From CH 100.0 to CH 110.0)

In this section, the banks of the river are mostly covered with vegetation and agriculture fields. This section of the river is crossed over by one (01) Road Bridges at CH 103.8. Minimum height of river bed recorded in this section is -10.2 m (CH 103.6) and the maximum is 9.5 m (CH 100.5) w.r.t. CD.

Chainage (km)		Reduced Depth (m) w.r.t. Chart Datum	
From	**To**	**Minimum**	**Maximum**
100.0	110.0	-10.2	9.5

River Stretch (From CH 110.0 to CH 120.0)

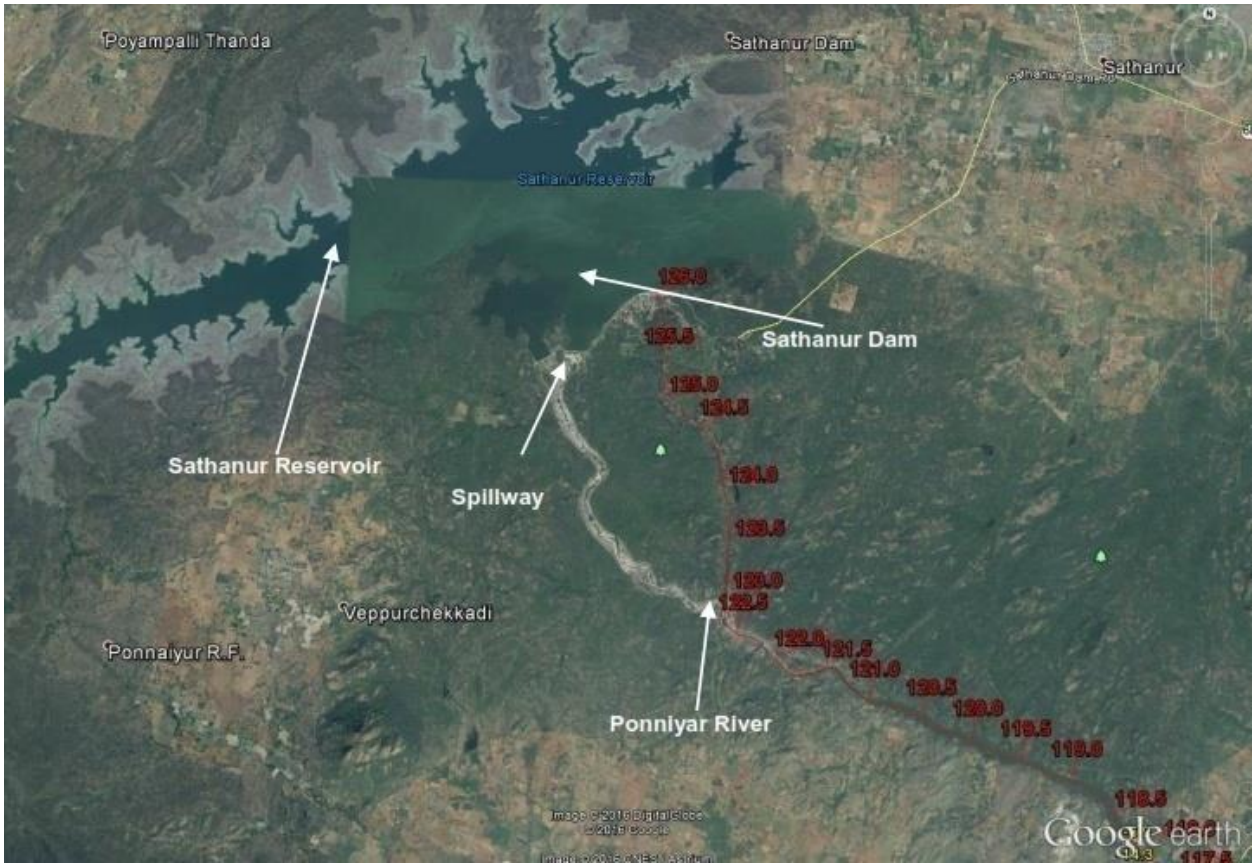
In this section, the banks of the river are mostly covered with vegetation, reserve forest and agriculture fields. One (01) water tanks is present in this section, located at CH 118.41. This section of the river is crossed over by one (01) Bridge of Kolamanjanur road at CH 117.4. Minimum height of river bed recorded in this section is -14.3 m (CH 118.2) and the maximum is -1.3 m (CH 111.3) w.r.t. CD.



Chainage (km)		Reduced Depth (m) w.r.t. Chart Datum	
From	To	Minimum	Maximum
110.0	120.0	-14.3	-1.3

River Stretch (From CH 120.0 to CH 126.0)

In this section, the banks of the river are mostly covered with vegetation, reserve forest and agriculture fields. The Sathanur Reservoir is formed by Sathanur dam, one of the major dams constructed across the Ponniyar River. Three (03) water Intakes are present in this section, located at CH 124.51, CH 124.58 and CH 125.99. The height of the river bed in this segment (CH 118.5 to CH 126.0) is varying between 2.0 to 5.0 m wrt CD.



Chainage (km)		Reduced Depth (m) w.r.t. Chart Datum	
From	**To**	**Minimum**	**Maximum**
120.0	126.0	2.0	5.0

c) Water levels Topographic survey

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
3.411	3.6	1	4	0.400
3.43	3.58	1	4.013	0.433
3.451	3.62	1	4.028	0.408
3.53	3.55	1	4.082	0.532
3.63	3.54	1	4.151	0.611
3.704	3.58	1	4.202	0.622
3.73	3.52	1	4.22	0.700
3.83	3.5	1	4.289	0.789
3.93	3.48	1	4.358	0.878
4.029	3.48	1	4.426	0.946
4.129	3.43	1	4.495	1.065
4.206	3.37	1	4.548	1.178
4.223	3.41	1	4.56	1.150
4.282	3.38	1	4.6	1.220
4.323	3.31	1	4.629	1.319
4.386	3.35	1	4.673	1.323
4.422	3.3	1	4.698	1.398
4.525	3.28	1	4.768	1.488
4.624	3.27	1	4.837	1.567
4.724	3.26	1	4.905	1.645
4.824	3.21	1	4.974	1.764
4.922	3.15	1	5.042	1.892
5.114	3.11	1	5.174	2.064
5.136	3.091	1	5.19	2.099
5.137	3.091	1	5.19	2.099
5.304	3.361	1	5.305	1.944
5.404	3.631	1	5.374	1.743
5.504	3.902	1	5.443	1.541
5.604	4.172	1	5.512	1.340
5.704	4.442	1	5.581	1.139
5.804	4.75	1	5.65	0.900
5.902	4.982	1	5.717	0.735
6.001	5.252	1	5.786	0.534
6.111	5.523	1	5.861	0.338
6.209	5.74	1	5.93	0.190
6.309	6.063	1	5.998	0.000
6.391	7.144	1	6.055	0.000
6.399	6.333	1	6.06	0.000
6.498	6.603	1	6.129	0.000
6.596	6.874	1	6.196	0.000
6.625	7.41	1	6.216	0.000

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
6.653	7.107	1	6.235	0.000
6.696	6.804	1	6.265	0.000
6.796	6.4	0.9	6.334	0.000
6.896	6.3	0.9	6.403	0.103
6.996	5.895	0.9	6.472	0.577
7.096	5.592		6.541	0.949
7.15	4.986		6.578	1.592
7.193	5.289		6.608	1.319
7.286	4.683		6.672	1.989
7.438	4.38		6.777	2.397
7.526	4.077		6.837	2.760
7.614	3.774		6.898	3.124
7.616	4.077		6.899	2.822
7.713	4.301		6.966	2.665
7.813	4.524		7.035	2.511
7.912	4.748		7.104	2.356
8.012	5.195		7.172	1.977
8.112	5.418		7.241	1.823
8.212	5.642		7.31	1.668
8.312	5.866		7.379	1.513
8.412	6.089		7.448	1.359
8.512	6.313		7.517	1.204
8.612	6.536		7.586	1.050
8.712	6.76		7.655	0.895
8.757	4.971		7.686	2.715
8.812	6.983		7.724	0.741
8.912	7.207		7.793	0.586
9.013	7.431		7.862	0.431
9.113	7.654		7.931	0.277
9.212	7.7		8	0.300
9.311	8.101	0.6	8.5	0.399
9.407	8.325	0.6	8.574	0.249
9.5	8.548	0.7	8.646	0.098
9.6	8.5	0.7	8.723	0.223
9.62	8.772	0.6	8.739	0.000
9.693	8.835	0.6	8.795	0.000
9.791	8.897	0.5	8.871	0.000
9.886	8.96	0.5	8.944	0.000
9.986	9.023	0.5	9.021	0.000
10.086	9.085	0.4	9.098	0.013
10.186	9.148	0.4	9.176	0.028
10.286	9.211	0.4	9.253	0.042

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
10.387	9.274	0.3	9.331	0.057
10.487	9.336	0.4	9.408	0.072
10.587	9.399	0.4	9.486	0.087
10.593	9.462	0.3	9.49	0.028
10.593	9.524	0.4	9.49	0.000
10.686	9.587	0.4	9.562	0.000
10.784	9.65	0.4	9.638	0.000
10.883	9.75	0.4	9.715	0.000
10.977	9.775	0.4	9.787	0.012
11.074	9.838	0.4	9.862	0.024
11.172	9.92	0.4	9.938	0.018
11.293	9.963	0.4	10.031	0.068
11.393	10.026	0.4	10.108	0.082
11.527	10.089	0.4	10.212	0.123
11.624	10.151	0.4	10.287	0.136
11.702	10.214	0.3	10.348	0.134
11.722	10.16	0.3	10.363	0.203
11.836	10.12	0.3	10.451	0.331
11.934	9.82	0.3	10.527	0.707
12.032	9.68		10.602	0.922
12.04	9.517		10.608	1.091
12.128	9.578		10.676	1.098
12.223	9.638		10.75	1.112
12.319	9.699		10.824	1.125
12.414	9.75		10.898	1.148
12.537	9.82		10.992	1.172
12.636	9.881		11.069	1.188
12.735	9.941		11.145	1.204
12.884	10.02		11.26	1.240
12.983	10.063		11.337	1.274
13.08	10.123		11.412	1.289
13.176	10.19		11.486	1.296
13.275	10.245		11.563	1.318
13.372	10.305		11.638	1.333
13.472	10.366		11.715	1.349
13.571	10.46		11.792	1.332
13.671	10.487		11.868	1.381
13.771	10.548		11.946	1.398
13.871	10.608		12.023	1.415
13.97	10.71		12.1	1.390
14.069	10.73		12.176	1.446
14.164	10.79		12.25	1.460

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
14.259	11.161		12.322	1.161
14.26	10.851		12.324	1.473
14.362	11.472		12.402	0.930
14.462	11.782		12.479	0.697
14.551	12.13		12.548	0.418
14.647	12.403		12.622	0.219
14.742	12.72		12.696	0.000
14.845	13.024		12.776	0.000
14.944	13.334		12.852	0.000
15.043	13.61		12.928	0.000
15.142	13.75		13.005	0.000
15.259	13.955		13.095	0.000
15.263	14.198		13.099	0.000
15.394	14.441		13.2	0.000
15.49	14.684		13.274	0.000
15.604	14.927		13.362	0.000
15.703	15.17		13.439	0.000
15.802	15.4		13.515	0.000
15.918	15.656		13.605	0.000
16.018	15.92		13.682	0.000
16.118	16.141		13.759	0.000
16.225	16.35		13.842	0.000
16.324	16.627		13.918	0.000
16.423	16.87		13.995	0.000
16.522	17.15		14.071	0.000
16.621	17.356		14.147	0.000
16.72	17.55		14.224	0.000
16.795	17.599		14.282	0.000
16.82	17.3		14.301	0.000
16.92	17.02		14.378	0.000
17.019	16.82		14.455	0.000
17.119	16.54		14.533	0.000
17.219	16.22		14.61	0.000
17.319	16.01		14.687	0.000
17.418	15.55		14.763	0.000
17.518	15.01		14.841	0.000
17.617	14.686		14.917	0.231
17.618	14.407		14.918	0.511
17.714	14.1		14.992	0.892
17.814	13.848		15.07	1.222
17.913	13.54		15.146	1.606
18.013	13.289		15.223	1.934

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
18.107	12.95		15.296	2.346
18.205	12.86		15.372	2.512
18.222	12.73		15.384	2.654
18.295	13.05		15.441	2.391
18.394	13.58		15.517	1.937
18.493	13.99		15.594	1.604
18.593	14.26		15.671	1.411
18.693	14.72		15.748	1.028
18.775	15.096		15.812	0.716
18.792	15.23		15.825	0.595
18.891	15.42		15.902	0.482
18.991	15.86		15.979	0.119
19.095	15.97		16.059	0.089
19.194	16.05		16.136	0.086
19.292	16.25		16.212	0.000
19.389	16.46		16.286	0.000
19.486	16.73		16.361	0.000
19.583	16.94		16.436	0.000
19.599	17.166		16.449	0.000
19.677	17.36		16.509	0.000
19.773	17.54		16.583	0.000
19.872	17.69		16.659	0.000
19.971	17.85		16.736	0.000
20.07	17.99		16.812	0.000
20.169	18.14		16.889	0.000
20.267	18.16		16.965	0.000
20.366	18.29		17.041	0.000
20.464	18.46		17.117	0.000
20.564	18.37		17.194	0.000
20.663	18.46		17.271	0.000
20.762	18.58		17.347	0.000
20.861	18.82		17.424	0.000
20.96	19.26		17.5	0.000
21.045	19.645		19.7	0.055
21.053	19.056		19.7	0.644
21.142	18.467		19.702	1.235
21.238	18.72		19.703	0.983
21.321	17.289		19.704	2.415
21.419	16.65		19.706	3.056
21.518	16.111		19.707	3.596
21.617	15.82		19.709	3.889
21.641	15.522		19.709	4.187

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
21.716	16.304		19.711	3.407
21.815	17.086		19.712	2.626
21.912	17.94		19.714	1.774
22.012	18.649		19.715	1.066
22.117	19.38		19.717	0.337
22.213	20.213		19.718	0.000
22.254	20.995		19.719	0.000
22.309	20.731		19.72	0.000
22.408	20.467		19.722	0.000
22.497	20.204		19.723	0.000
22.597	19.94		19.725	0.000
22.697	19.676		19.726	0.050
22.778	19.412		19.727	0.315
22.873	19.18		19.729	0.549
22.97	18.885		19.73	0.845
23.068	18.621		19.732	1.111
23.173	18.38		19.734	1.354
23.272	18.093		19.735	1.642
23.38	17.83		19.737	1.907
23.48	17.59		19.739	2.149
23.559	17.302		19.74	2.438
23.578	17.35		19.74	2.390
23.667	17.39		19.741	2.351
23.762	17.49		19.743	2.253
23.858	17.49		19.745	2.255
23.954	17.5		19.746	2.246
24.081	17.56		19.748	2.188
24.181	17.58		19.75	2.170
24.298	17.62		19.751	2.131
24.396	17.64		19.753	2.113
24.493	17.68		19.755	2.075
24.591	17.71		19.756	2.046
24.689	17.732		19.758	2.026
24.689	18.02		19.758	1.738
24.789	18.28		19.759	1.479
24.888	18.39		19.761	1.371
24.988	18.48		19.762	1.282
25.088	18.62		19.764	1.144
25.187	18.84		19.766	0.926
25.287	19.29		19.767	0.477
25.387	19.48		19.769	0.289
25.405	19.582		19.769	0.187

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
25.479	19.6		19.77	0.170
25.578	19.61		19.772	0.162
25.677	19.64		19.773	0.133
25.777	19.65		19.775	0.125
25.876	19.68		19.776	0.096
25.981	19.69		19.778	0.088
26.08	19.73		19.78	0.050
26.179	19.74		19.931	0.191
26.276	19.75		20.079	0.329
26.373	19.78		20.228	0.448
26.406	19.802		20.278	0.476
26.472	19.82		20.378	0.558
26.57	19.84		20.529	0.689
26.669	19.85		20.68	0.830
26.768	19.81		20.831	1.021
26.868	19.8		20.983	1.183
26.967	19.79		21.136	1.346
27.067	19.73		21.288	1.558
27.17	19.76		21.445	1.685
27.269	19.72		21.598	1.878
27.366	19.74		21.745	2.005
27.437	19.712		21.854	2.142
27.462	20		21.892	1.892
27.562	20.26		22.044	1.784
27.662	20.84		22.197	1.357
27.762	20.98		22.35	1.370
27.862	21.22		22.503	1.283
27.962	21.59		22.656	1.066
28.062	21.61		22.808	1.198
28.162	21.68		22.961	1.281
28.262	21.78		23.114	1.334
28.3	22.992		23.173	0.181
28.359	23.01		23.262	0.252
28.454	23.08		23.407	0.327
28.57	23.38		23.586	0.206
28.67	23.56		23.738	0.178
28.786	23.84		23.915	0.075
28.885	23.95		24.067	0.117
28.984	23.98		24.219	0.239
29.092	23.94		24.383	0.443
29.188	24.08		24.53	0.450
29.284	24.21		24.676	0.466

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
29.38	24.3		24.823	0.523
29.38	24.422		24.823	0.401
29.403	24.812		24.858	0.046
29.479	25.13		24.975	0.000
29.579	25.448		25.127	0.000
29.678	25.766		25.279	0.000
29.778	26.084		25.432	0.000
29.878	26.402		25.584	0.000
29.978	26.76		25.736	0.000
30.076	27.039		25.887	0.000
30.174	27.357		26.036	0.000
30.271	27.675		26.185	0.000
30.361	27.993		26.323	0.000
30.456	28.12		26.468	0.000
30.552	28.629		26.614	0.000
30.687	28.947		26.821	0.000
30.787	29.265		26.973	0.000
30.886	29.64		27.126	0.000
30.986	29.901		27.278	0.000
31.086	30.22		27.43	0.000
31.185	30.56		27.583	0.000
31.27	30.856		27.711	0.000
31.369	31.19		27.864	0.000
31.469	31.492		28.016	0.000
31.512	31.81		28.082	0.000
31.569	31.8		28.169	0.000
31.669	31.76		28.322	0.000
31.769	31.56		28.475	0.000
31.869	31.44		28.628	0.000
31.969	31.45		28.78	0.000
32.069	31.39		28.933	0.000
32.169	31.35		29.086	0.000
32.269	31.29		29.239	0.000
32.346	31.26		29.357	0.000
32.385	31.225		29.416	0.000
32.445	31.459		29.508	0.000
32.544	31.694		29.66	0.000
32.644	32.162		29.811	0.000
32.739	32.46		29.958	0.000
32.838	32.631		30.109	0.000
32.929	31.928		30.248	0.000
32.937	32.865		30.26	0.000

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
33.029	33.1		30.401	0.000
33.108	33.33		30.521	0.000
33.205	33.568		30.669	0.000
33.397	33.803		30.962	0.000
33.497	34.11		31.115	0.000
33.718	34.271		31.453	0.000
33.805	34.506		31.587	0.000
33.893	34.76		31.721	0.000
33.981	34.974		31.855	0.000
34.066	35.34		31.986	0.000
34.074	35.443		31.998	0.000
34.165	35.46		32.136	0.000
34.264	35.48		32.287	0.000
34.363	35.5		32.439	0.000
34.462	35.48		32.591	0.000
34.561	35.52		32.741	0.000
34.659	35.59		32.892	0.000
34.758	35.7		33.042	0.000
34.859	37.68		33.196	0.000
34.913	35.7		33.28	0.000
34.957	35.71		33.347	0.000
35.055	35.9		33.496	0.000
35.153	36.26		33.646	0.000
35.245	36.43		33.787	0.000
35.331	36.48		33.919	0.000
35.417	36.58		34.05	0.000
35.504	36.81		34.182	0.000
35.59	36.98		34.314	0.000
35.676	37.26		34.446	0.000
35.762	37.57		34.577	0.000
35.834	37.587		34.687	0.000
35.866	37.84		34.737	0.000
35.965	37.97		34.887	0.000
36.063	38.01		35.037	0.000
36.161	38.05		35.187	0.000
36.259	38.26		35.336	0.000
36.357	38.37		35.486	0.000
36.444	38.39		35.62	0.000
36.543	38.59		35.771	0.000
36.642	38.61		35.922	0.000
36.741	38.76		36.073	0.000
36.751	38.816		36.088	0.000

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
36.83	38.72		36.209	0.000
36.929	38.9		36.361	0.000
37.028	38.99		36.512	0.000
37.127	39.08		36.664	0.000
37.226	39.25		36.815	0.000
37.327	39.28		36.968	0.000
37.426	39.38		37.12	0.000
37.524	39.49		37.271	0.000
37.629	39.58		37.43	0.000
37.726	39.59		37.579	0.000
37.824	39.62		37.728	0.000
37.922	39.69		37.878	0.000
38.02	39.72		38.028	0.000
38.059	39.789		38.088	0.000
38.068	41.269		38.102	0.000
38.119	41.16		38.179	0.000
38.219	41.1		38.332	0.000
38.318	40.92		38.484	0.000
38.418	40.94		38.637	0.000
38.518	40.88		38.789	0.000
38.618	40.82		38.942	0.000
38.716	40.86		39.091	0.000
38.814	40.81		39.242	0.000
38.848	40.834		39.293	0.000
38.914	41.02		39.395	0.000
39.014	41.09		39.547	0.000
39.112	41.21		39.697	0.000
39.212	41.29		39.85	0.000
39.318	41.38		40.011	0.000
39.365	42.467		40.083	0.000
39.417	40.98		40.163	0.000
39.515	40.37		40.312	0.000
39.614	40.16		40.464	0.304
39.726	39.84		40.635	0.795
39.826	39.65		40.788	1.138
39.926	39.28		40.941	1.661
40.03	38.85		41.1	2.250
40.13	38.12		41.252	3.132
40.229	38.02		41.405	3.385
40.249	37.963		41.435	3.472
40.329	38.39		41.557	3.167
40.429	38.65		41.71	3.060

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
40.535	38.81		41.872	3.062
40.635	40.29		42.024	1.734
40.735	40.94		42.177	1.237
40.834	41.58		42.33	0.750
40.873	41.79		42.389	0.599
40.934	41.99		42.482	0.492
41.034	42.55		42.635	0.085
41.134	42.98		42.788	0.000
41.162	43.263		42.831	0.000
41.234	43.71		42.94	0.000
41.334	44.01		43.093	0.000
41.433	44.08		43.245	0.000
41.533	44.58		43.397	0.000
41.631	44.92		43.546	0.000
41.73	45.28		43.698	0.000
41.83	45.71		43.85	0.000
41.929	45.81		44.002	0.000
42.028	46.18		44.154	0.000
42.128	46.38		44.306	0.000
42.134	46.548		44.316	0.000
42.228	46.59		44.459	0.000
42.328	46.72		44.612	0.000
42.428	46.81		44.764	0.000
42.509	47		44.888	0.000
42.608	47.05		45.04	0.000
42.707	47.09		45.192	0.000
42.714	47.253		45.202	0.000
42.801	47.87		45.335	0.000
42.894	49		45.478	0.000
42.963	52.11		45.582	0.000
43.052	53.99		45.719	0.000
43.072	56.57		45.749	0.000
43.096	59.358		45.787	0.000
43.147	55.28		45.864	0.000
43.247	51.68		46.017	0.000
43.347	48.62		46.17	0.000
43.447	48.65		46.322	0.000
43.535	47.101		46.457	0.000
43.545	47.29		46.473	0.000
43.63	47.69		46.603	0.000
43.715	47.95		46.733	0.000
43.719	48.58		46.738	0.000

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
43.818	48.71		46.89	0.000
43.918	48.81		47.042	0.000
44.017	49.52		47.194	0.000
44.117	49.59		47.346	0.000
44.238	49.89		47.531	0.000
44.329	50.131		47.671	0.000
44.334	50.13		47.678	0.000
44.434	50.18		47.83	0.000
44.533	50.19		47.982	0.000
44.632	50.17		48.134	0.000
44.731	50.12		48.285	0.000
44.84	50.16		48.451	0.000
44.94	50.18		48.604	0.000
45.039	50.19		48.756	0.000
45.07	50.197		48.804	0.000
45.138	50.1		48.907	0.000
45.236	50.01		49.057	0.000
45.335	49.71		49.207	0.000
45.382	49.42		49.28	0.000
45.479	49.41		49.428	0.018
45.576	49.31		49.576	0.266
45.672	49.1	0.4	49.724	0.624
45.769	48.88	0.4	49.872	0.992
45.826	48.249	0.4	49.958	1.709
45.867	48.45	0.3	50.021	1.571
45.984	48.71		50.2	1.490
46.083	48.95		50.351	1.401
46.182	49.02		50.502	1.482
46.281	49.08		50.653	1.573
46.379	49.84		50.804	0.964
46.478	50.28		50.955	0.675
46.582	50.72		51.114	0.394
46.68	51.28		51.264	0.000
46.684	52.122		51.269	0.000
46.778	52.55		51.413	0.000
46.876	52.81		51.563	0.000
46.974	53.01		51.713	0.000
47.072	53.39		51.862	0.000
47.17	53.46		52.012	0.000
47.314	53.81		52.233	0.000
47.414	53.99		52.386	0.000
47.576	54.55		52.633	0.000

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
47.672	54.58		52.779	0.000
47.767	54.82	0.3	52.925	0.000
47.863	54.96	0.3	53.071	0.000
47.867	55.052	0.3	53.077	0.000
47.962	56.2	0.3	53.223	0.000
48.045	56.99	0.3	53.35	0.000
48.144	57.81		53.501	0.000
48.242	58.49		53.652	0.000
48.335	59.81		53.793	0.000
48.425	60.73		53.931	0.000
48.53	61.25		54.091	0.000
48.629	61.68		54.243	0.000
48.729	62.59		54.395	0.000
48.751	63.576		54.429	0.000
48.751	63.576		62	0.000
48.829	60.59		62.086	1.496
48.928	58.11		62.196	4.086
48.962	56.924		62.234	5.310
48.992	57		62.267	5.267
49.034	58.8		62.314	3.514
49.053	59.395		62.334	2.939
49.108	59.645		62.396	2.751
49.206	59.894		62.504	2.610
49.303	60.144		62.612	2.468
49.401	60.394		62.72	2.326
49.51	60.893		62.842	1.949
49.609	61.143		62.952	1.809
49.708	61.393		63.062	1.669
49.807	61.643		63.171	1.528
49.937	61.892		63.315	1.423
50.037	62.142		63.426	1.284
50.137	62.392		63.537	1.145
50.237	62.642		63.648	1.006
50.353	62.891		63.777	0.886
50.453	63.141		63.888	0.747
50.553	63.391		63.999	0.608
50.653	63.64		64.11	0.470
50.796	63.89		64.269	0.379
50.893	64.14		64.376	0.236
50.983	60.644		64.476	3.832
50.99	64.39		64.484	0.094
51.087	64.639		64.591	0.000

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
51.184	64.889		64.699	0.000
51.36	65.18		64.894	0.000
51.459	65.389		65.005	0.000
51.559	65.638		65.115	0.000
51.658	65.888		65.225	0.000
51.77	66.138		65.349	0.000
51.868	66.387		65.458	0.000
51.967	66.637		65.567	0.000
52.065	66.887		65.677	0.000
52.164	67.26		65.786	0.000
52.262	67.386		65.895	0.000
52.351	67.636		65.994	0.000
52.451	67.886		66.105	0.000
52.551	68.136		66.216	0.000
52.658	68.385		66.334	0.000
52.757	68.635		66.444	0.000
52.855	68.89		66.553	0.000
52.953	69.135		66.662	0.000
53.053	69.384		66.773	0.000
53.152	69.634		66.883	0.000
53.252	69.884		66.994	0.000
53.352	70.133		67.105	0.000
53.452	70.383		67.215	0.000
53.551	70.633		67.326	0.000
53.652	70.08		67.437	0.000
53.752	71.132		67.548	0.000
53.851	71.382		67.659	0.000
53.95	71.632		67.768	0.000
54.049	71.882		67.878	0.000
54.149	72.131		67.989	0.000
54.245	72.381		68.096	0.000
54.345	72.631		68.206	0.000
54.444	72.881		68.317	0.000
54.544	73.13		68.427	0.000
54.63	73.38		68.522	0.000
54.643	73.42		68.537	0.000
54.742	73.45		68.647	0.000
54.841	73.48		68.757	0.000
54.94	73.58		68.866	0.000
55.039	73.84		68.977	0.000
55.138	73.99		69.086	0.000
55.237	73.86		69.196	0.000

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
55.336	73.82		69.305	0.000
55.434	73.84		69.415	0.000
55.462	73.81		69.446	0.000
55.532	73.85		69.524	0.000
55.632	73.72		69.634	0.000
55.732	73.84		69.745	0.000
55.831	73.76		69.855	0.000
55.916	73.84		69.949	0.000
55.931	73.88		69.966	0.000
56.01	73.82		70.054	0.000
56.09	73.84		70.142	0.000
56.238	73.85		70.307	0.000
56.332	73.81		70.412	0.000
56.427	73.82		70.516	0.000
56.556	73.88		70.659	0.000
56.653	73.86		70.767	0.000
56.75	73.79		70.875	0.000
56.916	73.88		71.059	0.000
56.969	73.941		71.118	0.000
57.016	73.98		71.169	0.000
57.116	74.02		71.28	0.000
57.276	74.19		71.459	0.000
57.375	74.28		71.568	0.000
57.474	74.29		71.678	0.000
57.572	74.39		71.787	0.000
57.671	74.58		71.897	0.000
57.779	74.68		72.016	0.000
57.878	74.59		72.126	0.000
57.977	74.61		72.236	0.000
58.076	74.66		72.346	0.000
58.176	74.62		72.457	0.000
58.208	74.654		72.492	0.000
58.274	74.06		72.566	0.000
58.372	73.68		72.675	0.000
58.47	73.22		72.784	0.000
58.568	73		72.892	0.000
58.659	72.59		72.993	0.403
58.757	72.12		73.102	0.982
58.857	71.68	0.3	73.212	1.532
58.956	71	0.3	73.323	2.323
59.026	70.522	0.3	73.401	2.879
59.056	70.72	0.3	73.433	2.713

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
59.155	70.73	0.3	73.544	2.814
59.264	70.82	0.3	73.664	2.844
59.364	70.86	0.3	73.775	2.915
59.464	71.09	0.3	73.886	2.796
59.564	71.18	0.3	73.997	2.817
59.664	71.52	0.3	74.108	2.588
59.698	71.97	0.3	74.146	2.176
59.764	71.28	0.3	74.219	2.939
59.864	71	0.4	74.329	3.329
59.963	70.82	0.4	74.44	3.620
60.074	70.65		74.563	3.913
60.174	70.52		74.674	4.154
60.274	70.53	0.6	74.785	4.255
60.374	70.41	0.6	74.896	4.486
60.387	73.393	0.6	74.91	1.517
60.476	73.42	0.6	75.009	1.589
60.576	73.94	0.6	75.12	1.180
60.676	74.12	0.6	75.231	1.111
60.789	74.26	0.6	75.356	1.096
60.885	74.29	0.6	75.462	1.172
60.981	74.64	0.6	75.569	0.929
61.07	74.81		75.668	0.858
61.159	74.92		75.767	0.847
61.266	75.14		75.886	0.746
61.361	75.19		75.991	0.801
61.453	75.84		76.093	0.253
61.61	75.59		76.267	0.677
61.716	75.82		76.385	0.565
61.894	75.86		76.582	0.722
61.992	75.95		76.691	0.741
62.119	75.91		76.832	0.922
62.213	76.08		76.936	0.856
62.306	76.06		77.04	0.980
62.397	76.42		77.141	0.721
62.492	76.48		77.245	0.765
62.585	76.52		77.349	0.829
62.681	76.59		77.456	0.866
62.781	76.68		77.567	0.887
62.882	76.77		77.679	0.909
62.982	76.8	0.2	77.789	0.989
63.008	76.828	0.2	77.818	0.990
63.081	76.89	0.2	77.9	1.010

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
63.18	76.92	0.2	78.009	1.089
63.279	76.98	0.2	78.119	1.139
63.387	77.15	0.2	78.239	1.089
63.487	77.1	0.2	78.35	1.250
63.598	77	0.2	78.473	1.473
63.696	77.19	0.2	78.581	1.391
63.793	77.24	0.2	78.69	1.450
63.89	77.19	0.2	78.797	1.607
63.987	77.29	0.2	78.905	1.615
64.084	77.28	0.2	79.012	1.732
64.181	77.25	0.2	79.12	1.870
64.225	77.279	0.2	79.169	1.890
64.273	77.58	0.2	79.222	1.642
64.373	77.62	0.2	79.332	1.712
64.473	77.94	0.2	79.443	1.503
64.573	78.39	0.2	79.554	1.164
64.669	78.19	0.2	79.662	1.472
64.769	78.69	0.2	79.772	1.082
64.869	79.14	0.2	79.883	0.743
64.974	79.58	0.2	80	0.420
65.074	79.82	0.3	80.111	0.291
65.174	79.98	0.3	80.222	0.242
65.274	80.23	0.3	80.333	0.103
65.374	80.38	0.3	80.444	0.064
65.474	80.358	0.3	80.555	0.197
65.544	80.887	0.3	80.632	0.000
65.574	80.99	0.3	80.665	0.000
65.684	80.77	0.3	80.787	0.017
65.784	80.95	0.3	80.898	0.000
65.876	80.99	0.3	81	0.010
65.876	80.99	0.3	81	0.010
65.975	81.11	0.3	81.151	0.041
66.075	81.08	0.3	81.302	0.222
66.174	81.16	0.3	81.453	0.293
66.292	81.28	0.3	81.631	0.351
66.392	81.38	0.3	81.783	0.403
66.492	81.48	0.3	81.934	0.454
66.56	81.68	0.3	82.037	0.357
66.656	81.88	0.3	82.182	0.302
66.754	81.64	0.3	82.332	0.692
66.773	81.616	0.3	82.36	0.744
66.854	81.68	0.3	82.483	0.803

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
66.954	81.69	0.3	82.634	0.944
67.053	81.95	0.3	82.785	0.835
67.153	82.38		82.937	0.557
67.244	82.59		83.074	0.484
67.344	82.88		83.225	0.345
67.444	82.59		83.377	0.787
67.544	82.77		83.528	0.758
67.644	83.08		83.68	0.600
67.744	83.61		83.832	0.222
67.753	84.805		83.846	0.000
67.841	85.02		83.98	0.000
67.939	85.29		84.127	0.000
68.051	85.35		84.297	0.000
68.149	85.59		84.446	0.000
68.248	86.2		84.596	0.000
68.346	86.83		84.745	0.000
68.444	87.59		84.894	0.000
68.543	88.01		85.043	0.000
68.584	89.253		85.105	0.000
68.588	86.861		85.111	0.000
68.62	86.03		85.16	0.000
68.719	84.28		85.311	1.031
68.836	84.85		85.488	0.638
68.936	85.82		85.639	0.000
69.036	85.93		85.79	0.000
69.136	86.7		85.942	0.000
69.235	86.91		86.093	0.000
69.369	88.01		86.295	0.000
69.469	89.57	0.5	86.446	0.000
69.526	90.037	0.5	86.533	0.000
69.568	90.01	0.5	86.598	0.000
69.668	90.01	0.5	86.749	0.000
69.853	90.08	0.5	87.029	0.000
69.952	89.88	0.5	87.18	0.000
70.052	89.87	0.5	87.33	0.000
70.151	89.74	0.5	87.481	0.000
70.336	89.48	0.5	87.761	0.000
70.429	89.38	0.5	87.903	0.000
70.479	89.165	0.5	87.978	0.000
70.526	89.28	0.5	88.049	0.000
70.625	98.29	0.5	88.2	0.000
70.768	98.38	0.5	88.417	0.000

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
70.868	89.39	0.5	88.568	0.000
70.968	89.69	0.5	88.719	0.000
71.067	89.58	0.5	88.87	0.000
71.206	89.69	0.5	89.08	0.000
71.303	89.41	0.5	89.227	0.000
71.4	89.29	0.5	89.375	0.085
71.498	89.69	0.5	89.522	0.000
71.597	89.7	0.5	89.673	0.000
71.6	90.58	0.5	89.678	0.000
71.699	90.61	0.5	89.828	0.000
71.799	90.88	0.5	89.979	0.000
71.898	91.59	0.5	90.129	0.000
71.997	92.69	0.5	90.279	0.000
72.096	93.51	0.5	90.43	0.000
72.172	93.59	0.5	90.545	0.000
72.271	93.84	0.5	90.695	0.000
72.371	94.063	0.5	90.845	0.000
72.371	94.01	0.5	90.845	0.000
72.454	93.88	0.5	90.972	0.000
72.554	93.84	0.5	91.123	0.000
72.653	93.52		91.274	0.000
72.754	93.58		91.426	0.000
72.853	93.41		91.577	0.000
72.898	93.46		91.645	0.000
73.036	93.24		91.854	0.000
73.107	93.152		91.962	0.000
73.133	93.16		92.002	0.000
73.223	93.28		92.138	0.000
73.322	93.24		92.288	0.000
73.425	93.26		92.444	0.000
73.525	93.28		92.595	0.000
73.625	93.35		92.746	0.000
73.692	93.16		92.848	0.000
73.724	93.31		92.898	0.000
73.824	93.36	0.4	93.049	0.000
73.924	93.35	0.4	93.201	0.000
74.024	93.58	0.4	93.352	0.000
74.124	93.54	0.4	93.504	0.000
74.224	93.59	0.4	93.656	0.066
74.324	93.58	0.4	93.807	0.227
74.424	93.56	0.4	93.959	0.399
74.523	93.52	0.4	94.108	0.588

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
74.622	93.57	0.4	94.258	0.688
74.714	93.42	0.4	94.397	0.977
74.81	93.41	0.4	94.544	1.134
74.844	93.41	0.4	94.595	1.185
74.905	93.88	0.4	94.687	0.807
74.997	94.35	0.4	94.827	0.477
75.089	94.82	0.4	94.966	0.146
75.183	95.3	0.4	95.108	0.000
75.192	96.24	0.4	95.123	0.000
75.2	97.8	0.4	95.135	0.000
75.274	97.5	0.4	95.247	0.000
75.303	96.84	0.4	95.29	0.000
75.36	95.8	0.4	95.377	0.000
75.427	95.3	0.4	95.478	0.178
75.427	95.3	0.4	95.478	0.178
75.427	95.3	0.4	95.478	0.178
75.427	95.72	0.4	95.479	0.000
75.445	95.97	0.4	95.506	0.000
75.55	96.22	0.4	95.664	0.000
75.65	96.47	0.4	95.816	0.000
75.749	96.72	0.4	95.967	0.000
75.836	96.97	0.4	96.098	0.000
75.936	97.22	0.4	96.25	0.000
75.955	97.47	0.4	96.279	0.000
76.035	97.2	0.4	96.4	0.000
76.05	97.72	0.4	96.422	0.000
76.051	96.82	0.4	96.424	0.000
76.131	97.19		96.546	0.000
76.227	97.38		96.691	0.000
76.233	97.01		96.7	0.000
76.305	97.57		96.809	0.000
76.404	97.76		96.96	0.000
76.504	97.95		97.111	0.000
76.604	98.13		97.262	0.000
76.696	98.32		97.402	0.000
76.796	98.51		97.553	0.000
76.896	98.7		97.705	0.000
76.996	98.45		97.856	0.000
77.087	99.07		97.994	0.000
77.187	99.26		98.146	0.000
77.286	99.45		98.297	0.000
77.386	99.36		98.448	0.000

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
77.486	99.82		98.6	0.000
77.529	100.39		98.665	0.000
77.586	100.32		98.751	0.000
77.685	100.25		98.902	0.000
77.795	100.19		99.068	0.000
77.895	100.12		99.22	0.000
77.995	100.05		99.371	0.000
78.118	99.99		99.557	0.000
78.216	99.88		99.707	0.000
78.315	99.85		99.857	0.007
78.423	99.65		100.021	0.371
78.474	99.79		100.098	0.308
78.521	100.23		100.169	0.000
78.621	100.66		100.32	0.000
78.72	101.1		100.47	0.000
78.832	101.54		100.64	0.000
78.932	101.97		100.791	0.000
79.032	102.41		100.943	0.000
79.132	102.85		101.095	0.000
79.236	103.29		101.252	0.000
79.336	103.72		101.404	0.000
79.436	104.16		101.555	0.000
79.536	104.3		101.707	0.000
79.619	104.6		101.833	0.000
79.636	104.37		101.858	0.000
79.735	104.14		102.009	0.000
79.844	103.91		102.174	0.000
79.942	103.62		102.322	0.000
80.04	103.28	0.2	102.471	0.000
80.138	103.22	0.2	102.619	0.000
80.145	102.99	0.2	102.63	0.000
80.238	103.16	0.2	102.771	0.000
80.338	103.34	0.2	102.923	0.000
80.438	103.51	0.2	103.074	0.000
80.538	103.69	0.2	103.226	0.000
80.638	103.55	0.2	103.377	0.000
80.738	104.04	0.2	103.529	0.000
80.838	104.33	0.2	103.68	0.000
80.937	104.4	0.2	103.831	0.000
81.036	104.57	0.2	103.981	0.000
81.12	104.92	0.2	104.109	0.000
81.135	104.22	0.2	104.132	0.000

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
81.241	104.5	0.2	104.291	0.000
81.341	104.33	0.2	104.443	0.113
81.44	104.52	0.2	104.594	0.074
81.544	104.63	0.2	104.751	0.121
81.644	104.32	0.2	104.903	0.583
81.744	104.26	0.2	105.054	0.794
81.85	104.56	0.2	105.215	0.655
81.95	104.56	0.2	105.366	0.806
82.012	104.78	0.2	105.461	0.681
82.045	105.27	0.2	105.51	0.240
82.134	105.76	0.2	105.646	0.000
82.223	106.25	0.2	105.78	0.000
82.371	106.73	0.2	106.005	0.000
82.47	107.22	0.2	106.154	0.000
82.63	107.71	0.2	106.398	0.000
82.73	108.2	0.2	106.548	0.000
82.829	108.68	0.2	106.698	0.000
82.928	109.17	0.2	106.849	0.000
83.027	109.66	0.2	106.999	0.000
83.114	110.15	0.2	107.131	0.000
83.214	110.64	0.2	107.282	0.000
83.314	111.12	0.2	107.433	0.000
83.414	111.61	0.2	107.585	0.000
83.513	111.85	0.2	107.736	0.000
83.529	114.05	0.2	107.76	0.000
83.611	112.59	0.2	107.884	0.000
83.698	112.98	0.2	108.016	0.000
83.797	113.56	0.2	108.166	0.000
83.869	114.54	0.2	108.276	0.000
83.888	114.01	0.2	108.305	0.000
83.988	113.48	0.2	108.455	0.000
84.087	113	0.2	108.606	0.000
84.17	112.56	0.2	108.732	0.000
84.268	112	0.2	108.88	0.000
84.364	111.35	0.2	109.026	0.000
84.437	110.82	0.2	109.137	0.000
84.529	110.29	0.2	109.275	0.000
84.697	109.86	0.2	109.531	0.000
84.715	108.7	0.2	109.557	0.857
84.847	108.83	0.2	109.757	0.927
84.946	108.96	0.2	109.908	0.948
85.046	109.09	0.2	110.06	0.970

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
85.166	109.22	0.2	110.241	1.021
85.264	109.35	0.2	110.391	1.041
85.363	109.48	0.2	110.54	1.060
85.477	109.61	0.2	110.712	1.102
85.573	109.86	0.2	110.859	0.999
85.67	109.87	0.2	111.005	1.135
85.777	109.74	0.2	111.168	1.428
85.823	109.87	0.2	111.237	1.367
85.873	110.07	0.2	111.313	1.243
85.973	110.27	0.2	111.464	1.194
86.075	110.47	0.2	111.619	1.149
86.174	110.67	0.2	111.77	1.100
86.274	110.87	0.2	111.921	1.051
86.374	111.07	0.2	112.072	1.002
86.473	111.27	0.2	112.223	0.953
86.573	111.47	0.2	112.374	0.904
86.674	111.67	0.2	112.528	0.858
86.774	111.87	0.2	112.68	0.810
86.874	112.07	0.2	112.831	0.761
86.976	112.27	0.2	112.985	0.715
87.072	112.36	0.2	113.13	0.770
87.15	112.86	0.2	113.249	0.389
87.21	112.87	0.2	113.34	0.470
87.239	113.07	0.2	113.384	0.314
87.34	114.26	0.2	113.537	0.000
87.43	113.47	0.2	113.673	0.203
87.53	113.67	0.2	113.825	0.155
87.63	113.87	0.2	113.976	0.106
87.734	114.07	0.2	114.133	0.063
87.833	114.27	0.2	114.285	0.015
87.934	114.47	0.2	114.437	0.000
88.004	114.87	0.2	114.543	0.000
88.031	114.97	0.2	114.585	0.000
88.119	115.06	0.2	114.718	0.000
88.219	115.15	0.2	114.869	0.000
88.319	115.24	0.2	115.021	0.000
88.321	115.43	0.2	115.024	0.000
88.419	115.33	0.2	115.172	0.000
88.519	115.61	0.2	115.324	0.000
88.553	115.52	0.2	115.375	0.000
88.619	115.7	0.2	115.475	0.000
88.719	115.79	0.2	115.627	0.000

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
88.819	115.88	0.2	115.778	0.000
88.919	115.98	0.2	115.93	0.000
89.019	116	0.2	116.081	0.081
89.119	116.16	0.2	116.233	0.073
89.176	113.4	0.2	116.321	2.921
89.218	113.6	0.2	116.384	2.784
89.318	113.8	0.2	116.535	2.735
89.417	113.99	0.2	116.685	2.695
89.517	114.19	0.2	116.837	2.647
89.617	114.5	0.2	116.988	2.488
89.723	114.58	0.2	117.149	2.569
89.822	114.78	0.2	117.299	2.519
89.921	114.97	0.2	117.45	2.480
90.02	115.17	0.2	117.599	2.429
90.118	115	0.2	117.748	2.748
90.221	115.56	0.2	117.904	2.344
90.326	115.76	0.2	118.062	2.302
90.422	116.35	0.2	118.209	1.859
90.425	116.43	0.2	118.213	1.783
90.529	116.52	0.2	118.371	1.851
90.622	116.5	0.2	118.512	2.012
90.792	116.69	0.2	118.769	2.079
90.917	116.78	0.2	118.959	2.179
91.011	116.87	0.2	119.102	2.232
91.101	116.96	0.2	119.238	2.278
91.198	117	0.2	119.386	2.386
91.295	117.13	0.2	119.533	2.403
91.364	117.3	0.2	119.637	2.337
91.395	117.41	0.2	119.683	2.273
91.495	117.51	0.2	119.835	2.325
91.595	117.61	0.2	119.986	2.376
91.695	117.72	0.2	120.138	2.418
91.795	117.82	0.2	120.289	2.469
91.895	117.92	0.2	120.442	2.522
91.995	118	0.2	120.593	2.593
92.095	118.13	0.2	120.745	2.615
92.194	118.36	0.2	120.895	2.535
92.294	118.34	0.2	121.046	2.706
92.394	118.44	0.2	121.198	2.758
92.491	118.54	0.2	121.345	2.805
92.531	118.75	0.3	121.405	2.655
92.591	118.56	0.3	121.497	2.937

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
92.693	118.23	0.3	121.651	3.421
92.793	118.45	0.3	121.802	3.352
92.892	118.28	0.3	121.954	3.674
92.992	118.39	0.3	122.105	3.715
93.089	118.79	0.3	122.252	3.462
93.189	118.25	0.3	122.403	4.153
93.281	118.56	0.3	122.543	3.983
93.377	118.13	0.3	122.689	4.559
93.468	118.45	0.3	122.826	4.376
93.471	118.98	0.3	122.83	3.850
93.567	119.75	0.3	122.976	3.226
93.661	121.29	0.3	123.119	1.829
93.748	120.52	0.3	123.25	2.730
93.748	122.06	0.3	123.25	1.190
93.847	122.84	0.3	123.4	0.560
93.951	123.61	0.3	123.558	0.000
94.08	124.36	0.3	123.753	0.000
94.228	125.56	0.3	123.978	0.000
94.329	125.92	0.3	124.13	0.000
94.375	127.47	0.4	124.201	0.000
94.504	127.14	0.4	124.397	0.000
94.652	126.82	0.4	124.621	0.000
94.783	126.5	0.4	124.819	0.000
94.91	126.18	0.4	125.011	0.000
95.073	125.86	0.4	125.259	0.000
95.152	125.78	0.4	125.378	0.000
95.248	125.21	0.4	125.523	0.313
95.324	124.56	0.4	125.64	1.080
95.406	124.57	0.4	125.764	1.194
95.479	124.25	0.4	125.874	1.624
95.574	123.93	0.4	126.018	2.088
95.669	123.89	0.4	126.163	2.273
95.756	122.96	0.4	126.295	3.335
95.757	123.03	0.4	126.295	3.265
95.847	123.56	0.4	126.433	2.873
95.948	123.17	0.4	126.585	3.415
96.045	123.24	0.4	126.733	3.493
96.156	123.31	0.4	126.9	3.590
96.256	123.38	0.4	127.052	3.672
96.364	123.46	0.4	127.215	3.755
96.463	123.53	0.4	127.366	3.836
96.564	123.6	0.4	127.519	3.919

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
96.663	123.67	0.4	127.67	4.000
96.763	123.74	0.4	127.82	4.080
96.862	123.81	0.4	127.971	4.161
96.961	123.88	0.4	128.121	4.241
97.061	123.45	0.4	128.273	4.823
97.161	124	0.4	128.424	4.424
97.165	124.16	0.4	128.429	4.269
97.262	124.89	0.4	128.577	3.687
97.361	125.36	0.4	128.728	3.368
97.461	126.23	0.4	128.878	2.648
97.56	128.45	0.4	129.029	0.579
97.602	130.28	0.5	129.092	0.000
97.661	130.32	0.5	129.183	0.000
97.761	130.36	0.5	129.334	0.000
97.862	130.5	0.5	129.487	0.000
97.962	130.24	0.5	129.638	0.000
98.059	130.48	0.5	129.786	0.000
98.156	130.52	0.5	129.932	0.000
98.267	130.89	0.5	130.101	0.000
98.371	130.6	0.5	130.258	0.000
98.471	130.64	0.5	130.41	0.000
98.569	130.5	0.5	130.559	0.059
98.669	130.71	0.5	130.71	0.000
98.769	130.75	0.5	130.862	0.112
98.872	130.79	0.5	131.017	0.227
98.971	131	0.5	131.167	0.167
99.071	130.87	0.5	131.32	0.450
99.171	130.91	0.5	131.471	0.561
99.262	130.95	0.5	131.608	0.658
99.353	131.56	0.5	131.746	0.186
99.513	131.03	0.5	131.989	0.959
99.662	131.07	0.5	132.216	1.146
99.78	131.11	0.5	132.394	1.284
99.855	131.5	0.5	132.508	1.008
99.933	131.19	0.5	132.627	1.437
100.018	131.22	0.5	132.754	1.534
100.118	131.26	0.5	132.907	1.647
100.215	131.45	0.5	133.053	1.603
100.31	131.34	0.5	133.197	1.857
100.408	131.38	0.5	133.346	1.966
100.506	131.68	0.5	133.494	1.814
100.531	131.85	0.6	133.533	1.683

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
100.6	132.25	0.6	133.637	1.387
100.693	132.21	0.6	133.778	1.568
100.801	132.39	0.6	133.941	1.551
100.895	132.57	0.6	134.085	1.515
101.005	133	0.6	134.251	1.251
101.11	132.93	0.6	134.41	1.480
101.207	133.11	0.6	134.557	1.447
101.304	133.5	0.6	134.704	1.204
101.325	133.65	0.6	134.735	1.085
101.402	133.82	0.6	134.852	1.032
101.5	134	0.6	135.001	1.001
101.598	134.15	0.6	135.149	0.999
101.702	134.32	0.6	135.307	0.987
101.83	134.48	0.6	135.501	1.021
101.933	134.65	0.6	135.657	1.007
102.024	134.81	0.6	135.796	0.986
102.123	134.98	0.5	135.946	0.966
102.223	135.15	0.5	136.097	0.947
102.313	135.31	0.5	136.234	0.924
102.395	135.48	0.5	136.358	0.878
102.498	135.65	0.5	136.514	0.864
102.608	135.81	0.5	136.681	0.871
102.724	135.55	0.4	136.856	1.306
102.849	136.14	0.4	137.046	0.906
102.948	136.31	0.4	137.197	0.887
103.053	136.5	0.4	137.356	0.856
103.146	136.64	0.4	137.496	0.856
103.159	137.58	0.5	137.517	0.000
103.257	139.45	0.5	137.665	0.000
103.36	140.36	0.5	137.821	0.000
103.46	142.24	0.5	137.972	0.000
103.569	145.36	0.5	138.138	0.000
103.669	146	0.5	138.289	0.000
103.723	145.97	0.5	138.371	0.000
103.784	142.72	0.5	138.486	0.000
103.882	141.9	0.5	138.672	0.000
103.98	141.09	0.5	138.858	0.000
103.985	145.16	0.5	138.867	0.000
103.985	144.34	0.5	138.867	0.000
103.985	143.25	0.5	138.867	0.000
104.083	141.25	0.5	139.053	0.000
104.143	138.65	0.5	139.166	0.516

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
104.223	138.69	0.5	139.318	0.628
104.324	138.45	0.5	139.51	1.060
104.395	138.78	0.5	139.643	0.863
104.478	138.83	0.5	139.8	0.970
104.576	138.87	0.5	139.986	1.116
104.684	138.5	0.5	140.19	1.690
104.804	138.96	0.5	140.419	1.459
104.908	139.01	0.5	140.615	1.605
105	139.05	0.5	140.79	1.740
105.105	139.45	0.5	140.988	1.538
105.138	139.19	0.5	141.051	1.861
105.185	139.73	0.5	141.14	1.410
105.287	140.5	0.5	141.332	0.832
105.425	140.96	0.5	141.593	0.633
105.541	141.34	0.5	141.814	0.474
105.644	141.88	0.5	142.009	0.129
105.758	142.41	0.5	142.224	0.000
105.846	142	0.5	142.391	0.391
105.954	143.49	0.5	142.596	0.000
106.047	144.03	0.5	142.772	0.000
106.145	144.56	0.5	142.957	0.000
106.205	145.64	0.5	143.072	0.000
106.236	145.54	0.5	143.13	0.000
106.319	145.45	0.5	143.288	0.000
106.418	145.35	0.5	143.474	0.000
106.53	145.26	0.5	143.687	0.000
106.619	145.16	0.5	143.855	0.000
106.729	145.07	0.5	144.063	0.000
106.836	144.97	0.5	144.266	0.000
106.94	144.7	0.5	144.463	0.000
107.032	144.78	0.5	144.638	0.000
107.145	144.69	0.5	144.852	0.162
107.246	144.8	0.5	145.042	0.242
107.345	144.5	0.5	145.23	0.730
107.346	144.31	0.6	145.231	0.921
107.459	144.61	0.6	145.445	0.835
107.54	145	0.6	145.599	0.599
107.621	145.21	0.6	145.753	0.543
107.715	145.51	0.6	145.93	0.420
107.817	145.5	0.6	146.124	0.624
107.935	146.11	0.6	146.348	0.238
108.034	146.41	0.6	146.535	0.125

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
108.115	146.71	0.6	146.687	0.000
108.219	147.01	0.6	146.885	0.000
108.358	147	0.6	147.148	0.148
108.544	147.61	0.6	147.5	0.000
108.792	148.21	0.6	147.97	0.000
108.871	148.53	0.6	148.12	0.000
108.962	149	0.6	148.292	0.000
109.061	149.17	0.6	148.48	0.000
109.16	149.48	0.6	148.668	0.000
109.26	149.8	0.6	148.856	0.000
109.359	150	0.6	149.044	0.000
109.454	150.43	0.6	149.223	0.000
109.57	150.75	0.6	149.443	0.000
109.653	151.07	0.6	149.6	0.000
109.751	151.38	0.6	149.786	0.000
109.862	151.45	0.5	149.996	0.000
109.969	152.02	0.5	150.199	0.000
110.068	152.34	0.5	150.386	0.000
110.175	152.65	0.5	150.588	0.000
110.264	152.97	0.5	150.757	0.000
110.353	153.29	0.5	150.927	0.000
110.445	153.25	0.5	151.1	0.000
110.57	153.92	0.5	151.338	0.000
110.723	154.24	0.5	151.627	0.000
110.816	154.55	0.5	151.804	0.000
110.929	154.87	0.5	152.016	0.000
111.021	155	0.5	152.191	0.000
111.119	155.51	0.5	152.377	0.000
111.233	156.14	0.5	152.592	0.000
111.271	152.24	0.4	152.664	0.424
111.31	153.25	0.4	152.738	0.000
111.403	153	0.4	152.915	0.000
111.504	153.25	0.4	153.105	0.000
111.609	153.69	0.4	153.305	0.000
111.704	153.56	0.4	153.485	0.000
111.799	153.89	0.4	153.664	0.000
111.855	154.5	0.4	153.77	0.000
111.912	154.25	0.4	153.879	0.000
112.01	154.23	0.4	154.063	0.000
112.102	154.15	0.4	154.237	0.087
112.209	154	0.4	154.441	0.441
112.303	154.96	0.4	154.618	0.000

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
112.396	154.78	0.4	154.795	0.015
112.504	154.56	0.4	155	0.440
112.631	154.98	0.4	155.24	0.260
112.725	154.36	0.4	155.418	1.058
112.846	154.47	0.4	155.646	1.176
112.941	154.25	0.4	155.826	1.576
113.039	155	0.4	156.012	1.012
113.139	155.78	0.4	156.202	0.422
113.238	155.45	0.4	156.39	0.940
113.348	155.45	0.4	156.597	1.147
113.448	155.26	0.4	156.786	1.526
113.544	154.21	0.4	156.969	2.759
113.628	155.5	0.4	157.263	1.763
113.641	155.7	0.5	157.31	1.610
113.737	155	0.5	157.645	2.645
113.837	156.11	0.5	157.996	1.886
113.935	156.31	0.5	158.34	2.030
114.035	156.85	0.5	158.69	1.840
114.134	156.72	0.5	159.04	2.320
114.241	156.93	0.5	159.416	2.486
114.341	157.5	0.5	159.767	2.267
114.442	157.33	0.5	160.12	2.790
114.452	157.74	0.5	160.156	2.416
114.542	158.25	0.5	160.471	2.221
114.64	159	0.5	160.815	1.815
114.74	159.62	0.5	161.166	1.546
114.835	160.5	0.5	161.501	1.001
114.935	160.88	0.5	161.85	0.970
115.034	161.5	0.5	162.199	0.699
115.162	162	0.5	162.648	0.648
115.26	162.76	0.5	162.99	0.230
115.385	163.38	0.5	163.431	0.051
115.534	164.01	0.5	163.953	0.000
115.574	164.5	0.5	164.093	0.000
115.67	165.26	0.5	164.431	0.000
115.729	165.89	0.5	164.638	0.000
115.772	166.52	0.5	164.788	0.000
115.84	167	0.5	165.028	0.000
115.89	167.77	0.5	165.202	0.000
115.944	168.4	0.5	165.392	0.000
116.012	169.5	0.5	165.63	0.000
116.085	170.28	0.6	165.888	0.000

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
116.136	170	0.6	166.067	0.000
116.224	169.81	0.6	166.376	0.000
116.314	169.58	0.6	166.689	0.000
116.402	169.35	0.6	167.001	0.000
116.498	169.5	0.6	167.336	0.000
116.564	168.88	0.7	167.568	0.000
116.653	168.65	0.7	167.881	0.000
116.72	168	0.7	168.115	0.115
116.812	168.42	0.7	168.44	0.020
116.846	167.95	0.8	168.557	0.607
116.925	167.72	0.8	168.834	1.114
117.019	167.48	0.8	169.166	1.686
117.067	167.85	0.8	169.334	1.484
117.117	167.02	0.8	169.511	2.491
117.16	166.78	0.8	169.661	2.881
117.27	166.32	0.9	170.048	3.728
117.329	167	0.9	170.254	3.254
117.425	168.92	1	170.592	1.672
117.514	170.22	1.1	170.901	0.681
117.622	171.85	1.1	171.282	0.000
117.721	172.82	1.1	171.63	0.000
117.827	174.12	1.1	172	0.000
117.915	175.43	1.1	172.309	0.000
118.013	176.5	1.1	172.655	0.000
118.103	178.03	1.1	172.971	0.000
118.146	180.63	1.1	173.12	0.000
118.146	180.63	1.2	180	0.000
118.176	179.25	1.2	180.023	0.773
118.242	178.96	1.2	180.072	1.112
118.281	177.52	1.2	180.102	2.582
118.333	173.2	1.2	180.141	6.941
118.877	176.51	1.1	180.549	4.039
119.388	179.42	1.25	180.931	1.511
119.926	182.25	1.35	183.467	1.217
120.475	185.09	1.4	186.054	0.964
121.129	188.48	1.5	189.135	0.655
121.696	190.75	1.6	191.804	1.054
122.321	193.01	1.75	194.75	1.740
122.618	194.71	1.8	196.149	1.439
123.111	196.364	2.3	198.471	2.107
123.712	199.412	2.5	201.301	1.889
124.246	202.763	2.2	203.814	1.051

Chainage (km) A	River Bed Level w.r.t MSL (m) B	Measured Water Depths (m) C	Adopted C.D. w.r.t. M.S.L. D	Reduced Depth E=D-B
124.621	205.461	2.1	205.584	0.123
125.453	207.512	3	209.5	1.988

Table 17: Topographic survey Water levels (Observed, Reduction factor and Reduced)

Note: Negative (-) ive depths are reduced to zero as per discussion with IWAI authorities.

4.6 Observed and reduced bed profile along the river

4.6.1 Observed bed profile along the river

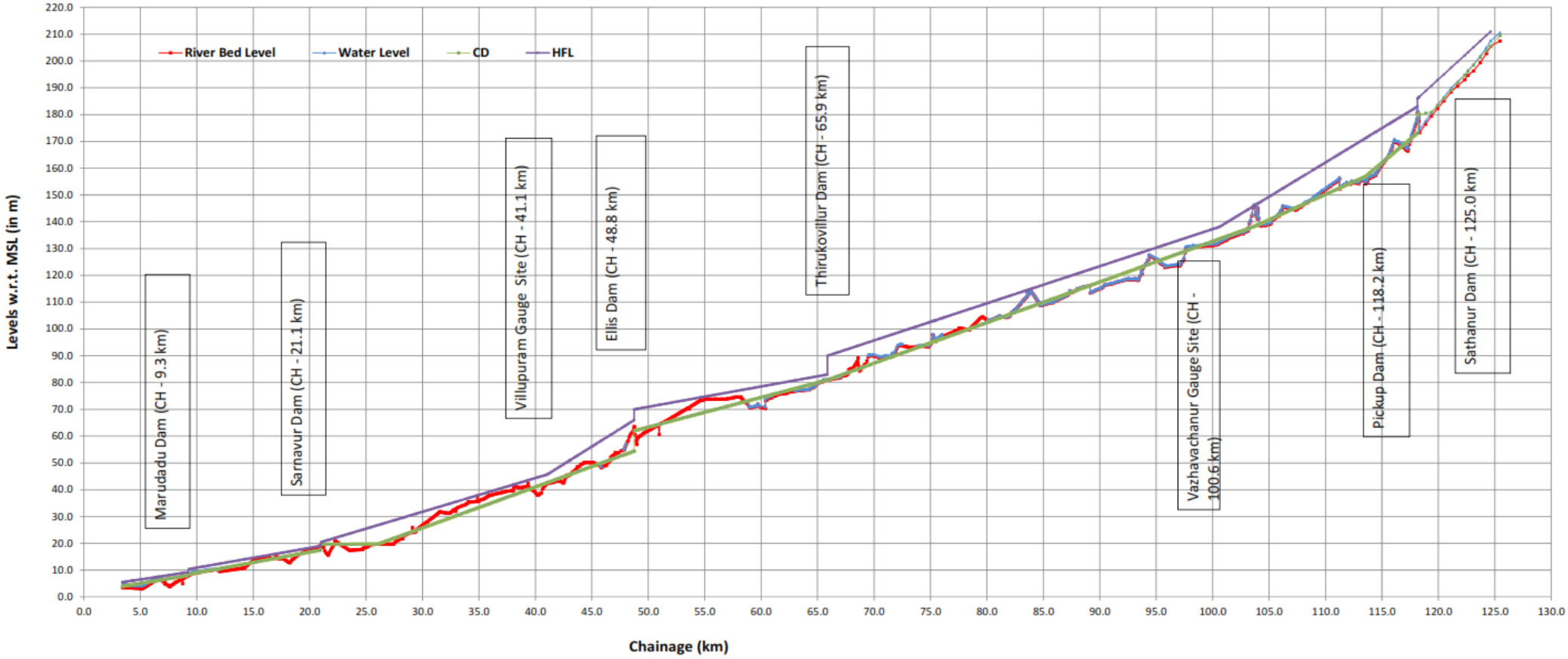


Figure 18: Riverbed Profile from 3.4 km to 125.5 km

Source: Deepest level single line longitudinal survey carried out at site in March-April 2016 and Gauge discharge data collected from CWC. Source data table is added as Annexure 6.

4.6.2 Reduced bed profile along the river

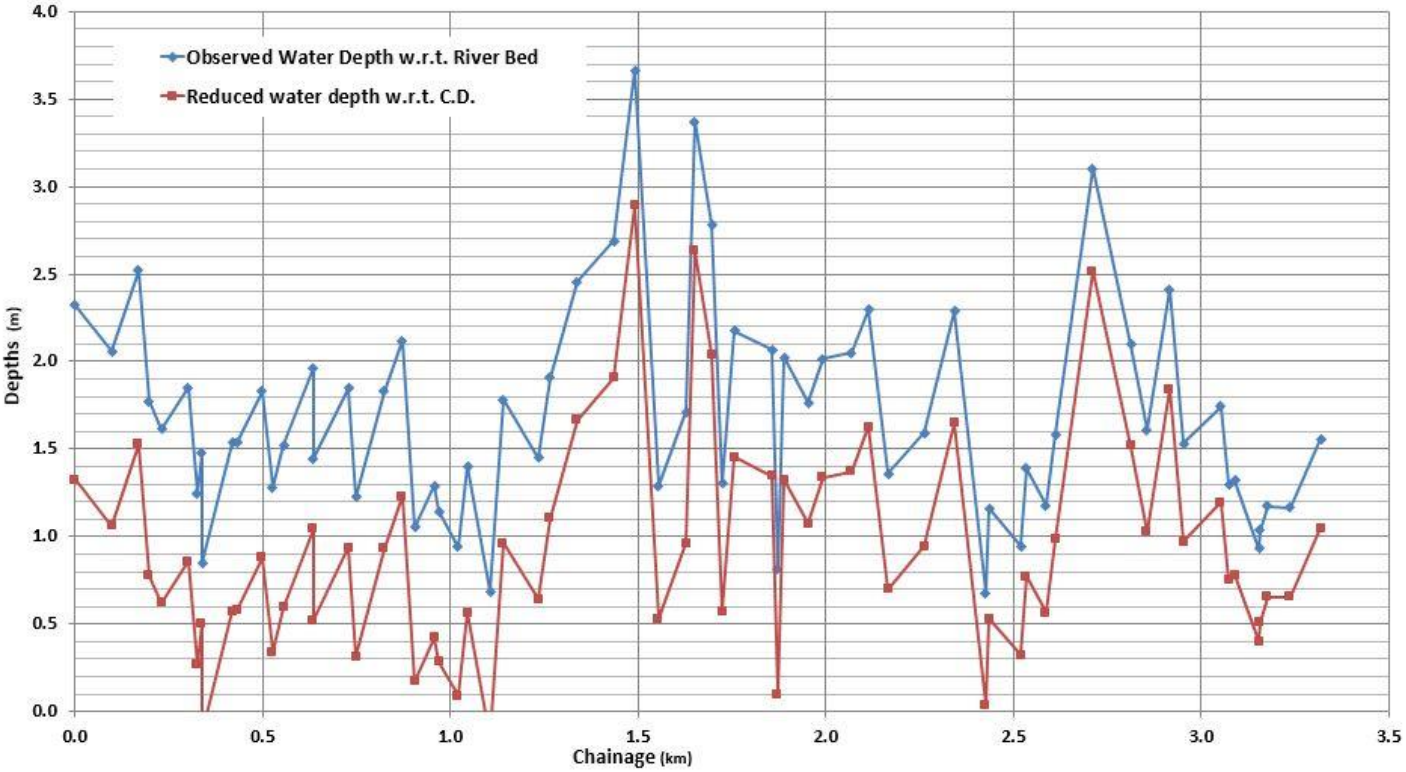


Figure 19: Depth Profile at the Estuary (CH 0 to CH 3.3), up to tidal influence.

Observed water depth is in meters w.r.t. river bed level. Reduced depth is w.r.t. CD.

4.7 Results from Hydrographic/Topographic Survey

- Tidal effect was predominant up to CH 3.3 during survey (Bathymetry survey has been carried out in this stretch), where water depth varies from -0.1 m to 2.9 m.
- Since the depths are shallow or river is dry at all other chainages, Water depths and river bed levels are measured by Topographic survey from CH 3.4 to CH 125.

4.8 Soil characteristics

The details of CH vs soil textures are tabulated in **Annexure 1**.

From visual observation, it can be seen that **sand** was mostly present in riverbed and **clay and rocky strata** was noticed in riverbed from chainage 76 to 125.5 km.

Critical Areas requiring detailed investigations

Detailed investigations shall be required at proposed ferry locations nearby temples, Existing boating points and ghats.

4.9 Water characteristics

From visual observation, clear water was found from chainage 0 to 3.3 km and after 3.3 km, water mixed with sand and clay was observed at some places and clear water was observed at most of places up to 125km.

4.10 Condition of banks

Condition of banks was depicted in inventory of structures in **Annexure 4**. Sandy/Eroded banks were observed from chainage 0 to 50 km. Bushy banks from chainage 50 to 90km and Rocky banks from chainage 90 to 125 km were observed. The condition of banks was found to be good.

The photographs of the river during reconnaissance survey are attached at the end.

4.11 Details of collected water level and Discharge data

The details of gauging stations as detailed in chapter 2 (refer 2.6.3 and 2.6.4) is again given below:

Name	Chainage (km)	Location	
		Lat.	Long.
Vazhavachanur, Tiruvannamalai, Tamil Nadu	100.6	12^0 03′ 57” N	78^0 58′ 41” E
Villupuram, Tamil Nadu	41.1	11^0 52′ 14” N	79^0 27′ 34” E

Table 18: Location details of gauging stations

The details of Gauge stations location, jurisdiction, establishment and data available for both Vazhavachanur and Villupuram Gauge sites are presented in the tables below:

General Details	
Station Name	Vazhavachanur
Station Code	CP000H2
Operational Status	Existing
Activity	HO
Station Type (Current)	GDSQ
Tehsil/Taluk	Chengum
District	Thiruvannamalai
State	Tamil Nadu
Latitude (DMS)	12°04'00"N
Longitude (DMS)	78°58'39"E
Altitude (m)	142.00
Distance to Outlet (km)	0
Toposheet No.	57L16
Catchment Area (sq. km)	10780.00

Table 19: Vazhavachanur GD site- General details

Jurisdiction Details	
Owner Agency	CWC
State/Regional Office	C&S RO, Coimbatore
Circle Office	S.E.(C&SR), Bangalore
Divisional Office	Hydrology Division, Chennai

Sub Divisional Office	Palar Ponnaiyar SD, Chennai
Section Office	Vazhavachanur
Nearest Airport	Chennai
Town	Tiruvannamalai
Railway Station	Thiruvannamalai
Bus Stand	Sadhakuppam
Station Bank	Left
Zero of Gauge (m)	133.00

Table 20: Vazhavachanur GD site- Jurisdiction details

Establishment Details		
Date of establishment	-	
Date of closure	-	
Parameters	**Start Date**	**End Date**
Gauge	26/2/1971	
Discharge	-	
Sediment	-	
Water Quality	-	
Rainfall(ORG)	1/9/2000	
Rainfall(SRG)	1/9/2000	
Temperature	1/9/2000	
Wind Velocity	12/9/2000	
Evaporation	11/9/2000	
Humidity	12/9/2000	
Sunshine	12/9/2000	

Table 21: Vazhavachanur GD site- Establishment details

Parameters	**Start Date**	**End Date**
Water Level	1/6/1978	29/3/2013
Discharge	1/6/1978	29/3/2013
Sediment	19/10/2001	29/3/2013
Water Quality	1/6/1995	1/5/2013
Rainfall	9/8/1997	31/5/2008
Temperature	20/07/1978	31/5/2009
Climatic	1/8/2003	31/7/2004

Table 22: Vazhavachanur GD site - Data availability

General Details	
Station Name	Villupuram
Station Code	CP000C6
Operational Status	Existing
Activity	HO
Station Type (Current)	GDQ

Tehsil/Taluk	Villupuram
District	Villupuram
State	Tamil Nadu
Latitude (DMS)	11°52'14"N
Longitude (DMS)	79°28'25"E
Altitude (m)	50.00
Distance to Outlet (km)	0
Toposheet No.	58M5
Catchment Area (sq. km)	12900.00

Table 23: Villupuram GD site- General details

Jurisdiction Details	
Owner Agency	CWC
State/Regional Office	C&S RO, Coimbatore
Circle Office	S.E.(C&SR), Bangalore
Divisional Office	Hydrology Division, Chennai
Sub Divisional Office	Palar Ponnaiyar SD, Chennai
Section Office	JE,S-Villupuram
Nearest Airport	Chennai-170 km
Town	Villupuram
Railway Station	Villupuram-12 km
Bus Stand	Villipuram
Station Bank	Right
Zero of Gauge (m)	42.00

Table 24: Villupuram GD site- Jurisdiction details

Establishment Details		
Date of establishment	14/03/1971	
Date of closure	-	
Parameters	**Start Date**	**End Date**
Gauge	14/03/1971	
Discharge	9/10/1972	
Sediment	-	
Water Quality	1/1/1987	
Rainfall(ORG)	1/7/1994	
Rainfall(SRG)	-	
Temperature	18/7/1971	
Wind Velocity	1/7/2008	
Evaporation	-	
Humidity	-	
Sunshine	-	

Table 25: Villupuram GD site- Establishment details

Parameters	Start Date	End Date
Water Level	14/03/1971	10/4/2012
Discharge	9/10/1972	10/4/2012
Sediment	Not Available	
Water Quality	1/6/1995	1/5/2013
Rainfall	4/7/1994	31/5/2008
Temperature	18/8/1971	31/5/2009
Climatic	Not Available	

Table 26: Villupuram GD site - Data availability

4.12 Methodology for analysis of Gauge- Discharge Data

The gauge-discharge data available for number of years for two gauging stations was analyzed in different ways as given below:

10 Daily average discharges

The ten daily average discharges in each month for each year were worked out and then the average of average 10 daily discharges over the entire period of data were worked out to get idea about availability of 10 daily average discharge during different months of the year. Based on these average 10 daily discharges it will be possible to work out available depth of flow for natural or design cross section of river. These data analysis will be helpful for navigation feasibility in given stretch of river. The outcome from this analysis will also be useful for mathematical model studies(to be carried out in stage II) to predict longitudinal water surface profiles for different discharges along given reach of river and also to design section of navigation channel on river bed.

Maximum minimum discharges and water levels

The yearly maximum discharge and water level for the entire period of data were extracted and then these data were statistically analysed using Gumbel extreme value distribution to estimate flood discharges for different return periods such as 2,5, 10, 25 ,50 and 100 years. Similarly high flood levels were analysed. The minimum flow and minimum water level data was also analysed. The estimated HFLs and Minimum water levels will be useful for planning navigation as well as for design of terminals for cargo and passenger traffic.

Gauge discharge curves

Using available gauge discharge data G-Q curves were developed for each gauge station. These will be helpful to compute water level for any discharge. Also for calibration and validation of mathematical model (studies required in stage II) this data will be very useful.

Comparison of River Cross Section Data:

The river cross sections at gauging stations on different station were available for different years. For a given gauging station the cross sections for different years including the latest cross section were superimposed to study changes in river bed levels and shifting of the deep channel if any over the period of data.

Period of availability for range of discharges

For a navigation channel to be feasible it is necessary that adequate discharge is available to maintain required depth/draft for fairly longer duration during the year. The data for each gauge station was analysed to find out period of availability for the different range of discharges. Based on past 20 to 30 years of data, % of days in a year for availability of different range of discharges was worked out. These data is very useful to estimate number of days for which minimum discharge required to facilitate navigation will be available in different rivers.

4.13 Bed Slope

The average bed slopes for Ponniyar River for the reach under consideration are given in table below:

River	Reach		River Bed Level Difference	Distance	Slope
	From	To			
Ponniyar	Vazhavachnur RBL 133.44 m	Villupuram RBL 42.125 m	91.305 m	63.478 km	1/695
	Villupuram RBL 42.125 m	Mouth RBL 0.0 m	42.125 m	39.65 km	1/941

Table 27: Bed Slope of Ponniyar River

RBL – River Bed Level (These are taken from CWC river cross sections at gauging sites)

4.14 River Cross sections

The CWC data of river cross sections at gauging sites on Ponniyar River was available for number of years. The river cross sections at two gauging sites for different years were compared to understand morphological changes over the longer period. Figure 20 & Figure 21 shows plots for Ponniyar river cross sections at Vazavachanur and Villipuram gauging stations respectively indicating comparison of cross sections in different years. Following table shows abstract of review of these studies.

Sr	River & Gauge location	General Description & Bank to Bank width	River bed level in 2012	Bank Levels	Comments/ observations
1	Ponnaiyar at Vazhavachanur	Well defined c/s width - 220 m, deep channel on left bank (*Figure 20*)	133.44m	140 to 141m	Practically no change in river section during 1999 to 2012 except increase in deep channel levels by 0.5m during 2004 to 2012
2	Ponnaiyar at Villupuram	Defined wide c/s width - 640 m, deep channel near centre and left bank (*Figure 21*)	42.125m	46.5m	Deep channel bed levels lowered by about 1.5 during 1999 to 2012

Table 28: River cross-sections over different years

4.15 Ten- Daily average Discharges

Vazhavachanur:

Analysis of 10 daily average flows is presented in Table 29. Figure 22 shows bar chart indicating variation in 10 daily average flows round the year. It could be seen from these data that practically negligible or no flow in river during May to September. In October – November also discharge remain low except during some moderate floods during North-East monsoon. The average 10 daily flow shows improvement due to these flash floods as could be seen in Figure 22.The results of this analysis indicate range of average 10 daily flows in different period of year as following.

- ➔ **June to September - 0 to 2 m^3/s**
- ➔ **October to December - 20 to 30 m^3/s or less**
- ➔ **January to May - 2 to 5 m^3/s or less**

The gauge- discharge curve derived from the daily flow data during periods of high floods is presented vide Figure 24.

Villupuram:

Analysis of 10 daily average flows is presented in *Table 30: Mean 10 daily discharges (in cumecs) for Villupuram*Table 30. Figure 23 shows bar chart indicating variation in 10 daily average flows round the year. It could be seen from these data that practically negligible or no flow in river during May to September. In October –November also discharge remain low except during some moderate floods during North-East monsoon. The average 10 daily flow shows improvement due to these flash floods as could be seen in Figure 23.The results of this analysis indicate range of average 10 daily flows in different period of year as following.

- ➔ **June to September : 0 to 2 m^3/s**
- ➔ **October to December : 20 to 30 m^3/s or less**
- ➔ **January to May : 2 to 5 m^3/s or less**

The gauge- discharge curve derived from the daily flow data during periods of high floods is presented vide Figure 25.

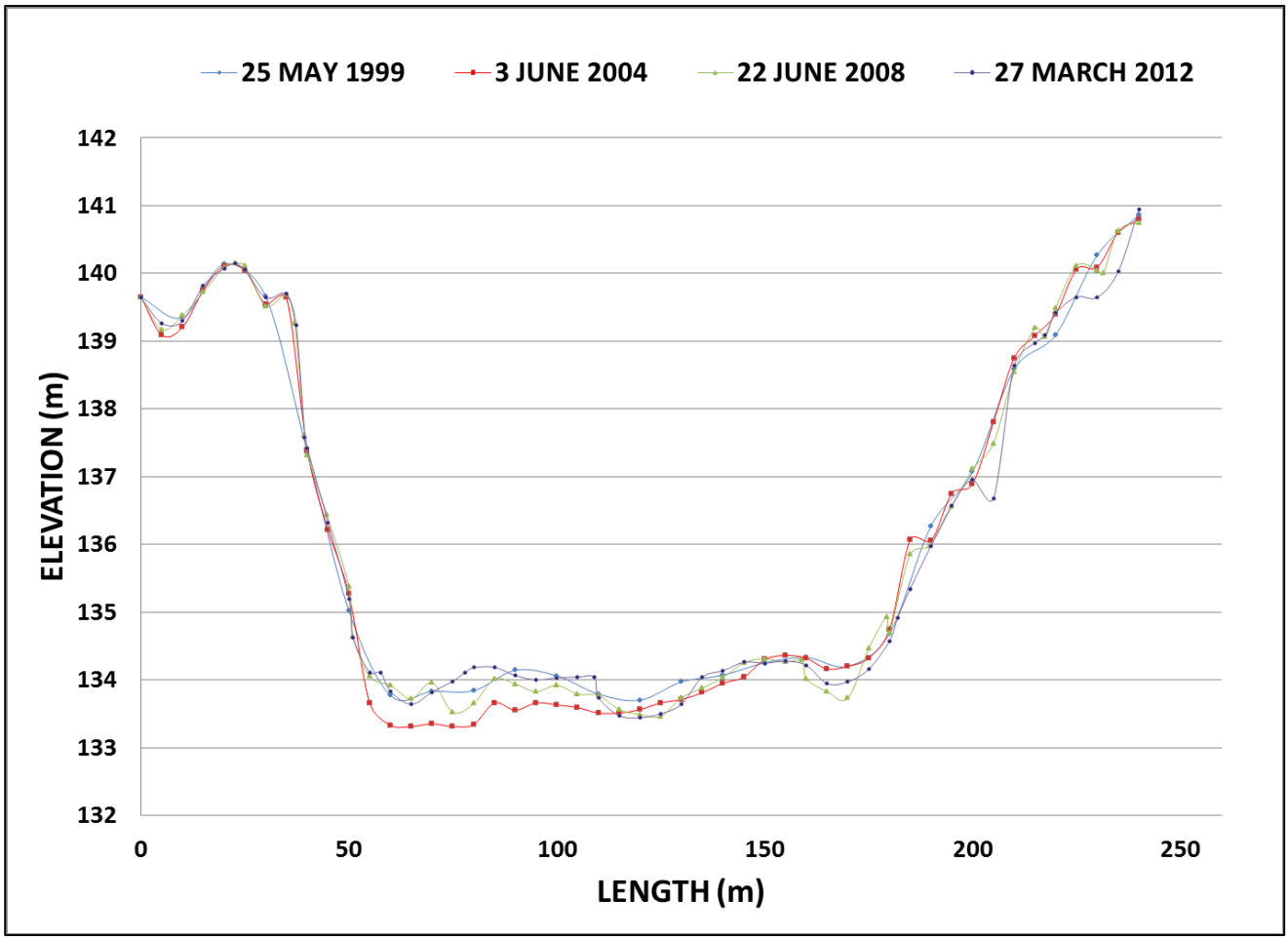


Figure 20: Comparison of Ponniyar river cross-section in different years at Vazhavachanur gauging station

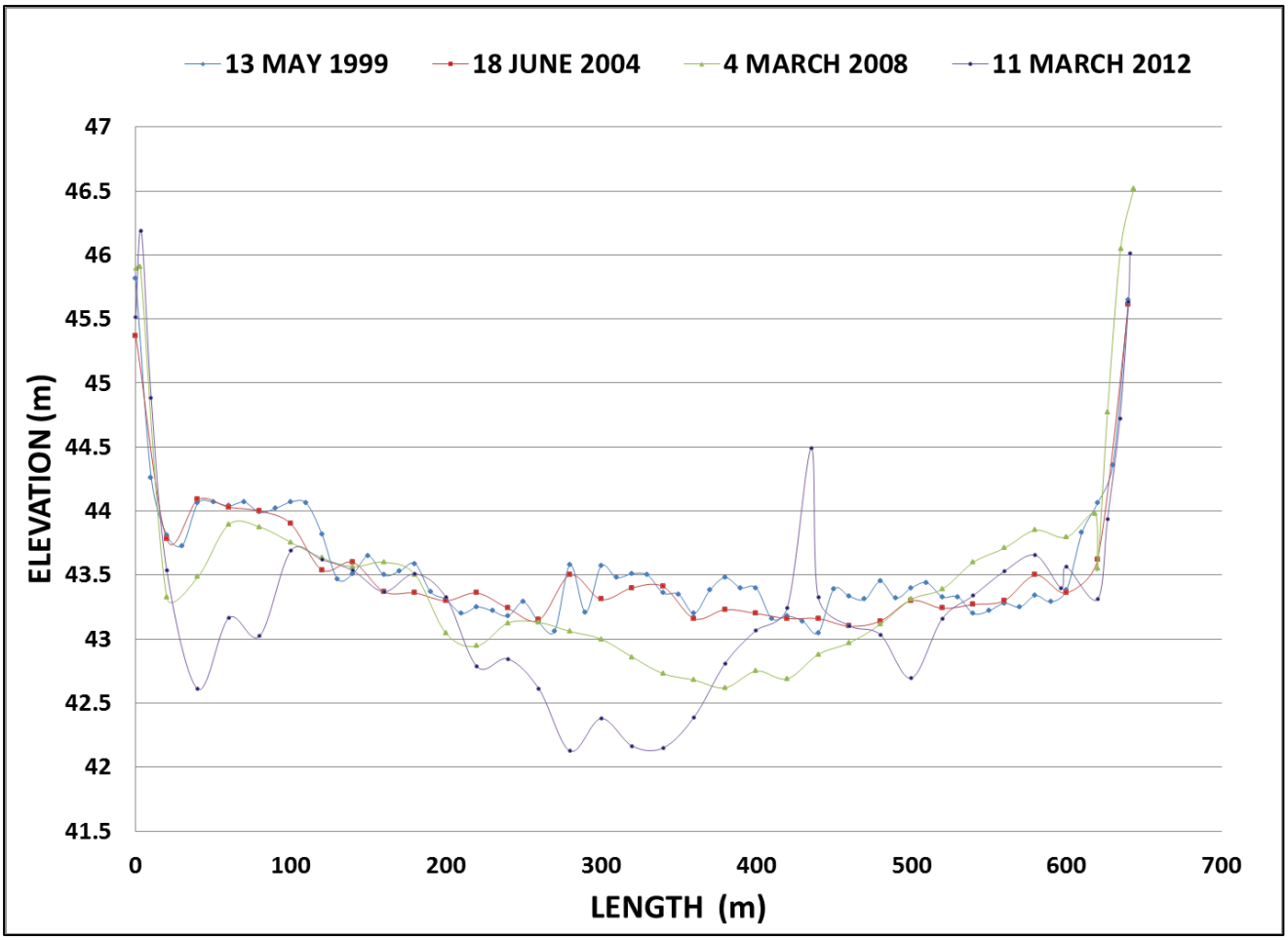


Figure 21: Comparison of Ponniyar river cross-section in different years at Villupuram gauging station

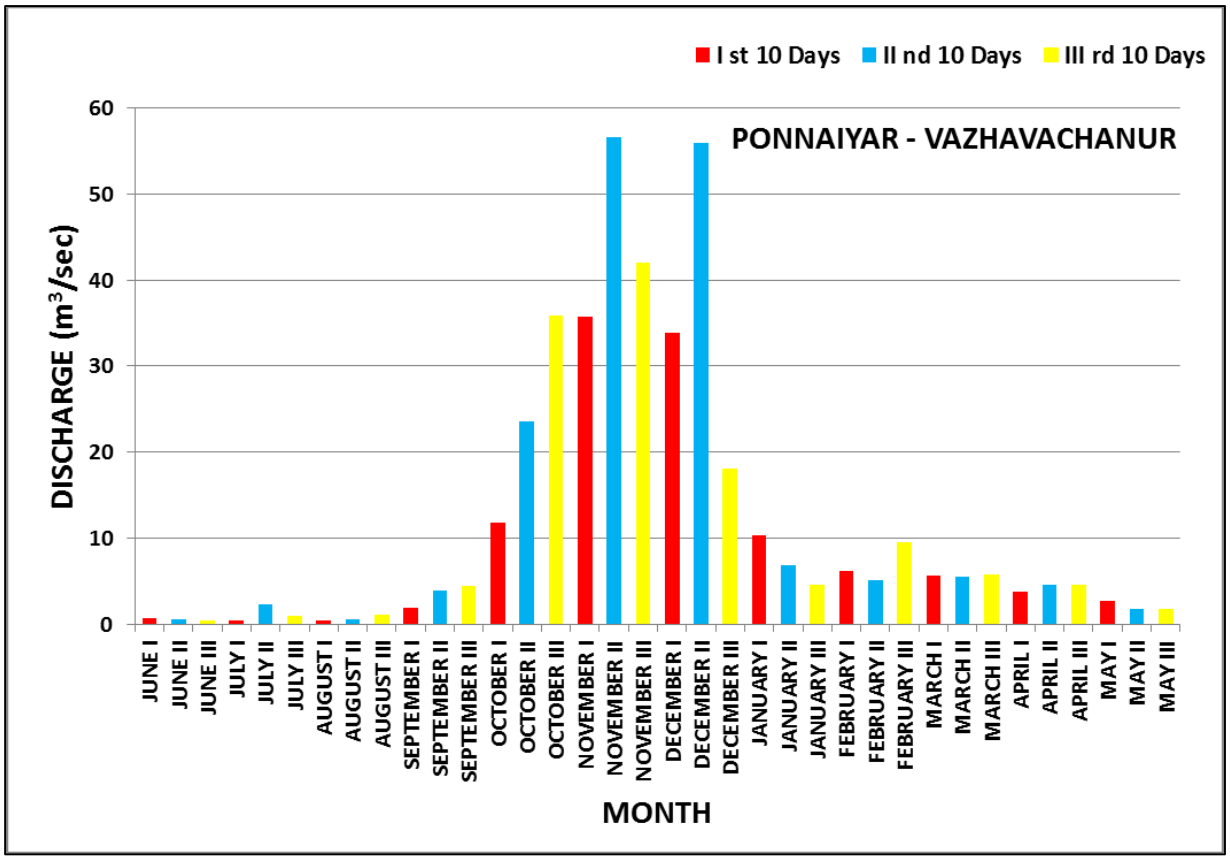


Figure 22: Average 10 daily discharges at Vazhavachanur gauging site on Ponniyar River

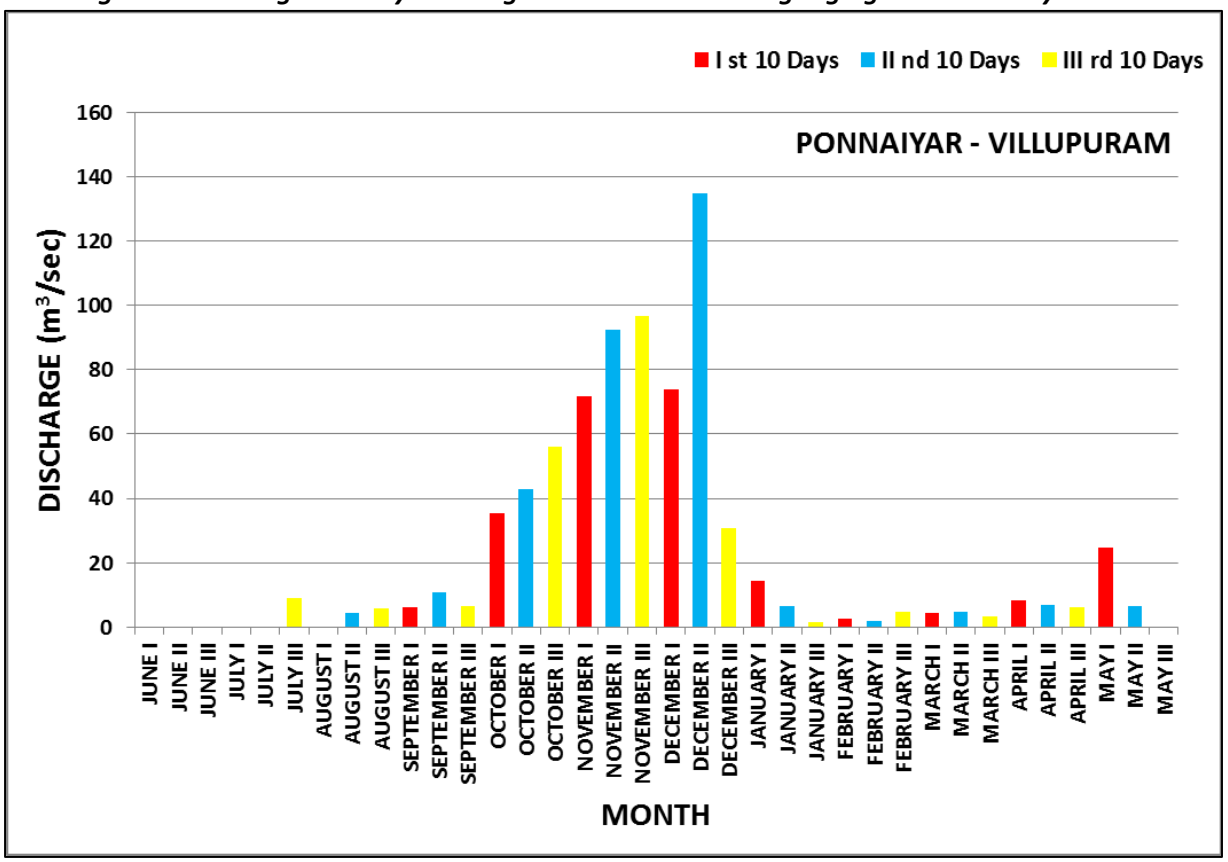


Figure 23: Average 10 daily discharges at Villupuram gauging site on Ponniyar River

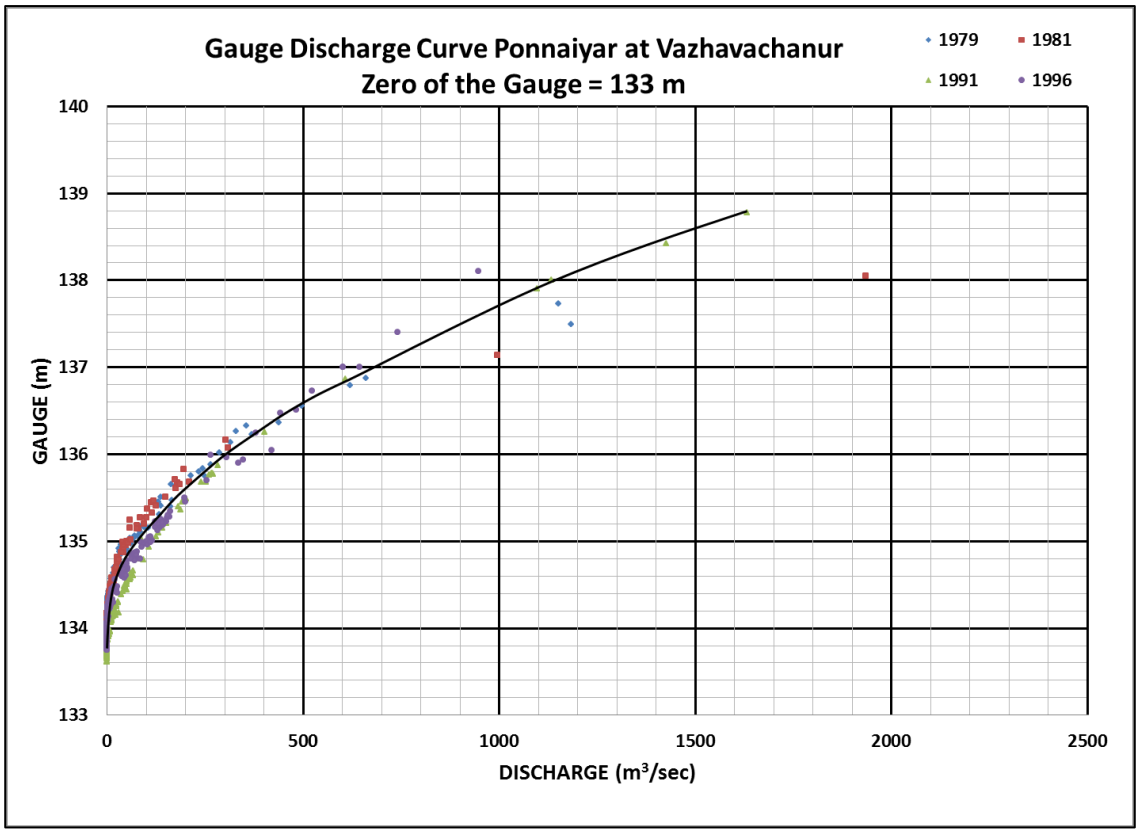


Figure 24: Gauge discharge curve for River Ponniyar at Vazhavachanur gauge station

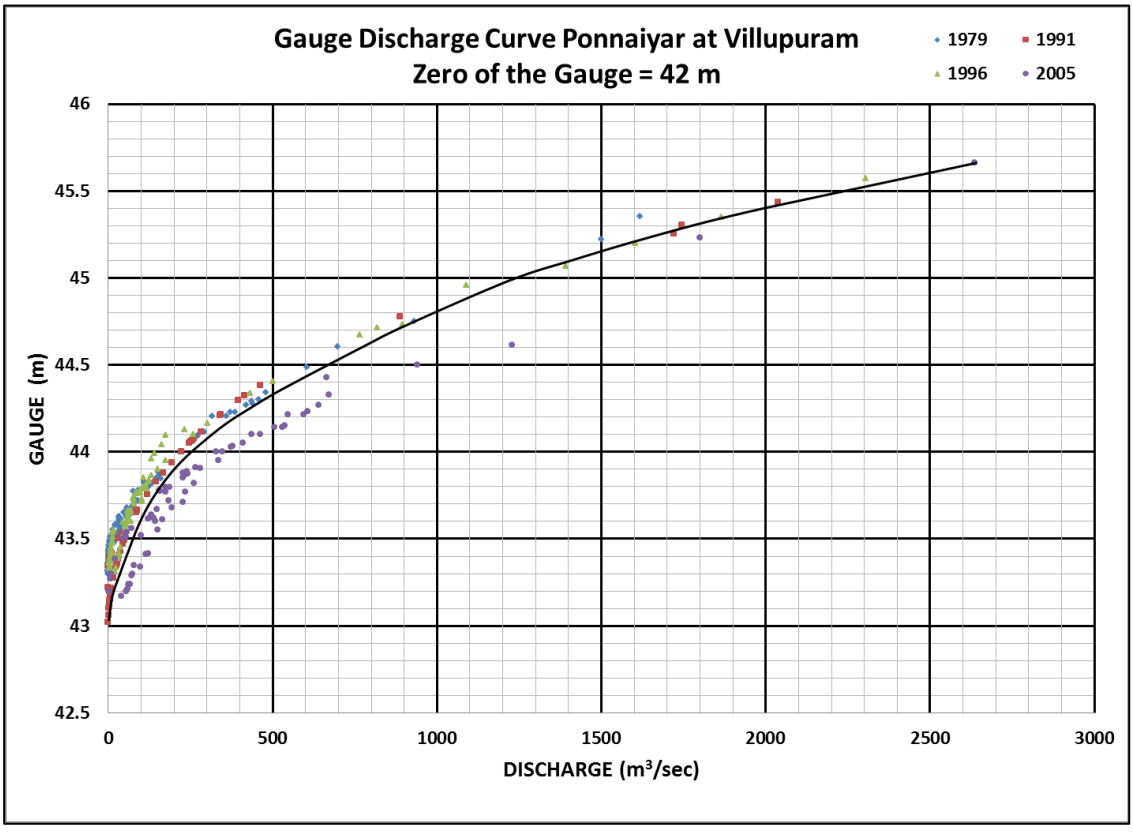


Figure 25: Gauge discharge curve for River Ponniyar at Villupuram gauge station

YEAR	JUNE			JULY			AUGUST			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER			JANUARY			FEBRUARY			MARCH			APRIL			MAY		
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
1978-1979	1.24	0.92	0.28	0.20	16.67	0.07	0.09	0.05	0.03	0.22	0.36	6.84	0.34	0.36	24.66	23.50	2.18	11.17	7.74	18.90	26.55	14.59	5.51	3.56	2.96	3.17	15.05	2.72	12.54	7.85	3.05	9.98	12.20	4.34	3.39	10.34
1979-1980	2.89	0.60	0.28	0.19	0.47	0.25	0.16	0.10	1.26	10.14	6.08	2.33	66.25	56.17	10.39	18.01	505.53	268.65	58.12	48.58	17.45	5.28	2.99	2.36	1.91	3.61	10.62	2.99	13.78	10.32	16.80	7.71	7.75	1.90	4.62	3.52
1980-1981	0.93	0.37	0.21	0.19	0.23	0.40	0.34	0.27	0.15	0.10	0.09	0.11	0.06	0.09	0.45	0.13	1.45	0.56	0.25	0.12	0.10	0.10	5.59	5.62	0.65	0.57	0.59	0.59	0.66	0.59	0.55	0.17	0.18	0.33	0.73	0.50
1981-1982	0.27	0.11	0.13	0.08	0.85	0.20	0.05	0.00	2.57	1.63	56.31	14.04	102.44	42.84	233.01	186.86	38.61	5.85	26.71	4.01	4.49	1.82	1.90	5.29	2.32	7.73	12.71	2.60	3.38	15.76	2.21	2.44	10.83	1.68	2.00	1.00
1982-1983	0.81	2.32	0.35	0.32	0.25	0.12	0.97	0.15	0.09	0.27	1.24	0.18	0.15	0.14	0.19	0.67	0.29	0.15	0.10	0.10	0.05	0.05	0.04	0.01	-	_	_	_	_	_	_	_	_	_	1.54	0.09
1983-1984	0.05	1.00	0.04	0.00		0.91	0.15	0.06	2.95	1.11	11.89	1.40	0.51	14.09	15.92	24.17	2.33	0.61	0.70	29.41	37.03	6.17	2.65	1.12	2.86	7.73	3.84	4.97	2.54	2.15	2.38	12.06	4.89	1.44	1.10	0.73
1984-1985	0.60	0.54	0.34	0.37	0.53	8.01	1.10	0.39	0.49	0.33	0.32	1.77	2.96	1.23	2.24	1.52	13.77	2.56	18.42	35.34	5.39	10.95	2.85	1.67	19.85	3.54	0.83	0.80	0.51	8.32	0.41	0.35	0.20	0.14		
1985-1986	0.65	0.15	_	_	0.14	0.36	0.09	0.00	1.87	0.57	0.13	5.24	1.61	0.50	5.65	26.69	4.26	2.89	2.83	1.21	0.57	0.45	21.13	1.80	0.50	0.36	12.63	24.77	0.23	0.13						0.87
1986-1987	-	-	-	-	-	-	-	-	-	_	0.08	0.30	27.13	39.42	0.40	2.01	16.12	25.57	7.23	1.52	21.67	5.89	1.41	1.79	27.01	1.74	1.89	1.26	1.54	2.35	1.14	0.99	0.54	0.22	0.11	0.47
1987-1988	0.22		0.44				0.23	0.41	0.06	0.28	0.45	0.67	3.01	5.83	53.35	28.82	1.22	1.31	6.54	5.70	7.40	2.69	1.34	1.17	22.82	21.27	1.01	0.38	0.58	2.00	0.69	0.55	0.44	0.29	0.21	0.22
1988-1989	0.23	0.09	0.07	0.74	0.36	0.17	0.68	0.37	0.87	0.84	1.16	1.04	1.51	67.15	60.28	1.20	0.54	1.50	0.44	17.83	0.51	0.88	0.90	0.33	0.99	0.58	0.43	0.65	0.89	0.30	0.14	0.08	0.05	0.05	0.07	0.22
1989-1990	0.09	0.05	0.03	0.93	0.11	0.04	0.03	_	_	_	0.44	0.27	0.15	0.23	28.45	0.76	1.50	0.31	0.42	0.27	0.12	11.08	0.33	0.16	_	_	_	_	_	_	_	_	_	_	_	_
1990-1991	-	-	-	-	-	-	-	-	-	-	0.15	0.22	0.02	0.00	0.22	0.17	0.10	0.18	0.31	0.10		9.55	_	_	-	-	-	-	-	-	-	-	-	-	-	-
1991-1992	_	_	0.01	_	_	_	_	_	_	_	0.38	2.97	1.28	0.41	33.00	204.29	632.06	146.62	53.45	26.78	13.82	7.41	1.22	1.23	36.46	0.98	12.36	4.53	1.13	0.80	15.15	0.93	1.10	13.85	0.92	0.27
1992-1993	1.84	1.81	1.91	2.15	1.93	1.97	1.97	1.97	1.97		1.94	1.95	2.37	2.08	1.76	2.84	153.81	33.02	15.94	8.73	4.96	2.48	12.32	23.53	1.35	1.47	16.35	7.50	1.17	1.47	1.03	15.55	1.33	0.42	0.24	11.69
1993-1994	0.18	0.14	0.17	0.17	_	_	_	_	_	_	_	0.28	1.07	1.28	0.46	1.66	4.41	2.03	197.42	35.16	35.08	12.81	1.31	1.09	1.43	19.03	19.46	2.40	2.26	3.43	14.07	5.37	12.59	1.15	7.15	6.21
1994-1995	0.40	0.18		0.11	_	_	_	0.31	0.73	0.19	1.20	0.43	0.31	0.68	3.00	43.70	17.10	8.27	3.37	2.25	37.55	7.53	3.64	2.29	2.24	2.03	2.05	2.50	2.43	2.33	7.51	3.42	0.48	1.98	0.94	0.53
1995-1996	0.36	0.27	0.40	0.02	0.22	0.02	_	_	0.60	0.10	0.05	0.39	0.31	0.28	0.33	0.34	0.25	24.27	46.83	10.52	0.33	9.16	6.37	0.36	0.25	0.46	0.28	0.35	0.14	0.09	0.03	0.43	0.13	0.04		0.16
1996-1997	1.61	1.73	0.17	_	_	_	_	0.24	0.63	12.19	6.42	48.71	102.31	192.15	142.60	34.17	14.90	42.76	49.68	522.17	105.52	41.76	25.32	6.26	4.83	3.86	6.86	13.47	9.19	16.77	3.26	12.32	6.67	5.97	2.68	0.00
1997-1998		0.14	_	_	_	_	0.06	0.39	0.06	_	_	0.63	1.32	1.41	13.86	85.52	121.02	208.90	162.05	114.88	67.89	20.56	4.12	2.71	2.50	2.25	19.82	7.78	6.63	2.96	2.00	8.16	10.29	1.85	1.24	0.65
1998-1999	0.44	0.37	0.30	0.26	1.37	1.51	0.46	0.96	4.35	2.39	0.88	0.91	5.20	122.57	30.40	95.29	56.71	15.47	57.59	169.32	27.70	9.88	3.52	3.42	3.69	5.16	18.57	2.63	2.72	1.96	1.90	2.00	6.44	5.89	1.33	0.71
1999-2000	0.84	0.44	0.30	0.43	0.71	0.37	0.24	0.84	0.53	0.35	0.40	0.46	0.58	0.58	51.59	31.07	31.72	4.78	4.57	8.98	5.24	0.81	1.29	6.37	10.43	8.87	2.95	2.42	13.31	11.58	2.35	11.39	14.31	1.03	0.63	0.88
2000-2001	0.34		0.09	0.01	_	_	0.39	0.14	_	_	_	_	1.32	67.93	109.74	20.89	19.62	2.02	5.10	0.99	1.93	16.66	14.71	1.93	2.35	1.90	2.03	2.35	6.15	13.47	2.84	4.70	1.10	0.55	0.58	0.49
2001-2002	-	-	-	-	-	0.84	-	-	-	-	1.16	0.21	25.12	101.77	47.59	19.31	14.39	2.08	3.67	42.55	8.16	_	_	_	_	_	_	1.74	1.42	_	_	_	_	_	_	_
2002-2003	-	-	-	-	-	-	-	-	-	-	-	-	-	0.25	0.43	2.15	0.67	_	_	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2003-2004	_	_	_	_	_	_	0.22	1.10	0.31	_	_	_	_	1.38	2.23	2.42	2.11	1.69	1.69			3.35	25.88	_	_	_	_	_	_	_	_	_	_	8.45	6.27	0.28
2004-2005	_	_	_	_	_	_	_	_	_	_	_	0.94	0.40		12.25	43.83	34.24	19.91	10.34	5.45	2.14	34.81	19.99	1.07	1.31	0.98	1.04	4.25	9.15	2.05	3.87	4.89	5.53	5.49		
2005-2006	_	_	_	_	_	_	_	_	_	_	_	33.98	1.26	0.79	217.72	186.21	69.46	373.87	154.56	255.74	54.81	21.71	7.45	3.28	0.49	0.51	0.99	10.46	1.39	0.13	_	_	_	_	_	_
2006-2007	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				-	-	14.30	0.29	-	-	-	-	-	-	-	-	-	-	
2007-2008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		332.80	14.89	-	-	-	-	-	19.76	4.92	-	-	-	-	-	-	-	0.56
2008-2009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26.70	67.70	16.08	3.62	3.73	3.70	1.39	11.11	18.05	26.50	10.64	2.59	1.48	1.08	1.36	1.57	1.74	1.34	1.32
2009-2010	0.89	0.38	_	_	_	_	_	_	_	_	0.54	0.94	0.77	0.52		1.66	14.87	7.85	8.24	13.20	15.95	6.67	5.42	3.16	2.08	11.76	26.59	29.45	1.85	1.28	1.36	1.13	1.23	2.86	1.69	1.03
2010-2011	_	_	3.91	1.51	2.08	1.10	0.47	0.51	0.93	0.16	3.26	1.24	1.16	0.37	1.75	40.45	30.52	80.89	95.25	48.69	23.37	13.93	7.74	5.82	4.65	1.30	19.69	4.57	4.89	27.61	3.80	3.03	8.69	3.82	1.03	2.41
2011-2012	0.96	0.49	0.03	_	_	_	_	1.86	0.74	0.26	0.58	0.60	1.24	5.76	1.99	9.59	3.16	19.00	14.32	10.13	15.04	37.09	14.04	7.03	5.19	3.44	1.71	9.98	49.40	11.88	1.91	1.92	2.66	2.37	1.85	0.52
2012-2013	_	_	_	_	9.14	0.36	_	_	1.68	_	_	0.88	1.64	1.07	8.10	5.40	1.21	2.26	2.50	1.11	0.61	0.49	0.23	26.65	0.14	_	_	0.20	0.22	_	_	_	_	_	_	_
MAXIMUM	2.89	2.32	3.91	2.15	16.67	8.01	1.97	1.97	4.35	12.19	56.31	48.71	102.44	192.15	233.01	204.29	632.06	373.87	197.42	522.17	105.52	41.76	25.88	26.65	36.46	21.27	26.59	29.45	49.40	27.61	16.80	15.55	14.31	13.85	7.15	11.69
MINIMUM	0.05	0.05	0.01	0.00	0.11	0.02	0.03	0.00	0.03	0.10	0.05	0.11	0.02	0.00	0.19	0.13	0.10	0.15	0.10	0.10	0.05	0.05	0.04	0.01	0.14	0.36	0.28	0.20	0.14	0.09	0.03	0.08	0.05	0.04	0.07	0.00
AVERAGE	0.75	0.61	0.47	0.45	2.34	0.98	0.43	0.51	1.09	1.83	3.86	4.48	11.79	23.53	35.94	35.79	56.57	41.99	33.88	55.89	18.06	10.33	6.83	4.56	6.17	5.09	9.50	5.65	5.45	5.73	3.73	4.62	4.63	2.71	1.81	1.76

Table 29: Mean 10 daily discharges (in cumecs) for Vazhavachanur

- DATA NOT AVAILABLE

YEAR	JUNE			JULY			AUGUST			SEPTEMBER			OCTOBER			NOVEMBER			DECEMBER			JANUARY			FEBRUARY			MARCH			APRIL			MAY		
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
1970-1971	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1971-1972	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1972-1973	-	-	-	-	-	-	-	-	-	-	-	-	11.85		15.48	49.26	4.81	0.51	221.10	114.65	33.32	23.12	13.29	3.76	4.91	0.06	0.24	2.11	0.18	-	-	10.15	4.08	-	-	-
1973-1974	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1974-1975	-	-	-	-	-	-	-	-	-	-	-	-	-	27.47	34.17	33.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1975-1976	-	-	-	-	-	-	-	-	-	-	-	-	3.28	0.82	0.83	171.72	69.93	26.11	4.52	1.15	0.59	0.18	19.17	5.35	1.01	0.08	0.00	-	-	-	-	-	-	-	-	-
1976-1977	-	-	-	-	-	-	-	-	-	-	-	-	1.84	1.72	0.93	0.56	23.41	4.35	2.67	1.83	0.72	0.20	0.10	0.10	16.51	1.50	-	-	-	-	-	-	-	-	-	-
1977-1978	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36.12	107.08	561.29	461.02	115.90	28.18	6.21	1.36	0.72	0.18	-	-	-	5.88	-	-	-	-	-	-	-	-
1978-1979	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	149.11	3.49	6.23	1.21	10.88	39.55	30.68	1.92	0.62	-	-	18.67	1.54	-	-	-	-	-	-	-	-
1979-1980	-	-	-	-	-	-	-	-	-	-	6.00	0.84	23.55	30.51	6.25	8.08	583.99	435.12	110.63	88.44	32.62	11.93	2.54	0.33	-	-	-	-	-	-	-	-	-	-	-	-
1980-1981	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1981-1982	-	-	-	-	-	-	-	-	-	-	35.12	9.62	142.09	23.69	88.50	209.29	38.85	0.97	22.54	0.55	0.37	0.10	0.03	0.27	0.07	-	-	-	-	-	-	-	-	-	-	-
1982-1983	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1983-1984	-	-	-	-	-	-	-	-	-	-	9.50	-	-	0.00	3.37	9.28	0.35	6.20	0.18	22.63	154.65	4.98	1.53	0.42	1.50	10.98	4.29	9.21	3.09	0.29	-	-	-	-	-	-
1984-1985	-	-	-	-	-	8.98	-	-	-	-	-	8.50	11.95	2.58	-	-	36.45	0.50	8.90	11.91	0.40	11.28	1.01	0.51	1.67	2.66	-	-	-	-	-	-	-	-	-	-
1985-1986	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.47	43.69	4.69	12.84	0.58	0.05		35.11	1.54	0.41	0.00	-	5.76	0.61	-	-	-	-	-	-	-
1986-1987	-	-	-	-	-	-	-	-	-	-	-	-	12.03	16.11	2.73	0.40	2.86	4.50	3.68	0.00	12.83	6.98	0.65	-	6.94	-	-	-	-	-	-	-	-	-	-	-
1987-1988	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26.28	9.99	0.00	0.34	42.63	8.16	3.90	0.98	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1988-1989	-	-	-	-	-	-	-	-	-	-	-	-	-	25.58	16.65	6.38	0.99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1989-1990	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1990-1991	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1991-1992	-	-	-	-	-	-	-	-	-	-	-	-	-	-	58.44	221.73	731.81	159.37	31.43	7.10	3.40	0.02	-	-	0.88	0.09	-	-	-	-	-	-	-	-	-	-
1992-1993	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	225.04	75.23	4.69	1.72	0.19	-	-	2.31	-	-	-	-	-	-	-	-	-	-	-	-
1993-1994	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.02	-	498.77	30.35	29.74	7.66	4.87	-	-	-	4.50	5.22	-	-	-	-	-	-	-	-
1994-1995	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	129.10	16.47	4.26	0.97	-	4.88	4.01	-	-	-	-	-	-	-	-	-	-	6.83	0.00	-
1995-1996	-	-	-	-	-	-	-	-	-	-	-	6.53	1.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1996-1997	-	-	-	-	-	-	-	-	-	-	-	18.24	101.95	158.49	122.51	9.12	6.42	63.17	67.32	1251.14	76.44	34.75	20.15	5.12	0.43	-	-	-	-	-	-	-	12.10	42.83	13.22	-
1997-1998	-	-	-	-	-	-	-	-	-	-	1.61	0.45	3.47	-	15.78	83.71	61.28	260.38	244.60	213.60	109.81	35.83	1.50	-	-	-	-	-	-	-	-	-	-	-	-	-
1998-1999	-	-	-	-	-	-	-	4.50	5.88	6.18	1.05	0.00	4.66	123.62	22.75	133.24	106.94	21.60	16.42	327.62	88.32	51.67	3.60	1.05	0.41	0.21	0.59	0.44	0.00	-	-	-	-	-	-	-
1999-2000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	157.90	14.23	0.16	13.34	3.99	3.27	2.81	0.79	0.40	0.02	-	-	-	-	-	-	-	-	-	-	-	-
2000-2001	-	-	-	-	-	-	-	-	-	-	-	-	-	82.18	110.28	4.47	0.51	1.53	1.47	0.09	0.12	0.77	0.56	0.16	-	-	-	-	-	-	-	-	-	-	-	-
2001-2002	-	-	-	-	-	-	-	-	-	-	-	-	105.10	63.20	22.93	12.19	5.90	2.41	-	-	0.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2002-2003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2003-2004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2004-2005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	158.40	102.41	51.34	6.17	1.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2005-2006	-	-	-	-	-	-	-	-	-	-	-	-	-	-	371.80	300.51	52.10	740.77	232.62	404.35	89.15	36.41	13.70	0.94	0.02	-	-	-	12.57	-	-	3.84	1.98	-	-	-
2006-2007	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.93	0.14	9.59	3.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2007-2008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	848.41	130.17	4.00	0.41	-	-	-	-	-	-	-	8.32	-	-	-	-	-

2008-2009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	166.21	111.27	29.03	5.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2009-2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10.50			1.31	3.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2010-2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	75.37	25.02	113.42	148.00	98.44	32.05	10.00	2.26	0.65	0.04	0.00	-	-	-	-	-	-	-	-	-
2011-2012	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.99	14.42	2.38	26.90	8.84	5.58	2.03	52.33	10.98	5.14	-	-	-	-	11.18	6.03	-	-	-	-	-
MAXIMUM	-	-	-	-	-	8.98	-	4.50	5.88	6.18	35.12	18.24	142.09	158.49	371.80	300.51	731.81	740.77	498.77	1251.14	154.65	52.33	35.11	5.35	16.51	10.98	18.67	9.21	12.57	6.03	8.32	10.15	12.10	42.83	13.22	0.00
MINIMUM	-	-	-	-	-	8.98	-	4.50	5.88	6.18	1.05	0.00	1.62	0.00	0.83	0.14	0.00	0.34	0.18	0.00	0.05	0.02	0.03	0.02	0.02	0.00	0.00	0.44	0.00	0.29	8.32	3.84	1.98	6.83	0.00	0.00
AVERAGE	-	-	-	-	-	8.98	-	4.50	5.88	6.18	10.66	6.31	35.28	42.77	55.99	71.68	92.33	96.61	73.78	135.04	30.85	14.35	6.41	1.58	2.68	1.73	4.72	4.31	4.60	3.16	8.32	7.00	6.05	24.83	6.61	-

Table 30: Mean 10 daily discharges (in cumecs) for Villupuram

- DATA NOT AVAILABLE

4.16 Monthly minimum and maximum Water levels

The gauge-discharge data at Vazhavachanur available from 1978-2012 is analyzed in different ways. The monthly minimum and maximum water levels for the entire period of data were taken and are tabulated below.

YEAR	JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY	
	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL
1978-1979	134.115	134.015	134.99	133.95	133.995	133.945	135.04	133.935	134.82	134.05	135.4	134.085	135.16	134.13	134.75	134.18	134.88	134.26	134.75	134.32	134.74	134.25	134.57	134.28
1979-1980	134.47	134.12	134.28	134.09	134.57	134.07	135.19	134.06	135.88	134.13	137.735	134.34	135.16	134.5	134.5	134.2	134.67	134.22	134.69	134.21	134.67	134.16	134.43	134.05
1980-1981	134.26	134.07	134.25	134.01	134.105	133.99	134.07	133.96	134.27	134.005	134.41	134.025	134.17	134.01	134.63	134.03	134.17	134.14	134.2	134.11	134.13	134.05	134.34	134.01
1981-1982	134.11	134.01	134.42	133.98	134.515	133.955	135.83	134.02	138.05	134.125	137.14	134.145	135.15	134.2	134.465	134.17	134.695	134.185	134.63	134.2	134.54	134.22	134.27	134.14
1982-1983	134.4	134.09	134.18	134.05	134.36	134.03	134.47	134.04	134.13	134.03	134.23	134.06	134.085	134.055	134.07	134.02	134.03	133.92	133.92	133.9			134.57	134
1983-1984	134.385	134	134.36	133.97	134.525	134	135.025	134.07	134.83	134.14	134.82	134.13	135.585	134.145	134.43	134.13	134.53	134.12	134.47	134.21	134.6	134.19	134.21	134.14
1984-1985	134.135	134.09	134.665	134.06	134.205	134.11	134.41	134.1	134.505	134.18	135.276	134.21	135.14	134.28	134.96	134.31	134.82	134.27	134.75	134.23	134.235	134.18	134.185	134.14
1985-1986	134.195	133.93	134.03	133.92	134.41	133.9	134.7	133.96	135	133.985	135.02	134.06	134.29	133.93	134.925	133.92	134.9	133.86	134.89	133.81	133.81	133.78	134.38	133.74
1986-1987	133.83	133.72	133.85	133.68	133.85	133.67	134.01	133.69	135.01	133.83	134.96	133.85	134.965	133.95	134.82	133.91	134.95	133.95	134.41	133.86	133.96	133.81	134.01	133.75
1987-1988	133.95	133.705	133.8	133.52	133.94	133.645	133.975	133.72	135.2	133.84	135.03	134.015	134.645	133.985	134.19	134.01	134.78	133.965	134.33	133.97	134.1	133.94	133.97	133.92
1988-1989	133.995	133.83	134.16	133.78	134.12	133.83	134.13	133.89	135.12	133.92	134.36	133.94	134.65	133.93	134.02	133.875	134.005	133.9	134.095	133.85	133.86	133.64	133.92	133.64
1989-1990	133.835	133.625	134.06	133.69	133.72	133.645	133.92	133.78	135.05	133.745	135.05	133.745	134.23	133.835	133.9	133.76	134.77	133.71	133.78	133.615	133.78	133.615	133.78	133.65
1990-1991	-	-	-	-	-	-	133.905	133.725	133.9	133.9	133.84	133.71	133.9	133.63	135.03	133.68	133.77	133.7						
1991-1992	133.842	133.692	133.75	133.68	133.78	133.61	134.155	133.625	135.156	133.76	138.782	133.962	134.657	133.98	134.18	133.85	134.617	133.78	134.15	133.83	134.22	133.84	134.16	133.75
1992-1993	133.871	133.68	134.032	133.68	133.708	133.68	133.942	133.66	134.008	133.77	136.474	133.75	134.325	133.94	134.6	133.88	134.43	133.87	134.29	133.86	134.29	133.84	134.29	133.78
1993-1994	133.88	133.74	133.74	133.71	-	-	133.91	133.835	134.045	133.879	134.206	133.9	137.137	133.97	134.313	133.97	134.55	133.98	134.3	134	134.3	134.01	134.28	133.86
1994-1995	133.89	133.77	133.88	133.73	133.94	133.72	134.03	133.78	134.29	133.81	135.55	133.92	134.67	134.06	134.64	134.05	134.08	134.05	134.16	134	134.32	133.95	134.2	133.94
1995-1996	133.99	133.87	133.99	133.84	134.09	133.83	133.97	133.85	133.96	133.87	134.63	133.895	134.72	133.915	134.61	133.91	133.99	133.83	133.96	133.82	134.11	133.8	134.1	133.78
1996-1997	134.42	133.75	133.95	133.83	134.2	133.75	135.94	133.94	137	134.56	135	134.13	138.1	134.21	134.78	133.95	134.3	133.9	134.37	133.97	134.37	133.89	134.28	133.84
1997-1998	133.88	133.8	133.82	133.78	133.87	133.69	133.93	133.7	134.9	133.84	136.4	134.38	135.81	134.46	134.57	133.99	134.59	133.97	134.4	133.98	134.45	133.98	134.06	133.9
1998-1999	133.91	133.83	134.18	133.8	134.32	133.85	134.16	133.89	136.2	133.92	135.6	134.12	136.35	134.22	134.29	133.94	134.35	133.93	134	133.89	134.14	133.85	134.15	133.78
1999-2000	133.9	133.73	133.87	133.69	133.96	133.66	133.83	133.69	136.01	133.715	134.825	133.89	134.41	133.9	134.33	133.84	134.51	133.91	134.48	133.96	134.5	133.91	134.11	133.84
2000-2001	133.91	133.77	133.86	133.68	133.95	133.64	133.82	133.55	136.21	133.79	134.45	133.8	134.34	133.71	134.43	133.81	133.85	133.77	134.41	133.83	134.1	133.74	133.76	133.68
2001-2002	133.68	133.5	133.92	133.41	133.66	133.54	133.87	133.58	135.95	133.69	134.95	133.74	134.5	133.67	133.81	133.74	133.81	133.8	133.97	133.79	133.85	133.8	133.82	133.65
2002-2003	133.77	133.55	133.53	133.38	133.7	133.35	133.63	133.38	133.915	133.53	134.06	133.56	133.56	133.41										
2003-2004					133.9	133.48	133.6	133.47	134.24	133.515	133.94	133.75	133.9	133.52	134.6	133.56	133.65	133.51	133.51	133.37			134.28	133.6
2004-2005	133.66	133.48	133.48	133.36			133.915	133.5	135.055	133.56	135.04	134.07	134.36	133.895	134.5	133.87	133.95	133.87	134.35	133.88	134.13	133.96	134.17	133.7

2005-2006	133.78	133.5	133.51	133.505	133.61	133.57	134.798	133.54	137.005	133.5	137.375	133.89	136.99	134.27	134.27	133.63	133.84	133.63	134.15	133.55	134.31	133.48	133.62	133.52
2006-2007	133.56	133.48	133.5	133.5	133.85	133.5			133.79	133.55	133.96	133.5	133.77	133.5	134.46	133.5	133.7	133.55						
2007-2008											134.4	133.53	136.25	133.77	133.71	133.55	134.42	134	134	133.57	133.9	133.55	133.8	133.6
2008-2009											136.35	133.57	135.95	133.73	133.99	133.8	134.57	133.82	134.45	133.9	133.98	133.88	133.985	133.92
2009-2010	133.95	133.77	133.8	133.51			134.1	133.76	133.88	133.7	135.105	133.72	134.74	134.11	134.24	134.07	134.79	133.96	134.83	133.95	134.02	133.945	134.115	133.73
2010-2011	134.43	133.71	134.165	133.75	134.04	133.9	134.325	133.89	134.12	133.95	135.72	134.13	135.735	134.32	134.35	134.13	134.71	134.01	134.75	134	134.54	134.07	134.12	133.96
2011-2012	134.01	133.78	133.99	133.77	134.165	133.8	134.03	133.84	134.7	133.94	135.105	134.06	135.605	134.175	135.1	134.18	134.33	134.05	135.21	134.06	134.14	134.05	134.16	133.92
2012-2013	133.92	133.78	134.57	133.86	134.125	133.79	134.05	133.79	134.52	133.83	134.34	133.83	134.15	133.78	134.93	133.72	133.74	133.68	133.78	133.64				
MAXIMUM	134.47	134.12	134.99	134.09	134.57	134.11	135.94	134.1	138.05	134.56	138.782	134.38	138.1	134.5	135.1	134.31	134.95	134.27	135.21	134.32	134.74	134.25	134.57	134.28
MINIMUM	133.56	133.48	133.48	133.36	133.61	133.35	133.6	133.38	133.79	133.5	133.84	133.5	133.56	133.41	133.71	133.5	133.65	133.51	133.51	133.37	133.78	133.48	133.62	133.52

Table 31: Monthly Minimum and Maximum Water levels at Vazhavachanur

- DATA NOT AVAILABLE

The gauge-discharge data at Villupuram available from 1970-2011 is analyzed in different ways. The monthly minimum and maximum water levels for the entire period of data were taken and are tabulated below.

YEAR	JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY	
	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL	WL
1970-1971	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43.46	43.36	43.55	43.34	43.63	43.38
1971-1972	-	-	43.48	43.35	43.74	43.34	43.415	42	43.825	43.38	43.695	43.42	44.95	43.42	43.58	43.395	43.5	43.385	42.7	42.3	43.58	43.32	43.6	43.375
1972-1973	-	-	-	-	-	-	-	-	43.4	42.22	43.245	42.3	45.415	42.32	42.47	42.155	42.225	42.11	42.23	42.09	42.34	42.06	42.345	42.14
1973-1974	-	-	-	-	42.24	42.165	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1974-1975	-	-	-	-	-	-	-	-	42.675	42.37	42.5	42.5	-	-	-	-	-	-	-	-	-	-	-	-
1975-1976	-	-	-	-	-	-	-	-	43.4	43.2	44.4	43.325	43.485	43.355	43.47	43.28	43.39	43.25	-	-	-	-	-	-
1976-1977	-	-	-	-	-	-	-	-	43.55	43.25	43.635	43.24	43.375	43.27	43.26	43.23	43.42	43.27	-	-	-	-	-	-
1977-1978	-	-	-	-	-	-	-	-	43.62	43.44	45.7	43.435	44.06	43.33	43.39	43.23	-	-	43.53	43.3	-	-	-	-
1978-1979	-	-	-	-	-	-	-	-	-	-	44.2	43.195	43.795	43.22	43.79	43.3	43.58	43.51	43.415	43.34	-	-	-	-
1979-1980	-	-	-	-	-	-	43.58	43.325	43.82	43.31	45.353	43.425	43.883	43.48	43.5	43.27	-	-	-	-	-	-	-	-
1980-1981	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1981-1982	-	-	-	-	-	-	43.86	43.36	44.26	43.365	44.338	43.23	43.675	43.185	43.265	43.11	43.2	43.11	-	-	-	-	-	-
1982-1983	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1983-1984	-	-	-	-	-	-	43.69	43.16	43.42	43.19	43.655	43.17	44.123	43.12	43.545	43.12	43.6	43.1	43.65	43.18	-	-	-	-
1984-1985	-	-	43.645	43.26	-	-	43.48	43.48	43.655	43.155	43.84	43.28	43.71	43.275	43.64	43.24	43.51	43.26	-	-	-	-	-	-
1985-1986	-	-	-	-	-	-	-	-	-	-	43.856	43.3	43.68	43.235	43.815	43.31	43.31	43.245	43.5	43.26	-	-	-	-
1986-1987	-	-	-	-	-	-	-	-	43.665	43.265	43.575	43.265	43.65	43.26	43.57	43.3	43.6	43.28	-	-	-	-	-	-
1987-1988	-	-	-	-	-	-	-	-	43.843	43.52	43.58	43.29	43.86	43.35	43.35	43.22	-	-	-	-	-	-	-	-
1988-1989	-	-	-	-	-	-	-	-	43.77	43.375	43.57	43.3	-	-	-	-	-	-	-	-	-	-	-	-
1989-1990	-	-	-	-	-	-	-	-	43.73	43.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1990-1991	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1991-1992	-	-	-	-	-	-	-	-	43.667	43.472	45.434	43.222	43.493	43.02	43.005	42.948	43.1	42.943	-	-	-	-	-	-
1992-1993	-	-	-	-	-	-	-	-	-	-	44.3	43.19	43.235	42.957	43.17	42.943	-	-	-	-	-	-	-	-
1993-1994	-	-	-	-	-	-	-	-	-	-	43.13	42.892	44.947	43.25	43.347	43.12	43.24	43.18	43.15	43.15	-	-	-	-

1994-1995	-	-	-	-	-	-	-	-	-	-	44.288	43.31	43.41	43.2	43.39	43.3	-	-	-	-	-	-	43.41	43.3
1995-1996	-	-	-	-	-	-	43.37	43.37	43.35	43.2	-	-	43.3	43.2	-	-	-	-	-	-	-	-	-	-
1996-1997	-	-	-	-	-	-	43.6	43.33	44.715	43.475	43.9	43.34	45.57	43.31	43.5	43.06	43.04	42.96	-	-	43.405	42.6	43.6	42.95
1997-1998	-	-	-	-	-	-	43.14	43.005	43.6	43.005	44.4	43.3	44.35	43.4	43.55	43.16	43.45	43.12	43.4	43.02	43.13	43.01	43.13	43.01
1998-1999	-	-	-	-	43.33	42.88	43.28	43.02	43.96	43.12	44.16	43.3	44.5	43.29	43.66	43.17	43.3	43.01	43.25	43.11	-	-	-	-
1999-2000	-	-	-	-	-	-	-	-	43.82	43.76	43.57	43.05	43.35	43.18	43.17	42.98	-	-	-	-	-	-	-	-
2000-2001	-	-	-	-	-	-	-	-	43.96	43.27	43.34	43.16	43.26	42.65	43.23	43.05	-	-	-	-	-	-	-	-
2001-2002	-	-	-	-	-	-	-	-	43.82	43.4	43.49	43.17	43.26	43.11	-	-	-	-	-	-	-	-	-	-
2002-2003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2003-2004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2004-2005	-	-	-	-	-	-	-	-	43.89	43.89	44.152	43.16	43.215	43.12	-	-	-	-	-	-	-	-	-	-
2005-2006	-	-	-	-	-	-	-	-	44.43	43.78	45.66	43.2	44.5	43.17	43.2	42.77	42.74	42.72	42.99	42.98	42.87	42.74	-	-
2006-2007	-	-	-	-	-	-	-	-	43.25	43.1	43.51	42.765	42.74	42.57	-	-	-	-	-	-	-	-	-	-
2007-2008	-	-	-	-	-	-	-	-	-	-	-	-	44.25	43.15	43.14	42.71	-	-	-	-	43.42	42.72	-	-
2008-2009	-	-	-	-	-	-	-	-	-	-	44.28	43.215	43.86	42.83	-	-	-	-	-	-	-	-	-	-
2009-2010	-	-	-	-	-	-	-	-	-	-	43.155	42.805	43.1	42.75	-	-	-	-	-	-	-	-	-	-
2010-2011	-	-	-	-	-	-	-	-	-	-	43.7	42.78	43.64	42.75	42.77	42.5	42.5	42.395	-	-	-	-	-	-
2011-2012	-	-	-	-	-	-	-	-	42.69	42.59	43.37	42.56	43.8	42.45	43.3	42.52	-	-	42.8	42.39	42.385	42.34	-	-
MAXIMUM	0	0	43.645	43.35	43.74	43.34	43.86	43.48	44.715	43.89	45.7	43.435	45.57	43.48	43.815	43.395	43.6	43.51	43.65	43.36	43.58	43.34	43.63	43.38
MINIMUM	0	0	43.48	43.26	42.24	42.165	43.14	42	42.675	42.22	42.5	42.3	42.74	42.32	42.47	42.155	42.225	42.11	42.23	42.09	42.34	42.06	42.345	42.14

Table 32: Monthly Minimum and Maximum Water levels at Villupuram

- DATA NOT AVAILABLE

4.17 Yearly minimum and maximum Water levels

Below table shows yearly maximum and minimum water levels at Vazhavachanur gauge site in Ponniyar:

YEAR	MAXIMUM	MINIMUM
	WATER LEVEL (m)	WATER LEVEL (m)
1978-1979	135.4	133.935
1979-1980	137.735	134.05
1980-1981	134.63	133.96
1981-1982	138.05	133.955
1982-1983	134.57	133.9
1983-1984	135.585	133.97
1984-1985	135.276	134.06
1985-1986	135.02	133.74
1986-1987	135.01	133.67
1987-1988	135.2	133.52
1988-1989	135.12	133.64
1989-1990	135.05	133.615
1990-1991	135.03	133.63
1991-1992	138.782	133.61
1992-1993	136.474	133.66
1993-1994	137.137	133.71
1994-1995	135.55	133.72
1995-1996	134.72	133.78
1996-1997	138.1	133.75
1997-1998	136.4	133.69
1998-1999	136.35	133.78
1999-2000	136.01	133.66
2000-2001	136.21	133.55
2001-2002	135.95	133.41
2002-2003	134.06	133.35
2003-2004	134.6	133.37
2004-2005	135.055	133.36
2005-2006	137.375	133.48
2006-2007	134.46	133.48
2007-2008	136.25	133.53
2008-2009	136.35	133.57
2009-2010	135.105	133.51
2010-2011	135.735	133.71
2011-2012	135.605	133.77
2012-2013	134.93	133.64

YEAR	MAXIMUM	MINIMUM
MAXIMUM	138.782	134.06
MINIMUM	134.06	133.35

Table 33: Yearly minimum and maximum Water Levels at Vazhavachanur

Below table shows yearly maximum and minimum water levels at Villupuram gauge site.

YEAR	MAXIMUM	MINIMUM
	WATER LEVEL (m)	WATER LEVEL (m)
1970-1971	43.63	43.34
1971-1972	44.95	42
1972-1973	45.415	42.06
1973-1974	42.24	42.165
1974-1975	42.675	42.37
1975-1976	44.4	43.2
1976-1977	43.635	43.23
1977-1978	45.7	43.23
1978-1979	44.2	43.195
1979-1980	45.353	43.27
1980-1981	-	-
1981-1982	44.26	43.11
1982-1983	-	-
1983-1984	44.123	43.1
1984-1985	43.84	43.155
1985-1986	43.856	43.235
1986-1987	43.665	43.26
1987-1988	43.843	43.22
1988-1989	43.77	43.3
1989-1990	43.725	43.44
1990-1991	-	-
1991-1992	45.434	42.943
1992-1993	44.3	42.943
1993-1994	44.947	42.892
1994-1995	44.288	43.2
1995-1996	43.37	43.2
1996-1997	45.57	42.6
1997-1998	44.35	43.005
1998-1999	44.5	42.88
1999-2000	43.82	42.98
2000-2001	43.96	42.65
2001-2002	43.82	43.11
2002-2003	-	-
2003-2004	-	-

2004-2005	44.152	43.12
2005-2006	45.66	42.72
2006-2007	43.51	42.57
2007-2008	44.25	42.71
2008-2009	44.28	42.83
2009-2010	43.155	42.75
2010-2011	43.7	42.395
2011-2012	43.8	42.34
MAXIMUM	45.7	43.44
MINIMUM	42.24	42

Table 34: Yearly minimum and maximum Water Levels at Villupuram

- DATA NOT AVAILABLE

4.18 Chart Datum/ Sounding Datum

As per discussion with IWAI, Chart Datum has been taken as following for different reaches

Tidal Reach:

C.D. is taken as C.D. of nearest port from Admiralty Tide Table (ATT- Volume 3) or Navigational charts

Non-Tidal Reach:

As per discussion with IWAI, Sounding datum in rivers is taken as Average of minimum yearly water level for Last six years at Vazhavachanur and Villupuram gauging sites. The gauge-discharge data of both sites was collected from CWC. Accordingly, the C.D. for both sites has been arrived as below:

C.D. at Vazhavachanur = [133.53 + 133.57 + 133.51 + 133.71 + 133.77 + 133.64] / 6
= **133.637 m**

C.D. at Villupuram = [42.34 + 42.395 + 42.75 + 42.83 + 42.71 + 42.57] / 6
= **42.635 m**

River name	Gauge Station	Chainage	CD Value	Gauge Station Position	
				Latitude	Longitude
Ponniyar	Vazhavachanur	100.6 km	133.637 meters above MSL	12^0 03′ 57” N	78^0 58′ 41” E
	Villupuram	41.1 km	42.635 meters above MSL	11^0 52′ 14” N	79^0 27′ 34” E

Table 35: Adopted Chart Datum Details

In case of Dams/ Bridges/ Barrages/ Check Dam, the C.D. has been taken as Ponding level or MDDL.

4.19 High Flood Levels

Tidal Reach

In Tidal reach, MHWS at Pondicherry Port as per Admirality Tide Table (ATT-Vol 3) has been adopted as High Flood Level.

MHWS: 1.3 (w.r.t. C.D.)

MSL : 0.9 (W.r.t. C.D.)

MHWS (w.r.t. M.S.L.) : 1.3 – 0.9 = 0.4 m (w.r.t. M.S.L.)

Non-Tidal Reach

Guage Sites: High flood levels are computed from last twenty years Gauge discharge data collected from CWC for guage sites. The maximum water level in last twenty years from the collected data has been adopted as H.F.L.

Vazhavachanur: -

Maximum flood discharge & HFL (during period of data) were 1935 m^3/s and 138.10 m respectively in October 1981 and December 1996.

Frequency Analysis of available yearly maximum flood data using Gumbel distribution indicate following flood discharges for different return periods.

Return Period in years	2	5	10	20	25	50	75	100	200
Discharge (m^3/s)	170.17	521.28	753.74	976.73	1047.46	1265.36	1392.01	1481.65	1697.14

The 100 year return flood at Vazhavachanur is calculated as 1481 m^3/s.

Villupuram: -

Maximum flood discharge & HFL (during period of data) were 2636 m^3/s and 45.66 m in November 2005.

Frequency Analysis of yearly maximum flood data using Gumbel distribution indicate following flood discharges for different return periods.

Return Period in years	2	5	10	20	25	50	75	100	200
Discharge (m^3/s)	128.09	406.01	590.02	766.52	822.51	994.98	1095.23	1166.18	1336.76

The 100 year return flood at Villupuram is calculated as 1166 m^3/s.

4.20 Monthly minimum and maximum Discharges

Vazhavachanur (Discharge in cumecs)

YEAR	JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY	
	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
1978-1979	1.3	0.1	57	0	0.2	0	63	0	36.4	0.2	140.9	0.7	62	1.6	30.5	3	36	1.5	25.8	2.1	25.7	1.5	15.6	2
1979-1980	9.9	0.2	2.3	0.1	11	0.1	90	0.1	264.6	1.5	1183.6	6	105.3	10.5	12.6	1.8	21.5	1.2	26.7	2.2	24.3	1.8	10.5	1
1980-1981	2.4	0.2	2.1	0.1	0.7	0.1	0.2	0	2.5	0	6.8	0.1	0.9	0	20.1	0.1	0.8	0.5	1.5	0.4	0.59	0.1	4.3	0.1
1981-1982	0.7	0.1	7.2	0	16.1	0	195.3	0.2	1935.1	0.7	995	2	57.8	1.8	11.1	1.1	22.6	1.1	20.4	1.7	14.6	1.6	3.6	0.7
1982-1983	8.1	0.3	0.9	0.1	6.6	0	10.9	0	0.5	0	1.8	0.1	0.1	0	0.1	0	0	0	0	0	-	-	13.8	0
1983-1984	8	0	6.2	0	15.9	0	47.4	0.2	37.4	0.4	35.5	0.4	194.1	0.5	8.6	0.9	14.6	0.5	10.2	1.8	18	1.2	1.7	0.7
1984-1985	0.7	0.2	21.2	0.2	1.9	0.3	6.6	0.2	9.9	1	85.1	0.8	69.6	1.5	40.8	1.4	27.2	0.7	19.3	0.4	0.5	0.1	0.2	0
1985-1986	3.7	0	0.7	0	11.5	0	29.1	0	58.8	0.2	63.9	1.3	6.8	0.5	54.8	0.4	50.4	0.2	49.2	0	0	0	9	0
1986-1987	0	0	0	0	0	0	1	0	66.7	0.2	64	0.3	62.5	1.1	44.7	0.8	63.8	1.4	12.7	0.7	1.5	0.3	1.9	0.1
1987-1988	1.651	0	0	0	1.371	0	1.763	0	92.71	0.523	74.93	0.724	34.31	0.612	3.875	0.9	47	0.579	10.6	0.178	2	0.154	0.4	0.113
1988-1989	0.683	0.063	3.979	0.03	2.7	0.054	2.417	0.136	86.46	0.323	11.5	0.303	31.54	0.29	1.372	0.191	1.204	0.3	2.4	0.187	0.242	0.034	0.827	0.05
1989-1990	0.25	0.025	2	0.025	0.05	0.025	0.885	0	62.5	0.05	62.5	0.05	6.16	0.149	0.5	0	48.81	0	0	0	0	0	0	0
1990-1991	-	-	-	-	-	-	0.827	0	0.744	0	0.421	0.014	0.718	0	86.83	0	0	0	-	-	-	-	-	-
1991-1992	0.06	0	0	0	0	0	21.7	0	140.8	0	1632	7.58	65.92	4.923	17.96	0.696	59.4	0.457	15.62	0.502	21.42	0.581	16.37	0
1992-1993	1.983	1.73	4.28	1.768	1.969	1.969	2.771	1.758	4.107	1.728	583	1.758	24.14	2.972	46.15	1.323	32.16	1.102	21.63	0.897	21.63	0.536	21.63	0.241
1993-1994	0.299	0.112	0.173	0.173	-	-	0.497	0.142	4.219	0.3	11.76	0.424	810.4	0.703	20.69	0.703	44.81	0.96	19.26	1.536	19.26	1.855	17.6	0.255
1994-1995	0.568	0	0.57	0	1.6	0	3.616	0	16.19	0.12	196	1.343	48.16	2.009	44.8	2	2.569	1.944	6.043	1.188	15.02	0.335	7.6	0.303
1995-1996	0.8	0	0.845	0	2.863	0	0.623	0	0.6	0	45.47	0.131	52.39	0.305	41.51	0.222	0.618	0	0.5	0	1.2	0	1	0
1996-1997	16.14	0	0	0	2.58	0	348	0	645.2	20.97	103	1.9	948	4.3	74.67	3.24	21.58	2.25	30.8	3.37	23.5	0.874	17.59	0
1997-1998	1.429	0	0	0	1.15	0	2.319	0	82	0.9	449.5	19.79	249.4	28.31	39.5	2.02	42	1.668	23.69	1.88	26.22	1.779	3.674	0.484
1998-1999	0.6	0.266	10.91	0	18.5	0.286	8.818	0.569	291	0.781	171.1	4.451	384	14.19	20.63	2.25	26	2.037	4.777	1.611	10.7	1.222	11.25	0.537
1999-2000	1.4	0.256	1.246	0.135	3.349	0.08	0.949	0.135	294.2	0.21	76.98	2	20.4	1.19	15.35	0.5	26.57	1.333	27.2	1.481	28.02	0.95	4.48	0.06
2000-2001	0.573	0	0.086	0	1.039	0	0	0	348.9	0	31.88	0	21.81	0.423	29.64	1.619	2.637	1.044	25.34	1.956	9.805	0.663	0.922	0.218
2001-2002	0	0	5.061	0	0	0	2.241	0	287.1	0	84.73	0.861	46.63	0	0	0	0	0	2.856	0	0	0	0	0

2002-2003	0	0	0	0	0	0	0	0	4.675	0	7.234	0	0	0	-	-	-	-	-	-	-	-	-
2003-2004	-	-	-	-	2.919	0	0	0	9.461	0	3.783	1.195	4.293	0	35.94	0	0	0	0	0			21.5	0
2004-2005	0	0	0	0			5.386	0	117.2	0	109.1	9.294	25.71	1.093	38.61	0.741	1.88	0.741	22.09	0.794	6.387	2.328	10.97	0
2005-2006	0	0	0	0	0	0	84.12	0	519.9	0	800.9	7.885	748.4	24.31	27.21	0.138	2.162	0.138	17.96	0	28.94	0	0	0
2006-2007	0	0	0	0	0	0	-	-	4.863	0.425	11.19	0.119	1.389	0	46	0	0.558	0	-	-	-	-	-	-
2007-2008	-	-	-	-	-	-	-	-	-	-	0	0	422.65	0	0	0	41.73	8.2	8.2	0	0	0	1.895	0
2008-2009	-	-	-	-	-	-	-	-	-	-	93.58	0	141.9	0.067	5.109	0.53	28.62	0.747	23.55	1.337	1.933	0.868	1.919	1.222
2009-2010	1.028	0	0	0	-	-	1.612	0	0.888	0	49.9	0.374	33.523	3.228	9.4	2.454	42.257	1.116	44.267	1.01	2.098	0.854	4.694	0
2010-2011	13.523	0	6.006	0	1.971	0.132	9.521	0	2.988	0.259	158.2	3.139	186.225	14.334	15.777	5.377	32.154	0.853	37.261	1.081	22.9	2.708	4.491	0.311
2011-2012	1.348	0	1.172	0	6.012	0	1.393	0	30.403	0.287	47.836	2.223	106.149	4.075	58.96	5.064	8.646	1.436	68.25	1.491	3.28	1.411	3.15	0
2012-2013	0	0	35.09	0	6.071	0	3.095	0	25.95	0.635	16.572	0.547	7.225	0.411	60.019	0.158	0.264	0	0.604	0	-	-	-	-
MAXIMUM	16.14	1.73	57	1.768	18.5	1.969	348	1.758	1935.1	20.97	1632	19.79	948	28.31	86.83	5.377	63.8	8.2	68.25	3.37	28.94	2.708	21.63	2
MINIMUM	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 36: Monthly Minimum and Maximum Discharges at Vazhavachanur

- DATA NOT AVAILABLE

Villupuram (Discharge in cumecs)

YEAR	JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY	
	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
1970-1971	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1971-1972	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1972-1973	-	-	-	-	-	-	-	-	50.5	0	93.5	0	600	0	27.8	1.4	8.7	0	6.6	0	28.6	0	0	0
1973-1974	-	-	-	-	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1974-1975	-	-	-	-	-	-	-	-	65.9	13.3	33.5	33.5	-	-	-	-	-	-	-	-	-	-	-	-
1975-1976	-	-	-	-	-	-	-	-	5	0	485	0.9	10.2	0.3	29.2	0.1	2.6	0.002	-	-	-	-	-	-
1976-1977	-	-	-	-	-	-	-	-	7.2	0.04	90	0.04	7.7	0.4	0.3	0.1	22.4	0.2	-	-	-	-	-	-
1977-1978	-	-	-	-	-	-	-	-	66.9	0	1530	9.5	213.4	3.2	2.9	0.1	-	-	13	0.1	-	-	-	-
1978-1979	-	-	-	-	-	-	-	-	-	-	365	0.2	121.8	0.8	105	0.1	30	7	4	0.3	-	-	-	-

YEAR	JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY	
	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
1979-1980	-	-	-	-	-	-	20	0	110	0.1	1618.7	1.3	160.4	18	23	0.2	-	-	-	-	-	-	-	-
1980-1981	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1981-1982	-	-	-	-	-	-	112	0	459.2	0	408.4	0	72	0	1.2	0	0.3	0	-	-	-	-	-	-
1982-1983	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1983-1984	-	-	-	-	-	-	33.6	0	7.4	0	27.6	0	373.2	0	15	0.1	22	0	29.7	0	-	-	-	-
1984-1985	-	-	22.8	0.3	-	-	8.5	8.5	27.4	0	123.9	0.4	42.5	0.4	27.9	0	10.1	0	-	-	-	-	-	-
1985-1986	-	-	-	-	-	-	-	-	-	-	121.3	0	43.7	0	89.2	1	0.6	0	13.5	0	-	-	-	-
1986-1987	-	-	-	-	-	-	-	-	31.8	0	16.7	0	28.2	0	16.8	0	21.6	0	-	-	-	-	-	-
1987-1988	-	-	-	-	-	-	-	-	83.64	0	19.51	0	80.99	2.318	1.906	0	-	-	-	-	-	-	-	-
1988-1989	-	-	-	-	-	-	-	-	71.4	0	20.2	0	-	-	-	-	-	-	-	-	-	-	-	-
1989-1990	-	-	-	-	-	-	-	-	44.07	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1990-1991	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1991-1992	-	-	-	-	-	-	-	-	87.54	43.01	2039	0	49.31	0.04	0.173	0	2.118	0	-	-	-	-	-	-
1992-1993	-	-	-	-	-	-	-	-	-	-	519.3	11.07	5.572	0.186	3.834	0.186	-	-	-	-	-	-	-	-
1993-1994	-	-	-	-	-	-	-	-	-	-	3.407	0.973	1214	4.454	16.93	3.944	5.216	3.944	5.216	5.216	-	-	-	-
1994-1995	-	-	-	-	-	-	-	-	-	-	386.6	1.597	7.647	0	6.655	1.089	-	-	-	-	-	-	8.5	0
1995-1996	-	-	-	-	-	-	6.53	6.53	5.768	0	-	-	2.374	0	-	-	-	-	-	-	-	-	-	-
1996-1997	-	-	-	-	-	-	57.16	3.6	818.9	10.59	150	2.5	2305	21	44.5	1.821	0.551	0	-	-	33.5	0	58.5	0
1997-1998	-	-	-	-	-	-	2.18	0	91.77	0	516.3	18.1	572	0	56	0	15	0	0	0	0	0	0	0
1998-1999	-	-	-	-	13.4	0	10.931	0	247.5	1.616	363.7	5.102	597.9	4.682	95.47	0.676	1.442	0	0.891	0	-	-	-	-
1999-2000	-	-	-	-	-	-	-	-	166.5	149.3	67	0	14.36	1.151	1.397	0	-	-	-	-	-	-	-	-
2000-2001	-	-	-	-	-	-	-	-	275	5.287	10	0.015	2.748	0	1.474	0	-	-	-	-	-	-	-	-
2001-2002	-	-	-	-	-	-	-	-	173.2	13.65	28.99	0.206	0.686	0.189	-	-	-	-	-	-	-	-	-	-
2002-2003	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2003-2004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

YEAR	JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY	
	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN
2004-2005	-	-	-	-	-	-	-	-	158.4	158.4	333.4	0.239	2.438	0.15	-	-	-	-	-	-	-	-	-	-
2005-2006	-	-	-	-	-	-	-	-	664.4	155.9	2636	0.975	940.9	40.7	40.32	0.524	0.141	0	12.76	11.79	3.843	0.163	-	-
2006-2007	-	-	-	-	-	-	-	-	3.726	0	54	0	0	0	-	-	-	-	-	-	-	-	-	-
2007-2008	-	-	-	-	-	-	-	-	-	-	-	-	848.408	0	11.361	0	-	-	-	-	56.88	0	-	-
2008-2009	-	-	-	-	-	-	-	-	-	-	330.7	14.11	261.626	0.098	-	-	-	-	-	-	-	-	-	-
2009-2010	-	-	-	-	-	-	-	-	-	-	25.907	0.567	17.414	0.226	-	-	-	-	-	-	-	-	-	-
2010-2011	-	-	-	-	-	-	-	-	-	-	299.4	12.25	233.715	14.65	15.419	0.25	0.288	0	-	-	-	-	-	-
2011-2012	-	-	-	-	-	-	-	-	6.815	1.897	81.094	0	35.019	0.862	143	2.921	-	-	26.319	0	0	0	-	-
MAXIMUM	0	0	22.8	0.3	13.4	0	112	8.5	818.9	158.4	2636	33.5	2305	40.7	143	3.944	30	7	29.7	11.79	56.88	0.163	58.5	0
MINIMUM	0	0	22.8	0.3	0	0	2.18	0	3.726	0	3.407	0	0	0	0.173	0	0.141	0	0	0	0	0	0	0

Table 37: Monthly Minimum and Maximum Discharges at Villupuram

- DATA NOT AVAILABLE

4.21 Yearly minimum and maximum Discharges

Below table shows yearly maximum and minimum discharges at Vazhavachanur gauging site.

YEAR	MAXIMUM DISCHARGE (m3/sec)	MINIMUM DISCHARGE (m3/sec)
1978-1979	140.9	0
1979-1980	1183.6	0.1
1980-1981	20.1	0
1981-1982	1935.1	0
1982-1983	13.8	0
1983-1984	194.1	0
1984-1985	85.1	0
1985-1986	63.9	0
1986-1987	66.7	0
1987-1988	92.71	0
1988-1989	86.46	0.03
1989-1990	62.5	0
1990-1991	86.83	0
1991-1992	1632	0
1992-1993	583	0.241
1993-1994	810.4	0.112
1994-1995	196	0
1995-1996	52.39	0
1996-1997	948	0
1997-1998	449.5	0
1998-1999	384	0
1999-2000	294.2	0.06
2000-2001	348.9	0
2001-2002	287.1	0
2002-2003	7.234	0
2003-2004	35.94	0
2004-2005	117.2	0
2005-2006	800.9	0
2006-2007	46	0
2007-2008	422.65	0
2008-2009	141.9	0
2009-2010	49.9	0
2010-2011	186.225	0
2011-2012	106.149	0
2012-2013	60.019	0

MAXIMUM	1935.1	0.241
MINIMUM	7.234	0

Table 38: Yearly minimum and maximum Discharges at Vazhavachanur

Below table shows yearly maximum and minimum discharges at Villupuram gauging site.

YEAR	MAXIMUM DISCHARGE (m^3/sec)	MINIMUM DISCHARGE (m^3/sec)
1970-1971	-	-
1971-1972	-	-
1972-1973	600	0
1973-1974	0	0
1974-1975	65.9	13.3
1975-1976	485	0
1976-1977	90	0.04
1977-1978	1530	0
1978-1979	365	0.1
1979-1980	1618.7	0
1980-1981	-	-
1981-1982	459.2	0
1982-1983	-	-
1983-1984	373.2	0
1984-1985	123.9	0
1985-1986	121.3	0
1986-1987	31.8	0
1987-1988	83.64	0
1988-1989	71.4	0
1989-1990	44.07	0
1990-1991	-	-
1991-1992	2039	0
1992-1993	519.3	0.186
1993-1994	1214	0.973
1994-1995	386.6	0
1995-1996	6.53	0
1996-1997	2305	0
1997-1998	572	0
1998-1999	597.9	0
1999-2000	166.5	0
2000-2001	275	0
2001-2002	173.2	0.189
2002-2003	-	-

2003-2004	-	-
2004-2005	333.4	0.15
2005-2006	2636	0
2006-2007	54	0
2007-2008	848.408	0
2008-2009	330.7	0.098
2009-2010	25.907	0.226
2010-2011	299.4	0
2011-2012	143	0
MAXIMUM	2636	13.3
MINIMUM	0	0

Table 39: Yearly minimum and maximum Discharges at Villupuram

- ***: Data not available***

5. Preliminary Traffic studies and Market Analysis

This chapter deals with the status of land use pattern, crops, agriculture existing industries, cargo, jetties and terminals, passenger ferry services along the river route.

5.1 Land use Pattern along waterway

The river passes through various districts as shown in the figure below:

Figure 26: Ponniyar River and nearby districts

District	Taluka	Population
Cuddalore	Cuddalore	221,801
	Panruti	162,692
Viluppuram	Vilupuram	
	Ullundurprttai	150,054
	Tirukkoyilur	30,212
	Sankarapuram	151,374
Tiruvannamalai	Thandrampet	178,648
	Tiruvannamalai	179,905

Table 40: Population of nearby Talukas as per Census 2011

The river is extensively dammed for irrigation, especially in Tamil Nadu. There are also reservoirs at Krishnagiri and Sathanur.

Name of State	Drainage area (sq km)	% of total
Karnataka	3530	22
Andhra Pradesh	210	1
Tamil Nadu	12279	77
Total	16019	100

Table 41: Whole stretch of River

The project scope is limited to 125 km length of the river from Sathanur Dam at Lat 12°11'0.06"N, Long 78°51'1.25"E in Tiruvannamali district to Cuddalore district at confluence of Bay of Bengal at Lat 11°46'21.76"N, Lon 79°47'41.70"E. Thus it covers two districts, Cuddalore and Villupuram within the region, the brief of which is described below.

5.1.1 Cuddalore

Cuddalore is a coastal district of Tamil Nadu. It has a total geographical area of 3,678 sq. km. The district is surrounded by Villupuram and Pudduchery in the north, Perambalur in the south-west and Ariyalur, Thanjavur and Nagapattinam in the south. The coastal length of the district is 68 km stretching from GunduUppalavadi in Cuddalore taluka to Pichavaram in Parangipettai taluka. The district is drained by Gaddilam and Pennaiyar in the north and Vellar and Kaveri in the south.

5.1.2 Villupuram

Villupuram is the largest district with 22 blocks in the state. The total geographical area of the district is 7194 sq km. The coastal length of the district is about 30 km. Kanchipuram district is the northern neighboring coastal district and Puducherry (U.T.) is in the south of the district. It also shares a substantial length of its borders with Cuddalore in the south. It almost touches Perambalur in south west. Salem and Dharmapuri districts are located in the west. Tiruvannamali along with Kanchipuram share their southern borders with the district.

5.1.3 Tiruvannamalai

Tiruvannamalai district is located at a distance of 125 km to southwest of Chennai. The total geographical area of the district is 6188 sq. km. It shares its borders in the north and west to Vellore. Krishnagiri and Dharmapuri districts are situated in the southwest. In the south, Thiruvannamalai, Javadhu Hills and Kailasagiri are the prominent hills of the district with an average elevation of more than 2,500 feet above sea level. One sixth of the district is covered with dense forest and hilly areas of Eastern Ghats.

5.2 Crops/Agriculture in the region

5.2.1 Cuddalore

Cereals and millets dominate nearly half of the production of the district. These were sown in an area of 1.3 MN hectares during Fasli1423. Pulses contributed to another share of nearly 16% of the total area. It accounts for a production of nearly 24,000 tonnes.

Major Crops	Area ('000' Hect.)	Production in ('000 tonnes)	% to the total area sown
Cereals & Millets	131,503	371	48
Pulses	43,056	24	16
Oil Seeds	16,263	42	6
Other Crops	83,853	NA	31

Table 42: Production of crops in Fasli1234 (Jul'13 – Jun'14)

Source: Department of Economics and Statistics, Chennai

Paddy, cumbu, pulses are the major food crops cultivated in the area while major cash crops are sugarcane, groundnut, gingelly and coconut.

Tamil Nadu Warehousing Corporation has developed 5 warehouses in Cuddalore port. 4 of them, each having a capacity of 3,000 metric tonnes, are used for agricultural products. One of them, having a capacity of 1,000 tonnes, is used for non-agricultural goods.

The district receives an annual rainfall of 1,207 mm. Most of the rainfall comes from northeast monsoons, which account for 58% of the total rainfall in the district. It receives 383 mm of rainfall from south-west monsoons which is 32% of the total precipitation. It also receives few showers in summer and winter which account for 7% and 3% of the total precipitation respectively.

5.2.2 Villupuram

The climate of Viluppuram District is fairly dry and on the whole healthy. The temperature is moderate throughout the year. Major food crops cultivated in Viluppuram district are paddy, Cholam, Ragi, Cumbu, Redgram. Blackgram, Horsegram and Varage. Major non-food crops grown here are Sugarcane, Groundnut, Cotton, Casurina and Coconut. Ponniyar is the principal river of the district. Other rivers traversing through the district are Manimuktha, Kedilam, Komugi, Sankaraparani, Malattar, and Varaganathi. Majority of the population depends on agriculture for its livelihood. The district primarily depends on tubewells, lakes, irrigation tanks etc. for its irrigation necessities. These rivers account for as much as 4% of the total irrigation requirement of the district. The average rainfall in the district is 1060mm per annum. There is uneven distribution of rainfall throughout the district. Marakanam and Vanur blocks receive fair amount of rainfall while in Kandamangalam and Koliyaur blocks, the rainfall is moderate and it is scanty in Kallakurichi and Sankarapuram. The soil formation of the district is mainly red soil, sandy loam and block cotton soil.

There is a fair population of livestock in the district. This had led to substantial production of dairy items in the district.

Animals	Population ('000)
Draught Animals	259
Buffaloes	167
Cows	497
Sheep	108
Goat	153
Pig	1,042
Poultry	666

Table 43: Population of Livestock in the district

Source: Department of Agriculture

The district has a coastal line of 30 km. Marakkanam and Vanur blocks lie on the east touching Bay of Bengal. There are 19 fishermen co-operative societies comprising of 20 villages in the district. Fishing activities are mostly carried out along the share as the rivers don not have water in abundance. Inland fishing is mostly carried out on PWD owned tanks and reservoirs.

There are four sugar factories located at Mundiyampakkam, Periasevalai, Kacharapalliyam, Mungailthuraipattu. There are 67 rice mills and 17 sago factories operating in the district. The raw material for these industries is sourced mostly from within the district.

The district has concentrates of rice mills in Tindivanam, Kallakurichi and Chinnasalem. They depend largely on the nearby villages for their raw materials. We see that all three are significantly distant from Ponniyar River. Kallakurichi and Chinnasalem also account for numerous wood carving activities in the district. RMG goods are majorly concentrated in Valavanur which lies in proximity to the river. The cluster is located at a distance of 10 km from Ponniyar River.

Products	Major Clusters	No of Units	Turnover
Rice mill	Tindivanam, Kallakurichi, Chinnasalem	90	600
RMG Goods	Valavanur	50	5
Wood Carving	Kallakurichi, Chinnasalem,	70	4

Table 44: Major industrial clusters in the districts

Major exportable items from the district are food products, granite, fish, mango pulp processing, chemical etc.

5.2.3 Tiruvannamalai

Paddy is the major crops cultivated in the district. Millets and pulses are the other food crops grown in the district. Groundnut is the major cash crop grown in the district. Sugarcane is also widely cultivated in the district. Tamil Nadu Warehousing Corporation has developed warehouses at Tiruvannamalai, Polur and Arni with a total capacity of 54 metric tonnes in the district. It has also developed 7 cold storages at Cheyyar, Chengam,

Chetpet, Tiruvannamalai, Vettavalam, Vandavasi and Polureach with a capacity of 25 metric tonnes. There are 3 spinning mills in the district located at Tiruvannamalai, Polur and Arni.

5.3 Availability of Bulk / Construction Material

River transportation would be viable for movement of bulk commodities like coal and minerals. Coal is a major import commodity from Tamil Nadu ports. Kamarajar Port and VOC Port act as gateway for import of indigenous and foreign coal to the state. Major share of the coal is consumed in the power plants located in the state. Tamil Nadu is a mineral rich state. There is abundant reserve of limestone, rough stone, silica and granite in the state. There is huge volume of export of minerals from VOC Port. The minerals are mostly sourced from the southern part of the state. They are exported to Maldives, Sri Lanka and other South East Asian countries.

Districts	Commodities Exported	Nearby Ports
Villupuram	-	Cuddalore
Thiruvannamalai	Silk Saree, Handloom lungies, Palm rosa oil,	
Cuddalore	Cashew, Organic Chemicals, Marine products	

Table 45: Commodities exported

5.3.1 Minerals

Following map shows location of mineral belt of Tamil Nadu with respect to Ponniyar River as well as the port infrastructure of Tamil Nadu. Mines located closer to rivers would have potential for shift of minerals to river route from existing road route.

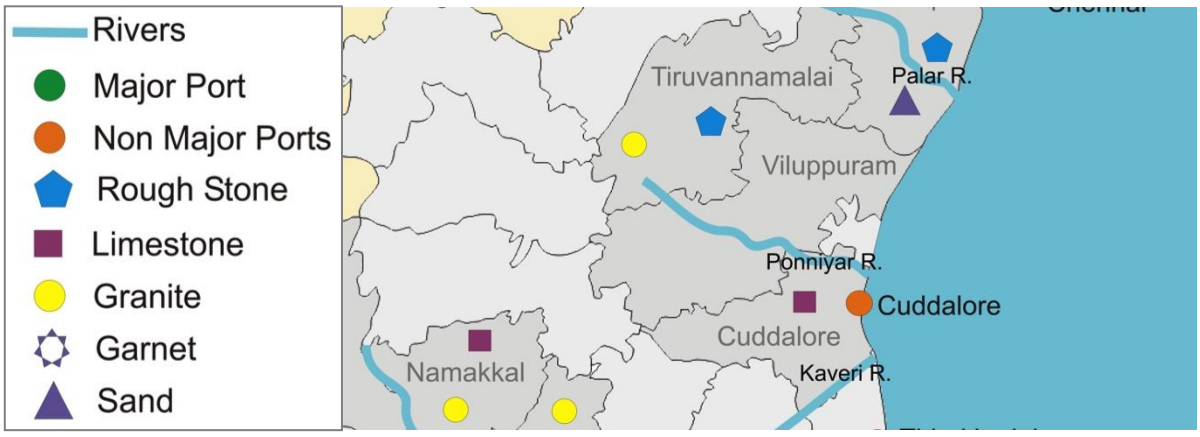


Figure 27: Minerals exported from Tamil Nadu

Following table describes location of mines with respect to the port exporting it and the river flowing closer to it.

District	Minerals	Produ-ction	Distance from Industrial Area (Km)			Opport-unity	Reasoning
			To River	River-Port	Direct to Port		
Cuddalore	Limestone	1,000 T	NA	NA	20	No	Minerals mines are located adjacent to port
Tiruvannamalai	Granite	4,774 CM	10	95	117	No	Negligible volume. No economy of scale for barge movement to port
	Rough Stone	NA					
Villupuram	Sand	22,000 T	8	53	50	May be	Low volume and scattered production throughout district
	Granite	NA					

Table 46: District wise minerals production and opportunity for river movement

Cuddalore

Lignite is majorly found in the district. Major chunks of the mineral is available in Chidambaram, Panruti, Virudhachalam and Cuddalore, most of which is under the lease of Neyveli Lignite Corporation Ltd (a Government of India undertaking) In Fy11, the district produced 62 million tones of lignite from these area. In minor mineral category, the district produces minimal quantity of limestone and white clay.

Mineral Category	Mineral	Production (M.T)
Major Minerals	Lignite	62,287,000
Minor Minerals	Limestone	1,000
	White Clay	1,000

Table 47: Production of minerals in Fy11

There were 41 quarrying activities in Cuddalore in Fy15. Panruti followed it with 21 quarryings. Other areas that were utilised for quarrying operations in the district are Chidambaram, Kattumannarkoil, Virudhachalam, Tittagudi and Kurinjipadi. Most of these areas have been used for lignite quarrying.

Talukas	No of quarrying
Cuddalore	41
Panruti	20
Chirdambaram	6
Kattumannarkoil	1
Virudhachalam	5
Tittagudi	1
Kurinjipadi	4

Table 48: Number of quarrying operations conducted in Fy15

Source: District Collectorate, Cuddalore

Out of these, only Chidambaram and Kattumannarkoil are in proximity to Kaveri. They are located within a distance of 10 km from the river. However, Kurinjipadi and Panruti are located at a distance of 30 km from Cuddalore port.

Villupuram

In major mineral category, Silica sand is mostly concentrated in Agaram Reserve forest in Tindivanamtaluka. It is estimated to have an approximate reserve of 2 lakh tonnes.

Mineral Category	Mineral	Production('000)
Major Minerals	Silica Sand	2
Minor Minerals	Steatite	11,787
	River Sand	20
	Black Granite	NA
	Red Earth	503

Table 49: Production of Major Minerals

Department of Mines and Geology 2010-11

Steatite is mainly found in Kallkurichitaluka. Black granite is majorly concentrated in Gingee, Kallakurichi, Tindivanam, Tirukoilur, Ulundurpet, Vanur and Viluppuram talukas. Apart from these, other minerals like multi-colored granite, blue metal, inferior grade sedimentary limestone are also present in abundance.

Tiruvannamalai

Black granite and rough stone is majorly mined in the district. There are 17 mining operations of Balck granite in Thamdrampattu. Rough stone is mined more or less throughout the district. There are a total 136 mining operations carried out all over the district for rough stone which accounts for more than 80% of the mining operation in the district. Tirvannamalai leads the number with 29 mining operations followed by Chheyar and Vandavasi. However, Chengam, Thnadrampattu, Polur and Arni also contribute significantly in the number.

Name of Taluka	Fire Clay	Black granite	Coloured granite	Rough stone	Total
Tiruvannamalai		6	1	29	36
Chengam		3		11	14
Thandrampattu		17	1	19	37
Polur			1	15	16
Cheyyar	1			25	26
Arni			1	17	18
Vandavasi		2		20	22
Total	1	27	4	136	169

Table 50: Number of mining and quarrying units in the district as of 2014-15

Source: Assistant Director of Geology and Mining

The district produced close to 1 million tonnes of blue metal and earth collectively in Fy15, out of which Blue metal contributed to 80% of the volume. Black granite and coloured granite was also produced significantly in the district from 31 different mining operations throughout the year.

Name of Mineral	Production (in Cum)
Black granite	4,314
Multi colored granite	460
Blue metal	803,002
Earth	194,876

Table 51: Production Volume of Minerals in the district
Source: Assistant Director of Geology and Mining

5.3.2 Soil

Cuddalore

Majorly, four types of soil are present in the district – Red loam, Laterite Soil, Black Soil and Coastal Alluviam. Red loam is mainly present in Panruti, Kurinjipadi and parts of Virudhachalam. Laterite soil is found in parts of Virudhachalam and Thittakudi. Black soil is found in KM Koil, Chidambaram and interiors of Cuddalore while sandy alluviam is found in the coastal region of Cuddalore, Kurinjipadi and Parangipettai.

Type of Soil	Places in District
Red Loam	Panruti, Kurinjipadi&Virudhachalam
Lateritic Soil	Virudhachalam&Thittakudi
Black Soil	K.M.Koil,Cuddalore,Chidambaram.
Sandy Coastal Alluviam	Cuddalore, Kurinjipadi, Parangipettai

Table 52: Distribution of various types of Soil
Source: Directorate of Economics and Statistics, Chennai

5.3.3 Conclusion

Limestone

Limestone is one of the major commodities exported from VOC port. Tamil Nadu produces close to 2.7 mn tonnes of limestone every year. Main reserves of the mineral are concentrated in Tiruchirapalli, Tuticorin and Tirunelveli. Tiruchirapalli is 282km from VOC Port by road. While Karaikal Port is at a distance of about 156 km from Tiruchirapally by roadways, by waterways, the district is at a distance of 220 km to Karaikal Port.

Cuddalore district produces minimal quantity of Limestone, which is just about 1,000 tonnes in a year. Volume is quite low. Limestone movement via river from Cuddalore cannot be considered for movement, as no economy of scale exists for barge movement

to port. One more reason behind no scope for river movement is that most of the mineral mines are located adjacent to port.

Rough Stone

Rough stone is the other major mineral mined in Tiruvannamalai. There are total 136 mining operations carried out all over the district, which accounts for more than 80% of mining operation in district. Minerals in the hinterland of Ponniyar River cannot be transported by River as the mineral deposits are located close to the port. Some mineral sites located very close to Ponniyar can be considered for movement via roadways. The rest can be transported directly to the port via roadways. The volume of production from hinterland of Ponniyar River is quite low which does not make it feasible to be transported to the ports via waterways.

Granite

Granite is produced in numerous districts in Tamil Nadu. There are 17 operational mining units in Tiruvannamalai. Black granite is majorly mined in this district. Other major districts into production of granite are Tamaraparani, Tiruchirappalli, Erode, Kancheepuram and Tuticorin. However the volume is not enough so that rivers to nearby ports can transport it.

All the industrial areas/ Consumption centers are located on such location where the difference between roadways & waterways is too high. Volume generated around Ponniyar River is very negligible; hence barge movement to port commercially not viable.

5.4 Existing Industries along Waterway

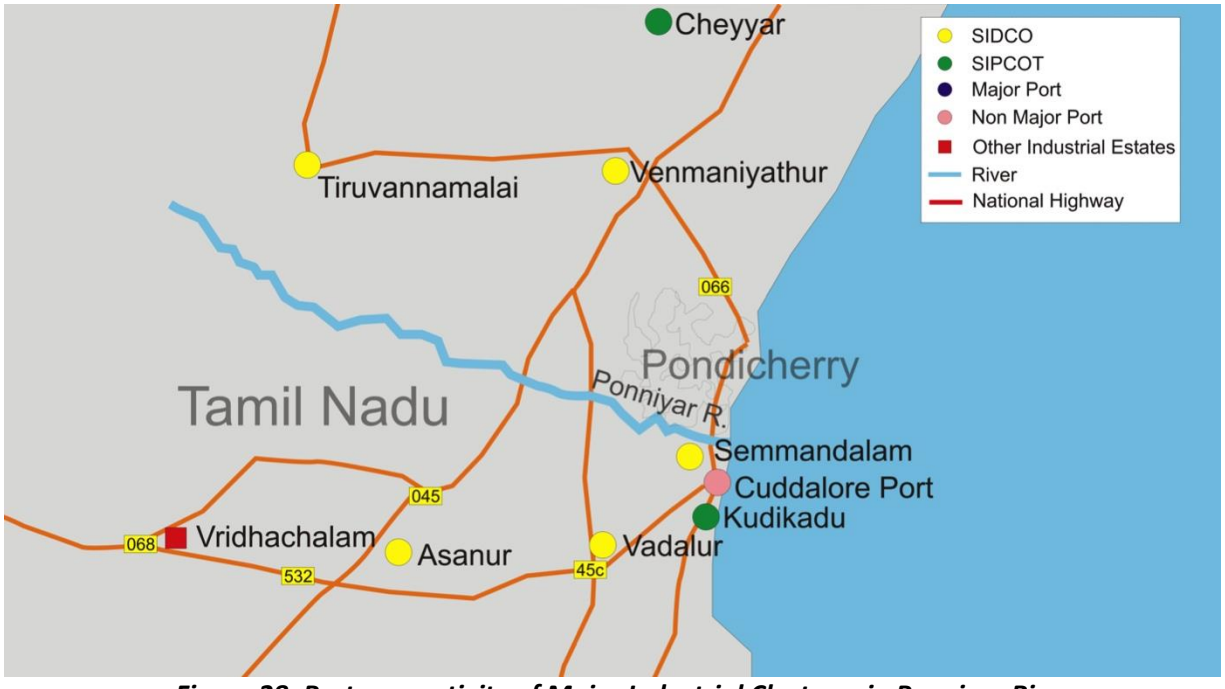


Figure 28: Port connectivity of Major Industrial Clusters via Ponniyar River

District	Industrial Area	Distance from Industrial Area (km)			Opportunity
		To River	River - Port	Direct to Port	
Villupuram	SIDCO, Asanur	42	52	78	No
	SIDCO, Venmaniyathur	59	54	86	No
Tiruvannamalai	SIPCOT, Cheyyar	114	62	131	No
	SIDCO, Thiruvannamalai	40	100	122	No
	SIDCO, Cheyyar (Upcoming)	114	62	131	No

Table 53: Distance Comparison between Roadways & Waterways (Ponniyar River)

5.4.1 Cuddalore

TIDCO has developed three industrial areas in the district at Semmandalam, Vadalur and Virudhachalam. At Virudhachalam, it has developed a ceramic industrial estate in a span of 42 acres. There are 64 units operating in the industrial estate. Semmandalam and Vadalur span in an area of 16 acres and 22 acres respectively. SIPCOT has developed an industrial area of 518 acres in Kadikadu in Phase-I with 61 units in operation. In Phase-II, it has acquired land of 159 acres with 7 units in operation.

Industrial Estate	Land acquired (acres)	No of Plots
TIDCO, Semmandalam	16	42
TIDCO, Vadalur	26	52
Ceramic Industrial Estate, Vridhachalam	42	64
SIPCOT Industrial Estate, Kudikadu	518	61
SIPCOT Industrial Estate, KudikaduPhase –II	159	7

Table 54: Industrial Estates in the district

All the industrial estates are located far off from Kaveri River. However, Semmandalam and Kudikadu are located within 15 km from Cuddalore port.

There are two major clusters of coir and ceramics in Cuddalore. Coir cluster is located in Cuddalore with an annual turnover of Rs 30 Cr. There are 200 coir units operating in the cluster. Ceramics business is concentrated in Virudhachalam region. There are 100 units operational in the region with an annual turnover of Rs 50 lakhs.

Products	Major Clusters	No of Units	Turnover (in cr)
Coir	Cuddalore	200	30
Ceramic	Vridhachalam	100	1

Table 55: Major Industrial Clusters

Both the clusters are significantly far from Kaveri River. However, coir cluster at Cuddalore is in the vicinity of Cuddalore port.

Tamil Nadu Warehousing Corporation has developed 5 warehouses in Cuddalore port. 4 of them, each having a capacity of 3,000 metric tonnes, are used for agricultural products. One of them, having a capacity of 1,000 tonnes, is used for non-agricultural goods.

Major products being exported from the district are cashew kernal, organic chemical and marine products.

5.4.2 Villupuram

There has been limited industrialization in the district in comparision to that in the state. At present, there are two industrial areas in the district – one at Ulundurpet and the other at Tindivanam. There are plans to developed 4 additional industrial areas in the district.

Industrial Estate	Land acquired (acres)	No.of Plots
Asanur Industrial Estate, Ulundurpet	107	146
VenmaniAthur Industrial Estate, Tindivanam	41	33

Table 56: Major Industrial Areas

Source: DIC, Villupuram

- An industrial estate to be developed by Villuppuram District Small Scale Industries Association in an area of 15 acres in Jankipuram near Villuppuram. 50 plots are to be developed by the association.
- TIDCO is mulling on development of an industrial estate in Ulundurpet to be spread in 200 acres exclusively for the benefit of SC/ST entrepreneurs.
- 45 acres of land has been acquired by TIDCO at VenmaniAthur in Tindivanam to develop an industrial estate.
- An industrial complex to be put by SIPCOT at Vikaravandi in 600 acres.

In major mineral category, Silica sand is mostly concentrated in Agaram Reserve forest in Tindivanam taluka. It is estimated to have an approximate reserve of 2 lakh tonnes.

5.4.3 Tiruvannamalai

Major clusters of industries are located in Tiruvannamalai, Vandavasi, Cheyyar, Arni, Janmamaruthur etc. Silk weaving is done majorly in Arni and Devikapuram. Handlooms are located are densely located in Vandavasi and Cheyyar blocks in the district. Kilkodungalur, Vazoor, Ponnur, Kannagampoondipudur, Cittaragavurpudur, Vedal, Ammaiyappattu, Koviloor, Cheyyar, Vadamanapakkam and Hasanamapettai are the hereditary handloom villages. The local population has been in the weaving profession since more than 100 years. There are more than 300 units operational in manufacturing

of Korai mat in Cheyyar and Vandavasi with a composite turnover of Rs. 50 lakhs per annum. Rice mills located in the Cheyyar account for an annual turnover of Rs. 4Cr. There are rare herbs and medicinal plants available in Javadhu hills and Melchengam.

Products	Clusters
Stone & Wood Carving	Tiruvannamalai
Silk weaving	Arni, Devikapuram
Handloom	Vandavasi, Cheyyar
Korai Mat	Avoor, Vandavasi
Rice Mill	Cheyyar
Mushroom & Honey Processing	Janmamaruthur
Herbal extraction	Janmamaruthur

Table 57: Products and its clusters in the district

Major commodities exported from the district are silk saris, handloom lungies, palm rosa oil, ponni rice and herbal products.

5.5 Existing Jetties and Terminals

Ponniyar River flows in the north of Cuddalore Port at a distance of 10 km from the port. The river flows through Tiruvannamalai, Villupuram and Cuddalore districts. Tiruvannamalai and Villupuram are among the most backward districts in terms of industrialization. Cheyyar SIDCO industrial estate, the only industrial area in Tiruvannamalai is located about 112 km from Ponniyar River. It is in the northern part of the district and close to Palar River. Chennai port will be nearer to the industrial estate compared to Cuddalore port. Venmaniyathur and Asanur Industrial Estates located in Villupuram are more than 40 km away from the river. Cotton based industries and leather industries can transport their products through the river. SIPCOT and SIDCO industrial estates in Cuddalore are closer to the sea port than the river. Hence the industries would not prefer the rivers for transportation.

The penetration of river Ponniyar in the hinterland is very low. Hence, it is commercially less attractive to be viable. However detailed assessment on the potential is described in the later part of section. Following chart shows reasoning behind not considering smaller rivers for transportation.

5.5.1 Cuddalore Port

Cuddalore Port is one of the prominent ports operating under the authority of Tamil Nadu Maritime Board. It is a lighterage port. The anchorage has a minimum depth of 8 m available at a distance of 0.5 nautical miles. In Fy15, the port handled a volume of 0.27 million tonnes. The state government plans to further develop the port, which will enhance the capacity of the port.

5.6 Preliminary traffic identified – within 50km

As part of our study, we've had discussions with industries and locals situated around the Ponniyar River. All our discussions indicated that there's no traffic in the river presently.

5.7 Existing cargo movement

Due to a lack of round the year availability of water, there is no existing cargo movement in the Ponniyar River.

The river is now known for its rich availability of sand, making it vulnerable to sand mafia. There's a fear that the indiscriminate sand mining could completely destroy the river.

5.8 Prominent City / Town / Places of Worship / Historical places for Tourism

Around the Ponniyar River, there are several popular places of tourism, worship and historical significance.

Silver beach

Silver beach is located nearly 5 kilometers away from the Ponniyar river. It is a vast beach with a 57-km long stretch, making it one of the longest beaches in Asia. There are a lot of adventure sports and water sports activities around the beach area. One of the highlights of the beach is the annual summer festival, which is held between May and June.

Devanatha Swamy Temple

This temple, made in the Dravidian style of architecture, is dedicated to the Hindu God, Vishnu. It is believed the temple was built during the Medieval Cholas (around 9th Century C.E.) The temple is surrounded by a granite wall, which encloses all its shrines and the bodies of water. The temple's gateway tower rises to a height of 60 feet. Devanatha Swamy temple is at a 5 km distance from Ponniyar River.

Padaleeswarar Temple

The temple is a shrine dedicated to Lord Shiva. It was constructed during the Pallava & Medieval Chola periods. It is one of the 274 Siva temples, whose history dates back to over 2000 years. The temple is 3 km away from Padaleeswarar temple.

Ponniyar River is also close to Puducherry, which is a popular tourist destination. Puducherry has several popular tourist spots.

Sri Aurobindo Ashram

It's a spiritual ashram named after Sri Aurobindo, a philosopher and yogi guru. The ashram houses the Samadhi of Sri Aurobindo and his spiritual collaborator, known as "the Mother." It is a popular tourist spot for visitors to Puducherry.

Auroville

It is a township founded by Sri Aurobindo Society in 1968. As of 2014, the township had a population of around 2,400 people from 50 different nationalities. At the centre of the township is a temple called Matrimandir. The temple does not belong to any particular religion, but is spiritually important to those wanting to practice internal yoga. The township also has restaurants, farms, guesthouses, etc.

Puducherry museum

This is a government museum, featuring sculptures from Chola, Pallava, and Vijaynagara temples. The museum also has arms, weapons and bronzes from the Vijaynagara and Nayaka periods. Other highlights of the museum are mirrors, furniture, paintings, and cutlery from the French period.

Gingee fort

The 800 feet tall and 80 feet wide fort is a popular historical tourist spot in the Villupuram District. The fort, which was built 800 years ago, has changed many hands, including the Marathas and Mughals before it was handed over to the Vijaynagar empire.

Kalyana Mahal

It is a pyramid-like structure within the Gingee fort. Built in Indo-Islamic style, the mahal has a square court, which is surrounded by rooms that were built for the ladies in the Governor's home. At the centre of the square court is a high square tower, made of stone, with a height of 27 meters.

Venugopala Swamy temple

The highlight of this temple is a beautiful structure, which depicts Lord Krishna playing on the flute with two consorts. At the front of the temple is a finely polished, broad slab.

Chakkarakulam and Chettikulam ponds

These are two famous temple ponds of the Gingee fort. It is believed Chettikulam was built during late 18th century when Marathas were occupying the place.

Ranganatha temple

This famous temple is built in Indo-Islamic style. The audience hall of the temple has a damaged roof, which is supported by pretty, little pointed arches. There is also a big iron cannon, with a length of 4 meters and a circumference of 2 meters.

Sad–at–Ullah Khan Mosque

As per Persian scriptures, the mosque was built in 1717-1718 A.D. Sad–at–Ullah Khan, the Nawab of Carnatic (1710 to 1732),built this mosque to commemorate his victory over Raja De Singh, a king who ruled Gingee from 1712 to 1714.

Abirameshwarar Temple

The temple, dedicated to Lord Shiva, was built in the 7th Century CE by Pallavas. It has a 110-feet tall Rajagopuram (grand entrance tower) with seven tiers.

Tiruvannamalai

This is a historical place with its primary identity revolving around the sacred shrine of Annamalaiyar Temple. This is one of the largest temples in India. Other popular tourist spots in Tiruvannamalai are the Ashrams ofRamana Maharishi, Yogi Ramsuratkumar&Seshadrinatha Swamigal.

Tiruvannamalai also has the ancient Jain temple complex, which has three Jain caves and four Jain temples. The complex also has a 16-feet high sculpture of Neminatha of the 12th century, which is the tallest Jain structure in Tamil Nadu.

5.9 Availability of Passenger Ferry Services

There are no passenger ferry services around the Ponniyar River.

5.10 Available and probable Water Sport Recreational Facilities

Located at 5 km north of Puducherry is the Kallialay Surf School. According to the Lonely Planet, surfing is gaining a lot of popularity along Tamil Nadu's coast. This well-equipped school, run by Spanish management, offers all types of surfing courses, right from beginner to advanced courses.

6. Observations, Inferences and Conclusions

6.1 Waterway

The total length of the river under present studies is detailed below:

125 Km length from Sathanur Dam to Cuddalore at confluence of Bay of Bengal (National Waterway 80)	**12°11'0.06"N, 78°51'1.25"E**	**11°46'21.76"N, 79°47'41.70"E**

6.2 Length

The length of waterway under present studies under consideration is 125 km.

6.3 LAD

	Chainage						
LAD (m)	0-3.3	3.3-25	25-50	50-75	75-100	100-125.5	Total
< 1.0	1.99	12.19	19.97	20.61	16.46	15.01	86.21
1.0 - 1.2	0.19	1.34	0.71	1.44	1.47	2.30	7.44
1.2 - 1.4	0.24	2.36	0.83	0.31	0.23	0.89	4.86
1.4 - 1.7	0.57	1.54	1.35	0.98	0.22	2.92	7.58
1.7 - 2.0	0.09	1.33	0.64	0.29	0.29	1.51	4.15
> 2.0	0.24	2.91	1.46	1.44	6.27	2.80	15.12

Table 58: LAD for the River Stretch

6.4 Cross-Structures

Bridges	**Horizontal clearance**	**Vertical clearance**
22 bridges between chainage 1.9 to 115.4 km	Varying from 4 to 35 meters	Varying from 0.5 to 5 meters
High Tension and Electric Lines		
26 High Tension and Electric Lines between chainage 15.5 to 111 km	Varying from 50 to 300 meters	Varying from 0.5 to 11 meters

Table 59: Details of Cross Structure on River

6.5 Water availability

Vazhavachanur: -

Results of analysis of data for assessing period of availability (% days in year) for different discharge ranges is presented in Table 60. Percentage of days in year for availability of discharge at this gauge site in excess of certain values is presented on a plot in figure 29. These results indicate the following:

Sr	Discharge (m^3/s) in excess of	Availability period in % days in year	Depth estimated from gauge and latest river cross section
1	5 m^3/s	20 % (about 70 days)	0.50 m
2	10 m^3/s	16 % (about 58 days)	0.70 m
3	20 m^3/s	11 % (about 38 days)	1.10 m
4	50 m^3/s	4.75 %(about 17 days)	1.40 m
5	100 m^3/s	2.18 % (about 7 days)	1.70 m

Table 60: Water availability in Ponniyar River at Vazhavachanur

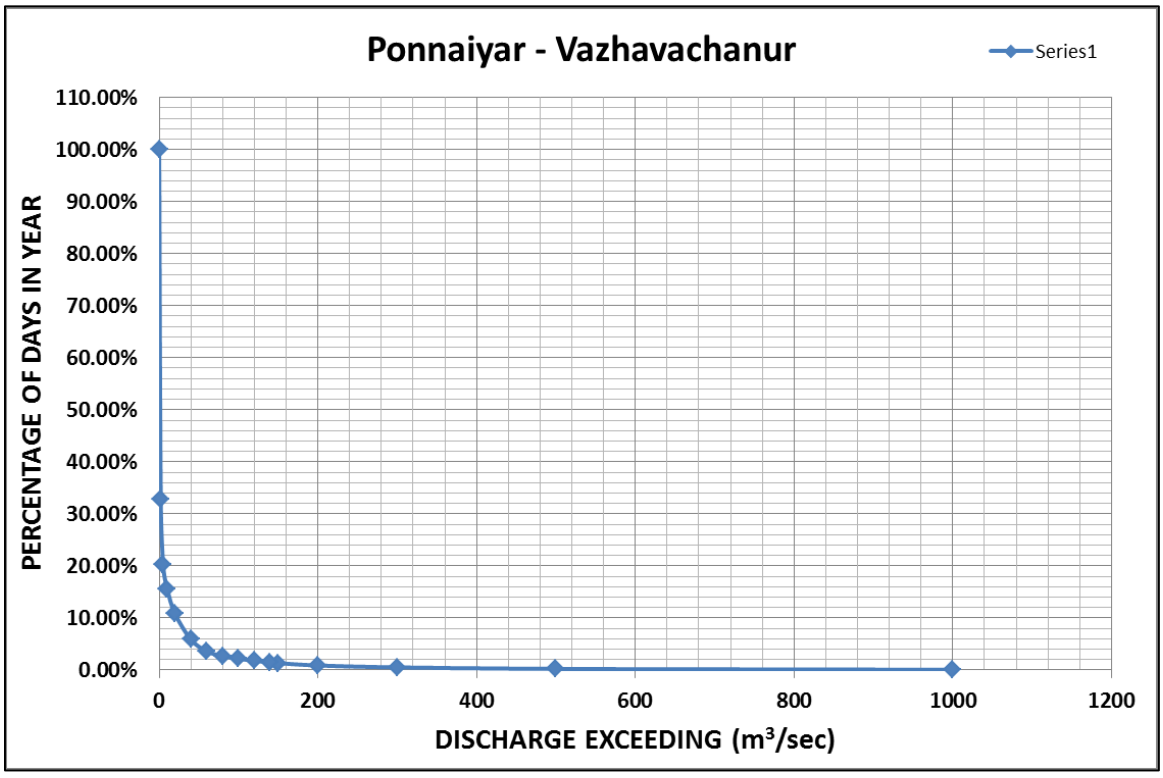


Figure 29: Period of exceedance of discharge in percentage of days in year for Ponniyar River at Vazhavachanur gauging station

Villupuram: - Results of analysis of data for assessing period of availability (% days in year) for different discharge ranges is presented in Table 61. Percentage of days in year for availability of discharge at this gauge site in excess of certain values is presented on a plot in figure 30. These results indicate the following:

Sr	Discharge (m^3/s) in excess of	Availability period in % days during monsoon	Depth estimated from gauge and latest river cross section
1	5 m^3/s	46 % (about 40 days)	1.1 m
2	10 m^3/s	36 % (about 32 days)	1.2 m
3	20 m^3/s	28 % (about 25 days)	1.25 m
4	40 m^3/s	19 % (about 17 days)	1.30 m
5	100 m^3/s	11 % (about 10 days)	1.60 m

Table 61: Water availability in Ponniyar River at Villupuram

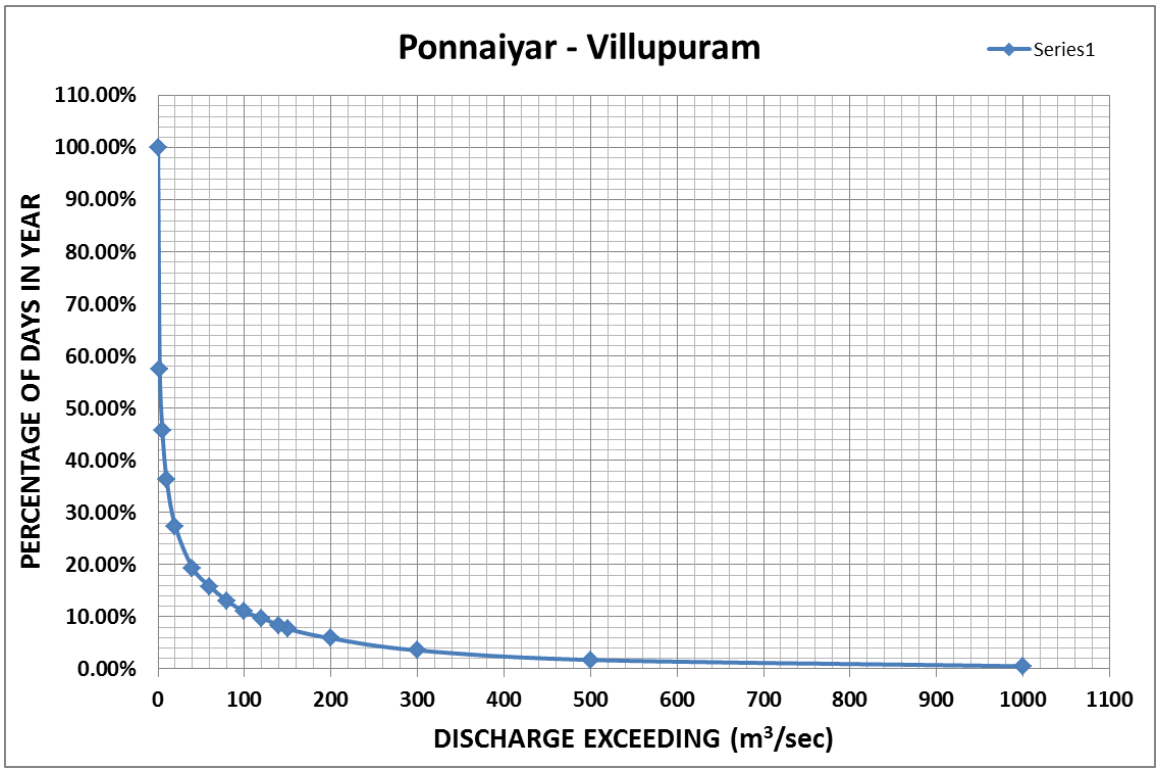


Figure 30: Period of exceedance of discharge in percentage of days in year for Ponniyar River at Villupuram gauging station

No of Days / YEAR	Range of Discharge (m^3/s)															
	0 to 2	2 to 5	5 to 10	11 to 20	21 to 40	41 to 60	61 to 80	81 to 100	101-120	121-140	141-150	151-200	201-300	301-500	501-1000	1001-2000
1978	154	12	9	9	21	6	2	0	0	0	1	0	0	0	0	0
1979	111	100	34	50	31	5	5	4	1	4	0	4	6	6	2	2
1980	245	70	16	22	13	0	0	0	0	0	0	0	0	0	0	0
1981	250	26	14	25	15	11	5	2	5	1	1	5	1	2	1	1
1982	267	60	9	25	4	0	0	0	0	0	0	0	0	0	0	0
1983	270	10	6	10	21	3	0	1	0	1	0	1	0	0	0	0
1984	220	87	27	21	2	4	4	1	0	0	0	0	0	0	0	0
1985	292	39	7	10	12	3	2	0	0	0	0	0	0	0	0	0
1986	297	13	9	7	13	21	5	0	0	0	0	0	0	0	0	0
1987	302	21	15	6	2	11	6	2	0	0	0	0	0	0	0	0
1988	308	16	3	2	8	16	11	2	0	0	0	0	0	0	0	0
1989	305	4	1	0	0	4	2	0	0	0	0	0	0	0	0	0
1990	159	1	1	0	2	1	0	0	0	0	0	0	0	0	0	0
1991	127	5	5	8	12	13	5	3	1	2	1	4	8	1	1	4
1992	240	23	26	41	7	7	3	0	3	0	0	0	0	0	2	0
1993	195	31	4	8	33	13	0	1	0	0	0	1	2	1	1	0
1994	229	53	12	46	11	12	0	1	0	0	0	1	0	0	0	0
1995	263	71	4	7	6	14	0	0	0	0	0	0	0	0	0	0
1996	243	20	9	13	11	17	8	6	6	8	3	7	2	7	6	0
1997	165	55	32	24	29	12	9	8	4	7	3	6	8	3	0	0
1998	159	84	9	43	36	6	2	4	4	3	4	6	2	3	0	0
1999	205	85	31	17	21	1	3	0	1	0	0	0	1	0	0	0
2000	244	48	6	15	39	0	4	4	2	0	1	1	1	1	0	0
2001	210	75	9	8	28	16	2	6	3	0	0	1	1	0	0	0
2002	332	15	1	0	0	0	0	0	0	0	0	0	0	0	0	0

No of Days / YEAR	Range of Discharge (m^3/s)															
	0 to 2	2 to 5	5 to 10	11 to 20	21 to 40	41 to 60	61 to 80	81 to 100	101-120	121-140	141-150	151-200	201-300	301-500	501-1000	1001-2000
2003	127	24	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2004	148	27	11	17	23	6	0	1	2	0	0	0	0	0	0	0
2005	165	24	31	6	23	5	9	10	6	5	1	9	8	7	6	0
2006	213	13	15	18	17	0	0	0	0	0	0	0	0	0	0	0
2007	49	1	3	0	2	2	1	0	0	0	0	0	1	1	0	0
2008	96	2	15	5	7	6	2	1	1	1	1	0	0	0	0	0
2009	205	43	20	19	29	1	0	0	0	0	0	0	0	0	0	0
2010	202	59	26	12	33	17	6	2	3	1	0	4	0	0	0	0
2011	168	84	60	28	22	2	0	0	1	0	0	0	0	0	0	0
2012	194	89	24	12	14	11	2	0	0	0	0	0	0	0	0	0
2013	81	1	0	0	0	5	1	0	0	0	0	0	0	0	0	0
N	7440	1391	505	534	547	251	99	59	43	33	16	50	41	32	19	7
ƐN	11067															
% occurrence	67.23%	12.57%	4.56%	4.83%	4.94%	2.27%	0.89%	0.53%	0.39%	0.30%	0.14%	0.45%	0.37%	0.29%	0.17%	0.06%

Table 62: Availability for days for discharge in different range at Vazhavachanur gauge station on Ponniyar River

No of Days / YEAR	Range of Discharge (m^3/s)															
	0 to 2	2 to 5	5 to 10	10 to 20	20 to 40	40 to 60	60 to 80	80 to 100	100 to 120	120 to 140	140 to 150	150 to 200	200 to 300	300 to 500	500 to 1000	1000 to 2750
1971																
1972	28	6	4	2	16	8	4	2	0	0	2	2	1	3	2	0
1973	87	12	10	14	11	0	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	3	9	1	2	0	0	0	0	0	0	0	0	0
1975	39	19	3	7	4	3	1	2	0	1	0	2	3	2	0	0
1976	91	19	8	8	10	0	0	1	0	0	0	0	0	0	0	0
1977	27	4	13	7	9	8	4	1	1	4	0	3	5	6	9	1
1978	41	11	7	9	3	1	2	3	1	1	0	1	1	1	0	0
1979	43	20	7	12	14	7	6	5	4	3	1	3	4	9	3	2
1980	12	7	4	4	1	0	0	0	0	0	0	0	0	0	0	0
1981	42	10	5	7	5	6	4	4	3	1	1	1	5	3	0	0
1982	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	31	10	4	6	4	2	0	0	2	0	0	3	1	2	0	0
1984	57	38	14	13	8	1	0	0	0	1	0	0	0	0	0	0
1985	51	15	14	9	3	3	0	1	1	1	0	0	0	0	0	0
1986	63	13	11	11	7	1	1	1	0	0	0	0	0	0	0	0
1987	17	16	7	16	5	0	1	2	0	0	0	0	0	0	0	0
1988	10	8	0	11	7	1	1	0	0	0	0	0	0	0	0	0
1989	2	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0
1990																
1991	4	9	11	2	10	5	0	2	1	0	2	2	7	5	1	3
1992	25	11	3	4	2	0	3	0	1	3	0	0	1	1	1	0
1993	6	11	3	4	8	4	0	0	1	0	0	2	1	1	1	1
1994	7	16	26	7	4	1	0	0	0	0	1	0	0	1	0	0

No of Days / YEAR	Range of Discharge (m^3/s)															
	0 to 2	2 to 5	5 to 10	10 to 20	20 to 40	40 to 60	60 to 80	80 to 100	100 to 120	120 to 140	140 to 150	150 to 200	200 to 300	300 to 500	500 to 1000	1000 to 2750
1995	6	3	6	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	3	19	8	7	10	12	6	8	5	1	3	2	2	4	6
1997	69	6	7	18	26	6	6	10	1	7	1	4	11	5	3	0
1998	119	14	25	22	13	7	5	9	6	3	1	8	6	4	2	0
1999	82	20	6	8	3	1	4	3	0	0	1	1	0	0	0	0
2000	68	8	7	2	2	0	4	1	1	0	0	4	3	0	0	0
2001	44	9	9	8	12	1	2	0	1	1	0	1	0	0	0	0
2002																
2003																
2004	12	2	3	8	2	5	1	0	2	0	1	2	1	1	0	0
2005	2	0	3	0	1	7	6	1	2	4	3	8	10	8	10	3
2006	68	7	4	7	13	2	0	0	0	0	0	0	0	0	0	0
2007	1	0	2	2	0	0	0	0	0	3	1	2	0	1	1	0
2008	23	11	4	10	2	1	9	2	0	1	0	0	4	1	0	0
2009	10	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0
2010	0	0	0	6	12	10	5	5	1	4	4	3	4	0	0	0
2011	50	19	19	12	4	2	1	1	0	0	0	0	0	0	0	0
2012	17	2	12	5	6	4	0	1	0	0	1	0	0	0	0	0
N	1295	361	285	273	244	109	84	63	37	43	21	55	70	56	37	16
ƐN	3049															
% occurrence	42.47%	11.84%	9.35%	8.95%	8.00%	3.57%	2.76%	2.07%	1.21%	1.41%	0.69%	1.80%	2.30%	1.84%	1.21%	0.52%

Table 63: Availability for days for discharge in different range at Villupuram gauge station on Ponniyar River

6.6 Cargo / Passenger / Tourism / Ro-Ro Facility

Kamarajar Port and VOC Port act as gateway for import of indigenous and foreign coal to the state. Major share of the coal is consumed in the power plants located in the state. There is huge volume of export of minerals from VOC Port. They are exported to Maldives, Sri Lanka and other South East Asian countries.

Due to a lack of round the year availability of water, there is no existing cargo movement in the Ponniyar River

There are no passenger ferry services around the Ponniyar River.

Located at 5 km north of Puducherry is the Kallialay Surf School. According to the Lonely Planet, surfing is gaining a lot of popularity along Tamil Nadu's coast. This well-equipped school, run by Spanish management, offers all types of surfing courses, right from beginner to advanced courses.

6.7 Classification of waterway: Suitable for Navigation

CH 0.0 – 4.0 km

This reach is a tidal reach (0-3.3 km) where tidal variation is approximately 1m. During the bathymetry survey minimum and maximum depths of -0.1m and 2.9 m were observed. Hence this reach can be developed as class II/ Class III waterway for whole year (365 days) with little dredging.

CH 4.0 – 22.6 km

Water was observed in 4.0 - 11.7 km reach with a maximum depth of 1m. The 4.0 – 22.6 km reach can be developed as class I waterway with additional measures (refer 6.8) which can be seen after Stage II studies.

Ch 22.6 km to 47.3 km

River was observed to be dry except some patches of water. The navigation can be developed for this stretch by some additional measures (Ref 6.8), which can only work out after Stage2 Studies.

Ch 47.3 to 65.9 km

A creek was observed flowing from Ch 59 km -65.9km with the maximum water depth of 0.60m (W.r.t. river bed). The navigation can be developed for this stretch by some additional measures (Ref 6.8), which can only work out after Stage2 Studies.

Ch 65.9 km to 117.2 km

During the reconnaissance survey, water was flowing in the river and the maximum water depth of 0.70 m (W.r.t. river bed) was observed. With little dredging and

modification of Thirukoilur anicut, this reach can be developed for Class I waterway (for a depth of 1-1.2m).

Ch 117.2 km to 125 km

Water was observed in the entire reach as water was flowing in full river width as seen at 123-125 km and 118-117.2km upto pickup dam. The maximum water depth of 3.0 m (W.r.t. river bed) was observed. The minimum water depth of 1.2 m is observed in this stretch. Sathnur Dam is located at upstream which is also used for power generation. Hence Navigation may be developed after 1 km from Sathnur Dam. Navigation of class I/II waterway is feasible in this stretch. Details can only work out after Stage II studies.

6.8 Proposed alternative methods for making waterway feasible

CH 0.0 – 4.0 km

This reach can be developed as class II/ Class III waterway for whole year (365 days) with little dredging. The detailed dredging quantity can be estimated after detailed survey in Stage II.

CH 4.0 – 22.6 km

Marudadu weir exists at Ch 9.8 km. It is an old structure which is in very bad shape. Reconstruction of this weir may lead to some water depths in this reach which can be seen after detailed cross-sectional survey in Stage II.

Ch 22.6 km to 47.3 km

Reconstruction/modification of Sornavur weir at ch 22.6 and Ellis weir at 47.3 may lead to storage of some water during monsoon season. This may create some water depths. The details of water depth and duration will require cross-section survey of river and mathematical modelling studies which can be taken up in 2nd stage.

Ch 47.3 to 65.9 km

This stretch starts from d/s of Thirukoilur anicut at Ch 65.9 up to Ellis weir at ch 47.3km. At present 4 canals off take form Thirukoilur anicut. During the survey patches of water were observed in this stretch. Modification of Ellis weir will lead to raising the water levels at upstream. Thirukoilur anicut can also be modified to maintain discharges and to make water available at downstream. Detailed mathematical model studies and Cross-section survey of river (Stage II) is required to firmly assess the feasibility of this stretch for Inland navigation.

Ch 65.9 km to 117.2 km

A pickup weir was observed at the start of this stretch. Thirukoilur anicut is a weir where gates are provided for offtaking canals (04 in No's). It exists at downstream end of this stretch. Shallow water was observed in this stretch. Modification of Thirukoilur anicut will create water storage and additional water depths. Modification of pickup weir may

add to more discharges in the reach. For feasibility for navigation, details of water depth will require cross-section survey of river and mathematical modelling studies which can be taken up in 2nd stage.

Ch 117.2 km to 125 km

Sathnur dam is a large reservoir and a well developed recreational spot. It is also used for Power generation. Navigation can be developed in a stretch from 1 km d/s of Sathnur dam to pick up weir at ch 117.2km. Modification of Pickup weir will lead to additional water depth in this stretch. Details can only work out after Stage II studies.

6.9 SWOT Analysis

Strength	Weakness
• 4 km reach (3.3 km tidal) is navigable for Class I navigation with little dredging round the year. • Existing weirs and anicut in the river facilitates water depths of 0.5 to 1 m in the reach of about 55-60 km upstream of Tirukoilur anicut for 60-90 days. • Modification of existing weirs can develop navigation	• 6 no's existing bridges in this reach need modification or reconstruction. • Negligible cargo traffic • Rocky strata from Chainage 76- 125.5 km.
Opportunities	**Threats**
• Local ferry and passenger traffic • Potential exists for Recreational development	• Steep slope of the river (70 m in 50 km) • Forest areas in about 7.5 km reach from Sathnur dam to pickup weir.

6.10 Recommendation for going into Stage-II

As depths of about 1 m are available without dredging for 6-7 months, we recommend Stage II studies (Detailed studies and investigations) to examine the possibility of various alternative methods (Like raising the height of existing weirs, construction of locks, etc.) to make the waterway feasible all-round the year for class I and Class II navigation.

Annexure 1: Soil Characteristics

Chainage (km)	Texture
0 – 8 km	SAND
8 – 14 km	CLAY
14 – 20 km	SAND
20 – 30 km	Clayey SAND
30 – 75 km	SAND
75 – 125 km	CLAY , ROCKY

Annexure 1: Soil Samples characteristics

Annexure 2: Collected Data

TIRUKOILUR ANICUT SYSTEM WITH FOUR OFFTAKING CANALS (collected from site)

Hydraulic Particulars of Tirukoilur Anicut:

1.	Length of Main Stream	362.1km
2.	Catchment Area	12321.24 sq km
3.	Max. Observed Discharge	(221218 c/s) +86.56m 09/12/1972
4.	Length of Anicut including falling shutter	456.30m
5.	Crest of Anicut	+82.90m
6.	Length of falling shutter	Left Flank: 91.45m, Right Flank: 18.30m
7.	Size of falling shutter	3.65mx0.60m (30 nos.)
8.	Sill of falling shutter	82.30m
9.	Crest of falling shutter	82.90m
10.	Size and sill of under sluice on either side	4x2.35x1.63 Sill +80.77m
11.	Area Irrigated Complete Project	22325 Acres (9038.46 Hectares)

Four Offtaking Canals:

- Vadamarudur Channel
  - No. of Vents: - 1 No.
  - Sill Level:- +81.430m
  - Discharge:- 15 c/s
  - Ayacut:- 421 Acres

- Sithalingamadam Channel
  - No. of Vents: - 1 No.
  - Sill Level:- +81.400m
  - Discharge:- 20 c/s
  - Ayacut:- 618 Acres

- Ragavaiyan Channel
  - No. of Vents: - 5 Nos.
  - Sill Level:- +81.430m
  - Discharge:- 317 c/s
  - Ayacut:- 9614 Acres

- Malattar Channel
  - No. of Vents: - 3 Nos.
  - Sill Level:- +81.351m
  - Discharge:- 297 c/s
  - Ayacut:- 4460 Acres

Annexure 3: Details for Hindrance

PROFORMA FOR HINDRANCE REGISTER										
Reference clause No. 16.5										
SL No.	**Nature of Hindrance**	**Items of work that could not be due executed to this hindrance**	**Date of Start of Hindrance**	**Signature of representative of EIC**	**Date of removal of hindrance**	**Overlapping period if any**	**Net hindrance in days**	**Weightage of this hindrance**	**Net effective days of hindrance**	**Remarks of Engineer-in-charge**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	Chainage 117.5Ch (Pickup anicut) to 125 Ch (Sathanur dam)- The area is crocodile affected, localites did not suggest to carry survey, even they were also not ready to go with us as in early few incident happened.	Bathymetry survey/Land Survey	First Approach - 02 Mar-03 Mar 16 Second Approach - 09 Apr-10 Apr 16.		NA	04 Days	04 Days	Life risk to carry out survey in the mentioned stretch.	04 Days.	

Annexure 4: Inventory of structures on Ponniyar River

Sl No.	Chainage (Km)	Max W.L.	Min W.L.	Types of Crops & Industry	Ferry/ Prominent Towns City/ Jetty/ Terminal	Utility/ Pipelines	Position	Historical and tourist places	Position	Bridges Name	Position	Position	Permanent Structure in Corridor of River	Position	Bank Condition	Critical Areas/Not approachable	Position	Local Name of River	Dams details	Position	HFL/Gauge stn. details	Position	Remarks	Other Details
1	3.5					-	-	-	-	Puducherry Bridge	11°46'26.47"N, 79°45'51.18"E	-	-	-	Sandy, Eroded	-	-		-	-	-	-		
2	3.5					-	-	-	-	Puducherry Bridge	11°46'26.30"N, 79°45'52.09"E	-	-	-	Sandy, Eroded	-	-		-	-	-	-	Water flowing in full river width, bushes on both banks	2 Road Bridges @7.5+1.5x2
3	4.4					-	-	-	-	Kumandanmedu Causeway, No HC and VC	11°46'26.13"N, 79°45'23.28"E	-	-	-	Sandy, Eroded	-	-		-	-	-	-	Water flowing in full width, bushes and coconut trees on both banks	
4	6.8					-	-	-	-	Chavadi Bridge	11°46'46.21"N, 79°44'09.83"E	-	-	-	Sandy, Eroded	-	-		-	-	-	-	Water flowing in full width,	Road Bridge @7.5+1.5x2
5	9.8					-	-	-	-	-	-	-	-	-	Sandy, Eroded	-	-		Marudadu Dam	11°47'41.53"N, 79°42'55.47"E	-	-		
6	10.9					-	-	-	-	Erandara villagam Ground Bridge,	11°47'30.01"N, 79°42'16.40"E	-	-	-	Sandy, Eroded	-	-		-	-	-	-	Water flowing in patches, Heavy vegetation with large no of coconut trees	
7	14.4					-	-	-	-	Mananadu Bridge,	11°48'18.58"N, 79°40'37.03"E	-	-	-	Sandy, Eroded	-	-		-	-	-	-	Dry bed, Bouldery strata with heavy bushes	
8	15.5					-	-	-	-	-	-	11°48'33.06"N, 79°40'06.33"E	-	-	Sandy, Eroded	-	-		-	-	-	-		
9	19.7					-	-	-	-	Kalinjikuppam Bridge,	11°48'09.22"N, 79°37'58.62"E	-	-	-	Sandy, Eroded	-	-		-	-	-	-	Dry sandy bed, heavy vegetation at both ends of bridge	
10	19.7					-	-	-	-	Kalinjikuppam Damaged Bridge	11°48'04.70"N, 79°37'54.42"E	-	-	-	Sandy, Eroded	-	-		-	-	-	-		
11	21.7					-	-	-	-	-	-	11°48'59.95"N, 79°37'15.70"E	-	-	Sandy, Eroded	-	-		-	-	-	-		
12	22.3					-	-	-	-	-	-	11°49'19.08"N, 79°37'09.23"E	-	-	Sandy, Eroded	-	-		-	-	-	-		
13	22.6					-	-	-	-	-	-	-	-	-	Sandy, Eroded	-	-		Sornavur Dam	11°49'31.69"N, 79°37'04.42"E	-	-		
15	28.3					-	-	-	-	-	-	11°50'26.83"N, 79°33'38.64"E	-	-	Sandy, Eroded	-	-		-	-	-	-		
16	29.0					-	-	-	-	Panrutti to	11°50'39	-	-	-	Sandy,	-	-		-	-	-	-	Completely Dry	

Sl No.	Chainage (Km)	Max W.L.	Min W.L.	Types of Crops & Industry	Ferry/ Prominent Towns City/ Jetty/ Terminal	Utility/ Pipelines	Position	Historical and tourist places	Position	Bridges Name	Position	Position	Permanent Structure in Corridor of River	Position	Bank Condition	Critical Areas/Not approachable	Position	Local Name of River	Dams details	Position	HFL/Gauge stn. details	Position	Remarks	Other Details
										Cuddalore Bridge,	.12"N, 79°33'17 .74"E				Eroded									sandy bed, heavy vegetation with large no of coconut trees	
17	29.2				Villupuram	Veeranam Water Pipeline, VC=6m, HC=20m	11°50'4 1.71"N, 79°33'1 1.86"E	-	-	-	-	-	-	-	Sandy, Eroded	-	-		-	-	-	-		
18	32.8					-	-	-	-	Railway Bridge,	11°51'25 .62"N, 79°31'19 .16"E	-	-	-	Sandy, Eroded	-	-		-	-	-	-	Completely dry bed with sandy and bouldery strata, light bushes	
19	36.8					-	-	-	-	-	-	11°51'56 .65"N, 79°29'12 .45"E	-	-	Sandy, Eroded	-	-		-	-	-	-		
20	39.4					-	-	-	-	-	-	-	-	-	Sandy, Eroded	-	-		-	-	Villupuram Gauge stn	11°52'0 5.94"N, 79°27'4 1.54"E		
21	41.4					-	-	-	-	-	-	11°52'18 .79"N, 79°26'41 .25"E	-	-	Sandy, Eroded	-	-		-	-	-	-		
22	41.7					-	-	-	-	Villupuram to Thindavanam Bridge,	11°52'16 .96"N, 79°26'27 .64"E	-	-	-	Sandy, Eroded	-	-		-	-	-	-	Completely Dry sandy bed, very less bushes, Paddy crops nearby	
23	41.7					-	-	-	-	Villupuram to Thindavanam Bridge,	11°52'16 .89"N, 79°26'26 .75"E	-	-	-	Sandy, Eroded	-	-		-	-	-	-		
24	42.9					-	-	-	-	Railway Bridge 2,	11°52'43 .92"N, 79°25'53 .88"E	-	-	-	Sandy, Eroded	-	-		-	-	-	-	Dry bed with heavy vegetation	
25	45.2					-	-	-	-	-	-	11°53'37 .73"N, 79°24'59 .14"E	-	-	Sandy, Eroded	-	-		-	-	-	-		
26	46.8					-	-	-	-	-	-	11°54'14 .25"N, 79°24'19 .76"E	-	-	Sandy, Eroded	-	-		-	-	-	-		
27	47.0					-	-	-	-	Thiruannamalai Bridge,	11°54'20 .70"N, 79°24'20 .61"E	-	-	-	Sandy, Eroded	-	-		-	-	-	-	Water flowing in patches, Very light vegetation	Road Bridge @7.5+1.5x2
28	47.3			Paddy, Sugarcane, Banana		-	-	-	-	-	-	-	-	-	Sandy, Eroded	-	-		Ellis Dam	11°54'1 2.47"N, 79°23'5 6.06"E	Ellis Dam, HFL value= +190.5, 09 Dec 1972. H	11°54'1 2.47"N, 79°23'5 6.06"E		
29	47.5				Thirukovillur	-	-	-	-	-	-	11°54'19 .27"N, 79°23'56 .27"E	-	-	Bushy	-	-		-	-	-	-		

Sl No.	Chainage (Km)	Max W.L.	Min W.L.	Types of Crops & Industry	Ferry/ Prominent Towns City/ Jetty/ Terminal	Utility/ Pipelines	Position	Historical and tourist places	Position	Bridges Name	Position	Position	Permanent Structure in Corridor of River	Position	Bank Condition	Critical Areas/Not approachable	Position	Local Name of River	Dams details	Position	HFL/Gauge stn. details	Position	Remarks	Other Details
30	49.1					-	-	-	-	-	-	11°54'39.08"N, 79°23'08.49"E	-	-	Bushy	-	-		-	-	-	-		
31	50.2					-	-	-	-	-	-	11°54'29.56"N, 79°22'33.06"E	-	-	Bushy	-	-		-	-	-	-		
32	50.2					-	-	-	-	Enathimangalam Road Bridge	11°54'22.99"N, 79°22'31.93"E	-	-	-	Bushy	-	-		-	-	-	-		
33	53.0					-	-	-	-	Paiyur Bridge,	11°53'59.29"N, 79°21'03.75"E	-	-	-	Bushy	-	-		-	-	-	-	Water flowing in width of 120m in middle, vegetation on both banks, rocky STRATA	
34	61.2					-	-	-	-	-	-	11°56'27.83"N, 79°17'39.40"E	-	-	Bushy	-	-		-	-	-	-		
35	65.9			Paddy, Sugarcane		-	-	-	-	-	-	-	-	-	Bushy	-	-		Thirukovillur Dam	11°57'07.35"N, 79°15'08.17"E	-	-	Offtaking Channels:- 1) Vadamarudur 2) Sithalingamadam 3) Ragavaiyan 4) Malattar Water flowing in all channels with their full capacity	well maintained system, people seen bathing in canals.
36	67.6					Well 1	11°57'21.20"N, 79°14'13.08"E	-	-	-	-	-	-	-	Bushy	-	-		-	-	-	-		
37	70.9					-	-	-	-	Thirukovillur Road Bridge, No VC and HC	11°58'31.75"N, 79°12'51.82"E	-	-	-	Bushy	-	-		-	-	-	-		
38	71.0					-	-	-	-	-	-	11°58'26.38"N, 79°12'45.08"E	-	-	Bushy	-	-		-	-	-	-		
39	71.7					-	-	-	-	Thirukovillur Thiruannamalai Bridge,	11°58'35.23"N, 79°12'21.00"E	-	-	-	Bushy	-	-		-	-	-	-	Water flowing in patches, rocky strata	
40	72.8					Water Intake 1, VC=6m, HC=8m	11°58'17.19"N, 79°11'47.86"E	-	-	-	-	-	-	-	Bushy	-	-		-	-	-	-		
41	73.2					-	-	-	-	-	-	11°58'22.59"N, 79°11'36.67"E	-	-	Bushy	-	-		-	-	-	-		
42	73.3					-	-	-	-	-	-	11°58'21.60"N, 79°11'32.97"E	-	-	Bushy	-	-		-	-	-	-		
43	73.4					-	-	-	-	-	-	11°58'24.72"N,	-	-	Bushy	-	-		-	-	-	-		

Sl No.	Chainage (Km)	Max W.L.	Min W.L.	Types of Crops & Industry	Ferry/ Prominent Towns City/ Jetty/ Terminal	Utility/ Pipelines	Position	Historical and tourist places	Position	Bridges Name	Position	Position	Permanent Structure in Corridor of River	Position	Bank Condition	Critical Areas/Not approachable	Position	Local Name of River	Dams details	Position	HFL/Gauge stn. details	Position	Remarks	Other Details
												79°11'28.93"E												
44	74.0					-	-	-	-	Trichy Thiruannamalai Bridge,	11°58'26.45"N, 79°11'08.19"E	-	-	-	Bushy	-	-		-	-	-	-	Water flowing in patches, rocky strata	
45	76.5					-	-	-	-	-	-	11°57'57.34"N, 79°09'53.53"E	-	-	Bushy	-	-		-	-	-	-		
46	79.1					Well 2	11°57'56.12"N, 79°08'26.80"E	-	-	-	-	-	-	-	Bushy	-	-		-	-	-	-		
47	81.8					-	-	-	-	-	-	11°58'41.45"N, 79°07'14.61"E	-	-	Bushy	-	-		-	-	-	-		
48	86.3					-	-	-	-	Malanurpet to Dhuravam Road Bridge,	12°00'09.47"N, 79°05'19.10"E	-	-	-	Bushy	-	-		-	-	-	-		
49	87.0					-	-	-	-	-	-	12°00'06.18"N, 79°04'55.12"E	-	-	Bushy	-	-		-	-	-	-		
50	95.2				Thiruannamalai	-	-	-	-	-	-	12°02'13.04"N, 79°01'16.53"E	-	-	Rocky	-	-		-	-	-	-		
51	100.6					-	-	-	-	-	-	12°03'48.15"N, 78°59'02.00"E	-	-	Rocky	-	-		-	-	-	-		
52	101.2					-	-	-	-	Vazhavachanur to Moongalthuraipattu Bridge,	12°03'53.07"N, 78°58'44.02"E	-	-	-	Rocky	-	-		-	-	-	-	Water flowing in patches, Factory on right bank u/s of bridge	
53	101.2					-	-	-	-	-	-	-	-	-	Rocky	-	-		-	-	Vazhavachanur Gauge stn BM	12°04'02.21"N, 78°58'45.58"E		
54	101.6					-	-	-	-	-	-	12°03'56.23"N, 78°58'33.24"E	-	-	Rocky	-	-		-	-	-	-		
55	103.7					-	-	-	-	-	-	12°04'08.00"N, 78°57'31.31"E	-	-	Rocky	-	-		-	-	-	-		
56	105.5					-	-	-	-	-	-	12°05'04.17"N, 78°57'30.58"E	-	-	Rocky	-	-		-	-	-	-		
57	108.7					-	-	-	-	Raindapuram to Allapannur Bridge,	12°05'39.38"N, 78°55'57.08"E	-	-	-	Rocky	-	-		-	-	-	-	Water flowing in 100m river width, light vegetation in bed and banks	
58	108.					-	-	-	-	-	-	12°05'41	-	-	Rocky	-	-		-	-	-	-		

Sl No.	Chainage (Km)	Max W.L.	Min W.L.	Types of Crops & Industry	Ferry/ Prominent Towns City/ Jetty/ Terminal	Utility/ Pipelines	Position	Historical and tourist places	Position	Bridges Name	Position	Position	Permanent Structure in Corridor of River	Position	Bank Condition	Critical Areas/Not approachable	Position	Local Name of River	Dams details	Position	HFL/Gauge stn. details	Position	Remarks	Other Details
	8											.12"N, 78°55'54 .80"E												
59	111.1					-	-	-	-	-	-	12°06'30 .70"N, 78°55'05 .50"E	-	-	Rocky	-	-		-	-	-	-		
60	115.4					-	-	-	-	Kolamanjanur Bridge,	12°08'01 .72"N, 78°53'57 .25"E	-	-	-	Rocky	-	-		-	-	-	-	Water flowing in width of 100m in river, heavy vegetation in bed and banks, bouldery strata	Road Bridge @7.5+1.5x2
61	116.8					Water Intake Tank	12°08'1 4.00"N, 78°53'3 4.12"E	-	-	-	-	-	-	-	Rocky	-	-		-	-	-	-	Water flowing in width of 100m river	
62	117.0					Water Intake Tank	12°08'1 3.36"N, 78°53'2 7.64"E	-	-	-	-	-	-	-	Rocky	-	-		-	-	-	-		
63	117.2					-	-	-	-	-	-	-	-	-	Rocky	-	-		Pickup Dam	12°08'1 9.91"N, 78°53'2 8.66"E	Pickup Dam, MFL value= 171.2 15m, 09 Dec 1972.	12°08'2 0.36"N, 78°53'2 9.44"E	Lined Canal is offtaking just u/s of the weir	Water flowing in full width, rocky strata in bed and both banks, heavy vegetation on both banks
64	118.0					Water Intake Tank	12°08'2 1.67"N, 78°53'2 6.52"E	-	-	-	-	-	-	-	Rocky	-	-		-	-	-	-		Rocky strata observed
65	118.1					Water Intake Tank	12°08'2 2.81"N, 78°53'2 5.94"E	-	-	-	-	-	-	-	Rocky	-	-		-	-	-	-		Rocky strata observed
66	123.1					Water Intake Tank	12°10'1 8.24"N, 78°51'1 7.26"E	-	-	-	-	-	-	-	Rocky	-	-		-	-	-	-		
67	123.4					Water Intake Tank	12°10'1 9.83"N, 78°51'1 5.6"E	-	-	-	-	-	-	-	Rocky	-	-		-	-	-	-		
68	125.0					-	-	-	-	-	-	-	-	-	Rocky	-	-		Sathanur Dam	12°10'5 9.7"N, 78°51'0 1.8"E	-	-	140m wide spillway, Powerhouse on left bank, Tail race channel, Canal Regulator, Sathanur dam developed as a recreational spot, Working model also exists.	Pond, Heavy vegetation on banks d/s of dam, Slope protection, Grass Turfing, Boating in reservoir area, Rocky strata observed in offtaking canals and d/s of powerhouse.

ANNEXURE 5:- PHOTOGRAPHS OF CROSS-STRUCTURES ON PONNIYAR RIVER

1: River Mouth

2**: River Start at chainage 0.30 km**

3: Road Bridge at Ponniyar River Mouth (Chainage 3.5 km)

4: Kumandanmedu Ground Bridge at Chainage 4.4 km

5: **Local crossing at ch 5.1 km**

6: Chavadi Bridge at Chainage 6.8 km

7: Marudadu Dam at Chainage 9.8 km

8: Marudadu Dam at Chainage 9.8 km

9: **Marudadu Dam at Chainage 9.8 km**

10: Mananadu Bridge at Chainage 14.4 km

11: **sandy river bed at chainage 21.0 km**

12: **HT line at Chainage 28.3**

13: Veeranam Chennai Water Pipeline at Chainage 29.2 km

14: MTBM at Villupuram Gauge Station at Chainage 40.9 km

15: Villupuram Bridge VC-4m, HC-18m at Chainage 41.7 km

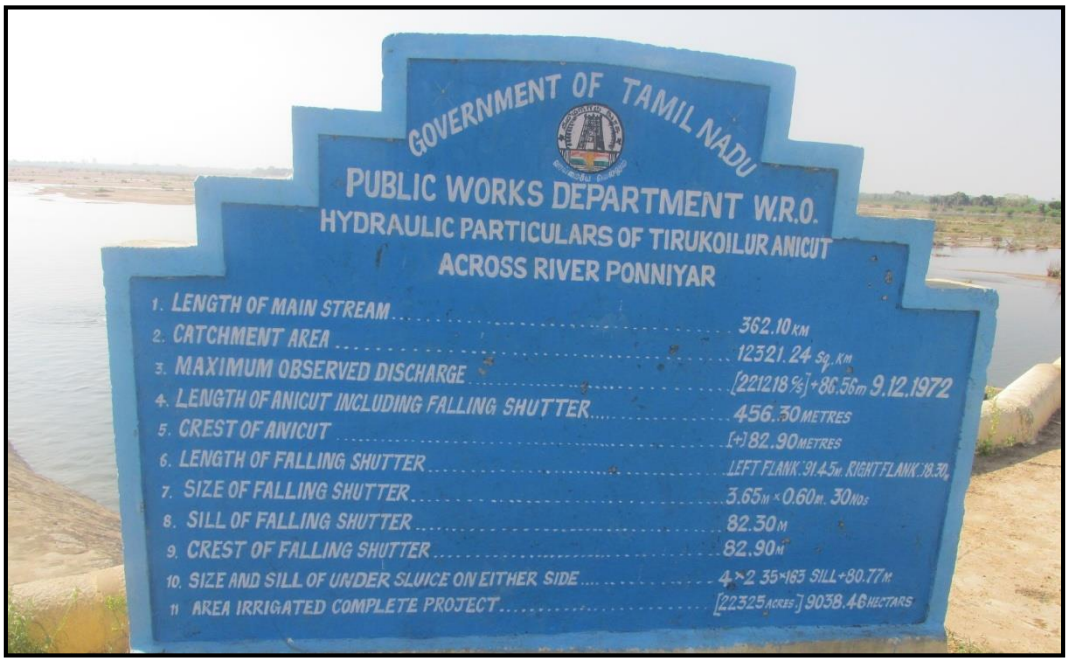
16: Railway Bridge at Chainage 42.9 km

17: **HFL on Ellis Dam at Chainage 47.3 km**

18: Paiyur Bridge at chainage 53.0 m

19: Google layout of Tirukoilur Anicut system at Chainage 65.9 km

20: Inauguration stones and History of Tirukoilur Anicut system at Chainage 65.9 km



21: Four Offtaking Canals of Tirukoilur Anicut system at Chainage 65.9 km

22: **Tirukoilur Anicut system at Chainage 65.9 km**

23: Tirukoilur Anicut system - Offtaking Canals- Chainage 65.9 km

24: Malanurpet to Thuruvam Road Bridge at chainage 86.3 km

25**: River at chainage 101.1 km**

26: Vazhavachanur to Moongalthuraipet Bridge at ch 101.2 km

27: Vazhavachanur CWC Benchmark at 103.8 km

28: Raindapuram to Allapannur Bridge at ch 108.7 km

29: Kolamanjanur Bridge, VC-6m, HC-18m at Chainage 115.4 km

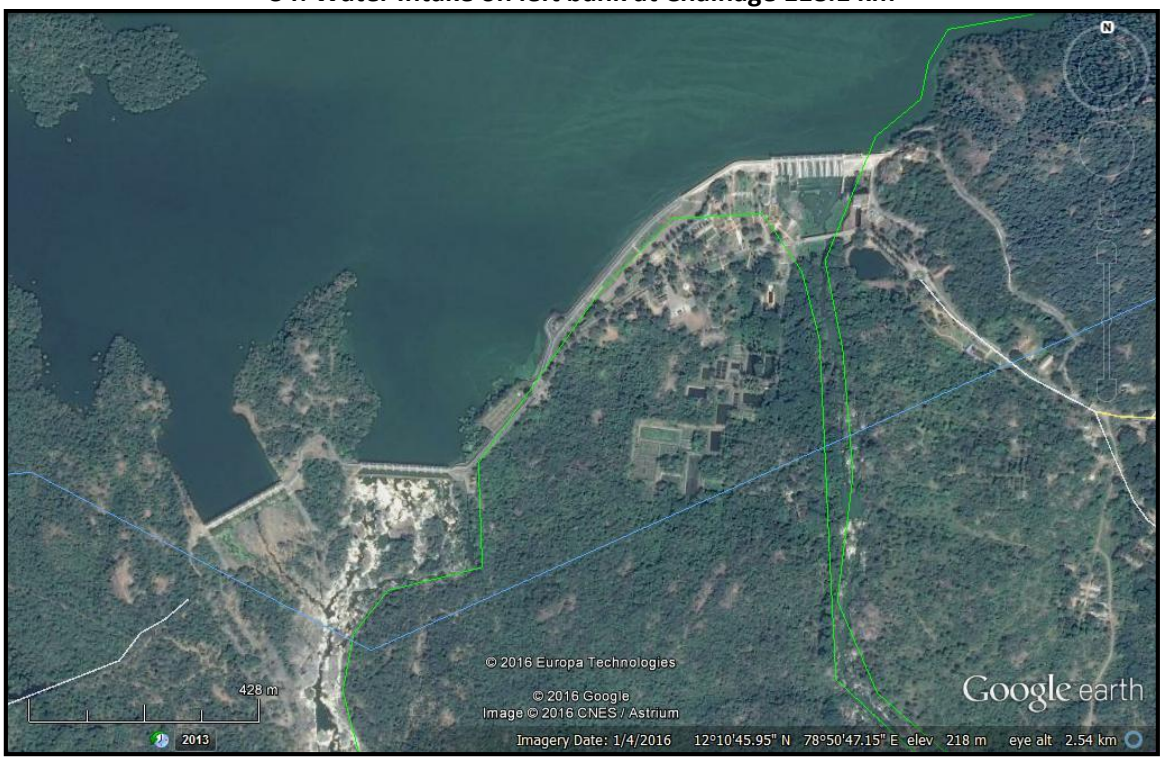
30: Water Intake on right bank at Chainage 116.8 km

31: Gauge measurement at Chainage 117.2 km

32: Pickup Dam at Chainage 117.2 km

33: Google layout of Pickup Dam at Chainage 117.2 km

34: Water Intake on left bank at Chainage 118.1 km



35: Google layout of Sathnur Dam at Chainage 125.0 km

36: Sathnur Dam Project at 125 km

37: Sathnur Dam Project and Power Tunnel at Chainage 125.0 km

38**: Sathnur Dam at Chainage 125.0 km**

39: Powerhouse of Sathnur Dam at Chainage 125.0 km

40: **Model of Sathnur Dam at Chainage 125.0 km**

41: Model of Sathnur Dam at Chainage 125.0 km

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
3.411	3.60	4.60	4.00	5.50
3.430	3.58	4.58	4.01	5.51
3.451	3.62	4.62	4.03	5.53
3.530	3.55	4.55	4.08	5.58
3.630	3.54	4.54	4.15	5.64
3.704	3.58	4.58	4.20	5.69
3.730	3.52	4.52	4.22	5.70
3.830	3.50	4.50	4.29	5.77
3.930	3.48	4.48	4.36	5.83
4.029	3.48	4.48	4.43	5.89
4.129	3.43	4.43	4.50	5.96
4.206	3.37	4.37	4.55	6.01
4.223	3.41	4.41	4.56	6.02
4.282	3.38	4.38	4.60	6.06
4.323	3.31	4.31	4.63	6.08
4.386	3.35	4.35	4.67	6.12
4.422	3.30	4.30	4.70	6.15
4.525	3.28	4.28	4.77	6.21
4.624	3.27	4.27	4.84	6.27
4.724	3.26	4.26	4.91	6.34
4.824	3.21	4.21	4.97	6.40
4.922	3.15	4.15	5.04	6.46
5.114	3.11	4.11	5.17	6.59
5.136	3.09	4.09	5.19	6.60
5.137	3.09	4.09	5.19	6.60
5.304	3.36	4.36	5.31	6.71
5.404	3.63	4.63	5.37	6.77
5.504	3.90	4.90	5.44	6.83
5.604	4.17	5.17	5.51	6.90
5.704	4.44	5.44	5.58	6.96
5.804	4.75	5.75	5.65	7.03
5.902	4.98	5.98	5.72	7.09
6.001	5.25	6.25	5.79	7.15
6.111	5.52	6.52	5.86	7.22

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
6.209	5.74	6.74	5.93	7.28
6.309	6.06	7.06	6.00	7.35
6.391	6.14	7.14	6.05	7.40
6.399	6.33	7.33	6.06	7.41
6.498	6.20	7.20	6.13	7.47
6.596	6.27	7.27	6.20	7.53
6.625	6.41	7.41	6.22	7.55
6.653	6.11	7.11	6.24	7.57
6.696	6.20	7.20	6.26	7.59
6.796	6.40	7.30	6.33	7.66
6.896	6.30	7.20	6.40	7.72
6.996	5.89	6.79	6.47	7.79
7.096	5.59		6.54	7.85
7.150	4.99		6.58	7.88
7.193	5.29		6.61	7.91
7.286	4.68		6.67	7.97
7.438	4.38		6.78	8.07
7.526	4.08		6.84	8.12
7.614	3.77		6.90	8.18
7.616	4.08		6.90	8.18
7.713	4.30		6.97	8.24
7.813	4.52		7.03	8.31
7.912	4.75		7.10	8.37
8.012	5.19		7.17	8.43
8.112	5.42		7.24	8.50
8.212	5.64		7.31	8.56
8.312	5.87		7.38	8.63
8.412	6.09		7.45	8.69
8.512	6.31		7.52	8.75
8.612	6.54		7.59	8.82
8.712	6.76		7.65	8.88
8.757	4.97		7.69	8.91
8.812	6.98		7.72	8.94
8.912	7.21		7.79	9.01
9.013	7.43		7.86	9.07
9.113	7.65		7.93	9.14

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
9.212	7.70		8.00	9.20
9.311	8.10	8.70	8.50	10.40
9.407	8.32	8.92	8.57	10.47
9.500	8.55	9.25	8.65	10.54
9.600	8.50	9.20	8.72	10.61
9.620	8.77	9.37	8.74	10.63
9.693	8.83	9.43	8.80	10.68
9.791	8.90	9.40	8.87	10.75
9.886	8.96	9.46	8.94	10.82
9.986	9.02	9.52	9.02	10.90
10.086	9.09	9.49	9.10	10.97
10.186	9.15	9.55	9.18	11.05
10.286	9.21	9.61	9.25	11.12
10.387	9.27	9.57	9.33	11.19
10.487	9.34	9.74	9.41	11.27
10.587	9.40	9.80	9.49	11.34
10.593	9.46	9.76	9.49	11.35
10.593	9.52	9.92	9.49	11.35
10.686	9.59	9.99	9.56	11.41
10.784	9.65	10.05	9.64	11.49
10.883	9.75	10.15	9.71	11.56
10.977	9.78	10.18	9.79	11.63
11.074	9.84	10.24	9.86	11.70
11.172	9.92	10.32	9.94	11.77
11.293	9.96	10.36	10.03	11.86
11.393	10.03	10.43	10.11	11.94
11.527	10.09	10.49	10.21	12.04
11.624	10.15	10.55	10.29	12.11
11.702	10.21	10.51	10.35	12.17
11.722	10.16	10.46	10.36	12.18
11.836	10.12	10.42	10.45	12.26
11.934	9.82	10.12	10.53	12.34
12.032	9.68		10.60	12.41
12.040	9.52		10.61	12.41
12.128	9.58		10.68	12.48
12.223	9.64		10.75	12.55

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
12.319	9.70		10.82	12.62
12.414	9.75		10.90	12.69
12.537	9.82		10.99	12.78
12.636	9.88		11.07	12.85
12.735	9.94		11.15	12.93
12.884	10.02		11.26	13.04
12.983	10.06		11.34	13.11
13.080	10.12		11.41	13.18
13.176	10.19		11.49	13.25
13.275	10.24		11.56	13.33
13.372	10.31		11.64	13.40
13.472	10.37		11.71	13.47
13.571	10.46		11.79	13.55
13.671	10.49		11.87	13.62
13.771	10.55		11.95	13.69
13.871	10.61		12.02	13.77
13.970	10.71		12.10	13.84
14.069	10.73		12.18	13.91
14.164	10.79		12.25	13.98
14.259	11.16		12.32	14.05
14.260	10.85		12.32	14.05
14.362	11.47		12.40	14.13
14.462	11.78		12.48	14.20
14.551	12.13		12.55	14.27
14.647	12.40		12.62	14.34
14.742	12.72		12.70	14.41
14.845	13.02		12.78	14.49
14.944	13.33		12.85	14.56
15.043	13.61		12.93	14.63
15.142	13.75		13.00	14.70
15.259	13.96		13.10	14.79
15.263	14.20		13.10	14.79
15.394	14.44		13.20	14.89
15.490	14.50		13.27	14.96
15.604	13.93		13.36	15.05
15.703	14.17		13.44	15.12

Annexure 6				
Chainage (km)	**River Bed Level w.r.t MSL (m)**	**Water Level w.r.t MSL (m)**	**Adopted C.D. w.r.t. M.S.L.**	**H.F.L. w.r.t. M.S.L.**
15.802	14.40		13.52	15.19
15.918	14.66		13.60	15.28
16.018	14.92		13.68	15.35
16.118	14.14		13.76	15.43
16.225	14.35		13.84	15.50
16.324	14.63		13.92	15.58
16.423	14.82		13.99	15.65
16.522	14.15		14.07	15.72
16.621	14.25		14.15	15.80
16.720	14.23		14.22	15.87
16.795	14.27		14.28	15.93
16.820	14.26		14.30	15.94
16.920	14.70		14.38	16.02
17.019	14.99		14.46	16.09
17.119	15.12		14.53	16.16
17.219	14.26		14.61	16.24
17.319	14.37		14.69	16.31
17.418	14.15		14.76	16.39
17.518	14.50		14.84	16.46
17.617	14.69		14.92	16.53
17.618	14.41		14.92	16.53
17.714	14.10		14.99	16.60
17.814	13.85		15.07	16.68
17.913	13.54		15.15	16.75
18.013	13.29		15.22	16.82
18.107	12.95		15.30	16.89
18.205	12.86		15.37	16.97
18.222	12.73		15.38	16.98
18.295	13.05		15.44	17.03
18.394	13.58		15.52	17.11
18.493	13.99		15.59	17.18
18.593	14.26		15.67	17.25
18.693	14.72		15.75	17.33
18.775	15.10		15.81	17.39
18.792	15.23		15.82	17.40
18.891	15.42		15.90	17.47

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
18.991	15.86		15.98	17.55
19.095	15.97		16.06	17.62
19.194	16.05		16.14	17.70
19.292	16.25		16.21	17.77
19.389	16.46		16.29	17.84
19.486	16.73		16.36	17.91
19.583	16.94		16.44	17.98
19.599	17.17		16.45	18.00
19.677	17.36		16.51	18.05
19.773	17.54		16.58	18.12
19.872	17.69		16.66	18.20
19.971	17.85		16.74	18.27
20.070	17.99		16.81	18.34
20.169	18.14		16.89	18.42
20.267	18.16		16.96	18.49
20.366	18.29		17.04	18.56
20.464	18.46		17.12	18.63
20.564	18.37		17.19	18.71
20.663	18.46		17.27	18.78
20.762	18.58		17.35	18.85
20.861	18.82		17.42	18.93
20.960	19.26		17.50	19.00
21.045	19.65		19.70	20.50
21.053	19.06		19.70	20.51
21.142	18.47		19.70	20.62
21.238	18.72		19.70	20.74
21.321	17.29		19.70	20.85
21.419	16.65		19.71	20.97
21.518	16.11		19.71	21.10
21.617	15.82		19.71	21.22
21.641	15.52		19.71	21.25
21.716	16.30		19.71	21.34
21.815	17.09		19.71	21.47
21.912	17.94		19.71	21.59
22.012	18.65		19.72	21.72
22.117	19.38		19.72	21.85

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
22.213	20.21		19.72	21.97
22.254	21.00		19.72	22.02
22.309	20.73		19.72	22.09
22.408	20.47		19.72	22.22
22.497	20.20		19.72	22.33
22.597	19.94		19.72	22.45
22.697	19.68		19.73	22.58
22.778	19.41		19.73	22.68
22.873	19.18		19.73	22.80
22.970	18.88		19.73	22.92
23.068	18.62		19.73	23.05
23.173	18.38		19.73	23.18
23.272	18.09		19.74	23.30
23.380	17.83		19.74	23.44
23.480	17.59		19.74	23.56
23.559	17.30		19.74	23.66
23.578	17.35		19.74	23.69
23.667	17.39		19.74	23.80
23.762	17.49		19.74	23.92
23.858	17.49		19.74	24.04
23.954	17.50		19.75	24.16
24.081	17.56		19.75	24.32
24.181	17.58		19.75	24.45
24.298	17.62		19.75	24.59
24.396	17.64		19.75	24.72
24.493	17.68		19.75	24.84
24.591	17.71		19.76	24.96
24.689	17.73		19.76	25.09
24.689	18.02		19.76	25.09
24.789	18.28		19.76	25.21
24.888	18.39		19.76	25.34
24.988	18.48		19.76	25.46
25.088	18.62		19.76	25.59
25.187	18.84		19.77	25.71
25.287	19.29		19.77	25.84
25.387	19.48		19.77	25.96

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
25.405	19.58		19.77	25.99
25.479	19.60		19.77	26.08
25.578	19.61		19.77	26.21
25.677	19.64		19.77	26.33
25.777	19.65		19.77	26.46
25.876	19.68		19.78	26.58
25.981	19.69		19.78	26.71
26.080	19.73		19.78	26.84
26.179	19.74		19.93	26.96
26.276	19.75		20.08	27.08
26.373	19.78		20.23	27.21
26.406	19.80		20.28	27.25
26.472	19.82		20.38	27.33
26.570	19.84		20.53	27.45
26.669	19.85		20.68	27.58
26.768	19.81		20.83	27.70
26.868	19.80		20.98	27.83
26.967	19.79		21.14	27.95
27.067	19.73		21.29	28.08
27.170	19.76		21.45	28.21
27.269	19.72		21.60	28.33
27.366	19.74		21.75	28.46
27.437	19.71		21.85	28.55
27.462	20.00		21.89	28.58
27.562	20.26		22.04	28.70
27.662	20.84		22.20	28.83
27.762	20.98		22.35	28.95
27.862	21.22		22.50	29.08
27.962	21.59		22.66	29.21
28.062	21.61		22.81	29.33
28.162	21.68		22.96	29.46
28.262	21.78		23.11	29.58
28.300	22.99		23.17	29.63
28.359	23.01		23.26	29.71
28.454	23.08		23.41	29.82
28.570	23.38		23.59	29.97

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
28.670	23.56		23.74	30.10
28.786	23.84		23.91	30.24
28.885	23.95		24.07	30.37
28.984	23.98		24.22	30.49
29.092	25.94		24.38	30.63
29.188	24.08		24.53	30.75
29.284	24.21		24.68	30.87
29.380	24.30		24.82	30.99
29.380	24.42		24.82	30.99
29.403	24.81		24.86	31.02
29.479	25.13		24.98	31.12
29.579	25.45		25.13	31.24
29.678	25.77		25.28	31.37
29.778	26.08		25.43	31.49
29.878	26.40		25.58	31.62
29.978	26.76		25.74	31.74
30.076	27.04		25.89	31.87
30.174	27.36		26.04	31.99
30.271	27.67		26.19	32.11
30.361	27.99		26.32	32.23
30.456	28.12		26.47	32.35
30.552	28.63		26.61	32.47
30.687	28.95		26.82	32.64
30.787	29.27		26.97	32.76
30.886	29.64		27.13	32.89
30.986	29.90		27.28	33.01
31.086	30.22		27.43	33.14
31.185	30.56		27.58	33.26
31.270	30.86		27.71	33.37
31.369	31.19		27.86	33.49
31.469	31.49		28.02	33.62
31.512	31.81		28.08	33.67
31.569	31.80		28.17	33.75
31.669	31.76		28.32	33.87
31.769	31.56		28.47	34.00
31.869	31.44		28.63	34.12

Annexure 6				
Chainage (km)	**River Bed Level w.r.t MSL (m)**	**Water Level w.r.t MSL (m)**	**Adopted C.D. w.r.t. M.S.L.**	**H.F.L. w.r.t. M.S.L.**
31.969	31.45		28.78	34.25
32.069	31.39		28.93	34.38
32.169	31.35		29.09	34.50
32.269	31.29		29.24	34.63
32.346	31.26		29.36	34.72
32.385	31.23		29.42	34.77
32.445	31.46		29.51	34.85
32.544	31.69		29.66	34.97
32.644	32.16		29.81	35.10
32.739	32.46		29.96	35.22
32.838	32.63		30.11	35.34
32.929	31.93		30.25	35.46
32.937	32.87		30.26	35.47
33.029	33.10		30.40	35.58
33.108	33.33		30.52	35.68
33.205	33.57		30.67	35.80
33.397	33.80		30.96	36.05
33.497	34.11		31.12	36.17
33.718	34.27		31.45	36.45
33.805	34.51		31.59	36.56
33.893	34.76		31.72	36.67
33.981	34.97		31.85	36.78
34.066	35.34		31.99	36.89
34.074	35.44		32.00	36.90
34.165	35.46		32.14	37.01
34.264	35.48		32.29	37.14
34.363	35.50		32.44	37.26
34.462	35.48		32.59	37.39
34.561	35.52		32.74	37.51
34.659	35.59		32.89	37.64
34.758	35.70		33.04	37.76
34.859	37.68		33.20	37.89
34.913	35.70		33.28	37.96
34.957	35.71		33.35	38.01
35.055	35.90		33.50	38.13
35.153	36.26		33.65	38.26

Annexure 6				
Chainage (km)	**River Bed Level w.r.t MSL (m)**	**Water Level w.r.t MSL (m)**	**Adopted C.D. w.r.t. M.S.L.**	**H.F.L. w.r.t. M.S.L.**
35.245	36.43		33.79	38.37
35.331	36.48		33.92	38.48
35.417	36.58		34.05	38.59
35.504	36.81		34.18	38.70
35.590	36.98		34.31	38.81
35.676	37.26		34.45	38.92
35.762	37.57		34.58	39.02
35.834	37.59		34.69	39.11
35.866	37.84		34.74	39.16
35.965	37.97		34.89	39.28
36.063	38.01		35.04	39.40
36.161	38.05		35.19	39.53
36.259	38.26		35.34	39.65
36.357	38.37		35.49	39.77
36.444	38.39		35.62	39.88
36.543	38.59		35.77	40.01
36.642	38.61		35.92	40.13
36.741	38.76		36.07	40.26
36.751	38.82		36.09	40.27
36.830	38.72		36.21	40.37
36.929	38.90		36.36	40.49
37.028	38.99		36.51	40.62
37.127	39.08		36.66	40.74
37.226	39.25		36.82	40.87
37.327	39.28		36.97	40.99
37.426	39.38		37.12	41.12
37.524	39.49		37.27	41.24
37.629	39.58		37.43	41.37
37.726	39.59		37.58	41.50
37.824	39.62		37.73	41.62
37.922	39.69		37.88	41.74
38.020	39.72		38.03	41.87
38.059	39.79		38.09	41.91
38.068	41.27		38.10	41.93
38.119	41.16		38.18	41.99
38.219	41.10		38.33	42.12

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
38.318	40.92		38.48	42.24
38.418	40.94		38.64	42.37
38.518	40.88		38.79	42.49
38.618	40.82		38.94	42.62
38.716	40.86		39.09	42.74
38.814	40.81		39.24	42.87
38.848	40.83		39.29	42.91
38.914	41.02		39.39	42.99
39.014	41.09		39.55	43.12
39.112	41.21		39.70	43.24
39.212	41.29		39.85	43.37
39.318	41.38		40.01	43.50
39.365	42.47		40.08	43.56
39.417	40.98		40.16	43.62
39.515	40.37		40.31	43.75
39.614	40.16		40.46	43.87
39.726	39.84		40.64	44.01
39.826	39.65		40.79	44.14
39.926	39.28		40.94	44.26
40.030	38.85		41.10	44.40
40.130	38.12		41.25	44.52
40.229	38.02		41.40	44.65
40.249	37.96		41.43	44.67
40.329	38.39		41.56	44.77
40.429	38.65		41.71	44.90
40.535	38.81		41.87	45.03
40.635	40.29		42.02	45.16
40.735	40.94		42.18	45.28
40.834	41.58		42.33	45.41
40.873	41.79		42.39	45.46
40.934	41.99		42.48	45.53
41.034	42.55		42.63	45.66
41.134	42.48		42.79	45.92
41.162	42.36		42.83	46.00
41.234	42.71		42.94	46.19
41.334	42.53		43.09	46.45

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
41.433	42.63		43.24	46.71
41.533	42.82		43.40	46.97
41.631	42.90		43.55	47.23
41.730	42.98		43.70	47.49
41.830	43.25		43.85	47.76
41.929	43.26		44.00	48.02
42.028	43.65		44.15	48.28
42.128	43.21		44.31	48.54
42.134	43.10		44.32	48.56
42.228	43.45		44.46	48.81
42.328	42.97		44.61	49.07
42.428	42.56		44.76	49.33
42.509	42.51		44.89	49.55
42.608	43.69		45.04	49.81
42.707	44.65		45.19	50.07
42.714	45.23		45.20	50.09
42.801	45.56		45.34	50.32
42.894	45.23		45.48	50.56
42.963	45.37		45.58	50.74
43.052	45.74		45.72	50.98
43.072	45.75		45.75	51.03
43.096	45.63		45.79	51.10
43.147	45.85		45.86	51.23
43.247	46.52		46.02	51.49
43.347	46.23		46.17	51.76
43.447	47.23		46.32	52.02
43.535	47.10		46.46	52.25
43.545	47.29		46.47	52.28
43.630	47.69		46.60	52.50
43.715	47.95		46.73	52.73
43.719	48.58		46.74	52.74
43.818	48.71		46.89	53.00
43.918	48.81		47.04	53.26
44.017	49.52		47.19	53.52
44.117	49.59		47.35	53.78
44.238	49.89		47.53	54.10

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
44.329	50.13		47.67	54.34
44.334	50.13		47.68	54.36
44.434	50.18		47.83	54.62
44.533	50.19		47.98	54.88
44.632	50.17		48.13	55.14
44.731	50.12		48.29	55.40
44.840	50.16		48.45	55.69
44.940	50.18		48.60	55.95
45.039	50.19		48.76	56.22
45.070	50.20		48.80	56.30
45.138	50.10		48.91	56.48
45.236	50.01		49.06	56.74
45.335	49.71		49.21	56.99
45.382	49.42		49.28	57.12
45.479	49.41		49.43	57.37
45.576	49.31		49.58	57.63
45.672	49.10	49.50	49.72	57.88
45.769	48.88	49.28	49.87	58.14
45.826	48.25	48.65	49.96	58.29
45.867	48.45	48.75	50.02	58.40
45.984	48.71		50.20	58.71
46.083	48.95		50.35	58.97
46.182	49.02		50.50	59.23
46.281	49.08		50.65	59.49
46.379	49.84		50.80	59.75
46.478	50.28		50.96	60.01
46.582	50.72		51.11	60.28
46.680	51.28		51.26	60.54
46.684	52.12		51.27	60.55
46.778	52.55		51.41	60.80
46.876	52.81		51.56	61.06
46.974	53.01		51.71	61.32
47.072	54.00		51.86	61.57
47.170	53.46		52.01	61.83
47.314	53.81		52.23	62.21
47.414	53.99		52.39	62.48

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
47.576	54.55		52.63	62.90
47.672	54.58		52.78	63.15
47.767	54.82	55.12	52.92	63.41
47.863	54.96	55.26	53.07	63.66
47.867	55.05	55.35	53.08	63.67
47.962	56.20	56.50	53.22	63.92
48.045	56.99	57.29	53.35	64.14
48.144	57.81		53.50	64.40
48.242	58.49		53.65	64.66
48.335	59.81		53.79	64.90
48.425	60.73		53.93	65.14
48.530	61.25		54.09	65.42
48.629	61.68		54.24	65.68
48.729	62.59		54.40	65.94
48.751	63.58		54.43	66.00
48.751	63.58		62.00	70.00
48.829	60.59		62.09	70.06
48.928	58.11		62.20	70.13
48.962	56.92		62.23	70.16
48.992	57.00		62.27	70.18
49.034	58.80		62.31	70.21
49.053	59.40		62.33	70.23
49.108	59.64		62.40	70.27
49.206	59.89		62.50	70.34
49.303	60.14		62.61	70.42
49.401	60.39		62.72	70.49
49.510	60.89		62.84	70.58
49.609	61.14		62.95	70.65
49.708	61.39		63.06	70.73
49.807	61.64		63.17	70.80
49.937	61.89		63.32	70.90
50.037	62.14		63.43	70.98
50.137	62.39		63.54	71.05
50.237	62.64		63.65	71.13
50.353	62.89		63.78	71.22
50.453	63.14		63.89	71.29

Annexure 6				
Chainage (km)	**River Bed Level w.r.t MSL (m)**	**Water Level w.r.t MSL (m)**	**Adopted C.D. w.r.t. M.S.L.**	**H.F.L. w.r.t. M.S.L.**
50.553	63.39		64.00	71.37
50.653	63.64		64.11	71.44
50.796	63.89		64.27	71.55
50.893	64.14		64.38	71.63
50.983	60.64		64.48	71.69
50.990	64.39		64.48	71.70
51.087	64.64		64.59	71.77
51.184	64.89		64.70	71.85
51.360	65.18		64.89	71.98
51.459	65.39		65.00	72.06
51.559	65.64		65.11	72.13
51.658	65.89		65.23	72.21
51.770	66.14		65.35	72.29
51.868	66.39		65.46	72.37
51.967	66.64		65.57	72.44
52.065	66.89		65.68	72.52
52.164	67.26		65.79	72.59
52.262	67.39		65.90	72.67
52.351	67.64		65.99	72.73
52.451	67.89		66.11	72.81
52.551	68.14		66.22	72.88
52.658	68.39		66.33	72.97
52.757	68.64		66.44	73.04
52.855	68.89		66.55	73.12
52.953	69.13		66.66	73.19
53.053	69.38		66.77	73.27
53.152	69.63		66.88	73.34
53.252	69.88		66.99	73.42
53.352	70.13		67.10	73.49
53.452	70.38		67.22	73.57
53.551	70.63		67.33	73.64
53.652	70.08		67.44	73.72
53.752	71.13		67.55	73.80
53.851	71.38		67.66	73.87
53.950	71.63		67.77	73.95
54.049	71.88		67.88	74.02

Annexure 6				
Chainage (km)	**River Bed Level w.r.t MSL (m)**	**Water Level w.r.t MSL (m)**	**Adopted C.D. w.r.t. M.S.L.**	**H.F.L. w.r.t. M.S.L.**
54.149	72.13		67.99	74.10
54.245	72.38		68.10	74.17
54.345	72.63		68.21	74.25
54.444	72.88		68.32	74.32
54.544	73.13		68.43	74.40
54.630	73.38		68.52	74.46
54.643	73.42		68.54	74.47
54.742	73.45		68.65	74.55
54.841	73.48		68.76	74.62
54.940	73.58		68.87	74.70
55.039	73.84		68.98	74.77
55.138	73.99		69.09	74.85
55.237	73.86		69.20	74.92
55.336	73.82		69.31	75.00
55.434	73.84		69.42	75.07
55.462	73.81		69.45	75.09
55.532	73.85		69.52	75.15
55.632	73.72		69.63	75.22
55.732	73.84		69.74	75.30
55.831	73.76		69.86	75.37
55.916	73.84		69.95	75.44
55.931	73.88		69.97	75.45
56.010	73.82		70.05	75.51
56.090	73.84		70.14	75.57
56.238	73.85		70.31	75.68
56.332	73.81		70.41	75.76
56.427	73.82		70.52	75.83
56.556	73.88		70.66	75.92
56.653	73.86		70.77	76.00
56.750	73.79		70.88	76.07
56.916	73.88		71.06	76.20
56.969	73.94		71.12	76.24
57.016	73.98		71.17	76.27
57.116	74.02		71.28	76.35
57.276	74.19		71.46	76.47
57.375	74.28		71.57	76.55

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
57.474	74.29		71.68	76.62
57.572	74.39		71.79	76.70
57.671	74.58		71.90	76.77
57.779	74.68		72.02	76.85
57.878	74.59		72.13	76.93
57.977	74.61		72.24	77.00
58.076	74.66		72.35	77.08
58.176	74.62		72.46	77.16
58.208	74.65		72.49	77.18
58.274	74.06		72.57	77.23
58.372	73.68		72.67	77.30
58.470	73.22		72.78	77.38
58.568	73.00		72.89	77.45
58.659	72.59		72.99	77.52
58.757	72.12		73.10	77.60
58.857	71.68	71.98	73.21	77.67
58.956	71.00	71.30	73.32	77.75
59.026	70.52	70.82	73.40	77.80
59.056	70.72	71.02	73.43	77.82
59.155	70.73	71.03	73.54	77.90
59.264	70.82	71.12	73.66	77.98
59.364	70.86	71.16	73.77	78.06
59.464	71.09	71.39	73.89	78.13
59.564	71.18	71.48	74.00	78.21
59.664	71.52	71.82	74.11	78.28
59.698	71.97	72.27	74.15	78.31
59.764	71.28	71.58	74.22	78.36
59.864	71.00	71.40	74.33	78.44
59.963	70.82	71.22	74.44	78.51
60.074	70.65		74.56	78.60
60.174	70.52		74.67	78.67
60.274	70.53	71.13	74.79	78.75
60.374	70.41	71.01	74.90	78.82
60.387	73.39	73.99	74.91	78.83
60.476	73.42	74.02	75.01	78.90
60.576	73.94	74.54	75.12	78.98

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
60.676	74.12	74.72	75.23	79.05
60.789	74.26	74.86	75.36	79.14
60.885	74.29	74.89	75.46	79.21
60.981	74.64	75.24	75.57	79.28
61.070	74.81		75.67	79.35
61.159	74.92		75.77	79.42
61.266	75.14		75.89	79.50
61.361	75.19		75.99	79.57
61.453	75.84		76.09	79.64
61.610	75.59		76.27	79.76
61.716	75.82		76.38	79.84
61.894	75.86		76.58	79.98
61.992	75.95		76.69	80.05
62.119	75.91		76.83	80.15
62.213	76.08		76.94	80.22
62.306	76.06		77.04	80.29
62.397	76.42		77.14	80.36
62.492	76.48		77.25	80.43
62.585	76.52		77.35	80.50
62.681	76.59		77.46	80.58
62.781	76.68		77.57	80.65
62.882	76.77		77.68	80.73
62.982	76.80	77.00	77.79	80.80
63.008	76.83	77.03	77.82	80.82
63.081	76.89	77.09	77.90	80.88
63.180	76.92	77.12	78.01	80.95
63.279	76.98	77.18	78.12	81.03
63.387	77.15	77.35	78.24	81.11
63.487	77.10	77.30	78.35	81.19
63.598	77.00	77.20	78.47	81.27
63.696	77.19	77.39	78.58	81.35
63.793	77.24	77.44	78.69	81.42
63.890	77.19	77.39	78.80	81.49
63.987	77.29	77.49	78.90	81.57
64.084	77.28	77.48	79.01	81.64
64.181	77.25	77.45	79.12	81.71

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
64.225	77.28	77.48	79.17	81.75
64.273	77.58	77.78	79.22	81.78
64.373	77.62	77.82	79.33	81.86
64.473	77.94	78.14	79.44	81.93
64.573	78.39	78.59	79.55	82.01
64.669	78.19	78.39	79.66	82.08
64.769	78.69	78.89	79.77	82.16
64.869	79.14	79.34	79.88	82.24
64.974	79.58	79.78	80.00	82.32
65.074	79.82	80.12	80.11	82.39
65.174	79.98	80.28	80.22	82.47
65.274	80.23	80.53	80.33	82.54
65.374	80.38	80.68	80.44	82.62
65.474	80.36	80.66	80.55	82.70
65.544	80.89	81.19	80.63	82.75
65.574	80.99	81.29	80.67	82.77
65.684	80.77	81.07	80.79	82.85
65.784	80.95	81.25	80.90	82.93
65.876	80.99	81.29	81.00	83.00
65.876	80.99	81.29	81.00	90.00
65.975	81.11	81.41	81.15	90.14
66.075	81.08	81.38	81.30	90.28
66.174	81.16	81.46	81.45	90.41
66.292	81.28	81.58	81.63	90.58
66.392	81.38	81.68	81.78	90.72
66.492	81.48	81.78	81.93	90.85
66.560	81.68	81.98	82.04	90.95
66.656	81.88	82.18	82.18	91.08
66.754	81.64	81.94	82.33	91.22
66.773	81.62	81.92	82.36	91.24
66.854	81.68	81.98	82.48	91.35
66.954	81.69	81.99	82.63	91.49
67.053	81.95	82.25	82.79	91.63
67.153	82.38	0.00	82.94	91.77
67.244	82.59		83.07	91.90
67.344	82.88		83.23	92.03

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
67.444	82.59		83.38	92.17
67.544	82.77		83.53	92.31
67.644	83.08		83.68	92.45
67.744	83.61		83.83	92.59
67.753	84.81		83.85	92.60
67.841	85.02		83.98	92.72
67.939	85.29		84.13	92.86
68.051	85.35		84.30	93.01
68.149	85.59		84.45	93.15
68.248	86.20		84.60	93.29
68.346	86.83		84.74	93.42
68.444	87.59		84.89	93.56
68.543	88.01		85.04	93.69
68.584	89.25		85.11	93.75
68.588	86.86		85.11	93.76
68.620	86.03		85.16	93.80
68.719	84.28		85.31	93.94
68.836	84.85		85.49	94.10
68.936	85.82		85.64	94.24
69.036	85.93		85.79	94.38
69.136	86.70		85.94	94.52
69.235	86.91		86.09	94.65
69.369	88.01		86.29	94.84
69.469	89.57	90.07	86.45	94.98
69.526	90.04	90.54	86.53	95.06
69.568	90.01	90.51	86.60	95.12
69.668	90.01	90.51	86.75	95.25
69.853	90.08	90.58	87.03	95.51
69.952	89.88	90.38	87.18	95.65
70.052	89.87	90.37	87.33	95.78
70.151	89.74	90.24	87.48	95.92
70.336	89.48	89.98	87.76	96.18
70.429	89.38	89.88	87.90	96.31
70.479	89.17	89.67	87.98	96.38
70.526	89.28	89.78	88.05	96.44
70.625	89.29	89.79	88.20	96.58

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
70.768	89.38	89.88	88.42	96.78
70.868	89.39	89.89	88.57	96.92
70.968	89.69	90.19	88.72	97.05
71.067	89.58	90.08	88.87	97.19
71.206	89.69	90.19	89.08	97.38
71.303	89.41	89.91	89.23	97.52
71.400	89.29	89.79	89.37	97.65
71.498	89.69	90.19	89.52	97.79
71.597	89.70	90.20	89.67	97.93
71.600	90.58	91.08	89.68	97.93
71.699	90.61	91.11	89.83	98.07
71.799	90.88	91.38	89.98	98.20
71.898	91.59	92.09	90.13	98.34
71.997	92.69	93.19	90.28	98.48
72.096	93.51	94.01	90.43	98.62
72.172	93.59	94.09	90.54	98.72
72.271	93.84	94.34	90.70	98.86
72.371	94.06	94.56	90.85	99.00
72.371	94.01	94.51	90.85	99.00
72.454	93.88	94.38	90.97	99.11
72.554	93.84	94.34	91.12	99.25
72.653	93.52		91.27	99.39
72.754	93.58		91.43	99.53
72.853	93.41		91.58	99.67
72.898	93.46		91.65	99.73
73.036	93.24		91.85	99.92
73.107	93.15		91.96	100.02
73.133	93.16		92.00	100.05
73.223	93.28		92.14	100.18
73.322	93.24		92.29	100.31
73.425	93.26		92.44	100.46
73.525	93.28		92.59	100.60
73.625	93.35		92.75	100.73
73.692	93.16		92.85	100.83
73.724	93.31		92.90	100.87
73.824	93.36	93.76	93.05	101.01

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
73.924	93.35	93.75	93.20	101.15
74.024	93.58	93.98	93.35	101.29
74.124	93.54	93.94	93.50	101.43
74.224	93.59	93.99	93.66	101.56
74.324	93.58	93.98	93.81	101.70
74.424	93.56	93.96	93.96	101.84
74.523	93.52	93.92	94.11	101.98
74.622	93.57	93.97	94.26	102.12
74.714	93.42	93.82	94.40	102.24
74.810	93.41	93.81	94.54	102.38
74.844	93.41	93.81	94.59	102.42
74.905	93.88	94.28	94.69	102.51
74.997	94.35	94.75	94.83	102.63
75.089	94.82	95.22	94.97	102.76
75.183	95.30	95.70	95.11	102.89
75.192	96.24	96.64	95.12	102.91
75.200	97.80	98.20	95.13	102.92
75.274	97.50	97.90	95.25	103.02
75.303	96.84	97.24	95.29	103.06
75.360	95.80	96.20	95.38	103.14
75.427	95.30	95.70	95.48	103.23
75.427	95.30	95.70	95.48	103.23
75.427	95.30	95.70	95.48	103.23
75.427	95.72	96.12	95.48	103.23
75.445	95.97	96.37	95.51	103.26
75.550	96.22	96.62	95.66	103.40
75.650	96.47	96.87	95.82	103.54
75.749	96.72	97.12	95.97	103.68
75.836	96.97	97.37	96.10	103.80
75.936	97.22	97.62	96.25	103.94
75.955	97.47	97.87	96.28	103.96
76.035	97.20	97.60	96.40	104.07
76.050	97.72	98.12	96.42	104.09
76.051	96.82	97.22	96.42	104.09
76.131	97.19		96.55	104.21
76.227	97.38		96.69	104.34

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
76.233	97.01		96.70	104.35
76.305	97.57		96.81	104.45
76.404	97.76		96.96	104.58
76.504	97.95		97.11	104.72
76.604	98.13		97.26	104.86
76.696	98.32		97.40	104.99
76.796	98.51		97.55	105.13
76.896	98.70		97.70	105.27
76.996	98.45		97.86	105.40
77.087	99.07		97.99	105.53
77.187	99.26		98.15	105.67
77.286	99.45		98.30	105.81
77.386	99.36		98.45	105.94
77.486	99.82		98.60	106.08
77.529	100.39		98.67	106.14
77.586	100.32		98.75	106.22
77.685	100.25		98.90	106.36
77.795	100.19		99.07	106.51
77.895	100.12		99.22	106.65
77.995	100.05		99.37	106.79
78.118	99.99		99.56	106.96
78.216	99.88		99.71	107.09
78.315	99.85		99.86	107.23
78.423	99.65		100.02	107.38
78.474	99.79		100.10	107.45
78.521	100.23		100.17	107.52
78.621	100.66		100.32	107.65
78.720	101.10		100.47	107.79
78.832	101.54		100.64	107.95
78.932	101.97		100.79	108.09
79.032	102.41		100.94	108.22
79.132	102.85		101.09	108.36
79.236	103.29		101.25	108.51
79.336	103.72		101.40	108.64
79.436	104.16		101.56	108.78
79.536	104.30		101.71	108.92

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
79.619	104.60		101.83	109.04
79.636	104.37		101.86	109.06
79.735	104.14		102.01	109.20
79.844	103.91		102.17	109.35
79.942	103.62		102.32	109.48
80.040	103.28	103.48	102.47	109.62
80.138	103.22	103.42	102.62	109.76
80.145	102.99	103.19	102.63	109.77
80.238	103.16	103.36	102.77	109.89
80.338	103.34	103.54	102.92	110.03
80.438	103.51	103.71	103.07	110.17
80.538	103.69	103.89	103.23	110.31
80.638	103.55	103.75	103.38	110.45
80.738	104.04	104.24	103.53	110.59
80.838	104.33	104.53	103.68	110.73
80.937	104.40	104.60	103.83	110.86
81.036	104.57	104.77	103.98	111.00
81.120	104.92	105.12	104.11	111.12
81.135	104.22	104.42	104.13	111.14
81.241	104.50	104.70	104.29	111.28
81.341	104.33	104.53	104.44	111.42
81.440	104.52	104.72	104.59	111.56
81.544	104.63	104.83	104.75	111.70
81.644	104.32	104.52	104.90	111.84
81.744	104.26	104.46	105.05	111.98
81.850	104.56	104.76	105.22	112.13
81.950	104.56	104.76	105.37	112.27
82.012	104.78	104.98	105.46	112.35
82.045	105.27	105.47	105.51	112.40
82.134	105.76	105.96	105.65	112.52
82.223	106.25	106.45	105.78	112.64
82.371	106.73	106.93	106.00	112.85
82.470	107.22	107.42	106.15	112.99
82.630	107.71	107.91	106.40	113.21
82.730	108.20	108.40	106.55	113.35
82.829	108.68	108.88	106.70	113.48

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
82.928	109.17	109.37	106.85	113.62
83.027	109.66	109.86	107.00	113.76
83.114	110.15	110.35	107.13	113.88
83.214	110.64	110.84	107.28	114.02
83.314	111.12	111.32	107.43	114.16
83.414	111.61	111.81	107.58	114.29
83.513	111.85	112.05	107.74	114.43
83.529	114.05	114.25	107.76	114.45
83.611	112.59	112.79	107.88	114.57
83.698	112.98	113.18	108.02	114.69
83.797	113.56	113.76	108.17	114.82
83.869	114.54	114.74	108.28	114.92
83.888	114.01	114.21	108.30	114.95
83.988	113.48	113.68	108.46	115.09
84.087	113.00	113.20	108.61	115.23
84.170	112.56	112.76	108.73	115.34
84.268	112.00	112.20	108.88	115.48
84.364	111.35	111.55	109.03	115.61
84.437	110.82	111.02	109.14	115.71
84.529	110.29	110.49	109.28	115.84
84.697	109.86	110.06	109.53	116.07
84.715	108.70	108.90	109.56	116.10
84.847	108.83	109.03	109.76	116.28
84.946	108.96	109.16	109.91	116.42
85.046	109.09	109.29	110.06	116.56
85.166	109.22	109.42	110.24	116.72
85.264	109.35	109.55	110.39	116.86
85.363	109.48	109.68	110.54	116.99
85.477	109.61	109.81	110.71	117.15
85.573	109.86	110.06	110.86	117.29
85.670	109.87	110.07	111.01	117.42
85.777	109.74	109.94	111.17	117.57
85.823	109.87	110.07	111.24	117.63
85.873	110.07	110.27	111.31	117.70
85.973	110.27	110.47	111.46	117.84
86.075	110.47	110.67	111.62	117.98

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
86.174	110.67	110.87	111.77	118.12
86.274	110.87	111.07	111.92	118.26
86.374	111.07	111.27	112.07	118.39
86.473	111.27	111.47	112.22	118.53
86.573	111.47	111.67	112.37	118.67
86.674	111.67	111.87	112.53	118.81
86.774	111.87	112.07	112.68	118.95
86.874	112.07	112.27	112.83	119.09
86.976	112.27	112.47	112.98	119.23
87.072	112.36	112.56	113.13	119.36
87.150	112.86	113.06	113.25	119.47
87.210	112.87	113.07	113.34	119.55
87.239	113.07	113.27	113.38	119.59
87.340	114.26	114.46	113.54	119.73
87.430	113.47	113.67	113.67	119.86
87.530	113.67	113.87	113.82	120.00
87.630	113.87	114.07	113.98	120.13
87.734	114.07	114.27	114.13	120.28
87.833	114.27	114.47	114.28	120.42
87.934	114.47	114.67	114.44	120.56
88.004	114.87	115.07	114.54	120.65
88.031	114.97	115.17	114.58	120.69
88.119	115.06	115.26	114.72	120.81
88.219	115.15	115.35	114.87	120.95
88.319	115.24	115.44	115.02	121.09
88.321	115.43	115.63	115.02	121.09
88.419	115.33	115.53	115.17	121.23
88.519	115.61	115.81	115.32	121.37
88.553	115.52	115.72	115.38	121.41
88.619	115.70	115.90	115.48	121.50
88.719	115.79	115.99	115.63	121.64
88.819	115.88	116.08	115.78	121.78
88.919	115.98	116.18	115.93	121.92
89.019	116.00	116.20	116.08	122.06
89.119	116.16	116.36	116.23	122.20
89.176	113.40	113.60	116.32	122.28

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
89.218	113.60	113.80	116.38	122.33
89.318	113.80	114.00	116.53	122.47
89.417	113.99	114.19	116.68	122.61
89.517	114.19	114.39	116.84	122.75
89.617	114.50	114.70	116.99	122.89
89.723	114.58	114.78	117.15	123.03
89.822	114.78	114.98	117.30	123.17
89.921	114.97	115.17	117.45	123.31
90.020	115.17	115.37	117.60	123.44
90.118	115.00	115.20	117.75	123.58
90.221	115.56	115.76	117.90	123.72
90.326	115.76	115.96	118.06	123.87
90.422	116.35	116.55	118.21	124.00
90.425	116.43	116.63	118.21	124.01
90.529	116.52	116.72	118.37	124.15
90.622	116.50	116.70	118.51	124.28
90.792	116.69	116.89	118.77	124.51
90.917	116.78	116.98	118.96	124.69
91.011	116.87	117.07	119.10	124.82
91.101	116.96	117.16	119.24	124.94
91.198	117.00	117.20	119.39	125.08
91.295	117.13	117.33	119.53	125.21
91.364	117.30	117.50	119.64	125.31
91.395	117.41	117.61	119.68	125.35
91.495	117.51	117.71	119.83	125.49
91.595	117.61	117.81	119.99	125.63
91.695	117.72	117.92	120.14	125.76
91.795	117.82	118.02	120.29	125.90
91.895	117.92	118.12	120.44	126.04
91.995	118.00	118.20	120.59	126.18
92.095	118.13	118.33	120.74	126.32
92.194	118.36	118.56	120.89	126.46
92.294	118.34	118.54	121.05	126.59
92.394	118.44	118.64	121.20	126.73
92.491	118.54	118.74	121.35	126.87
92.531	118.75	119.05	121.41	126.92

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
92.591	118.56	118.86	121.50	127.01
92.693	118.23	118.53	121.65	127.15
92.793	118.45	118.75	121.80	127.29
92.892	118.28	118.58	121.95	127.42
92.992	118.39	118.69	122.10	127.56
93.089	118.79	119.09	122.25	127.70
93.189	118.25	118.55	122.40	127.83
93.281	118.56	118.86	122.54	127.96
93.377	118.13	118.43	122.69	128.10
93.468	118.45	118.75	122.83	128.22
93.471	118.98	119.28	122.83	128.22
93.567	119.75	120.05	122.98	128.36
93.661	121.29	121.59	123.12	128.49
93.748	120.52	120.82	123.25	128.61
93.748	122.06	122.36	123.25	128.61
93.847	122.84	123.14	123.40	128.75
93.951	123.61	123.91	123.56	128.89
94.080	124.36	124.66	123.75	129.07
94.228	125.56	125.86	123.98	129.27
94.329	125.92	126.22	124.13	129.41
94.375	127.47	127.87	124.20	129.48
94.504	127.14	127.54	124.40	129.66
94.652	126.82	127.22	124.62	129.86
94.783	126.50	126.90	124.82	130.04
94.910	126.18	126.58	125.01	130.22
95.073	125.86	126.26	125.26	130.44
95.152	125.78	126.18	125.38	130.55
95.248	125.21	125.61	125.52	130.69
95.324	124.56	124.96	125.64	130.79
95.406	124.57	124.97	125.76	130.91
95.479	124.25	124.65	125.87	131.01
95.574	123.93	124.33	126.02	131.14
95.669	123.89	124.29	126.16	131.27
95.756	122.96	123.36	126.29	131.39
95.757	123.03	123.43	126.30	131.39
95.847	123.56	123.96	126.43	131.52

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
95.948	123.17	123.57	126.58	131.66
96.045	123.24	123.64	126.73	131.79
96.156	123.31	123.71	126.90	131.94
96.256	123.38	123.78	127.05	132.08
96.364	123.46	123.86	127.22	132.23
96.463	123.53	123.93	127.37	132.37
96.564	123.60	124.00	127.52	132.51
96.663	123.67	124.07	127.67	132.65
96.763	123.74	124.14	127.82	132.78
96.862	123.81	124.21	127.97	132.92
96.961	123.88	124.28	128.12	133.06
97.061	123.45	123.85	128.27	133.20
97.161	124.00	124.40	128.42	133.34
97.165	124.16	124.56	128.43	133.34
97.262	124.89	125.29	128.58	133.48
97.361	125.36	125.76	128.73	133.61
97.461	126.23	126.63	128.88	133.75
97.560	128.45	128.85	129.03	133.89
97.602	130.28	130.78	129.09	133.95
97.661	130.32	130.82	129.18	134.03
97.761	130.36	130.86	129.33	134.17
97.862	130.50	131.00	129.49	134.31
97.962	130.24	130.74	129.64	134.45
98.059	130.48	130.98	129.79	134.58
98.156	130.52	131.02	129.93	134.71
98.267	130.89	131.39	130.10	134.87
98.371	130.60	131.10	130.26	135.01
98.471	130.64	131.14	130.41	135.15
98.569	130.50	131.00	130.56	135.29
98.669	130.71	131.21	130.71	135.43
98.769	130.75	131.25	130.86	135.56
98.872	130.79	131.29	131.02	135.71
98.971	131.00	131.50	131.17	135.84
99.071	130.87	131.37	131.32	135.98
99.171	130.91	131.41	131.47	136.12
99.262	130.95	131.45	131.61	136.25

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
99.353	131.56	132.06	131.75	136.37
99.513	131.03	131.53	131.99	136.59
99.662	131.07	131.57	132.22	136.80
99.780	131.11	131.61	132.39	136.96
99.855	131.50	132.00	132.51	137.07
99.933	131.19	131.69	132.63	137.18
100.018	131.22	131.72	132.75	137.29
100.118	131.26	131.76	132.91	137.43
100.215	131.45	131.95	133.05	137.57
100.310	131.34	131.84	133.20	137.70
100.408	131.38	131.88	133.35	137.83
100.506	131.68	132.18	133.49	137.97
100.531	131.85	132.45	133.53	138.00
100.600	132.25	132.85	133.64	138.10
100.693	132.21	132.81	133.78	138.34
100.801	132.39	132.99	133.94	138.61
100.895	132.57	133.17	134.08	138.86
101.005	133.00	133.60	134.25	139.14
101.110	132.93	133.53	134.41	139.40
101.207	133.11	133.71	134.56	139.65
101.304	133.50	134.10	134.70	139.90
101.325	133.65	134.25	134.74	139.95
101.402	133.82	134.42	134.85	140.15
101.500	134.00	134.60	135.00	140.40
101.598	134.15	134.75	135.15	140.65
101.702	134.32	134.92	135.31	140.92
101.830	134.48	135.08	135.50	141.25
101.933	134.65	135.25	135.66	141.51
102.024	134.81	135.41	135.80	141.74
102.123	134.98	135.48	135.95	142.00
102.223	135.15	135.65	136.10	142.25
102.313	135.31	135.81	136.23	142.48
102.395	135.48	135.98	136.36	142.69
102.498	135.65	136.15	136.51	142.96
102.608	135.81	136.31	136.68	143.24
102.724	135.55	135.95	136.86	143.54

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
102.849	136.14	136.54	137.05	143.85
102.948	136.31	136.71	137.20	144.11
103.053	136.50	136.90	137.36	144.38
103.146	136.64	137.04	137.50	144.61
103.159	137.58	138.08	137.52	144.65
103.257	139.45	139.95	137.67	144.90
103.360	140.36	140.86	137.82	145.16
103.460	142.24	142.74	137.97	145.42
103.569	145.36	145.86	138.14	145.70
103.669	146.00	146.50	138.29	145.95
103.723	145.97	146.47	138.37	146.09
103.784	142.72	143.22	138.49	146.25
103.882	141.90	142.40	138.67	146.50
103.980	141.09	141.59	138.86	146.75
103.985	145.16	145.66	138.87	146.76
103.985	144.34	144.84	138.87	146.76
103.985	143.25	143.75	138.87	146.76
104.083	141.25	141.75	139.05	147.01
104.143	138.65	139.15	139.17	147.17
104.223	138.69	139.19	139.32	147.37
104.324	138.45	138.95	139.51	147.63
104.395	138.78	139.28	139.64	147.81
104.478	138.83	139.33	139.80	148.02
104.576	138.87	139.37	139.99	148.27
104.684	138.50	139.00	140.19	148.55
104.804	138.96	139.46	140.42	148.86
104.908	139.01	139.51	140.62	149.12
105.000	139.05	139.55	140.79	149.36
105.105	139.45	139.95	140.99	149.63
105.138	139.19	139.69	141.05	149.71
105.185	139.73	140.23	141.14	149.83
105.287	140.50	141.00	141.33	150.09
105.425	140.96	141.46	141.59	150.45
105.541	141.30	141.80	141.81	150.74
105.644	141.88	142.38	142.01	151.01
105.758	142.41	142.91	142.22	151.30

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
105.846	142.00	142.50	142.39	151.52
105.954	143.49	143.99	142.60	151.80
106.047	144.03	144.53	142.77	152.04
106.145	144.56	145.06	142.96	152.29
106.205	145.64	146.14	143.07	152.44
106.236	145.54	146.04	143.13	152.52
106.319	145.45	145.95	143.29	152.74
106.418	145.35	145.85	143.47	152.99
106.530	145.26	145.76	143.69	153.28
106.619	145.16	145.66	143.86	153.50
106.729	145.07	145.57	144.06	153.78
106.836	144.97	145.47	144.27	154.06
106.940	144.70	145.20	144.46	154.32
107.032	144.78	145.28	144.64	154.56
107.145	144.69	145.19	144.85	154.85
107.246	144.80	145.30	145.04	155.11
107.345	144.50	145.00	145.23	155.36
107.346	144.31	144.91	145.23	155.36
107.459	144.61	145.21	145.44	155.65
107.540	145.00	145.60	145.60	155.86
107.621	145.21	145.81	145.75	156.07
107.715	145.51	146.11	145.93	156.31
107.817	145.50	146.10	146.12	156.57
107.935	146.11	146.71	146.35	156.87
108.034	146.41	147.01	146.54	157.12
108.115	146.71	147.31	146.69	157.33
108.219	147.01	147.61	146.89	157.60
108.358	147.00	147.60	147.15	157.95
108.544	147.61	148.21	147.50	158.43
108.792	148.21	148.81	147.97	159.06
108.871	148.53	149.13	148.12	159.27
108.962	149.00	149.60	148.29	159.50
109.061	149.17	149.77	148.48	159.75
109.160	149.48	150.08	148.67	160.01
109.260	149.80	150.40	148.86	160.26
109.359	150.00	150.60	149.04	160.51

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
109.454	150.43	151.03	149.22	160.76
109.570	150.75	151.35	149.44	161.05
109.653	151.07	151.67	149.60	161.27
109.751	151.38	151.98	149.79	161.52
109.862	151.45	151.95	150.00	161.80
109.969	152.02	152.52	150.20	162.08
110.068	152.34	152.84	150.39	162.33
110.175	152.65	153.15	150.59	162.60
110.264	152.97	153.47	150.76	162.83
110.353	153.29	153.79	150.93	163.06
110.445	153.25	153.75	151.10	163.29
110.570	153.92	154.42	151.34	163.61
110.723	154.24	154.74	151.63	164.01
110.816	154.55	155.05	151.80	164.24
110.929	154.87	155.37	152.02	164.53
111.021	155.00	155.50	152.19	164.77
111.119	155.51	156.01	152.38	165.02
111.233	156.14	156.64	152.59	165.31
111.271	152.24	152.64	152.66	165.41
111.310	153.25	153.65	152.74	165.51
111.403	153.00	153.40	152.92	165.75
111.504	153.25	153.65	153.11	166.00
111.609	153.69	154.09	153.31	166.27
111.704	153.56	153.96	153.48	166.52
111.799	153.89	154.29	153.66	166.76
111.855	154.50	154.90	153.77	166.90
111.912	154.25	154.65	153.88	167.05
112.010	154.23	154.63	154.06	167.30
112.102	154.15	154.55	154.24	167.53
112.209	154.00	154.40	154.44	167.81
112.303	154.96	155.36	154.62	168.05
112.396	154.78	155.18	154.79	168.29
112.504	154.56	154.96	155.00	168.56
112.631	154.98	155.38	155.24	168.89
112.725	154.36	154.76	155.42	169.13
112.846	154.47	154.87	155.65	169.44

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
112.941	154.25	154.65	155.83	169.68
113.039	155.00	155.40	156.01	169.93
113.139	155.78	156.18	156.20	170.19
113.238	155.45	155.85	156.39	170.44
113.348	155.45	155.85	156.60	170.72
113.448	155.26	155.66	156.79	170.98
113.544	154.21	154.61	156.97	171.22
113.628	155.50	155.90	157.26	171.44
113.641	155.70	156.20	157.31	171.47
113.737	155.00	155.50	157.65	171.72
113.837	156.11	156.61	158.00	171.97
113.935	156.31	156.81	158.34	172.22
114.035	156.85	157.35	158.69	172.48
114.134	156.72	157.22	159.04	172.73
114.241	156.93	157.43	159.42	173.01
114.341	157.50	158.00	159.77	173.26
114.442	157.33	157.83	160.12	173.52
114.452	157.74	158.24	160.16	173.55
114.542	158.25	158.75	160.47	173.78
114.640	159.00	159.50	160.82	174.03
114.740	159.62	160.12	161.17	174.28
114.835	160.50	161.00	161.50	174.53
114.935	160.88	161.38	161.85	174.78
115.034	161.50	162.00	162.20	175.04
115.162	162.00	162.50	162.65	175.37
115.260	162.76	163.26	162.99	175.61
115.385	163.38	163.88	163.43	175.94
115.534	164.01	164.51	163.95	176.32
115.574	164.50	165.00	164.09	176.42
115.670	165.26	165.76	164.43	176.67
115.729	165.89	166.39	164.64	176.82
115.772	166.52	167.02	164.79	176.93
115.840	167.00	167.50	165.03	177.10
115.890	167.77	168.27	165.20	177.23
115.944	168.40	168.90	165.39	177.37
116.012	169.50	170.00	165.63	177.54

Annexure 6				
Chainage (km)	River Bed Level w.r.t MSL (m)	Water Level w.r.t MSL (m)	Adopted C.D. w.r.t. M.S.L.	H.F.L. w.r.t. M.S.L.
116.085	170.28	170.88	165.89	177.73
116.136	170.00	170.60	166.07	177.86
116.224	169.81	170.41	166.38	178.08
116.314	169.58	170.18	166.69	178.31
116.402	169.35	169.95	167.00	178.54
116.498	169.50	170.10	167.34	178.78
116.564	168.88	169.58	167.57	178.95
116.653	168.65	169.35	167.88	179.18
116.720	168.00	168.70	168.12	179.35
116.812	168.42	169.12	168.44	179.59
116.846	167.95	168.75	168.56	179.67
116.925	167.72	168.52	168.83	179.88
117.019	167.48	168.28	169.17	180.12
117.067	167.85	168.65	169.33	180.24
117.117	167.02	167.82	169.51	180.37
117.160	166.78	167.58	169.66	180.48
117.270	166.32	167.22	170.05	180.76
117.329	167.00	167.90	170.25	180.91
117.425	168.92	169.92	170.59	181.16
117.514	170.22	171.32	170.90	181.38
117.622	171.85	172.95	171.28	181.66
117.721	172.82	173.92	171.63	181.91
117.827	174.12	175.22	172.00	182.18
117.915	175.43	176.53	172.31	182.41
118.013	176.50	177.60	172.66	182.66
118.103	178.03	179.13	172.97	182.89
118.146	180.63	181.83	173.12	183.00
118.146	180.63	181.83	180.00	186.00
118.176	179.25	180.45	180.02	186.12
118.242	178.96	180.16	180.07	186.37
118.281	177.52	178.72	180.10	186.52
118.333	173.20	174.40	180.14	186.72
118.877	176.51	177.61	180.55	188.82
119.388	179.42	180.67	180.93	190.79
119.926	182.25	183.60	183.47	192.87
120.475	185.09	186.49	186.05	194.99

Annexure 6				
Chainage (km)	**River Bed Level w.r.t MSL (m)**	**Water Level w.r.t MSL (m)**	**Adopted C.D. w.r.t. M.S.L.**	**H.F.L. w.r.t. M.S.L.**
121.129	188.48	189.98	189.14	197.52
121.696	190.75	192.35	191.80	199.71
122.321	193.01	194.76	194.75	202.12
122.618	194.71	196.51	196.15	203.27
123.111	196.36	198.66	198.47	205.17
123.712	199.41	201.91	201.30	207.49
124.246	202.76	204.96	203.81	209.55
124.621	205.46	207.56	205.58	211.00
125.453	207.51	210.51	209.50	214.21