INLAND WATERWAYS AUTHORITY OF INDIA, A-13, SECTOR-1, NOIDA
DIST-GAUTAM BUDHA NAGAR, UTTAR PRADESH, PIN- 201 301(UP)

"FINAL FEASIBILITY REPORT ON HYDROGRAPHIC SURVEY

PUTHIMARI RIVER (NW-82) (58.234 km)

FROM "CONFLUENCE WITH BRAHMAPUTRA RIVER NEAR BAMUNBORI TO GHOPLA"

Survey Period from 24.10.15 to 05.11.15

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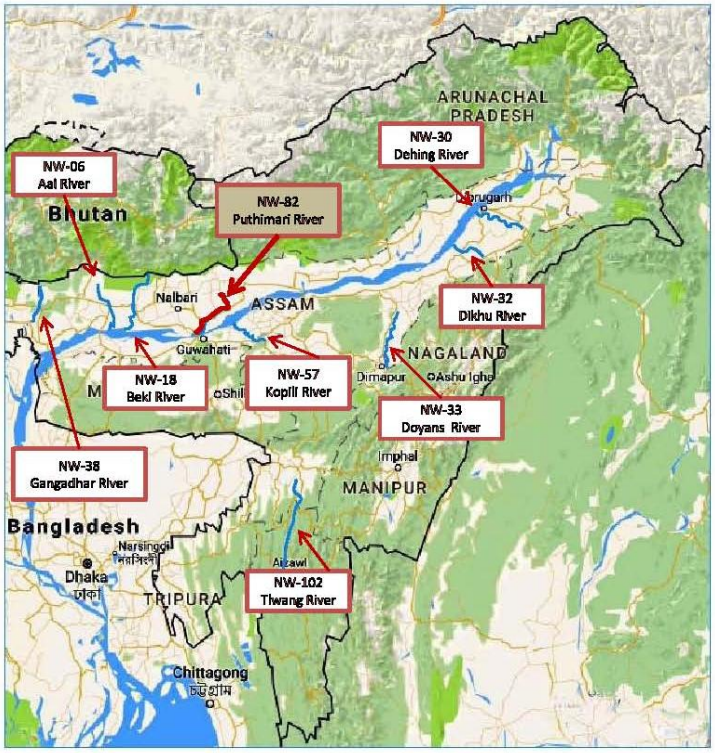

FINAL REPORT ON HYDROGRAPHICAL SURVEY OF PUTHIMARI RIVER, ASSAM

REPORT SUBMISSION DATE- 05.11.2018

SUBMITTED BY:

PRECISION SURVEY CONSULTANCY

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Acknowledgement

Precision Survey Consultancy (PSC), Salap, Howrah express its sincere gratitude to **IWAI** for awarding the work and guidance for completing this Project of detailed Hydrographic Survey and the Feasibility Report in **Region-II-(Puthimari River) from Confluence with Brahmaputra River near Bamunbori to Bridge on NH-31 near village Ghopla (58.234 Km).**

We would like to use this opportunity to pen down our profound gratitude and appreciations to **Ms. Nutan Guha Biswas, IAS, Chairperson, IWAI** for spending their valuable time and guidance for compleing this project of "Detailed Hydrography and Topography survey in Puthimari River." PSC would also like to thanks **Shri Pravir Pandey, Vice Chairman, IA&AS., Shri Shashi Bhushan Shukla, Member (Traffic), Shri Alok Ranjan, Member (Finance) and Shri S.K.Gangwar, Member (Technical).**

PSC wishes to express their gratitude to **Cdr. Ashish Arya, Hydrographic Chief, IWAI, Cdr. P.K. Srivastava, Ex. Hydrographic Chief, Shri S.V.K. Reddy, Chief Engineer-I, IWAI** for his guidance and inspiration for this project. PSC would also like to thank **Shri Rajiv Singhal, A.H.S., IWAI** for invaluable support and suggestions provided throughout the survey period. PSC is pleased to place on record our sincere thanks to other staff and officers of **IWAI** for their excellent support and co-operation throughout the survey period.

List of Abbreviations

CD	Chart Datum
DGPS	Differential Global Positioning Systems
ETS	Electronic Total Station
GPS	Global Positioning Systems
LBM	Local Bench Mark
MSL	Mean Sea Level
RL	Reference Level
SD	Sounding Datum
SBAS	Satellite-Based Augmentation System
TBC	Trimble Business Centre
FRP	Fiber Reinforced Plastic

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Salient Features of Puthimari River

Sl.	Particulars	Details
1.	Name of Consultant	Precision Survey consultancy
2.	Region number & State(s)	Region II, Assam
3.	a) Waterway name b) NW # c) Total Stretch and length of declared NW (from…. To….; total length) d) Survey Period (… to …)	a) Puthimari River b) NW-82 c) From Brahmaputra River near Bamunbori (Chainage-0.00 km) to Bridge on NH-31 near village Ghopla (58.234 Km). d) 24th October to 5th November, 2015
4.	Tidal & non tidal portions (from… to, length, average tidal variation)	There are no Tidal influence or portions found in this zone of River.
5.	LAD status (Least Available Depth)	**Observed Depth**

i) < 1.2 m
ii) 1.2 m to 1.4 m
iii) 1.5 m to 1.7 m
iv) 1.8 m to 2.0 m
v) > 2.0 m

Sub Stretch-1 (0.00-10.00 km)	Sub Stretch-2 (10.00-20.00 km)	Sub Stretch-3 (20.00 – 30.00 km)	Sub Stretch-4 (30.00-40.00 km)
10	10	10	3.5
0	0	0	2.5
0	0	0	0.7
0	0	0	1.0
0	0	0	2.3
Total-10.0	Total-10.0	Total- 10.0	Total- 10.0

i) < 1.2 m
ii) 1.2 m to 1.4 m
iii) 1.5 m to 1.7 m
iv) 1.8 m to 2.0 m
v) > 2.0 m

Sub Stretch-5 (40.00-50.00 km)	Sub Stretch-6 (50.00-58.234 km)	Total (km)
3.5	3.0	40.00
2.2	2.0	6.7
1.5	1.0	3.2
1.0	1.0	3.0
1.8	1.234	5.334
Total- 10.0	Total- 8.234	Total- 58.234 km

Sl.	Particulars	Details

Reduced Depth

LAD status (Least Available Depth)	Sub Stretch-1 (0.00-10.00 km)	Sub Stretch-2 (10.00-20.00 km)	Sub Stretch-3 (20.00 – 30.00 km)	Sub Stretch-4 (30.00-40.00 km)
i) < 1.2 m	10	10	10	2.4
ii) 1.2 m to 1.4 m	0	0	0	1.8
iii) 1.5 m to 1.7 m	0	0	0	0.5
iv) 1.8 m to 2.0 m	0	0	0	1.0
v) > 2.0 m	0	0	0	4.3
	Total-10.0	Total-10.0	Total- 10.0	Total- 10.0

	Sub Stretch-5 (40.00-50.00 km)	Sub Stretch-6 (50.00-58.234 km)	Total (km)
i) < 1.2 m	2.3	2.0	36.7
ii) 1.2 m to 1.4 m	1.7	1.0	4.5
iii) 1.5 m to 1.7 m	1.0	2.0	3.5
iv) 1.8 m to 2.0 m	1.4	1.2	3.6
v) > 2.0 m	3.6	2.034	9.934
	Total- 10.0	Total- 8.234	Total- 58.234 km

6. Cross structures

i) Dams, weirs, barrages etc (total number; with navigation locks or not)

ii) Bridges, Power cables etc [total number; range of horizontal and vertical clearances

i) There is no dam found in this zone of River.

ii) RCC Bridge- 06(Six), Rail Bridge- 01(one)

iii) Wooden Bridge- 02 (Two), Under- Construction Bridge-01(one)

Clearance w.r.t H.F.L	Min (m)	Max (m)
Horizontal Clearance (m)	20.64	41.51
Vertical Clearance w.r.t. H.F.L (m)	1.27	5.82

iv) Electric Line- 7 (Seven)

Clearance w.r.t H.F.L	Min (m)	Max (m)
Horizontal Clearance (m)	106.68	211.67
Vertical Clearance w.r.t. H.F.L (m)	5.40	6.80

<table>
<tr><th>Sl.</th><th>Particulars</th><th>Details</th></tr>
<tr><td>7.</td><td>Slope</td><td>
<table>
<tr><th colspan="2">Reach</th><th>River / Canal Bed Level Change (m)</th><th>Distance (km)</th><th>Slope (m/km)</th><th>Slope (cm/km)</th></tr>
<tr><th>From</th><th>To</th><th></th><th></th><th></th><th></th></tr>
<tr><td>0.00</td><td>6.703</td><td>1.252</td><td>6.703</td><td>0.187</td><td>18.678</td></tr>
<tr><td>6.704</td><td>32.038</td><td>6.772</td><td>25.334</td><td>0.267</td><td>26.731</td></tr>
<tr><td>32.039</td><td>42.797</td><td>2.695</td><td>10.758</td><td>0.251</td><td>25.051</td></tr>
<tr><td>42.798</td><td>55.031</td><td>3.064</td><td>12.233</td><td>0.250</td><td>25.047</td></tr>
<tr><td>55.032</td><td>58.234</td><td>0.74</td><td>3.202</td><td>0.231</td><td>23.111</td></tr>
<tr><td colspan="3">Total</td><td>58.230</td><td>Avg-0.237</td><td>Avg-23.723</td></tr>
</table>
</td></tr>
<tr><td>8.</td><td>Discharge Report</td><td>
<table>
<tr><th>Sl. No</th><th>Chainage (km)</th><th>Discharge (Cu.m/sec)</th><th rowspan="5">Dated 24.10.15 to 05.11.15</th></tr>
<tr><td>1</td><td>35.500</td><td>16.470</td></tr>
<tr><td>2</td><td>42.797</td><td>52.847</td></tr>
<tr><td>3</td><td>54.433</td><td>54.166</td></tr>
<tr><td colspan="2">Avg. Discharge</td><td>41.161</td></tr>
</table>
</td></tr>
<tr><td>9.</td><td>i) Present IWT operations

ii) Ferry services, tourism, cargo, if any</td><td>i) As Follows

ii) There are Four numbers of Passenger ferry services named Kablapur, Mukalma, Hawuli, and Pam ghat are available near at chainage of 6.370 km, 12.700 km, 13.726 km and 17.917 km respectively in this zone of river. There is light cargo like vegetables, light goods etc. available in this zone of river.</td></tr>
<tr><td>10.</td><td>Approx Distance of Rail & Road from Industry</td><td>Nearest Railway station- Bihata Railway Station (35.20 km approx)
Name of National highway close to the River- NH-15, NH-31, NH-37, NH-40
Name of SH- SH-2, SH-41, SH-9</td></tr>
<tr><td>11.</td><td>Any other information/ comment</td><td></td></tr>
</table>

Section-1: Introductory Considerations

1.1River Course: Background information, Historical Information, Origin, End

Puthimari in Assam (region) is located in India - about 927 mile (or 1,492 km) east of New Delhi, the country's capital town. Puthimari River, mainly, flows through Kamrup and Baksa district in Assam. It originates from the foothills of the Himalayan Ranges in Bhutan at an altitude of 3750m above M.S.L. It is known as Oontany River in Bhutan up to Indo-Bhutan border, Bornodi after crossing the border and 'Puthimari' after crossing Nagrijuli Tea Estate. It is 112km long, of which 32km lies in Bhutan while the rest 80km lies in Assam. It has a catchment area of 1787 km2 (712 km2 in hills and 1075 km2 in plains.

Puthimari river is one of the of the main northern bank tributaries of Brahmaputra river. It shows various geomorphic features such as floodplains, meanders and river islands. In this area the river shows wide floodplains formed by the Brahmaputra River which flows from east to west in the lower portion. The Puthimari River flows from north to south. The region is also characterized by heavy floods due to high rainfall during monsoon. The Puthimari River catchment lies within the Sub-Himalayas and is bounded by ranges. The river shows meandering nature.

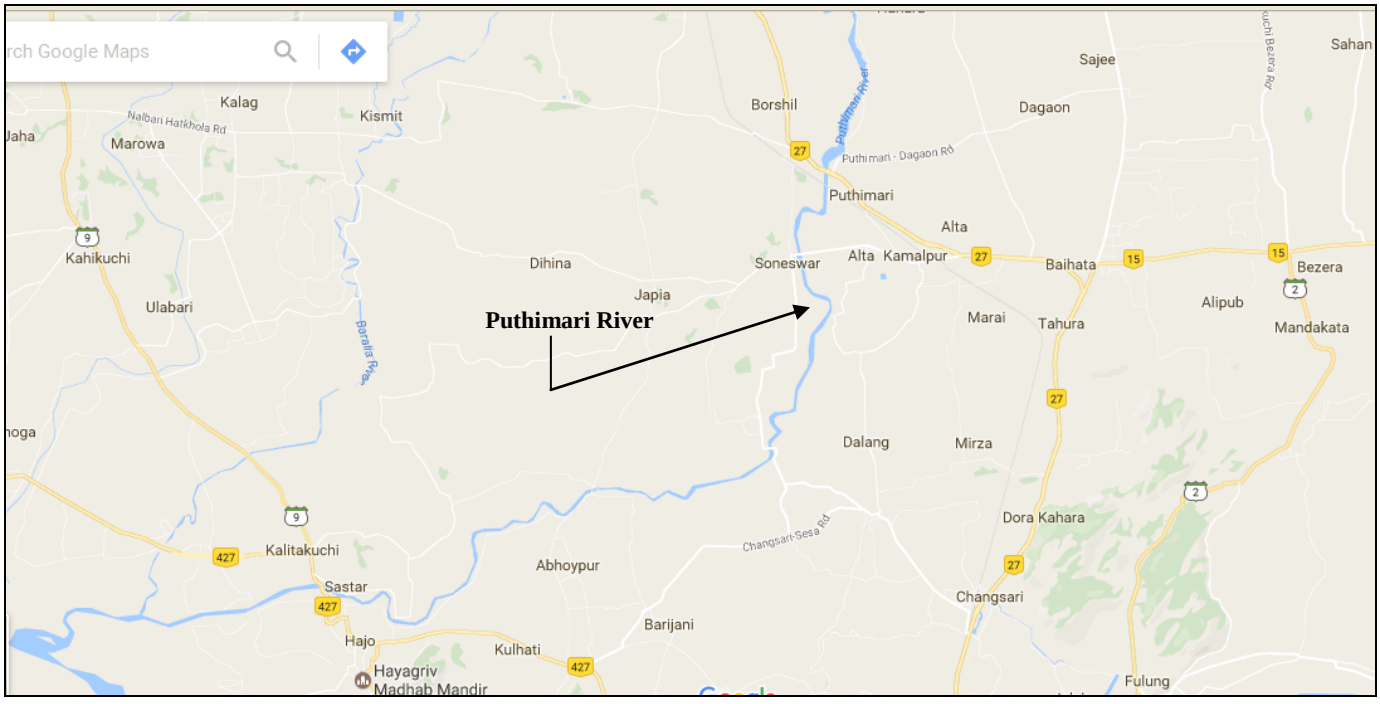


Figure 1- Site Map of Puthimari River

1.2 Tributaries / Network of River/ Basin

Puthimari has two Tributaries in this zone of river-

i) Baralia

ii) Nona

1.3State / District through which river passes

North Cachar hills and karbi anglong and enters the plains in Nagaon district of Assam.

1.4 Project Site Map

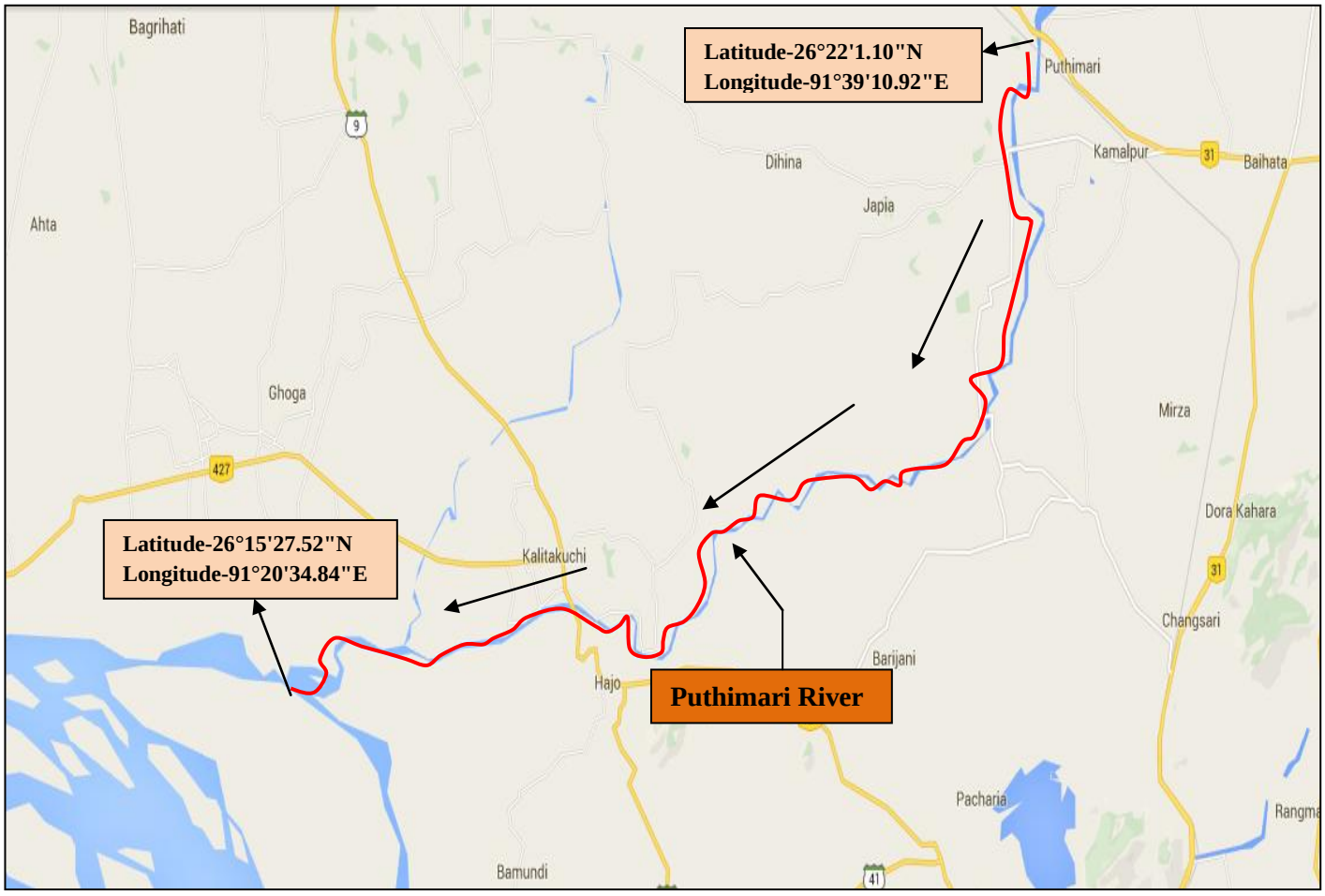


Figure 2 Project Site Location Map

1.5 River Key Map

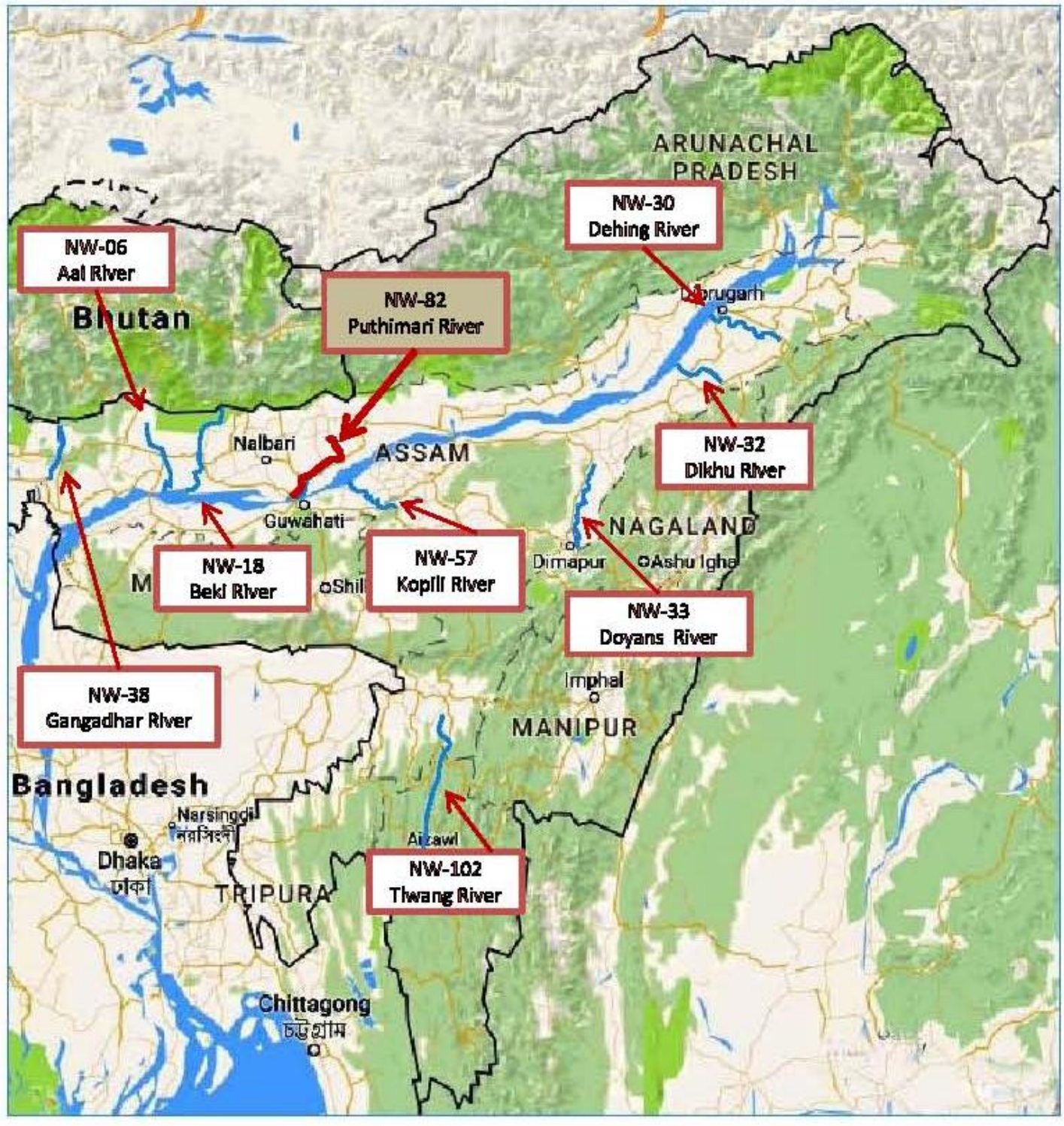


Figure 3-River Key Map

1.6 Scope of work

The Scope of work shall cover all technical aspects of hydrographic survey at par with International Standards including the following for development of the river/canal for inland navigation.

The detailed hydrographic survey is to be carried out by using Automated Hydrographic Survey System (using digital Echo sounder for depth measurement, DGPS Beacons Receivers for position fixing and Hypackmax or equivalent software for data logging). The survey is to be conducted in WGS"84 datum.

- Detailed Hydrographic Survey to assess the navigability of the waterway.
- To collect Water and bottom samples, current meter observation and discharge from the deepest route at every 10 km interval.
- To identify cross structures which are obstructing navigation
- To identify the length of bank protection required.
- The BM is denoted by a "." mark engraved on a plate. The plate is fixed on a 5cm diameter GI pipe. The GI pipe is cemented with construction pillar of 30cmX30cmX150cm.
- The pillar extends 60.cms above ground level. Inscription "IWAI", "PSC" and BM No. can be seen on the face of the pillar.
- The main objective of the Study was to recommend the strategy and programs for the development of the Puthimari River waterway and to provide an appropriate economic and organizational framework for restoring trade and navigation (cargo and passengers) on the Puthimari River with an aim to do as follows:
- Improve public and private investments into transport on the Puthimari River, in accordance with adequate economic and financial analysis;
- Propose enhancement of coordination of activities regarding inland navigation and to set up priorities of public interests;
- Obtain an integrated approach considering water management, energy production, flood control and environmental aspects in the Puthimari River basin and Propose improvement of the infrastructure.

Section-2: Methodology Adopted to undertake Study

2.1 Methodology Adopted including Resources and equipment used and calibration

Following equipments are employed for the Bathymetric and Topographic survey:-

Equipment	Make	Version	Qty Employed
Echo sounder	Bathy MF 500	……	1
Current Meter	AEM 213-D	……	1
Tide Gauge	Manual (Pole type)	----------	4
RTK	South S86T	----------	3
GPS Sets	Trimble –Becon Receiver SPS 361	----------	1
Software	HYPACK data acquisition	Version 14	1
Software	AUTOCAD	2013	1
Software	Microsoft Office	2013	1

Table 1 Details Equipments List

- **Conduct of survey work**

  - **Topographic Survey**

The Topographic survey has been carried out from "Confluence with Brahmaputra river near Bamunbori at (Lat 26°15'27.52"N, Long 91°20'34.84"E) to Bridge on NH-31 near village Ghopla at (Lat 26°22'1.10"N, Long 91°39'10.92"E)." The length of the Topography survey is from chainage 0.00 km to chainage 58.234 km.

  - The topographic survey was conducted to ascertain following in the survey area:-
    - Spot levels
    - High bank Line
    - Vegetation covered
    - Bridges and permanent structures
    - Road, culvert and other communication network

GPS RTK (Real Time Kinematic) satellite navigation is a technique used in land survey and in hydrographic survey based on the use of carrier phase measurements of the GPS, GLONASS and / or Galileo signals where a single reference station provides the real-time corrections, providing up to centimeter-level accuracy. When referring to GPS in particular, the system is also commonly referred to as Carrier-Phase Enhancement, CPGPS. RTK systems use a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier that it measured, and the mobile units compare their own phase measurements with the ones received from the base station. There are several ways to transmit a correction signal from base station to mobile station. The most popular way to achieve real-time, low-cost signal transmission is to use a radio modem, typically
in the UHF band. This allows the units to calculate their relative position to millimeters, although their absolute position is accurate only to the same accuracy as the position of the base station.

- **Bathymetry Survey:-**

The Bathymetry survey of Puthimari River has been carried out from chainage 35.00 km to 42.135 km, 42.135 km to 48.300 km and 48.300 km to 58.234 km. Bathy 500 MF was used to obtain soundings onboard the survey boat. A working frequency of 210 KHz was used for sounding operations. The digital output from the echo sounder was automatically fed to the HYPACK data logging software on a real-time basis for the acquisition of survey data. No breakdown of equipment was reported and the performance of the equipment was found to be satisfactory during the entire duration of the survey.

The sound velocity was set to 1499 m/s on single beam echo sounder during acquisition. The Daily bar checks were done prior to the sounding operation and before the closing of the sounding operation for the day. Being very shallow depths, the echo sounder depths were also cross-checked in between by using demarcated sounding poles during the conduct of the survey. The sounding lines were run using Survey boat to identify the design line of the Puthimari River for the possible stretch. The cross lines were run perpendicular to the orientation of river flow (i.e. perpendicular to the orientation of depth contours) in respective stretches. The spot sounding was also carried out in the area where the survey boat cannot be operated due to low depth. The hemisphere DGPS and Sounding Pole were used for Spot sounding at shallow locations in the Puthimari River. The DGPS position along with water depths was recorded simultaneously and the tidal reduction was applied to the obtained depths.

Figure 4-During Bathymetry survey

2.2 Description of Bench mark/Authentic reference level used

For Topographic Survey, Horizontal control has been carried out from the Bench mark no: - CP-12 which is leveled from the Rail Bridge gauge beside NH-31. The CP position of Maguri village is-

	Geographic position		UTM position		
Location Name	Latitude (N)	Longitude (E)	Northing	Easting	Elevation (m)
Maguri village	26°21'49.06"	91°39'10.67"	2916655.98	365601.95	55.262 m. w.r.t. MSL

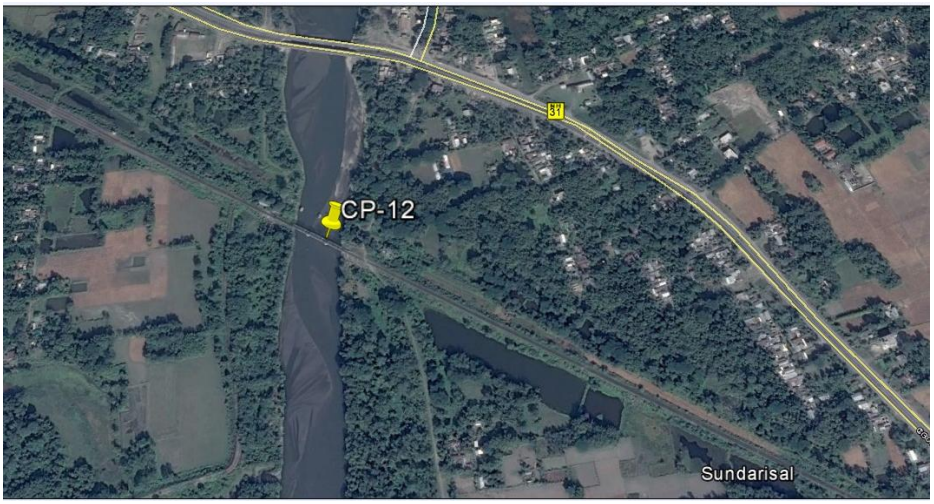


Figure 5- G.T.S Location of Puthimari river

2.3 Tidal Influence Zone and tidal variation in different stretches

There is no tidal influence or tidal effects found in this river.

2.4 - Methodology to fix Chart Datum/ Sounding Datum:-

IWAI had provided Sounding Datum at Puthimari NH Road crossing and at confluence with Brahmaputra River. The same was used to arrive the Sounding Datum values at BM Pillars and at tide gauges.

Sl. No	Place	Sounding Datum w.r.t MSL (Provided by IWAI)
01	Puthimari NH Road Crossing (Chainage-55.017 km)	49.873 meter
02	Brahmaputra Confluence (Chainage-0.00 km)	36.094 meter

2.5 – Six years minimum Water Levels to arrive at Chart Datum (CD) / Sounding Datum (SD):-

The CD levels of Puthimari River are -

Puthimari NH Road Crossing (Chainage- 55.017 km) - 49.873 meter

Brahmaputra Confluence (Chainage-0.00 km)-36.094 meter

2.6 -Transfer of Sounding Datum table for Tidal Rivers:-

There is no tidal influence or tidal effects found in this river.

2.7 –Table indicataing tidal variation at different observation points (say at every 10KM):-

There is no tidal influence or tidal effects found in this river.

2.8 - Salient features of Dam, Barrages, Weirs, Anicut, Locks, Aqueducts etc.:-

There are no Dams, Barrage, weirs, Anicut, Locks, Aqueducts found in this zone of Rivers.

2.9- Description of erected Bench mark Pillars :-

Station	Chainage (km)	Latitude (N)	Longitude (E)	Easting (m)	Northing (m)	BM Height above MSL (m)	BM Height above SD (m)
BM 1	6.703	26°15'57.3621"	91°17'50.2145"	329966.61	2906253.887	46.529	3.337
BM 2	32.038	26°15'57.6835"	91°30'54.3343"	351720.584	2905995.847	52.159	3.907
BM 3	42.797	26°17'16.7013"	91°35'19.9856"	359116.051	2908344.164	52.909	4.675
BM 4	55.031	26°20'48.8143"	91°38'47.3576"	364936.863	2914809.693	58.019	13.074
BM 5	57.986	26°22'2.5212"	91°39'7.9276"	365530.389	2917071.975	57.422	13.815

Table 2 Benchmark Details

2.10 Details of collected Water level of different gauge stations :-

SL. No	Chainage (km)	Gauge station	Location	Easting	Northing	Latitude (N)	Longitude (E)	W.L w.r.t MSL (m)	Period of observation
1	54.990	Gauge Station-(TP)- 1	Kamalpur-Dimu road near RCC bridge	364921.9	2914765.5	26°20'47.38112"	91°38'46.823"	49.964	24 hrs
2	48.546	Gauge Station-(TP)- 2	Ketekibari village near RCC bridge	364009.0	2909597.6	26°17'59.123"	91°38'15.8935"	47.751	24 hrs
3	48.471	Gauge Station-(TP)- 3	Ketekibari village near RCC bridge	364013.3	2909522.5	26°17'56.6946"	91°38'16.0713"	48.161	24 hrs
4	35.342	Gauge Station-(TP)- 4	Patni village near wooden bridge	354127.9	2904837.4	26°15'20.9424"	91°32'21.554"	45.602	24 hrs
5	30.000	Gauge Station-(TP)- 5	Hardia pam village	349816.9	2905367.6	26°15'36.5614"	91°29'45.9724"	44.407	24 hrs
6	25.000	Gauge Station-(TP)- ` 6	Bersulia village near wooden bridge	344960.2	2905498.7	26°15'38.9525"	91°26'50.9125"	42.964	24 hrs
7	20.000	Gauge Station-(TP)- 7	Balattari village	342122.0	2905262.9	26°15'30.1634"	91°25'8.7465"	41.668	24 hrs
8	15.000	Gauge Station-(TP)- 8	Kalardia village	337373.6	2905332.5	26°15'30.5321"	91°22'17.5725"	41.279	24 hrs
9	10.000	Gauge Station-(TP)- 9	Sobhamari village	332653.8	2904420.3	26°14'58.9435"	91°19'27.9045"	40.820	24 hrs
10	5.000	Gauge Station-(TP)- 10	Belbeli village	328232.3	2905439.0	26°15'30.1627"	91°16'48.1137"	39.577	24 hrs

Figure 6 Water Level at Different Gauge Stations

.

2.11- Chart Datum / Sounding Datum and Reductions details:-

Sl no	CWC gauge / Dam / Barrage / Weir / Anicut / Bench Mark / tide gauges	Chainage (km)	Stretch for corrected soundings and topo levels (km)	Established Sounding Datum w.r.t. MSL (m) at col. A.	Sounding Datum of Tide Gauge w.r.t. MSL (m)	Correction in WL data for Bathymetric survey (m)	Topo level data to be converted as depth for volume calculation w.r.t. SD (m)
	A	B	C (50% stretch is to be selected on both side of tide gauge)	D +ve indicates above MSL -ve indicates below MSL	E	F = (E- WL data in MSL)	G = (E- topo levels in MSL)
1	Puthimari NH Road Crossing	55.017		49.873			Puthimari Reduced Topo.xyz
2	GS-(TP)- 1	54.990	51.8-58.234		49.866	-0.098	Submitted in Soft Copy
3	GS-(TP)- 2	48.546	48.5-51.8		48.252	0.501	
4	GS-(TP)- 3	48.471	41.9-48.5		48.234	0.073	
5	GS-(TP)- 4	35.342	32.7-41.9		44.945	-0.657	
6	GS-(TP)- 5	30.000	27.5-32.7		43.607	-0.800	
7	GS-(TP)- 6	25.000	22.5-27.5		42.355	-0.609	
8	GS-(TP)- 7	20.000	17.5-22.5		41.103	-0.565	
9	GS-(TP)- 8	15.000	12.5-17.5		39.851	-1.428	
10	GS-(TP)- 9	10.000	7.5-12.5		38.598	-2.222	
11	GS-(TP)- 10	5.000	2.5-7.5		37.346	-2.231	
12	Confluence (192)	0.000	0.0-2.5	36.094	36.094	-2.574	

Table 3 Chart Datum/Sounding Datum and Reduction Details

2.12- High Flood Level (H.F.L.) at known gauge stations and cross-structures:-

Sl No	Location and description of CWC gauge / Dam / Barrages / Weirs / Anicut / Locks / Aqueducts / BM	Cross-structure details	Chainage (km)	Established HFL / MHWS / FSL / MWL / FRL w.r.t. MSL (m)	Computed HFL at Cross-Structures w.r.t. MSL (m)
1	Barangabari Village	Puthimari NH Road Crossing	55.017	55.080	
2	Maguri Village	Rail Bridge	57.602		58.90

Table 4 H. F.L Details

2.13 - Average Bed Slope:-

Reach		River / Canal Bed Level Change (m)	Distance (km)	Slope (m/km)	Slope (cm/km)
From	To				
0.00	6.703	1.252	6.703	0.187	18.678
6.704	32.038	6.772	25.334	0.267	26.731
32.039	42.797	2.695	10.758	0.251	25.051
42.798	55.031	3.064	12.233	0.250	25.047
55.032	58.234	0.74	3.202	0.231	23.111
Total			58.230	Avg-0.237	Avg-23.723

Table 5- Average bed slope

2.14 -Details of Dam, Barrages, Weirs, Anicut, etc. w.r.t. MSL:-

There are no Dams, Barrages, weirs, Anicut found in this zone of River.

2.15 Details of Locks:-

There are no locks found in this zone of river.

2.16 Details of Aqueducts:-

There are no aqueducts found in this zone of River.

2.17- Details of existing Bridges and Crossings over waterway:-

There are two Wooden Bridges, one under construction RCC Bridge are located in this zone of river. The wooden bridges are temporary build up for the communication of villagers. In rainy season these wooden bridges become damaged, sometimes collapsed. So these bridges have no particular piers and clearances.

Sl. No	Chainage (km)	Location	Cross Structure Details	Position (UTM)		Position (Global)		Length (m)	Width (m)	No of Piers	Horizontal Clearance (m)	Vertical Clearance w.r.t H.F.L (m)	Remarks
				Easting	Northing	Latitude (N)	Longitude (E)						
1	25.635	Bamdia Village	Wooden Bride	345619.6536	2905336.4719	26°15'33.94"	91°27'14.73"	134.72	1.77	-	--	--	Temporary
2	32.050	Saniyadi Village	RCC Bridge	351736.7110	2905940.8923	26°15'55.90"	91°30'54.93"	94.00	9.29	5	21.180	2.495	Complete
3	34.920	Satdala Village	Under Construction RCC Bridge	353723.8934	2904959.2286	26°15'24.75"	91°32'6.95"	109.89	5.44	-	--	--	Under Construction
4	35.348	Satdala Village	Wooden Bridge	354146.6484	2904844.6523	26°15'21.17"	91°32'22.24"	94.07	2.72	-	--	--	Temporary
5	42.844	Mukhaniya Village	RCC Bridge	359148.3448	2908464.7341	26°17'20.61"	91°35'21.08"	123.83	8.04	2	41.51	3.20	Complete
6	48.495	Ketekibari Village	RCC Bridge	364024.4663	2909553.4948	26°17'57.70"	91°38'16.45"	104.62	8.47	2	20.64	5.82	Complete
7	55.030	Barangabari Village	RCC Bridge	364892.5008	2914803.4093	26°20'48.60"	91°38'45.76"	121.95	7.97	2	39.59	3.015	Complete
8	57.602	Maguri Village	Rail Bridge	364892.5008	2916648.2037	26°21'48.81"	91°39'11.25"	130.63	5.92	3	31.18	1.27	Complete
9	57.959	Kendukona Village	RCC Bridge	365618.8653	2917023.5478	26°22'0.99"	91°39'11.11"	139.20	10.15	2	40.79	4.013	Complete
10	57.979	Kendukona Village	RCC Bridge	365622.3990	2917041.3334	26°22'1.58"	91°39'11.25"	134.43	8.19	2	39.58	2.011	Complete

Table 6 Bridge Details

2.18 - Details of other Cross structures, pipe-lines, under water cables:-

There are no other cross structures, pipe lines or underwater cables found in this zone of river.

2.19 – High Tension lines/Electric Lines/Telecommunication Lines:-

Sl. no	Line	Chainage (km)	Location	Position				No of piers	Horizontal clearance (m)	Vertical clearance w.r.t H.F.L (m)	Remarks
				Latitude (N)	Longitude (E)	Easting	Northing				
1.	Electrical Line	25.516	Barsulia Village	26°15'37.11"	91°27'10.47"	345502.7620	2905435.3510	4	211.67	4.457	Complete
2.	Electrical Line	32.501	Sokiapara Village	26°15'50.92"	91°31'10.46"	352165.1590	2905782.8860	4	123.88	6.50	Complete
3.	Electrical Line	42.625	Gerua Village	26°17'19.10"	91°35'12.48"	358909.4757	2908420.8008	4	120.36	3.900	Complete
4.	Electrical Line	48.144	Bausilautoli Village	26°17'45.36"	91°38'14.29"	363960.6489	2909174.0890	4	106.68	4.350	Complete
5.	Electrical Line	54.433	Barangabari Village	26°20'29.34"	91°38'50.28"	365011.0790	2914209.7590	4	125.75	4.950	Complete
6.	Electrical Line	55.024	Dakhin Singra Village	26°20'48.12"	91°38'42.77"	364809.501	2914789.952	4	114.60	4.40	Complete
7.	Electrical Line	57.949	Maguri Village	26°22'01.30"	91°39'07.82"	365526.9	2917033.3	4	162.9	5.220	Complete

Table 7 Electrical Line Details

2.20- Current Meter and Discharge Details:-

Since water depth was too low between Chainage 0.000 km and 35.500 km, no bathymetry survey, current or discharge measurements have been conducted. The data recorded for ch.35.500 km, 42.797 km and 54.433 km are given below-

Stretch No.	Chainage (km)	Position				Observed Depth (m) (D)	Velocity (m/sec.)	Average Velocity (m/sec.)	X-Sectional area (sq. m.)	Discharge (Cubic meter/sec)
		Latitude (N)	Longitude (E)	Easting (m)	Northing (m)		0.5 D			
1	35.500	26°15'27.388"	91°32'37.236"	354564.3000	2905030.6000	0.5	0.121	0.121	136.12	16.470
1	42.797	26°17'19.623"	91°35'18.646"	359080.1	2908434.375	1.2	0.263	0.263	200.94	52.847
2	54.433	26°20'48.945"	91°38'44.842"	364866.6	2914813.8	1.1	0.212	0.212	255.50	54.166

Table 8 Current Meter Details

2.21 - (a) Soil Sample Locations:-

Sample No.	Chainage (km)	Easting (m)	Northing (m)	Latitude (N)	Longitude (E)	Depth (m)
1	6.703	329811.2	2905789.557	26°15'42.232"	91°17'44.85"	0.3
2	32.038	351714.1	2905921.68	26°15'55.292"	91°30'54.151"	0.2
3	42.797	359080.1	2908434.375	26°17'19.623"	91°35'18.646"	1.2
4	55.031	364866.6	2914813.8	26°20'48.945"	91°38'44.842"	0.7
5	57.986	365603.1	2917051.49	26°22'01.913"	91°39'10.563"	0.8

Table 9- Soil Sample Details

(b) Water Sample Locations:-

Sample No.	Chainage (km)	Easting (m)	Northing (m)	Latitude (N)	Longitude (E)	Total Depth (d) (m)	Mid-Depth (0.5d) (m)
1	6.703	329811.2	2905789.557	26°15'42.232"	91°17'44.85"	0.3	0.15
2	32.038	351714.1	2905921.68	26°15'55.292"	91°30'54.151"	0.2	0.10
3	42.797	359080.1	2908434.375	26°17'19.623"	91°35'18.646"	1.2	0.6
4	55.031	364866.6	2914813.8	26°20'48.945"	91°38'44.842"	0.7	0.35
5	57.986	365603.1	2917051.49	26°22'01.913"	91°39'10.563"	0.8	0.40

Table 10-Water Sample Details

Section-3: Detailed Hydrographic Survey- Stretch Wise

3.1From Chainage 0.00 Km to Chainage 10.00 Km (Paschim Kazia Village to Kaplabari Village)

Figure 7 Chainage 0.00 km to Chainage 10.00 km

The River width of Puthimari River from Chainage 0.00 Km. to Chainage 10.00 Km is 166m to 180m approximate width. The average width portion of the river is 170m.

Peradhara village is located as starting point of the survey. Kaplabari village is located at a distance of 1.88km from the BM-1, left side of the river bank. From the 7.00km chainage, Maximum portion of the river covered by island. Kablapur Ghat is located as a distance of 138.78m from the river bank. Maneri village, Pachim Kazia village, Roumari Gaon village, Kaltali village, Nadia village, Rampur village, Larkuchi village, Bhelakhaiti village are situated at left bank side of the river and Khagrakati village is situated at the right bank side of the river. Four canals are located near at chainage of 1km, 2.5km, 3.75km and 9km at right bank side of the river. BM-1 is located near at chainage of 6.703 km. A temporary ferry ghat named Kablapur ferry ghat is located near at chainage of 6.370 km.

Class	Chainage (km)		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)
I	0.00	10.00	0.1	0.3	10000	357775.36	-0.3	0	10000	410000.39
II	0.00	10.00	0.07	0.3	10000	602095.11	-0.3	0	10000	746509.28
III	0.00	10.00	0.04	0.3	10000	915151.79	-0.3	0	10000	1094398.6
IV	0.00	10.00	0.04	0.3	10000	1296060.8	-0.3	0	10000	1431761.98

3.2 From Chainage 10.00 Km to Chainage 20.00 Km (Kaplabari Village to Angradi Village)

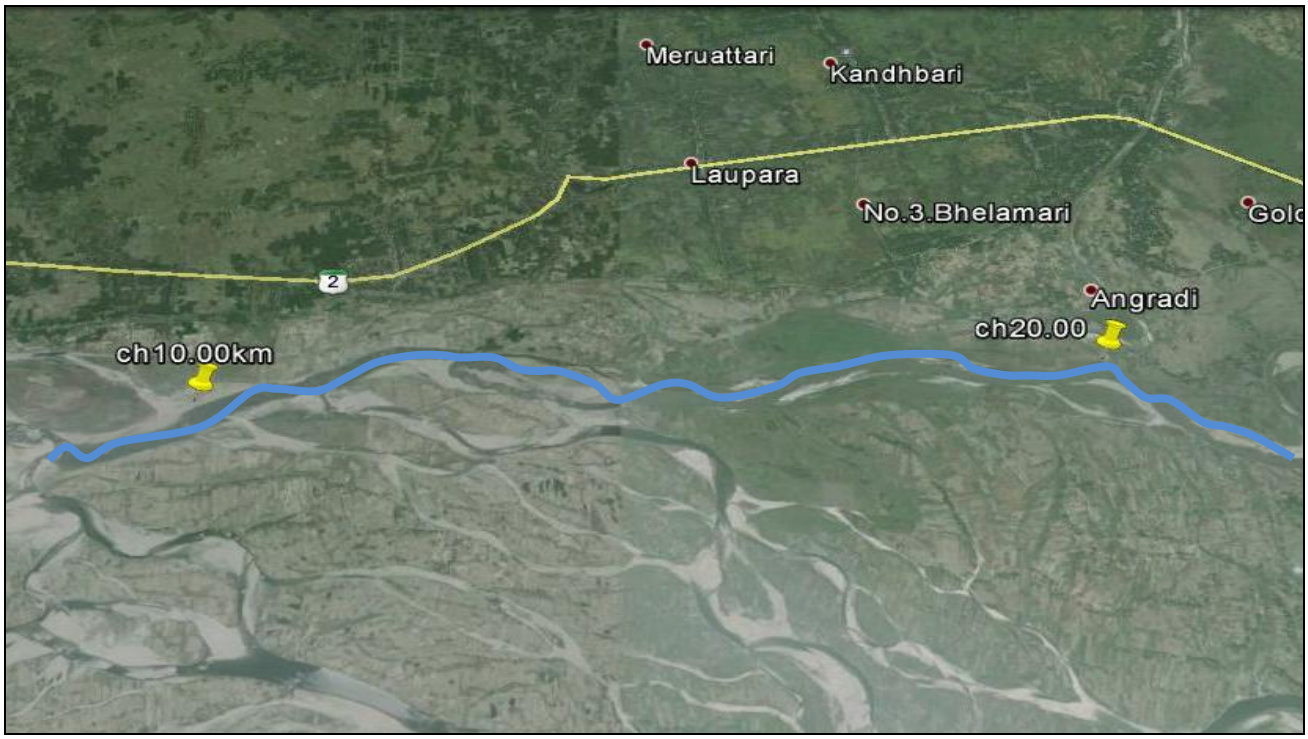


Figure 8 Chainage 10.00km to Chainage 20.00km

The river width of Puthimari River from Chainage10.00 Km. to 20.00 Km is 138m to 160m approximate width. The average width portion of the river is 150m.

During the survey it was noticed that Mukalma Ghat and pam ghat have been located near at chainage of 12.777km and 18.598km. Kalardia village is located at a distance of 122.42m from the right side of the river bank. From 14.477km chainage, Hawuli Ghat village is located left side of the river bank. Both side of the river bank is covered by paddy area. Bhelengimari village, Balattari village, Kaorekhaiti village are situated at the right bank side of the river and Bartala village, Bhelamari village, Mukalmua village, Khuliamari village, Kauriheti village, Baramara village are situated at the left bank side of the river. An irrigation canal is located near at chainage of 15 km. Two ferry ghat is located near at chainage of 12.700 km and 13.726 km respectively. Pam ghat is also located near at chainage of 17.917 km.

Class	Chainage (km)		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)
I	10.00	20.00	0.1	0.3	10000	415713.04	-0.3	0	10000	414809.22
II	10.00	20.00	0.07	0.3	10000	633487.39	-0.3	0	10000	784332.82
III	10.00	20.00	0.04	0.3	10000	959712.31	-0.3	0	10000	1147333.9
IV	10.00	20.00	0.04	0.3	10000	1355360.8	-0.3	0	10000	1413231.81

Figure 9- Mukalma ghat (Chainage-12.700 km)

Figure 10- Hawuli ghat (Chainage-13.726 km)

3.3 From Chainage 20.00 Km to Chainage 30.00 Km (Angradi Village to Kalitakuchi Village)

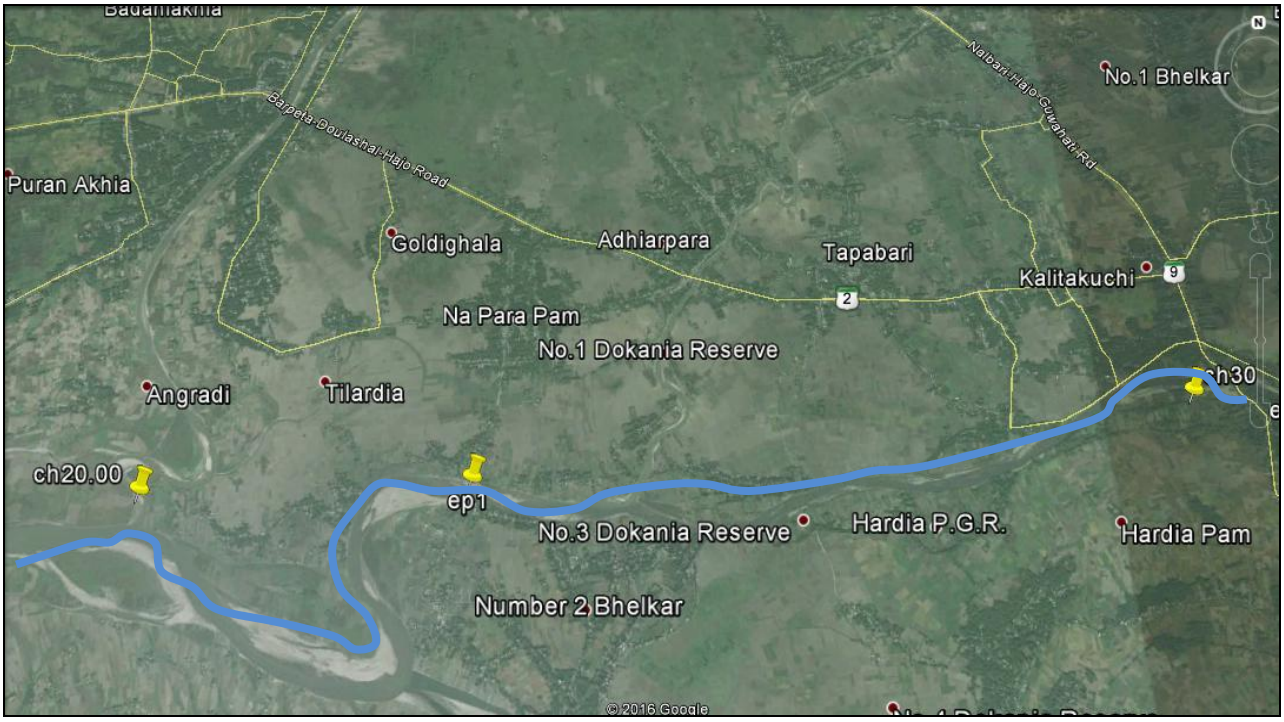


Figure 11 Chainage 20.00 km to Chainage 30.00 km

The River width of Puthimari River from Chainage 20.00 Km. to Chainage 30.00 Km is 110m to 203m approximate width .The average width portion of the river is 125m.

During the survey, the surveyor noticed that, A wooden bridge has been located near at chainage of 25.635km, the Bridge position is-(Lat- 26°15'33.94"N, Long-91°27'14.73"E) Khulimari village is located near left side of the river bank. Sholmari village is located near chainage 24.00km. Angradi village, Puranakhia village, Tilardia village, Barsulia village, sarusulia village, Bangalpara village are situated at the left bank side of the river and Bhelkar village, Dokania Reserve, Hardia P.G.R are situated at the right bank side of the river. Paddy land are also located both bank side of the river. Three irrigation canals have been also located near at chainage of 20.750km, 23.300km and 26.800km.

Class	Chainage (km)		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)
I	20.00	30.00	0.1	0.3	10000	392779	-0.3	0	10000	396511.69
II	20.00	30.00	0.07	0.3	10000	610402.7	-0.3	0	10000	739477
III	20.00	30.00	0.04	0.3	10000	933479.4	-0.3	0	10000	1094702.6
IV	20.00	30.00	0.04	0.3	10000	1302941.2	-0.3	0	10000	1381023.6

Figure 12- Wooden Bridge (Chainage-25.635 km)

3.4 From chainage 30.00 Km to Chainage 40.00 Km (Kalitakuchi Village to Niz- Hazo Village)

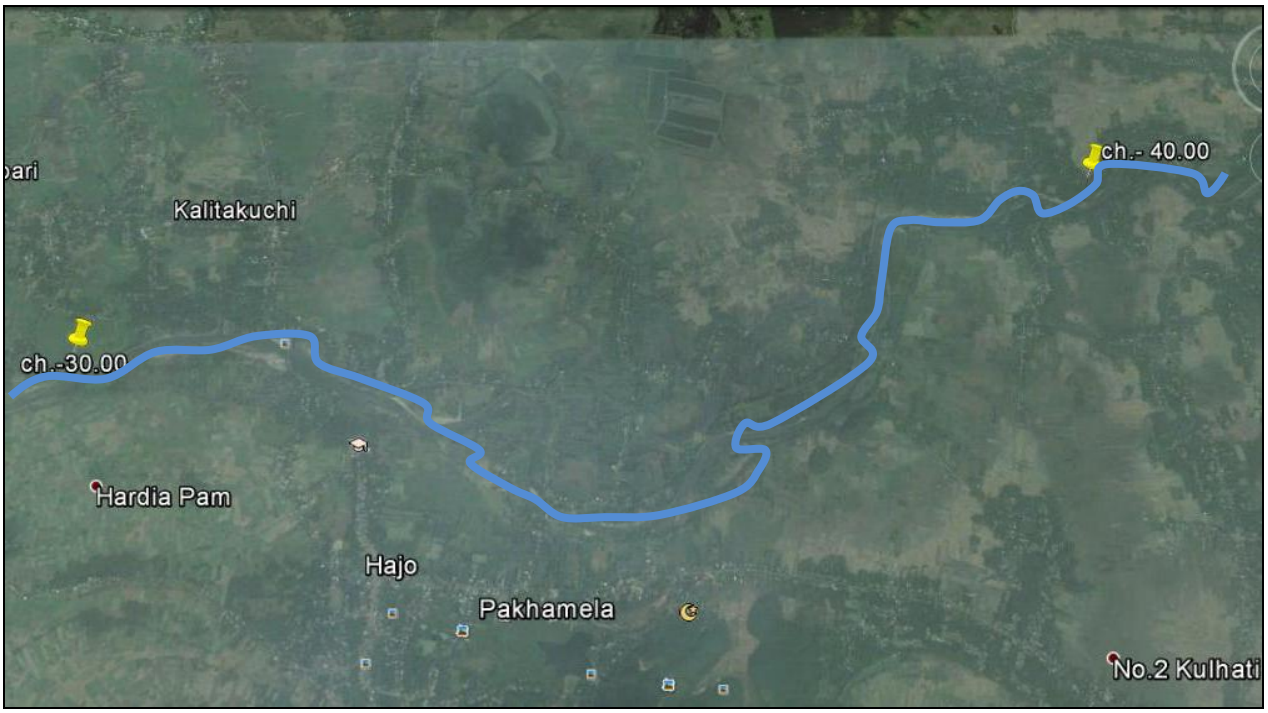


Figure 13 - Chainage 30.00 km to Chainage 40.00 km

The river width of Puthimari River from Chainage 30.00 Km. to Chainage 40.00 Km is 65m to 82.00m approximate width. The average width portion of the river is 65m.

A RCC bridge has been crossing over the river bank near at chainage of 32.050km. The Bridge location is (Lat-26°15'55.90"N, Long-91°30'54.93"E). Sastar village is located at a distance of 225.98m from the left side of the river bank and other side Majarkuri village is located at a distance of 237.87m from the river bank. From the chainage 32.00 to 33.00km, both side of the river bank is covered by agricultural land and many people connected with farm. A Wooden bridge has been crossing over the river near at chainage of 35.348km. The Bridge location is (Lat-26°15'21.17"N, Long-91°32'22.24"E) Gandheli Tari, Sastar, Majarkuri, Nadia, Barsapari, Saktibari villages are situated left bank side of the river and Sarubakara, Hajo, Ujan Tokradia, Patni, Abhoypur villages are situated right bank side of the river. An under construction Bridge is also situated near at chainage of 34.920km. The Bridge location is (Lat-26°15'24.75"N, Long-91°32'6.95"E).

Class	Chainage (km)		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)
I	30.00	40.00	0.1	4.0	10000	325596.6	-0.3	2.9	10000	292556.5
II	30.00	40.00	0.07	4.1	10000	475876.4	-0.3	3.1	10000	558312.9
III	30.00	40.00	0.04	5.2	10000	779895.2	-0.3	3.2	10000	882838.1
IV	30.00	40.00	0.04	5.2	10000	1081444.4	-0.3	3.5	10000	1264168.06

Figure 14- RCC Bridge (Chainage- 32.050 km)

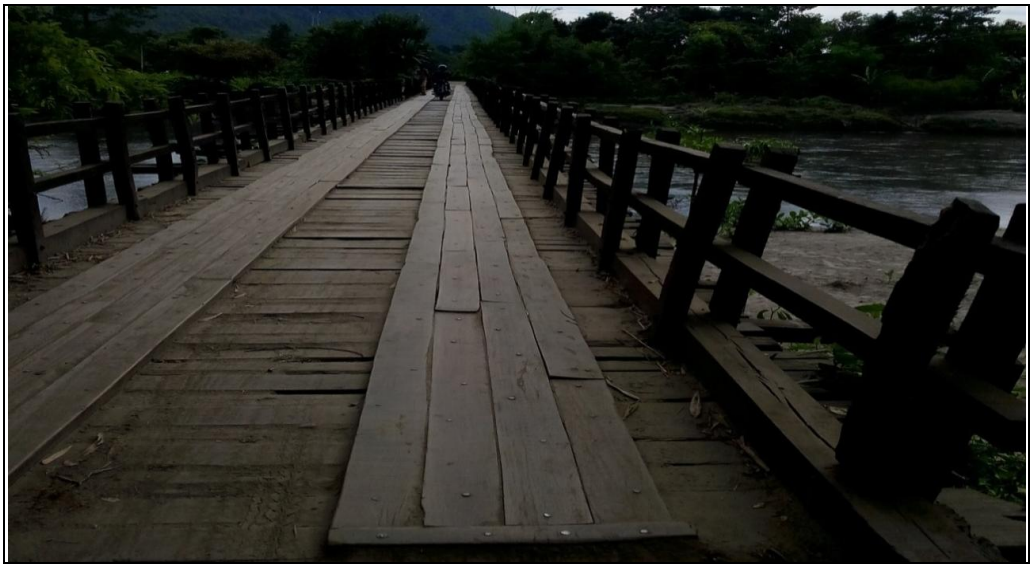


Figure 15- Wooden Bridge (Chainage- 35.348 km)

Figure 16- Under- Construction RCC Bridge (Chainage- 34.920 km)

3.5 From chainage 40.00 Km to Chainage 50.00 Km (Niz- Hazo Village to Ketekibari Village)

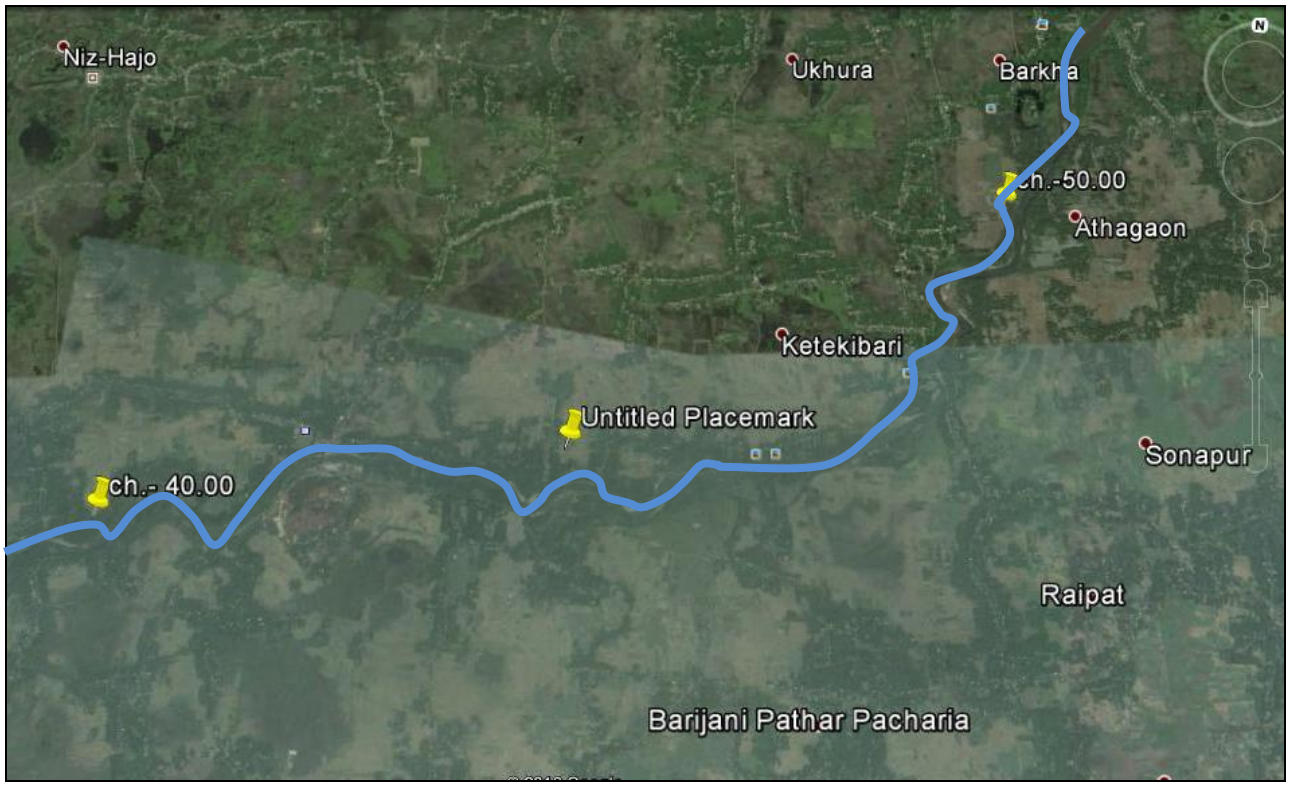


Figure 17 Chainage 40.00 km to Chainage 50.00 km

The river width of Puthimari from Chainage 40.00 Km. to Chainage 50.00 Km is 35 to 106approximate width. The average width portion of the river is 45 m.

From 42.500km, BM 3 is located at a distance of 31.43m from the RCC Bridge. Two RCC Bridges have been situated near at chainage of 42.844 km and 48.495 km respectively. The Bridges location are (Lat-26°17'20.61"N, Long-91°35'21.08"E) , (Lat-, Long-91°38'16.45"E) respectively. Hadala village is located at a distance of 1.28km from BM 3. Bausiloutoli village is situated at a distance of 251m (approx) from the left side of the river bank. Gerua, Hadala, Bausiloutoli, Dhonaka, Sonapur, Dalang villages are situated right bank side of the river and Rajabazar, Tetelia, Ketekibari; Mokhania villages are situated left bank side of the river.

Class	Chainage (km)		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)
I	40.00	50.00	0.5	4.1	10000	177198.4	0.1	2.5	10000	181679.3
II	40.00	50.00	0.4	4.9	10000	332959	0.1	2.5	10000	357000.5
III	40.00	50.00	0.3	5.0	10000	587170.2	0.1	2.7	10000	632560.6
IV	40.00	50.00	0.1	3.9	10000	815657.2	0.01	3.1	10000	847087

Figure 18- RCC Bridge (Chainage-42.844 km)

Figure 19 RCC Bridge (Chainage-48.495 km)

3.6 From chainage 50.00 Km to Chainage 58.234 Km (Ketekibari Village to Ghopla Village)

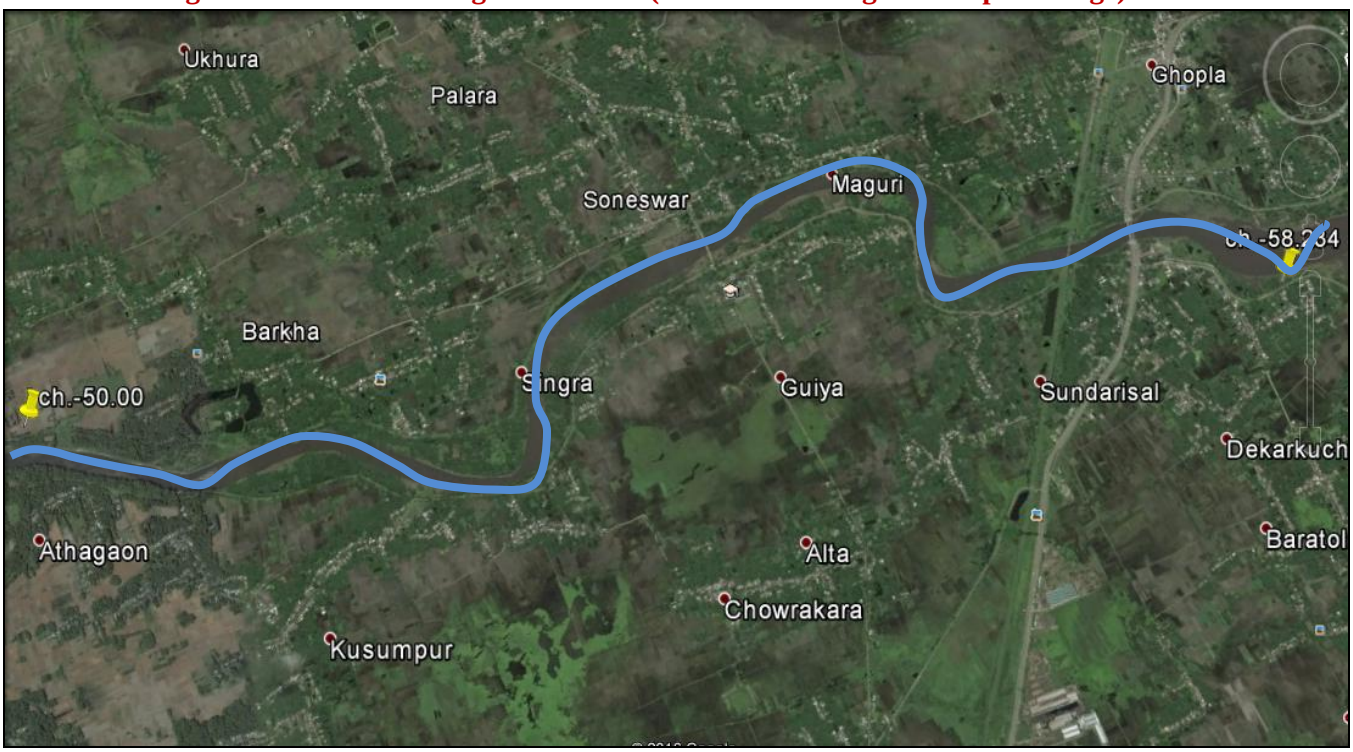


Figure 20 Chainage 50.00km to Chainage 58.234km

The river width of Puthimari River from Chainage 50.00 Km. to 58.234 Km is 46m to 111m approximate width. The average width portion of the river is 55m.

During the survey, the surveyor noticed that singra village is located at a distance of 35.5mt (approx) left bank of the river bank. From 51.00km to 54.00km chainage, village area have been located both side of the river bank. Three RCC Bridges have been situated near at chainage of 55.030km, 57.959km and 57.979 km. The RCC Bridges location are (Lat-26°20'48.60"N, Long-91°38'45.76"E), (Lat-26°22'0.99"N, Long-91°39'11.11"E), (Lat-26°22'1.58"N, Long-91°39'11.25"E) respectively and another Rail bridge has been situated near at chainage of 57.602km. The Rail Bridge location is (Lat-26°21'48.81"N, Long-91°39'11.25"E) Barkha, Ukhura, palara, Soneswar, Maguri, Ghopla, Khudra Dimu villages are situated left bank side of the river and Athagaon, Kusumpur, Alta, Sundarisal, Guiya, Dakhin Singra, Dekarkuchi, Baratala, Namghar villages are situated right bank side of the river.

Class	Chainage (km)		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)
I	50.00	58.234	0.2	3.4	10000	193299.2	0.1	3.1	10000	207808.6
II	50.00	58.234	0.1	3.7	10000	358215.7	0.1	3.1	10000	392039.7
III	50.00	58.234	0.1	3.9	10000	601114.9	0.01	3.1	10000	648935.3
IV	50.00	58.234	0.1	3.9	10000	819075.4	0.01	3.1	10000	878528.36

Figure 21 - RCC Bridge (Chainage- 55.030 km)

Figure 22- Rail Bridge (Chainage-57.602 km)

Figure 23- RCC Bridge- (Chainage-57.959 km)

Figure 24- RCC Bridge-(Chainage-57.979 km)

- **Bathymetry Survey:-**

a) Length of the stretch for which the Bathymetric survey has been carried out:-

The layer of water in the river Puthimari is not sufficient for carrying out the Bathymetric survey. The Length of the Bathymetric survey is tabulated below:-.

Date of Survey	Type of survey	Chainage	
		From (km)	To (km)
03.11.15	Bathymetry Survey	35.000	42.135
04.11.15	Bathymetry Survey	42.135	48.300
05.11.15	Bathymetry Survey	48.300	58.234

- **Topographic Survey:-**

a) Length of the stretch for which the Topographic survey has been carried out:-

The Topography survey has been carried out from confluence with Brahmaputra River near Bamunbori to Bridge on NH-31 near village Ghopla. The Length of the Topography survey of the river is from chainage 0.00 km to chainage 58.234 km.

a) Prominent Dams / Barrage:-

There are no Dams, Barrage found in this zone of River.

c) Tidal stretch, tidal range. Pondage stretch / length of Dam, Barrages, Weirs, Anicut, Locks:-

There are no Dams, Barrages, weirs, Anicut; Locks found in this zone of river.

d) Description of stretch w.r.t. different depths, widths, current, discharge:-

The stretch-wise description has been shown in the salient features, page no-7

e) Conditions of banks (protected, un-protected)

Puthimari River annually bears the brunt of floods and where embankment construction and repairing seems like permanent affair. Displacement of people living on the banks of rivers due to river bank erosion is another major issue here. The tributaries continue to erode the banks rapidly. The River banks are constantly being changed by means of flood of very high magnitude, channel widening, and change in channel pattern and of river bank erosion. To protect the shore and its properties various methods are in use like, geobags filling with sand, porcupine (triangle shaped concrete structure), sand bags and boulder bags called Gabions are in use to strengthen the embankments.

From Hazu village to Hadala villages are protected by Bituminus road near BM-3 right bank side of the river.
From Rajabazar village to Ketekibari villages are also protected by Bituminus road, left bank side of the river.
From Sarusulia village to Satdala villages are also protected by Bituminus road left bank side of the river.

f) Navigational Hazards - Rocks, rapid waterfalls, steep gradient: -

During the period of survey, no navigational hazards like rocks, rapid waterfalls, and steep gradients were found.

g) Details of Protected Area- Wildlife Defence: -

The most part of the riverside area has been surrounded by dense forest. Manas National park and Bornadi wildlife sanctuary has been located nearly 30km far away from the river side. The area is protected for wildlife defence.

h) NH/SH/MDR along and/or in vicinity:-

NH-15, NH-31, NH-37, NH-40 are the important way for the communication of villagers and also for the tourists.

i) Railway Line and Stations in the vicinity:-

The only Railway line is situated near at chainage of 57.38 km. Bihara Railway station is situated in this zone of river.

j) Land Use Pattern along Waterway on visual assessment:-

The major portion of the right bank of the river is occupied by agriculture. Major crops are rice, tea, mustard, sugarcane, black dhal, vegetables like, radish, cabbage, cauliflower, etc. The left bank mostly occupied with scattered forest area and agriculture. The most important forest products are timber, bamboo and firewood.

k) Crops / Agriculture in the region on visual assessment:-

The Major crops along the river is Paddy, jute, Tea, Rice, Wheat, Maize, Sorghum, gram, Millets, Sugarcane and Spices are cultivated here.

l) Availability of Bulk / Construction Material: -

The construction materials like sand, Brick etc. are found in this zone of river. There are some cement factories and the brick fields are located and the sand is available from the river.

m) Existing Industries along Waterway with their types and details: -

There are some industries like cement, wood are found in this zone of river.

n) Existing Jetties and Terminals (with conditions and facilities): -

The Temporary jetties are located near at chainage of 6.371 km named Kablapur Ghat, chainage 15.00 km named Mukalma Ghat, chainage 13.744 km named Hawuli Ghat, chainage 17.946 km named Pam Ghat.

Sl no	Chainage (km)	Name of Ferry Ghat	Easting	Northing	Latitude (N)	Longitude (E)	Remarks
1	6.370	Kablapur Ghat	329984.00	2906091.00	26°15'52.10"	91°17'50.94"	Temporary Jetty
2	12.700	Mukalma ghat	336125.00	2905537.00	26°15'36.68"	91°21'32.50"	
3	13.726	Hawuli Ghat	337326.00	2905199.00	26°15'26.19"	91°22'15.93"	
4	17.917	Pam Ghat	340716.00	2905464.00	26°15'36.17"	91°24'17.98"	

o) Existing Cargo Movement: -

There are four numbers of Passenger ferry services available in this zone of river. Kablapur ghat, Mukalma ghat, Hawuli ghat and Pam ghat are located near at chainage of 6.370 km, 12.700 km, 13.726 km and 17.917 km respectively. The light cargo movement like vegetables, vehicles like cycle, light goods are available in this zone of river.

p) Prominent City / Town / Places of Worship / Historical places for Tourism:-

The Prominent cities situated near the bank of river Puthimari are Kamrup, Guwahati, Ghopla etc. Kamakhya Temple is the chief historical and Tourist places for the outsider and also for the Tourist. Shankardev Kalakshetra, Umananda Temple, Assam State Zoo, Shilpagram ,Chandubi Lake, Sonapur, Madan Kamdev, Chandrapur and Bornadi Wildlife Sanctuary, Jaintia Hill are also the famous Historical and Tourist places.

q) Availability of Passenger Ferry Services: -

The Ferry services are located near at chainage of 6.371 km named Kablapur Ghat, chainage 15.00 km named Mukalma Ghat, chainage 13.744 km named Hawuli Ghat, chainage 17.946km named Pam Ghat. A Burning Ghat is also located near at chainage of 31.4 km.

Sl no	Chainage (km)	Name of ferry Ghat	Easting	Northing	Latitude (N)	Longitude (E)	Remarks
1	6.370	Kablapur Ghat	329984.00	2906091.00	26°15'52.10"	91°17'50.94"	Temporary Ferry
2	12.700	Mukalma ghat	336125.00	2905537.00	26°15'36.68"	91°21'32.50"	
3	13.726	Hawuli Ghat	337326.00	2905199.00	26°15'26.19"	91°22'15.93"	
4	17.917	Pam Ghat	340716.00	2905464.00	26°15'36.17"	91°24'17.98"	

r) Available and probable Water Sport Recreational Facilities: -

There is no water sports and other facilities available in this river.

s) Fishing activities:-

Puthimari River is the lifeline of the people of Guwahati, Dakhin Singra, Maguri etc. Puthimari provides diverse habitat in its downstream for living biota such as stream, riparian zones and wetlands etc. Puthimari has some of the richest riverine fisheries in India. The river has over fish species and forms an important component of livelihood and nutritional security in the downstream stretches in Assam. The wetlands are ecologically and economically important for the local people. Fishing in. Puthimari is very famous among the people. The common fish at Puthimari is the Golden Mahseer and some small fishes. Puthimari is one of the only tributaries of Brahmaputra with a resident population of the endangered Gangetic Dolphin which is the National aquatic animal of India.

t)Sand mining:-

Illegal river sand mining across the country is on the rise for past many years in Indian, which results in adverse impact on river system and dependent communities. In Puthimari gravel mining was noticed during the survey period. Besides this, sand is also exported to other states as it becomes demandful for making Building or Industries.

u) Tributaries:-

The Tributaries of puthimari River are-

i) Nona

ii) Baralia

v) Details of Irrigation Canals and Outlets:-

The irrigation canal and outlets have been situated near at chainage of 1km, 3.9km, 9.5km, 23.5km right bank side of the river and 2.5km, 20.9km, 27km left bank side of the river. These canals supply valuable water for the cultivation purposes.

w) Details of Nalas, polluted water discharge in to the rivers and treatment plants:-

There are no nalas found in this zone of river.

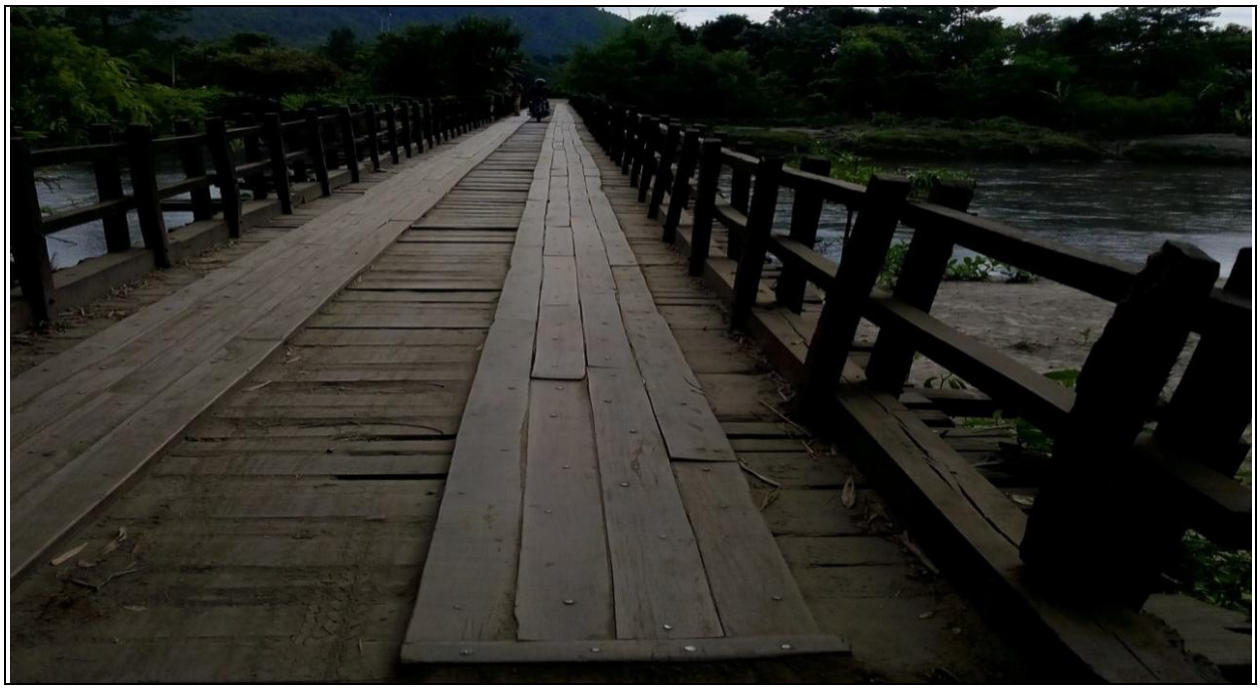
x) Usage of water (drinking, irrigation, industries, navigation etc.) water quality:-

In Recent time's man avoid to drinking the water of the river but the water is essential for cultivation which is the main occupation for the villagers of this region. The water is also used in the industrial hubs. Ferry services are also navigable in this region of river. The water is used as irrigation purposes. With the help of the irrigation system, the cultivation can easily accessible. Irrigation Canals supply the sufficient water for the cultivation.

aa) Photographs of cross-structures in each stretch with description, location, Chainage, clearance

This wooden Bridge is situated near at chainage of 25.635km at Bamdia Village. The Bridge location is (Lat-26°15'33.94",Long-91°27'14.73").

The RCC Bridge is situated near at chainage of 32.050km at Saniyadi Village. The Bridge location is (Lat-26°15'55.90"N, Long-91°30'54.93"E). The Bridges have a good horizontal and vertical clearance for the waterways development.



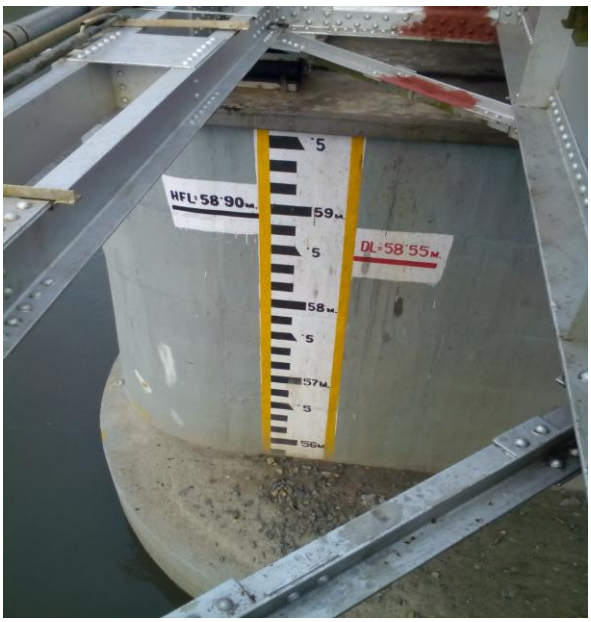
The wooden Bridge is situated near at chainage of 35.348km at Satdala Village.The Bridge location is (Lat-26°15'21.17"N, Long-91°32'22.24"E).

The under- Construction Bridge is situated near at chainage of 34.920km at Satdala Village. The bridge location is (Lat-26°15'24.75"N, Long-91°32'6.95"E).

The RCC Bridge is situated near at chainage of 42.844km at Mukhaniya Village. The Bridge location is (Lat-26°17'20.61"N, Long- 91°35'21.08"E).The Bridge has a good horizontal and vertical clearance for the waterways development.

The RCC Bridge is situated near at chainage of 48.495km at Ketekibari Village. The Bridge location is (Lat-26°17'57.70"N, Long-91°38'16.45"E). The Bridge has a good horizontal and vertical clearance for the waterways development.

The RCC Bridge is situated near at chainage of 55.030km at Barangabari Village. The Bridge location is (Lat-26°20'48.60"N, Long-91°38'45.76"E). The Bridge has a good horizontal and vertical clearance for the waterways development.



The Rail Bridge is situated near at chainage of 57.602km at Maguri Village. The Bridge location is (Lat-26°21'48.81"N, Long-91°39'11.25"E) . The Bridge has a good horizontal and vertical clearance for the waterways development.

The RCC Bridge is situated near at chainage of 57.959km at Kendukona Village. The Bridge location is (Lat-26°22'0.99"N, Long-91°39'11.11"E). The Bridges hava a good horizontal and vertical clearance for the waterways development.

The RCC Bridge is situated near at chainage of 57.979km at Kendukona Village. The Bridge location is (Lat-26°22'1.58"N, Long-91°39'11.25"E). The Bridges hava a good horizontal and vertical clearance for the waterways development.

Section 4: Terminals

There is no existing terminal found n this zone of river.

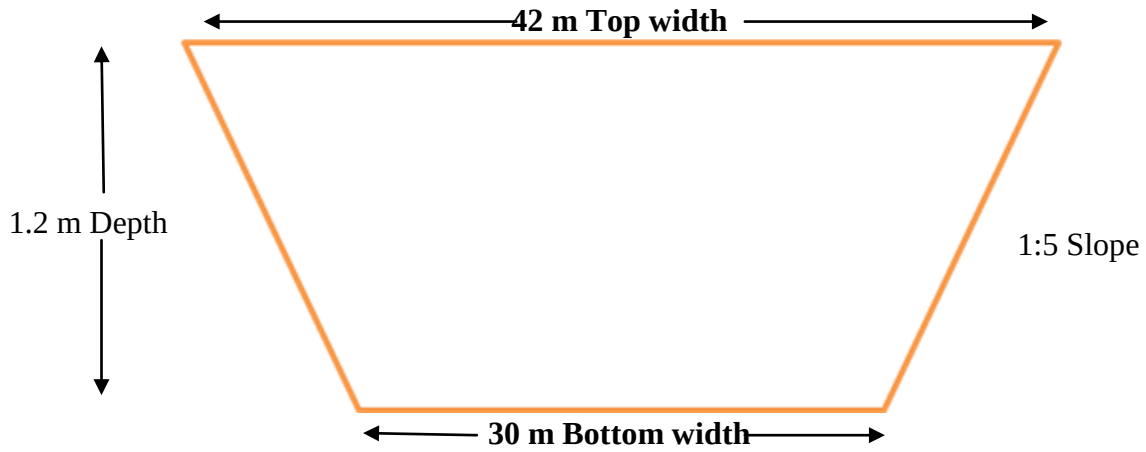
4.1 Details of Land use, owner etc.:-

The both side bank of the River Puthimari used for mainly in cultivation. The Farmers are cultivated their crops with using this fertile land and grows a huge amount of crops every year. Besides, some portions of the land are surrounded by small industries and Forests. Though bolder pitching is found in some places, But in Recent times, the bank of the river has been worn away in some places for lack of trees. Sometimes, the land of the river has been changed into a heap of garbage. As a result, the river side becomes polluted land. In the Monsoon period, Flood and erosion has been affected both side of the river bank.

Section 5: Fairway development:-

Dredging sections, summary of depths and dredging quantity for different classification of waterways (stretch-wise)

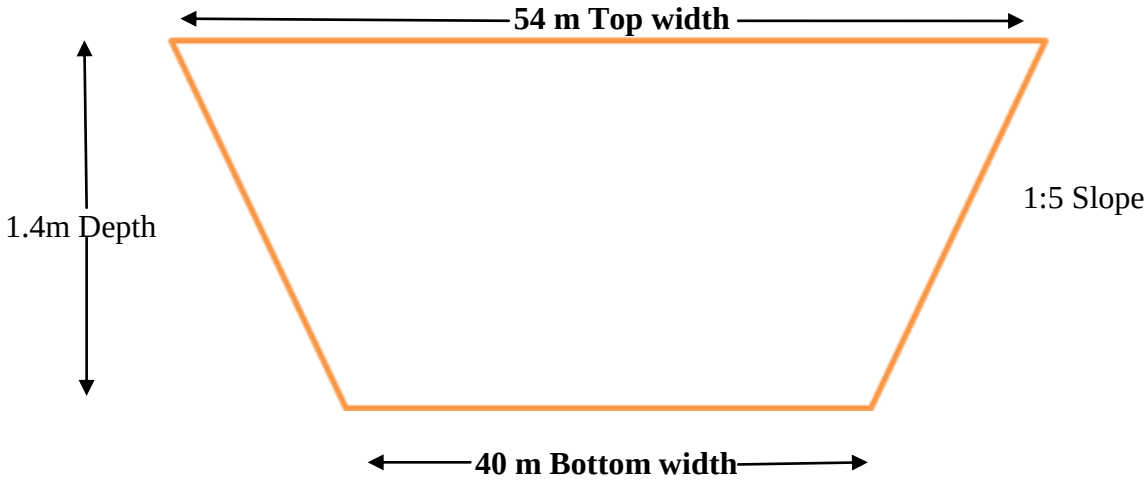
Class-I: - (Channel design: - Bottom width- 30 meter, Top width- 42 meter)



Location		Chainage (km)		As per Observed Soundings						As per Reduced Soundings					
From	To	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Avg depth of cut (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Qty (cubic meter)	Min. Depth (m)	Max Depth (m)	Length of Shoal (m)	Avg depth of cut (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Qty (cubic meter)
Paschim kazia Village	Kaplabari Village	0.00	10.00	0.1	0.3	10000	1.08	357775.36	357775.36	-0.3	0	10000	1.24	410000.39	410000.39
Kaplabari Village	Angradi Village	10.00	20.00	0.1	0.3	10000	1.26	415713.04	773488.40	-0.3	0	10000	1.26	414809.22	824809.61
Angradi Village	Kalitalakuchi Village	20.00	30.00	0.1	0.3	10000	1.19	392779.00	1166267.40	-0.3	0	10000	1.20	396511.69	1221321.30
Kalitalakuchi Village	Niz-Hazo Village	30.00	40.00	0.1	4.0	10000	0.99	325596.60	1491864.00	-0.3	2.9	10000	0.89	292556.50	1513877.80
Niz-Hazo Village	Ketekibari Village	40.00	50.00	0.5	4.1	10000	0.54	177198.40	1669062.40	0.1	2.5	10000	0.55	181679.30	1695557.10
Ketekibari Village	Gopala Village	50.00	58.234	0.2	3.4	10000	0.59	193299.20	1862361.60	0.1	3.1	10000	0.63	207808.60	1903365.70
Total						60000		1862361.60		Total		60000		1903365.70	

Table 11 Dredging quantity for class-I

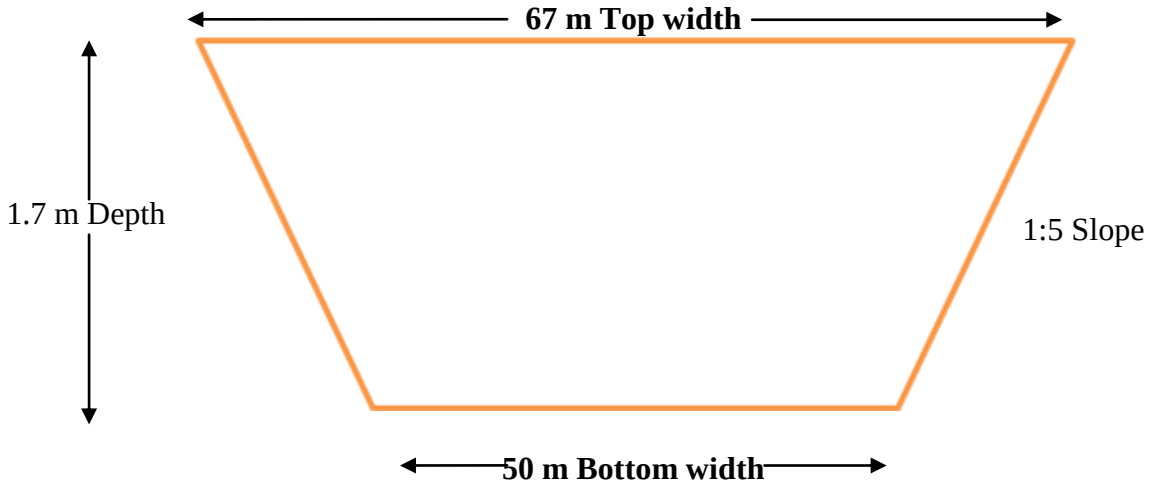
Class-II: - (Channel design: - Bottom width- 40 meter, Top width- 54 meter)



Location		Chainage (km)		As per Observed Soundings						As per Reduced Soundings					
From	To	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Avg depth of cut (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Qty (cubic meter)	Min Depth (m)	Max Depth (m)	Length of Shoal (m)	Avg depth of cut (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Qty (cubic meter)
Paschimkazia Village	Kaplabari Village	0.00	10.00	0.07	0.3	10000	1.37	602095.11	602095.11	-0.3	0	10000	1.70	746509.28	746509.28
Kaplabari Village	Angradi Village	10.00	20.00	0.07	0.3	10000	1.44	633487.39	1235582.50	-0.3	0	10000	1.78	784332.82	1530842.10
Angradi Village	Kalitalakuchi Village	20.00	30.00	0.07	0.3	10000	1.39	610402.70	1845985.20	-0.3	0	10000	1.68	739477.00	2270319.10
Kalitalakuchi Village	Niz-Hazo Village	30.00	40.00	0.07	4.1	10000	1.08	475876.40	2321861.60	-0.3	3.1	10000	1.27	558312.90	2828632.00
Niz-Hazo Village	Ketekibari Village	40.00	50.00	0.4	4.9	10000	0.76	332959.00	2654820.60	0.1	2.5	10000	0.81	357000.50	3185632.50
Ketekibari Village	Gopala Village	50.00	58.234	0.1	3.7	10000	0.81	358215.70	3013036.30	0.1	3.1	10000	0.89	392039.70	3577672.20
Total						60000		3013036.30		Total		60000		3577672.20	

Table 12- Dredging quantity for class-II

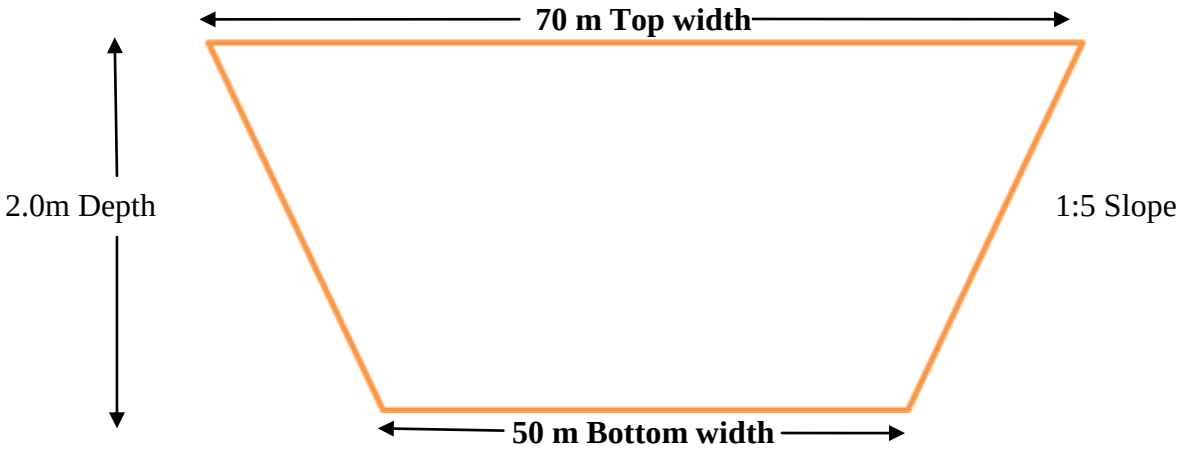
Class-III: - (Channel design: - Bottom width- 50 meter, Top width- 67 meter)



Location		Chainage (km)		As per Observed Soundings						As per Reduced Soundings					
From	To	From	To	Min depth (m)	Max depth (m)	Length of Shoal (m)	Avg depth of cut (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Qty (cubic meter)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Avg depth of cut (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Qty (cubic meter)
Paschimkazia Village	Kaplabari Village	0.00	10.00	0.04	0.3	10000	1.66	915151.790	915151.790	-0.3	0	10000	1.99	1094398.600	1094398.600
Kaplabari Village	Angradi Village	10.00	20.00	0.04	0.3	10000	1.74	959712.310	1874864.100	-0.3	0	10000	2.09	1147333.900	2241732.500
Angradi Village	Kalitalakuchi Village	20.00	30.00	0.04	0.3	10000	1.70	933479.400	2808343.500	-0.3	0	10000	1.99	1094702.600	3336435.100
Kalitalakuchi Village	Niz-Hazo Village	30.00	40.00	0.04	5.2	10000	1.52	835966.700	3644310.200	-0.3	3.2	10000	1.72	945115.000	4281550.100
Niz-Hazo Village	Ketekibari Village	40.00	50.00	0.3	5.0	10000	1.07	591268.500	4235578.700	0.1	2.7	10000	1.18	646625.500	4928175.600
Ketekibari Village	Gopala Village	50.00	58.234	0.1	3.9	10000	1.67	920377.960	5155956.660	0.01	3.1	10000	1.74	959871.300	5888046.900
Total						60000		5155956.660		Total		60000		5888046.900	

Table 13 Dredging quantity for class-III

Class-IV: - (Channel design: - Bottom width- 50 meter, Top width- 70 meter)



Location		Chainage (km)		As per Observed Soundings						As per Reduced Soundings					
From	To	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Avg depth of cut (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Qty (cubic meter)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Avg depth of cut (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Qty (cubic meter)
Paschimkazia Village	Kaplabari Village	0.00	10.00	0.04	0.3	10000	2.36	1296060.80	1296060.80	-0.3	0	10000	2.60	1431761.98	1431761.98
Kaplabari Village	Angradi Village	10.00	20.00	0.04	0.3	10000	2.46	1355360.80	2651421.60	-0.3	0	10000	2.57	1413231.81	2844993.79
Angradi Village	Kalitalakuchi Village	20.00	30.00	0.04	0.3	10000	2.37	1302941.20	3954362.80	-0.3	0	10000	2.51	1381023.6	4226017.39
Kalitalakuchi Village	Niz-Hazo Village	30.00	40.00	0.04	5.2	10000	1.97	1081444.40	5035807.20	-0.3	3.5	10000	2.30	1264168.06	5490185.45
Niz-Hazo Village	Ketekibari Village	40.00	50.00	0.3	5.0	10000	1.48	815657.20	5851464.40	0.1	2.8	10000	1.54	847087	6337272.45
Ketekibari Village	Gopala Village	50.00	58.234	0.1	3.9	10000	1.49	819075.40	6670539.80	0.01	3.1	10000	1.60	878528.36	7215800.81
Total						60000		6670539.80		Total		60000		7215800.81	

Table 14 Dredging quantity for class-IV

Section 6: Conclusion:

The surveyed stretch of Puthimari River is 58.234 km in length and was not explored for any navigational possibility in earlier time. As much as 03 major and minor ferry services were being operated along the survey stretch by private concerns. The settlements are thickly populated on the right bank where as the left bank is sparsely distributed. However, there is a good scope for developing tourism along the entire stretch of Puthimari. The river bed of Puthimari river is mainly sandy in nature with isolated incident of small scale and conventional sand/Gravel mining by the local peoples. The river banks of entire stretch are covered with vegetation and beyond that cultivation is prominent. Encroachment was observed in many parts of the river banks. The water flow of the river is not obstructed from top to bottom of the entire stretch. The average water velocity during the survey period is around 0.80 m/s. Six numbers of RCC Bridges and a Railway line have been provides a smooth communication for the daily native villagers and also for the tourists. Two important RCC Bridges are located near at Ghopla which is linked with NH-31. After the RCC Bridges, a railway line is located. Bihata Railway station is close to the river side. Kamalpur-Dimu road is also located in this zone of river near at Soneswar village. Kamrup, Kamakhya temple have become a really tourist place in this zone of river. Pam Ghat, Hawuli Ghat Ferry services have been also communicated in this zone which is important for the waterways development. Bornadi wildlife sanctuary and some forest have been located in this zone which is protected in this zone of river.

NH-31 is the major communicative way in this zone of river. Kamrup is the main place where the tourist attraction appeared. Kamakhaya temple at kamrup, Guwahati is the tourist places situated in this zone of river. Ghopla, Dakhin singra, Maguri, Soneswar, Singra, Kusumpur, Ketekibari, Tetelia, Gerua, Nadia etc. villages are situated in this zone of river.

6.1 Dredging Summery

Class Details	As per Observed Soundings (cubic meter)	As per Reduced Soundings (cubic meter)
Class I	1862361.60	1903365.70
Class II	3013036.30	3577672.20
Class III	5155956.66	5888046.90
Class IV	6670539.80	7215800.81

Table 15 Total Dredging Quantity

Annexure:-

Annexure-1 Source and type of data collected from various agencies:-

The Chart Datum value of Puthimari (NH-31 Road Crossing) and Confluence with Brahmaputra river are provided by IWAI office.

Annexure-2 Min. / max. depth, length of shoal per km-wise for different classification in the designed dredged channel:-

Class-I:-

Chainage (km)		As per Observed Soundings					As per Reduced Soundings				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Quantity (cubic meter)
0	1	0.1	0.3	1000	28972.68	28972.68	-0.3	0	1000	45249.86	45249.86
1	2	0.1	0.3	1000	45249.86	74222.54	-0.3	0	1000	34095.98	79345.84
2	3	0.1	0.3	1000	34095.98	108318.52	-0.3	0	1000	36162.53	115508.37
3	4	0.1	0.3	1000	36162.53	144481.05	-0.3	0	1000	38759.38	154267.75
4	5	0.1	0.3	1000	38759.38	183240.43	-0.3	0	1000	45284.99	199552.74
5	6	0.1	0.3	1000	45284.99	228525.42	-0.3	0	1000	45284.99	244837.73
6	7	0.1	0.3	1000	38639.90	267165.32	-0.3	0	1000	38639.90	283477.63
7	8	0.1	0.3	1000	45305.02	312470.34	-0.3	0	1000	45305.02	328782.65
8	9	0.1	0.3	1000	38856.34	351326.68	-0.3	0	1000	38856.34	367638.99
9	10	0.1	0.3	1000	6448.68	357775.36	-0.3	0	1000	42361.40	410000.39
10	11	0.1	0.3	1000	42361.40	400136.76	-0.3	0	1000	38815.80	448816.19
11	12	0.1	0.3	1000	38815.80	438952.56	-0.3	0	1000	45223.50	494039.69
12	13	0.1	0.3	1000	45223.50	484176.06	-0.3	0	1000	38827.44	532867.13
13	14	0.1	0.3	1000	38827.44	523003.50	-0.3	0	1000	44718.10	577585.23
14	15	0.1	0.3	1000	44718.10	567721.60	-0.3	0	1000	38683.29	616268.52
15	16	0.1	0.3	1000	38683.29	606404.89	-0.3	0	1000	45263.44	661531.96
16	17	0.1	0.3	1000	45263.44	651668.33	-0.3	0	1000	38775.93	700307.89
17	18	0.1	0.3	1000	38775.93	690444.26	-0.3	0	1000	45118.20	745426.09
18	19	0.1	0.3	1000	45118.20	735562.46	-0.3	0	1000	37925.94	783352.03
19	20	0.1	0.3	1000	37925.94	773488.40	-0.3	0	1000	41457.58	824809.61
20	21	0.1	0.3	1000	41457.58	814945.98	-0.3	0	1000	34725.62	859535.23
21	22	0.1	0.3	1000	34725.62	849671.60	-0.3	0	1000	56619.78	916155.01
22	23	0.1	0.3	1000	56619.78	906291.38	-0.3	0	1000	38818.73	954973.74
23	24	0.1	0.3	1000	38818.73	945110.11	-0.3	0	1000	28211.25	983184.99
24	25	0.1	0.3	1000	28211.25	973321.36	-0.3	0	1000	31322.33	1014507.30
25	26	0.1	0.3	1000	31322.33	1004643.70	-0.3	0	1000	43584.96	1058092.30

Chainage (km)		As per Observed Soundings					As per Reduced Soundings				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Quantity (cubic meter)
26	27	0.1	0.3	1000	43584.96	1048228.70	-0.3	0	1000	34271.57	1092363.90
27	28	0.1	0.3	1000	34271.57	1082500.20	-0.3	0	1000	45152.71	1137516.60
28	29	0.1	0.3	1000	45152.71	1127652.90	-0.3	0	1000	38614.45	1176131.00
29	30	0.1	0.3	1000	38614.45	1166267.40	-0.3	0	1000	45190.30	1221321.30
30	31	0.1	0.3	1000	45190.30	1211457.70	-0.3	0	1000	38831.53	1260152.80
31	32	0.1	0.3	1000	38831.53	1250289.20	-0.3	0	1000	45228.06	1305380.90
32	33	0.1	0.3	1000	45228.06	1295517.30	-0.3	0	1000	37767.25	1343148.20
33	34	0.1	0.3	1000	37767.25	1333284.50	-0.3	0	1000	37381.51	1380529.70
34	35	0.1	0.6	1000	37381.51	1370666.00	-0.3	0	1000	34013.71	1414543.40
35	36	0.2	1.1	1000	34013.71	1404679.70	-0.3	0.3	1000	28816.77	1443360.10
36	37	0.5	1.2	1000	28816.77	1433496.50	0.1	0.6	1000	19160.40	1462520.50
37	38	0.5	2.3	1000	19160.40	1452656.90	-0.3	0.4	1000	17058.67	1479579.20
38	39	0.6	3.4	1000	17058.67	1469715.60	-0.3	0.7	1000	22148.38	1501727.60
39	40	0.6	4	1000	22148.38	1491864.00	0.2	2.9	1000	12150.21	1513877.80
40	41	0.6	2.7	1000	12150.21	1504014.20	0.2	1.6	1000	17981.16	1531859.00
41	42	0.5	1.9	1000	17981.16	1521995.30	0.1	1.6	1000	18807.86	1550666.80
42	43	0.5	3	1000	18807.86	1540803.20	0.5	1.2	1000	17007.93	1567674.80
43	44	2.6	4.1	1000	17007.93	1557811.10	0.4	1.3	1000	22535.16	1590209.90
44	45	0.5	4.3	1000	22535.16	1580346.30	0.3	1.9	1000	14265.96	1604475.90
45	46	0.5	4.7	1000	14265.96	1594612.20	0.3	2.3	1000	17385.89	1621861.80
46	47	0.5	2.3	1000	17385.89	1611998.10	0.3	2.1	1000	20732.13	1642593.90
47	48	0.5	2.3	1000	20732.13	1632730.30	0.3	2.1	1000	21455.32	1664049.20
48	49	0.5	3.4	1000	21455.32	1654185.60	0.3	2.5	1000	14876.81	1678926.00
49	50	0.5	3.4	1000	14876.81	1669062.40	0.3	2.5	1000	16631.04	1695557.10
50	51	0.5	3.4	1000	16631.04	1685693.40	0.3	3.1	1000	19781.69	1715338.80
51	52	0.4	3.3	1000	19781.69	1705475.10	0.3	3.1	1000	20448.59	1735787.30
52	53	0.4	1.9	1000	20448.59	1725923.70	0.3	1.5	1000	17845.12	1753632.50
53	54	0.6	3	1000	17845.12	1743768.80	0.1	0.7	1000	20148.79	1773781.30
54	55	0.7	2.6	1000	20148.79	1763917.60	0.2	0.7	1000	10279.49	1784060.70
55	56	0.2	2.6	1000	10279.49	1774197.10	0.2	0.7	1000	16707.18	1800767.90
56	57	0.3	1.2	1000	16707.18	1790904.30	0.1	0.5	1000	31205.04	1831973.00
57	58	0.3	1.2	1000	31205.04	1822109.30	0.1	0.5	1000	40252.31	1872225.30
58	58.234	0.4	0.9	1000	40252.31	1862361.60	0.1	0.5	1000	31140.39	1903365.70
Total				59000	1862361.60				59000	1903365.70	

Table 16 Dredging quantity per km for class-I

Class-II:-

Chainage (km)		As per Observed Soundings					As per Reduced Soundings				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)
0	1	0.07	0.3	1000	44661.64	44661.64	-0.3	0	1000	55717.54	55717.54
1	2	0.07	0.3	1000	68922.48	113584.12	-0.3	0	1000	85890.62	141608.16
2	3	0.07	0.3	1000	53030.77	166614.89	-0.3	0	1000	65398.79	207006.95
3	4	0.07	0.3	1000	57521.51	224136.40	-0.3	0	1000	69404.86	276411.81
4	5	0.07	0.3	1000	59036.37	283172.77	-0.3	0	1000	73567.55	349979.36
5	6	0.07	0.3	1000	68975.68	352148.45	-0.3	0	1000	85957.07	435936.43
6	7	0.07	0.3	1000	58854.01	411002.46	-0.3	0	1000	73343.75	509280.18
7	8	0.07	0.3	1000	69006.05	480008.51	-0.3	0	1000	85994.89	595275.07
8	9	0.08	0.3	1000	59183.60	539192.11	-0.3	0	1000	73680.59	668955.66
9	10	0.09	0.3	1000	62903.00	602095.11	-0.3	0	1000	77553.62	746509.28
10	11	0.09	0.3	1000	59122.47	661217.58	-0.3	0	1000	73678.28	820187.56
11	12	0.07	0.3	1000	68881.95	730099.53	-0.3	0	1000	85839.76	906027.32
12	13	0.07	0.3	1000	59140.44	789239.97	-0.3	0	1000	73700.46	979727.78
13	14	0.08	0.3	1000	68337.95	857577.92	-0.3	0	1000	83783.02	1063510.80
14	15	0.08	0.3	1000	59004.47	916582.39	-0.3	0	1000	72964.40	1136475.20
15	16	0.07	0.3	1000	68943.42	985525.81	-0.3	0	1000	85916.61	1222391.80
16	17	0.09	0.3	1000	59062.10	1044587.90	-0.3	0	1000	73602.38	1295994.20
17	18	0.07	0.3	1000	68721.40	1113309.30	-0.3	0	1000	85640.27	1381634.50
18	19	0.08	0.3	1000	57855.07	1171164.40	-0.3	0	1000	70291.91	1451926.40
19	20	0.09	0.3	1000	64418.16	1235582.50	-0.3	0	1000	78915.75	1530842.10
20	21	0.07	0.3	1000	54234.59	1289817.10	-0.3	0	1000	63880.44	1594722.60
21	22	0.08	0.3	1000	86239.92	1376057.10	-0.3	0	1000	107404.38	1702126.90
22	23	0.08	0.3	1000	59125.98	1435183.00	-0.3	0	1000	72569.10	1774696.00
23	24	0.07	0.3	1000	46464.02	1481647.10	-0.3	0	1000	52469.23	1827165.30
24	25	0.07	0.3	1000	48909.36	1530556.40	-0.3	0	1000	57410.38	1884575.70
25	26	0.09	0.3	1000	65779.62	1596336.00	-0.3	0	1000	81617.23	1966192.90
26	27	0.09	0.3	1000	53227.23	1649563.30	-0.3	0	1000	62863.83	2029056.70
27	28	0.08	0.3	1000	68774.78	1718338.00	-0.3	0	1000	85270.06	2114326.80
28	29	0.07	0.3	1000	58815.71	1777153.80	-0.3	0	1000	71539.87	2185866.60
29	30	0.07	0.3	1000	68831.43	1845985.20	-0.3	0	1000	84452.41	2270319.10
30	31	0.08	0.3	1000	59146.30	1905131.50	-0.3	0	1000	73695.07	2344014.10
31	32	0.08	0.3	1000	68888.54	1974020.00	-0.3	0	1000	85848.40	2429862.50

Chainage (km)		As per Observed Soundings					As per Reduced Soundings				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)
32	33	0.07	0.3	1000	57499.02	2031519.00	-0.3	0	1000	69814.63	2499677.20
33	34	0.07	0.3	1000	59203.24	2090722.30	-0.3	0	1000	67182.20	2566859.40
34	35	0.09	0.9	1000	52714.25	2143436.50	-0.3	0	1000	61974.39	2628833.70
35	36	0.1	1.3	1000	48923.49	2192360.00	-0.3	0.3	1000	52557.98	2681391.70
36	37	0.4	1.4	1000	30367.89	2222727.90	0.1	0.8	1000	33145.23	2714537.00
37	38	0.4	2.6	1000	32193.65	2254921.60	-0.3	0.4	1000	40875.73	2755412.70
38	39	0.5	3.5	1000	40296.73	2295218.30	-0.3	0.9	1000	37336.20	2792748.90
39	40	0.5	4.1	1000	26643.26	2321861.60	0.1	3.1	1000	35883.15	2828632.00
40	41	0.5	2.8	1000	37174.07	2359035.60	0.1	1.2	1000	36070.05	2864702.10
41	42	0.4	2.1	1000	29415.89	2388451.50	0.1	1.8	1000	37529.94	2902232.00
42	43	0.4	3.4	1000	32529.87	2420981.40	0.4	1.4	1000	29431.99	2931664.00
43	44	0.4	2.9	1000	35836.83	2456818.20	0.3	1.5	1000	43979.78	2975643.80
44	45	0.4	4.5	1000	34020.13	2490838.30	0.2	2.1	1000	32026.68	3007670.50
45	46	0.4	4.9	1000	31488.72	2522327.10	0.2	2.3	1000	35104.96	3042775.40
46	47	0.4	2.5	1000	34565.91	2556893.00	0.2	2.1	1000	37223.59	3079999.00
47	48	0.4	2.7	1000	39918.35	2596811.30	0.2	2.1	1000	42020.61	3122019.60
48	49	0.4	3.6	1000	29096.03	2625907.40	0.2	2.5	1000	30599.41	3152619.00
49	50	0.4	3.6	1000	28913.29	2654820.60	0.2	2.5	1000	33013.45	3185632.50
50	51	0.4	3.7	1000	35590.51	2690411.20	0.2	3.1	1000	40189.77	3225822.30
51	52	0.3	3.5	1000	34342.55	2724753.70	0.2	3.1	1000	35653.74	3261476.00
52	53	0.3	2.1	1000	34518.65	2759272.40	0.2	1.5	1000	36197.24	3297673.20
53	54	0.5	3.2	1000	36429.61	2795702.00	0.1	0.7	1000	37802.88	3335476.10
54	55	0.6	2.8	1000	21832.29	2817534.30	0.1	0.7	1000	22341.38	3357817.50
55	56	0.1	2.8	1000	29012.18	2846546.40	0.1	0.7	1000	30478.52	3388296.00
56	57	0.2	1.2	1000	54577.62	2901124.10	0.1	0.5	1000	50654.54	3438950.60
57	58	0.2	1.2	1000	54132.84	2955256.90	0.1	0.5	1000	73899.20	3512849.80
58	58.234	0.3	0.9	1000	57779.37	3013036.30	0.1	0.5	1000	64822.46	3577672.20
Total				59000	3013036.30				59000	3577672.20	

Table 17 Dredging quantity per km for class-II

Class-III:-

Chainage (km)		As per Observed Soundings					As per Reduced Soundings				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)
0	1	0.04	0.3	1000	68254.33	68254.33	-0.3	0	1000	82102.63	82102.63
1	2	0.04	0.3	1000	104170.24	172424.57	-0.3	0	1000	125224.06	207326.69
2	3	0.04	0.3	1000	81829.56	254254.13	-0.3	0	1000	97211.32	304538.01
3	4	0.04	0.3	1000	90455.25	344709.38	-0.3	0	1000	105395.24	409933.25
4	5	0.04	0.3	1000	89228.45	433937.83	-0.3	0	1000	107241.55	517174.80
5	6	0.04	0.3	1000	104250.08	538187.91	-0.3	0	1000	125320.22	642495.02
6	7	0.04	0.3	1000	88951.24	627139.15	-0.3	0	1000	106928.80	749423.82
7	8	0.04	0.3	1000	104294.80	731433.95	-0.3	0	1000	125373.50	874797.32
8	9	0.06	0.3	1000	89450.94	820884.89	-0.3	0	1000	107393.41	982190.73
9	10	0.08	0.3	1000	94266.90	915151.79	-0.3	0	1000	112207.90	1094398.60
10	11	0.08	0.3	1000	89357.56	1004509.40	-0.3	0	1000	107417.79	1201816.40
11	12	0.04	0.3	1000	104107.44	1108616.80	-0.3	0	1000	125148.72	1326965.10
12	13	0.04	0.3	1000	89385.02	1198001.80	-0.3	0	1000	107450.58	1434415.70
13	14	0.06	0.3	1000	103485.41	1301487.20	-0.3	0	1000	122924.52	1557340.20
14	15	0.06	0.3	1000	89245.19	1390732.40	-0.3	0	1000	106677.80	1664018.00
15	16	0.04	0.3	1000	104200.78	1494933.20	-0.3	0	1000	125260.95	1789279.00
16	17	0.08	0.3	1000	89265.99	1584199.20	-0.3	0	1000	107307.71	1896586.70
17	18	0.04	0.3	1000	103865.90	1688065.10	-0.3	0	1000	124858.00	2021444.70
18	19	0.06	0.3	1000	87765.99	1775831.10	-0.3	0	1000	103227.52	2124672.20
19	20	0.08	0.3	1000	99032.99	1874864.10	-0.3	0	1000	117060.27	2241732.50
20	21	0.04	0.3	1000	83582.97	1958447.00	-0.3	0	1000	95810.16	2337542.60
21	22	0.06	0.3	1000	130342.84	2088789.90	-0.3	0	1000	156549.38	2494092.00
22	23	0.06	0.3	1000	89356.17	2178146.00	-0.3	0	1000	106136.70	2600228.70
23	24	0.04	0.3	1000	75399.43	2253545.50	-0.3	0	1000	83223.67	2683452.40
24	25	0.04	0.3	1000	76438.47	2329983.90	-0.3	0	1000	87261.47	2770713.80
25	26	0.08	0.3	1000	99509.15	2429493.10	-0.3	0	1000	119038.11	2889752.00
26	27	0.08	0.3	1000	81983.27	2511476.40	-0.3	0	1000	94089.16	2983841.10
27	28	0.06	0.3	1000	103946.06	2615422.40	-0.3	0	1000	124290.15	3108131.30
28	29	0.04	0.3	1000	88893.62	2704316.00	-0.3	0	1000	104944.04	3213075.30
29	30	0.04	0.3	1000	104027.42	2808343.50	-0.3	0	1000	123359.79	3336435.10
30	31	0.06	0.3	1000	89394.26	2897737.70	-0.3	0	1000	107422.54	3443857.60
31	32	0.06	0.3	1000	104117.83	3001855.60	-0.3	0	1000	125145.70	3569003.30
32	33	0.04	0.3	1000	87213.65	3089069.20	-0.3	0	1000	102709.90	3671713.20
33	34	0.04	0.3	1000	92721.89	3181791.10	-0.3	0	1000	103426.57	3775139.80
34	35	0.08	1.1	1000	81062.03	3343609.20	-0.3	0.2	1000	87225.08	3955022.80
35	36	0.1	1.4	1000	55708.51	3399317.70	-0.3	0.4	1000	60235.95	4015258.70

Chainage (km)		As per Observed Soundings					As per Reduced Soundings				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)
36	37	0.3	1.7	1000	67077.23	3466394.90	0.1	0.9	1000	72032.43	4087291.10
37	38	0.3	2.7	1000	60555.70	3526950.60	-0.3	0.5	1000	64752.72	4152043.90
38	39	0.4	3.7	1000	61288.06	3588238.70	-0.3	1	1000	67229.34	4219273.20
39	40	0.4	5.2	1000	56071.50	3644310.20	0.1	3.2	1000	62276.89	4281550.10
40	41	0.4	2.7	1000	60808.98	3705119.20	0.1	1.3	1000	65825.12	4347375.20
41	42	0.3	2.3	1000	53050.22	3758169.40	0.1	2	1000	66213.08	4413588.30
42	43	0.3	3.7	1000	70620.57	3828790.00	0.3	1.7	1000	65858.70	4479447.00
43	44	0.3	3.1	1000	54801.51	3883591.50	0.2	1.6	1000	67998.28	4547445.30
44	45	0.3	4.7	1000	56850.26	3940441.70	0.1	2.7	1000	53566.63	4601011.90
45	46	0.3	5	1000	57985.71	3998427.50	0.1	2.3	1000	72972.17	4673984.10
46	47	0.3	3.1	1000	69394.64	4067822.10	0.1	2.1	1000	61881.78	4735865.80
47	48	0.3	3.1	1000	53403.17	4121225.30	0.1	2.1	1000	62888.39	4798754.20
48	49	0.3	3.8	1000	54183.64	4175408.90	0.1	2.5	1000	53079.61	4851833.80
49	50	0.3	3.8	1000	60169.78	4235578.70	0.1	2.5	1000	76341.71	4928175.60
50	51	0.3	3.9	1000	63181.87	4298760.60	0.1	3.1	1000	56046.83	4984222.40
51	52	0.2	3.9	1000	59592.55	4358353.10	0.1	3.1	1000	70907.58	5055130.00
52	53	0.2	2.4	1000	54149.73	4412502.80	0.1	1.5	1000	56808.81	5111938.80
53	54	0.4	3.5	1000	50350.16	4462853.00	0.01	0.7	1000	48157.66	5160096.40
54	55	0.5	3.1	1000	47310.70	4510163.70	0.02	0.7	1000	50187.67	5210284.10
55	56	0.1	3.1	1000	77925.74	4588089.40	0.02	0.7	1000	96787.41	5307071.50
56	57	0.1	1.2	1000	84009.41	4672098.80	0.01	0.5	1000	106557.20	5413628.70
57	58	0.1	1.2	1000	104424.92	4776523.80	0.01	0.5	1000	87140.38	5500769.10
58	58.234	0.2	0.9	1000	460188.98	5155956.66	0.1	0.5	1000	479935.65	5888046.90
Total				59000	5155956.66		Total		59000	5888046.90	

Table 18 Dredging quantity per km for class-III

Class-IV:-

Chainage (km)		As per Observed Soundings					As per Reduced Soundings				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)
0	1	0.04	0.3	1000	97165.98	97165.98	-0.3	0	1000	147150.95	147150.95
1	2	0.04	0.3	1000	147692.95	244858.93	-0.3	0	1000	126291.78	273442.73
2	3	0.04	0.3	1000	116005.22	360864.15	-0.3	0	1000	147024.86	420467.59
3	4	0.04	0.3	1000	127301.79	488165.94	-0.3	0	1000	126436.64	546904.23
4	5	0.04	0.3	1000	126480.18	614646.12	-0.3	0	1000	147779.4	694683.63
5	6	0.04	0.3	1000	147804.74	762450.86	-0.3	0	1000	146824.14	841507.77
6	7	0.04	0.3	1000	126114.41	888565.27	-0.3	0	1000	126581.32	968089.09
7	8	0.04	0.3	1000	147869.05	1036434.3	-0.3	0	1000	147883.48	1115972.57
8	9	0.06	0.3	1000	126667.06	1163101.4	-0.3	0	1000	188909.79	1304882.36
9	10	0.08	0.3	1000	132959.44	1296060.8	-0.3	0	1000	126879.62	1431761.98
10	11	0.08	0.3	1000	126690.68	1422751.5	-0.3	0	1000	147988.63	1579750.61
11	12	0.04	0.3	1000	147603.27	1570354.8	-0.3	0	1000	147696.16	1727446.77
12	13	0.04	0.3	1000	126728.7	1697083.5	-0.3	0	1000	126704.69	1854151.46
13	14	0.06	0.3	1000	145319.75	1842403.2	-0.3	0	1000	147854.34	2002005.8
14	15	0.06	0.3	1000	125962.34	1968365.6	-0.3	0	1000	146819.03	2148824.83
15	16	0.04	0.3	1000	147735.36	2116100.9	-0.3	0	1000	126757.52	2275582.35
16	17	0.08	0.3	1000	126561.52	2242662.4	-0.3	0	1000	147214.06	2422796.41
17	18	0.04	0.3	1000	147260.69	2389923.1	-0.3	0	1000	147841.45	2570637.86
18	19	0.06	0.3	1000	122261.69	2512184.8	-0.3	0	1000	126587	2697224.86
19	20	0.08	0.3	1000	139236.8	2651421.6	-0.3	0	1000	147768.93	2844993.79
20	21	0.04	0.3	1000	114718.27	2766139.9	-0.3	0	1000	126210.91	2971204.7
21	22	0.06	0.3	1000	184657.68	2950797.6	-0.3	0	1000	147709.36	3118914.06
22	23	0.06	0.3	1000	125331	3076128.6	-0.3	0	1000	141827.24	3260741.3
23	24	0.04	0.3	1000	103076.17	3179204.7	-0.3	0	1000	124087.24	3384828.54
24	25	0.04	0.3	1000	105307.04	3284511.8	-0.3	0	1000	125270.24	3510098.78
25	26	0.08	0.3	1000	140650.53	3425162.3	-0.3	0	1000	147691.01	3657789.79
26	27	0.08	0.3	1000	112749.96	3537912.3	-0.3	0	1000	147251.54	3805041.33
27	28	0.06	0.3	1000	146655.01	3684567.3	-0.3	0	1000	126145.7	3931187.03
28	29	0.04	0.3	1000	124097.24	3808664.5	-0.3	0	1000	147070.34	4078257.37
29	30	0.04	0.3	1000	145698.26	3954362.8	-0.3	0	1000	147760.02	4226017.39
30	31	0.06	0.3	1000	126695.19	4081058	-0.3	0	1000	126292.68	4352310.07
31	32	0.06	0.3	1000	147589.4	4228647.4	-0.3	0	1000	146789.11	4499099.18
32	33	0.04	0.3	1000	121780.51	4350427.9	-0.3	0	1000	145565.64	4644664.82
33	34	0.04	0.3	1000	125090.37	4475518.3	-0.3	0	1000	118364.73	4763029.55
34	35	0.08	1.1	1000	110487.32	4586005.6	-0.3	0	1000	134211.32	4897240.87

Chainage (km)		As per Observed Soundings					As per Reduced Soundings				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)
35	36	0.1	1.4	1000	108410.75	4694416.3	-0.3	0.5	1000	127903.01	5025143.88
36	37	0.3	1.7	1000	78056.03	4772472.4	0.1	1	1000	110844.82	5135988.7
37	38	0.3	2.7	1000	93066.11	4865538.5	-0.3	0.6	1000	131590.79	5267579.49
38	39	0.4	3.7	1000	82688.36	4948226.8	-0.3	1.2	1000	124679.08	5392258.57
39	40	0.4	5.2	1000	87580.4	5035807.2	0.1	3.5	1000	97926.88	5490185.45
40	41	0.4	2.7	1000	79380.97	5115188.2	0.1	1.4	1000	101790.12	5591975.57
41	42	0.3	2.3	1000	85228.76	5200417	0.1	2.1	1000	85269.41	5677244.98
42	43	0.3	3.7	1000	73265.07	5273682	0.3	1.8	1000	76984.91	5754229.89
43	44	0.3	3.1	1000	96931.94	5370614	0.2	1.8	1000	86245.74	5840475.63
44	45	0.3	4.7	1000	77245.65	5447859.6	0.1	2.8	1000	79649.4	5920125.03
45	46	0.3	5	1000	81166.68	5529026.3	0.1	2.3	1000	96578.49	6016703.52
46	47	0.3	3.1	1000	92515.08	5621541.4	0.1	2.1	1000	87410.87	6104114.39
47	48	0.3	3.1	1000	79596	5701137.4	0.1	2.1	1000	96883.62	6200998.01
48	49	0.3	3.8	1000	82904.67	5784042	0.1	2.5	1000	81066.25	6282064.26
49	50	0.3	3.8	1000	67422.38	5851464.4	0.1	2.5	1000	55208.19	6337272.45
50	51	0.3	3.9	1000	96187.05	5947651.5	0.1	3.1	1000	87207.61	6424480.06
51	52	0.2	3.9	1000	73579.41	6021230.9	0.1	3.1	1000	84175.3	6508655.36
52	53	0.2	2.4	1000	90974.9	6112205.8	0.1	1.5	1000	82461.4	6591116.76
53	54	0.4	3.5	1000	73726.98	6185932.8	0.01	0.7	1000	70292.24	6661409
54	55	0.5	3.1	1000	66728.72	6252661.5	0.02	0.7	1000	110335.99	6771744.99
55	56	0.1	3.1	1000	66823.76	6319485.2	0.02	0.7	1000	117481.88	6889226.87
56	57	0.1	1.2	1000	117832.19	6437317.4	0.01	0.5	1000	142897.29	7032124.16
57	58	0.1	1.2	1000	111351.35	6548668.8	0.01	0.5	1000	141606.74	7173730.9
58	58.234	0.2	0.9	1000	121870.98	6670539.8	0.1	0.5	1000	42069.91	7215800.81
Total				59000	6670539.8		Total		59000	7215800.81	

Table 19 Dredging quantity per km for class-IV

Annexure-3 Observed Depth in 200 m. interval:-

Chainage (In meter)	Class-I		Class-II		Class-III		Class-IV	
	Observed		Observed		Observed		Observed	
	Min	Max	Min	Max	Min	Max	Min	Max
0	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
200	0.1	0.3	0.09	0.3	0.08	0.3	0.08	0.3
400	0.2	0.3	0.18	0.3	0.16	0.3	0.16	0.3
600	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
800	0.1	0.2	0.07	0.2	0.04	0.2	0.04	0.2
1000	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
1200	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
1400	0.1	0.2	0.08	0.2	0.06	0.2	0.06	0.2
1600	0.1	0.3	0.07	0.3	0.04	0.3	0.04	0.3
1800	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
2000	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
2200	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2
2400	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
2600	0.2	0.3	0.18	0.3	0.16	0.3	0.16	0.3
2800	0.1	0.2	0.09	0.2	0.08	0.2	0.08	0.2
3000	0.1	0.2	0.07	0.2	0.04	0.2	0.04	0.2
3200	0.1	0.3	0.09	0.3	0.08	0.3	0.08	0.3
3400	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
3600	0.2	0.3	0.18	0.3	0.16	0.3	0.16	0.3
3800	0.1	0.2	0.07	0.2	0.04	0.2	0.04	0.2
4000	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
4200	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
4400	0.2	0.3	0.18	0.3	0.16	0.3	0.16	0.3
4600	0.1	0.3	0.07	0.3	0.04	0.3	0.04	0.3
4800	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
5000	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
5200	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2
5400	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
5600	0.2	0.3	0.18	0.3	0.16	0.3	0.16	0.3
5800	0.1	0.2	0.09	0.2	0.08	0.2	0.08	0.2
6000	0.1	0.3	0.07	0.3	0.04	0.3	0.04	0.3
6200	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
6400	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
6600	0.1	0.2	0.08	0.2	0.06	0.2	0.06	0.2
6800	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
7000	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
7200	0.1	0.2	0.08	0.2	0.06	0.2	0.06	0.2

Chainage (In meter)	Class-I		Class-II		Class-III		Class-IV	
	Observed		Observed		Observed		Observed	
	Min	Max	Min	Max	Min	Max	Min	Max
7400	0.1	0.2	0.09	0.2	0.08	0.2	0.08	0.2
7600	0.1	0.3	0.07	0.3	0.04	0.3	0.04	0.3
7800	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
8000	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
8200	0.1	0.2	0.08	0.2	0.06	0.2	0.06	0.2
8400	0.2	0.3	0.17	0.3	0.14	0.3	0.14	0.3
8600	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
8800	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
9000	0.1	0.3	0.1	0.3	0.1	0.3	0.1	0.3
9200	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
9400	0.2	0.3	0.18	0.3	0.16	0.3	0.16	0.3
9600	0.1	0.2	0.09	0.2	0.08	0.2	0.08	0.2
9800	0.2	0.3	0.17	0.3	0.14	0.3	0.14	0.3
10000	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
10200	0.1	0.3	0.1	0.3	0.1	0.3	0.1	0.3
10400	0.2	0.3	0.18	0.3	0.16	0.3	0.16	0.3
10600	0.2	0.3	0.17	0.3	0.14	0.3	0.14	0.3
10800	0.1	0.2	0.09	0.2	0.08	0.2	0.08	0.2
11000	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
11200	0.2	0.3	0.18	0.3	0.16	0.3	0.16	0.3
11400	0.1	0.2	0.07	0.2	0.04	0.2	0.04	0.2
11600	0.1	0.3	0.09	0.3	0.08	0.3	0.08	0.3
11800	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
12000	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
12200	0.1	0.2	0.09	0.2	0.08	0.2	0.08	0.2
12400	0.2	0.3	0.18	0.3	0.16	0.3	0.16	0.3
12600	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
12800	0.1	0.2	0.07	0.2	0.04	0.2	0.04	0.2
13000	0.1	0.2	0.09	0.2	0.08	0.2	0.08	0.2
13200	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
13400	0.2	0.3	0.18	0.3	0.16	0.3	0.16	0.3
13600	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
13800	0.1	0.3	0.08	0.3	0.06	0.3	0.06	0.3
14000	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
14200	0.2	0.3	0.17	0.3	0.14	0.3	0.14	0.3
14400	0.1	0.2	0.09	0.2	0.08	0.2	0.08	0.2
14600	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
14800	0.1	0.3	0.08	0.3	0.06	0.3	0.06	0.3
15000	0.2	0.3	0.17	0.3	0.14	0.3	0.14	0.3
15200	0.1	0.3	0.09	0.3	0.08	0.3	0.08	0.3
15400	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
15600	0.2	0.3	0.18	0.3	0.16	0.3	0.16	0.3

Chainage (In meter)	Class-I		Class-II		Class-III		Class-IV	
	Observed		Observed		Observed		Observed	
	Min	Max	Min	Max	Min	Max	Min	Max
15800	0.1	0.2	0.07	0.2	0.04	0.2	0.04	0.2
16000	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
16200	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
16400	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2
16600	0.1	0.3	0.09	0.3	0.08	0.3	0.08	0.3
16800	0.2	0.3	0.18	0.3	0.16	0.3	0.16	0.3
17000	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
17200	0.1	0.2	0.07	0.2	0.04	0.2	0.04	0.2
17400	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
17600	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
17800	0.1	0.2	0.08	0.2	0.06	0.2	0.06	0.2
18000	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2
18200	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
18400	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
18600	0.1	0.3	0.08	0.3	0.06	0.3	0.06	0.3
18800	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
19000	0.2	0.3	0.17	0.3	0.14	0.3	0.14	0.3
19200	0.1	0.2	0.09	0.2	0.08	0.2	0.08	0.2
19400	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
19600	0.2	0.3	0.18	0.3	0.16	0.3	0.16	0.3
19800	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2
20000	0.1	0.3	0.09	0.3	0.08	0.3	0.08	0.3
20200	0.2	0.3	0.18	0.3	0.16	0.3	0.16	0.3
20400	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
20600	0.1	0.2	0.07	0.2	0.04	0.2	0.04	0.2
20800	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
21000	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
21200	0.1	0.2	0.08	0.2	0.06	0.2	0.06	0.2
21400	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
21600	0.2	0.3	0.17	0.3	0.14	0.3	0.14	0.3
21800	0.1	0.2	0.09	0.2	0.08	0.2	0.08	0.2
22000	0.1	0.3	0.1	0.3	0.1	0.3	0.1	0.3
22200	0.2	0.3	0.18	0.3	0.16	0.3	0.16	0.3
22400	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
22600	0.1	0.2	0.09	0.2	0.08	0.2	0.08	0.2
22800	0.1	0.3	0.08	0.3	0.06	0.3	0.06	0.3
23000	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
23200	0.2	0.3	0.17	0.3	0.14	0.3	0.14	0.3
23400	0.1	0.3	0.09	0.3	0.08	0.3	0.08	0.3
23600	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
23800	0.2	0.3	0.18	0.3	0.16	0.3	0.16	0.3
24000	0.1	0.2	0.07	0.2	0.04	0.2	0.04	0.2

Chainage (In meter)	Class-I		Class-II		Class-III		Class-IV	
	Observed		Observed		Observed		Observed	
	Min	Max	Min	Max	Min	Max	Min	Max
24200	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
24400	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
24600	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2
24800	0.1	0.3	0.09	0.3	0.08	0.3	0.08	0.3
25000	0.2	0.3	0.18	0.3	0.16	0.3	0.16	0.3
25200	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
25400	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2
25600	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
25800	0.2	0.3	0.18	0.3	0.16	0.3	0.16	0.3
26000	0.1	0.2	0.09	0.2	0.08	0.2	0.08	0.2
26200	0.2	0.3	0.17	0.3	0.14	0.3	0.14	0.3
26400	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
26600	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2
26800	0.2	0.3	0.18	0.3	0.16	0.3	0.16	0.3
27000	0.2	0.3	0.17	0.3	0.14	0.3	0.14	0.3
27200	0.1	0.2	0.09	0.2	0.08	0.2	0.08	0.2
27400	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2
27600	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
27800	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
28000	0.1	0.2	0.08	0.2	0.06	0.2	0.06	0.2
28200	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
28400	0.1	0.3	0.09	0.3	0.08	0.3	0.08	0.3
28600	0.2	0.3	0.18	0.3	0.16	0.3	0.16	0.3
28800	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
29000	0.1	0.2	0.07	0.2	0.04	0.2	0.04	0.2
29200	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
29400	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
29600	0.1	0.2	0.08	0.2	0.06	0.2	0.06	0.2
29800	0.1	0.3	0.1	0.3	0.1	0.3	0.1	0.3
30000	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
30200	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
30400	0.1	0.2	0.08	0.2	0.06	0.2	0.06	0.2
30600	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
30800	0.2	0.3	0.17	0.3	0.14	0.3	0.14	0.3
31000	0.1	0.2	0.09	0.2	0.08	0.2	0.08	0.2
31200	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
31400	0.1	0.3	0.08	0.3	0.06	0.3	0.06	0.3
31600	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
31800	0.1	0.3	0.09	0.3	0.08	0.3	0.08	0.3
32000	0.2	0.3	0.18	0.3	0.16	0.3	0.16	0.3
32200	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
32400	0.1	0.2	0.07	0.2	0.04	0.2	0.04	0.2

Chainage (In meter)	Class-I		Class-II		Class-III		Class-IV	
	Observed		Observed		Observed		Observed	
	Min	Max	Min	Max	Min	Max	Min	Max
32600	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
32800	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
33000	0.1	0.2	0.08	0.2	0.06	0.2	0.06	0.2
33200	0.1	0.3	0.07	0.3	0.04	0.3	0.04	0.3
33400	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
33600	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
33800	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2
34000	0.2	0.3	0.19	0.3	0.18	0.3	0.18	0.3
34200	0.2	0.3	0.18	0.3	0.16	0.3	0.16	0.3
34400	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2
34600	0.2	0.3	0.1	0.3	0.1	0.3	0.1	0.3
34800	0.1	0.2	0.09	0.2	0.08	0.2	0.08	0.2
35000	0.3	0.6	0.2	0.9	0.1	1.1	0.1	1.4
35200	0.2	0.9	0.1	1	0.1	1.2	0.1	1.3
35400	0.3	0.6	0.2	0.9	0.1	1.1	0.1	1.3
35600	0.5	1.1	0.4	1.3	0.3	1.4	0.3	1.7
35800	0.6	0.9	0.5	1.2	0.4	1.3	0.4	1.4
36000	0.5	0.7	0.4	1.3	0.3	1.4	0.3	1.7
36200	0.6	1.1	0.5	1.4	0.4	1.7	0.4	1.8
36400	0.9	1.1	0.8	1.3	0.7	1.5	0.7	1.7
36600	0.8	1.2	0.7	1.2	0.6	1.4	0.6	1.5
36800	0.6	0.9	0.5	1	0.4	1.2	0.4	1.5
37000	0.5	1.2	0.4	1.3	0.3	1.5	0.3	1.6
37200	0.7	1	0.6	1.2	0.5	1.4	0.5	1.7
37400	0.6	1	0.5	1.3	0.4	1.5	0.4	1.6
37600	1	2.3	0.9	2.6	0.8	2.7	0.8	2.8
37800	0.5	1	0.4	1.3	0.3	1.4	0.3	1.6
38000	1.1	0.7	1	1.9	0.9	1	0.9	1.2
38200	1	1.4	0.9	1.6	0.8	1.7	0.8	1.8
38400	0.6	1.2	0.5	1.3	0.4	1.5	0.4	1.7
38600	0.7	1.3	0.6	1.4	0.5	1.7	0.5	1.9
38800	0.9	2.1	0.8	2.3	0.7	2.8	0.7	2.9
39000	1.1	3.4	1	3.5	0.9	3.7	0.9	3.9
39200	1.2	1.4	1.1	1.7	1	1.9	1	2.1
39400	0.9	1.2	0.8	1.5	0.7	1.7	0.7	1.8
39600	1.6	4	1.5	4.1	1.4	5.2	1.4	5.4
39800	2	3.2	1.9	3.5	1.8	3.7	1.8	3.9
40000	0.6	1	0.5	1.3	0.4	1.5	0.4	1.7
40200	1.2	1.7	1.1	1.8	1	1.8	1	1.9
40400	2	2.7	1.9	2.8	1.8	2.7	1.8	2.4
40600	0.7	1.7	0.6	1.9	0.5	2.1	0.5	3.1
40800	1.6	2.2	1.5	2.4	1.4	2.7	1.4	3.5

Chainage (In meter)	Class-I		Class-II		Class-III		Class-IV	
	Observed		Observed		Observed		Observed	
	Min	Max	Min	Max	Min	Max	Min	Max
41000	0.6	1.2	0.5	1.3	0.4	1.5	0.4	2.6
41200	0.9	1.2	0.8	1.3	0.7	1.5	0.7	1.8
41400	0.6	1.9	0.5	2.1	0.4	2.3	0.4	2.9
41600	0.5	1.6	0.4	1.8	0.3	2.1	0.3	2.4
41800	0.6	1.1	0.5	1.2	0.4	1.5	0.4	1.8
42000	0.6	1.3	0.5	1.4	0.4	1.6	0.4	1.9
42200	0.5	1.1	0.4	1.2	0.3	1.3	0.3	2.3
42400	0.5	1.2	0.4	1.3	0.3	1.4	0.3	1.8
42600	0.6	3	0.5	3.4	0.4	3.7	0.4	3.9
42800	0.6	1.3	0.5	1.4	0.4	1.6	0.4	1.9
43000	0.6	2.1	0.5	2.4	0.4	2.6	0.4	2.8
43200	0.7	1.6	0.6	1.8	0.5	1.9	0.5	2.3
43400	0.6	1.4	0.5	1.5	0.4	1.7	0.4	1.9
43600	0.5	1.2	0.4	1.3	0.3	1.5	0.3	1.7
43800	0.7	1.2	0.6	1.4	0.5	1.6	0.5	1.8
44000	0.9	2.6	0.8	2.9	0.7	3.1	0.7	3.2
44200	0.6	1.1	0.5	1.5	0.4	1.7	0.4	1.9
44400	0.7	1.7	0.6	1.9	0.5	2.1	0.5	2.5
44600	0.5	1.9	0.4	2.1	0.3	2.3	0.3	2.5
44800	1	3	0.9	3.4	0.8	3.5	0.8	3.7
45000	0.6	4.3	0.5	4.5	0.4	4.7	0.4	4.9
45200	0.7	2.2	0.6	2.4	0.5	2.5	0.5	2.7
45400	0.5	2	0.4	2.1	0.3	2.3	0.3	2.7
45600	0.5	4.7	0.4	4.9	0.3	5	0.3	5.2
45800	0.6	1.6	0.5	1.8	0.4	2.1	0.4	2.3
46000	0.5	2.3	0.4	2.5	0.3	2.7	0.3	2.9
46200	1	1.4	0.9	1.7	0.8	1.9	0.8	2
46400	0.6	2.2	0.5	2.5	0.4	3.1	0.4	3.4
46600	0.6	2.2	0.5	2.5	0.4	2.9	0.4	3.1
46800	0.5	1.5	0.4	1.7	0.3	1.9	0.3	2.1
47000	0.6	2	0.5	2.1	0.4	2.3	0.4	2.5
47200	0.5	0.7	0.4	1.1	0.3	1.3	0.3	1.4
47400	0.7	0.9	0.6	1.2	0.5	1.4	0.5	1.6
47600	0.7	0.9	0.6	1.2	0.5	1.4	0.5	1.5
47800	0.5	0.8	0.4	1	0.3	1.2	0.3	1.5
48000	0.6	2.3	0.5	2.7	0.4	3.1	0.4	3.5
48200	0.5	2.1	0.4	2.3	0.3	2.5	0.3	2.9
48400	0.5	2.3	0.4	2.5	0.3	2.7	0.3	2.9
48600	0.7	1.9	0.6	2.1	0.5	2.3	0.5	2.5
48800	0.9	1.3	0.8	1.5	0.7	1.8	0.7	1.9
49000	0.7	3.4	0.6	3.6	0.5	3.8	0.5	4.1
49200	0.6	2.9	0.5	3.1	0.4	3.4	0.4	4.2

Chainage (In meter)	Class-I		Class-II		Class-III		Class-IV	
	Observed		Observed		Observed		Observed	
	Min	Max	Min	Max	Min	Max	Min	Max
49400	1.4	2.3	1.3	2.5	1.2	2.7	1.2	3.1
49600	1	1.1	0.9	1.2	0.8	1.3	0.8	1.5
49800	1	1.9	0.9	2.1	0.8	2.3	0.8	2.5
50000	0.5	2.1	0.4	2.3	0.3	2.5	0.3	2.7
50200	1	3.4	0.9	3.7	0.8	3.9	0.8	4.1
50400	1.2	1.6	1.1	1.8	1	2.1	1	2.2
50600	0.7	2.6	0.6	2.8	0.5	2.9	0.5	3.1
50800	0.7	2.3	0.6	2.5	0.5	3.1	0.5	3.5
51000	0.5	0.9	0.4	1.2	0.3	2.1	0.3	2.5
51200	0.7	3.3	0.6	3.5	0.5	3.9	0.5	4.1
51400	0.5	1.6	0.4	1.8	0.3	2.1	0.3	2.5
51600	0.6	1.4	0.5	1.5	0.4	1.7	0.4	1.9
51800	0.4	1.2	0.3	1.3	0.2	1.5	0.2	1.7
52000	0.4	1.7	0.3	1.9	0.2	2.1	0.2	2.2
52200	0.5	1.7	0.4	2.1	0.3	2.2	0.3	2.3
52400	1	1.4	0.9	1.6	0.8	1.8	0.8	1.9
52600	1.2	1.9	1.1	2.1	1	2.4	1	2.5
52800	0.5	1	0.4	1.2	0.3	1.4	0.3	1.5
53000	0.7	1.6	0.6	1.8	0.5	2.1	0.5	2.3
53200	1.2	3	1.1	3.2	1	3.5	1	3.7
53400	0.6	2.7	0.5	2.9	0.4	3.1	0.4	3.4
53600	0.7	1	0.6	1.2	0.5	1.4	0.5	1.7
53800	1	1.3	0.9	1.5	0.8	1.7	0.8	1.9
54000	0.7	1.4	0.6	1.7	0.5	1.9	0.5	2.1
54200	0.8	1.2	0.7	1.4	0.6	1.5	0.6	1.7
54400	1	1.5	0.9	1.7	0.8	1.9	0.8	2.1
54600	0.9	1.6	0.8	1.8	0.7	1.9	0.7	2
54800	0.8	1	0.7	1.2	0.6	1.5	0.6	1.8
55000	0.7	2.6	0.6	2.8	0.5	3.1	0.5	3.5
55200	0.3	0.6	0.2	0.6	0.1	0.6	0.1	0.6
55400	0.2	0.4	0.1	0.4	0	0.4	0	0.4
55600	0.3	0.6	0.2	0.6	0.1	0.6	0.1	0.6
55800	0.2	0.5	0.1	0.5	0	0.5	0	0.5
56000	0.3	0.7	0.2	0.7	0.1	0.7	0.1	0.7
56200	0.5	1.2	0.4	1.2	0.3	1.2	0.3	1.2
56400	0.3	0.6	0.2	0.6	0.1	0.6	0.1	0.6
56600	0.3	0.7	0.2	0.7	0.1	0.7	0.1	0.7
56800	0.4	0.9	0.3	0.9	0.2	0.9	0.2	0.9
57000	0.5	1.2	0.4	1.2	0.3	1.2	0.3	1.2
57200	0.3	0.7	0.2	0.7	0.1	0.7	0.1	0.7
57400	0.4	1	0.3	1	0.2	1	0.2	1
57600	0.5	1.2	0.4	1.2	0.3	1.2	0.3	1.2

Chainage (In meter)	Class-I		Class-II		Class-III		Class-IV	
	Observed		Observed		Observed		Observed	
	Min	Max	Min	Max	Min	Max	Min	Max
57800	0.4	1	0.3	1	0.2	1	0.2	1
58000	0.5	0.9	0.4	0.9	0.3	0.9	0.3	0.9
58234	0.4	0.7	0.3	0.7	0.2	0.7	0.2	0.7

Table 20- observed depth at 200 m intervals

Annexure-4 Reduced Depth in 200 m. Interval:-

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Reduced		Reduced		Reduced		Reduced	
	Min	Max	Min	Max	Min	Max	Min	Max
0	-0.3	0	-0.3	0	-0.3	0	-0.3	0
200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
1000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
1200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
1400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
1600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
1800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
2000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
2200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
2400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
2600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
2800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
3000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
3200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
3400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
3600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
3800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
4000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
4200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
4400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
4600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
4800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
5000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
5200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
5400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
5600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
5800	-0.3	0	-0.3	0	-0.3	0	-0.3	0

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Reduced		Reduced		Reduced		Reduced	
	Min	Max	Min	Max	Min	Max	Min	Max
6000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
6200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
6400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
6600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
6800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
7000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
7200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
7400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
7600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
7800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
8000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
8200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
8400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
8600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
8800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
9000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
9200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
9400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
9600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
9800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
10000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
10200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
10400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
10600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
10800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
11000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
11200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
11400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
11600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
11800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
12000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
12200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
12400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
12600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
12800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
13000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
13200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
13400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
13600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
13800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
14000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
14200	-0.3	0	-0.3	0	-0.3	0	-0.3	0

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Reduced		Reduced		Reduced		Reduced	
	Min	Max	Min	Max	Min	Max	Min	Max
14400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
14600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
14800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
15000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
15200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
15400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
15600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
15800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
16000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
16200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
16400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
16600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
16800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
17000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
17200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
17400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
17600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
17800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
18000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
18200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
18400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
18600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
18800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
19000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
19200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
19400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
19600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
19800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
20000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
20200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
20400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
20600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
20800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
21000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
21200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
21400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
21600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
21800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
22000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
22200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
22400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
22600	-0.3	0	-0.3	0	-0.3	0	-0.3	0

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Reduced		Reduced		Reduced		Reduced	
	Min	Max	Min	Max	Min	Max	Min	Max
22800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
23000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
23200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
23400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
23600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
23800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
24000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
24200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
24400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
24600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
24800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
25000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
25200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
25400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
25600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
25800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
26000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
26200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
26400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
26600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
26800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
27000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
27200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
27400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
27600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
27800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
28000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
28200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
28400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
28600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
28800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
29000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
29200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
29400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
29600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
29800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
30000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
30200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
30400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
30600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
30800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
31000	-0.3	0	-0.3	0	-0.3	0	-0.3	0

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Reduced		Reduced		Reduced		Reduced	
	Min	Max	Min	Max	Min	Max	Min	Max
31200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
31400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
31600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
31800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
32000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
32200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
32400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
32600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
32800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
33000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
33200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
33400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
33600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
33800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
34000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
34200	-0.3	0	-0.3	0	-0.3	0	-0.3	0
34400	-0.3	0	-0.3	0	-0.3	0	-0.3	0
34600	-0.3	0	-0.3	0	-0.3	0	-0.3	0
34800	-0.3	0	-0.3	0	-0.3	0	-0.3	0
35000	-0.3	0.1	-0.3	0.1	-0.3	0.2	-0.3	0.3
35200	-0.1	0.1	-0.1	0.1	-0.1	0.1	-0.1	0.2
35400	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2
35600	0.1	0.3	0.1	0.3	0.1	0.4	0.1	0.5
35800	0.1	0.1	0.1	0	0.1	0.1	0.1	0.2
36000	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.3
36200	0.3	0.4	0.3	0.4	0.3	0.5	0.3	0.6
36400	0.5	0.6	0.5	0.8	0.5	0.9	0.5	1
36600	0.1	0.3	0.1	0.1	0.1	0.2	0.1	0.5
36800	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.4
37000	0.2	0.4	0.2	0.1	0.2	0.2	0.2	0.3
37200	-0.1	0.3	-0.1	0.3	-0.1	0.4	-0.1	0.5
37400	-0.1	0.3	-0.1	0.4	-0.1	0.4	-0.1	0.5
37600	0.1	0.3	0.1	0.3	0.1	0.3	0.1	0.4
37800	0.1	0.2	0.1	0.3	0.1	0.5	0.1	0.6
38000	-0.3	0.1	-0.3	0.1	-0.3	0.1	-0.3	0.3
38200	0.1	0.3	0.1	0.4	0.1	0.5	0.1	0.8
38400	0.2	0.3	0.1	0.4	0.1	0.5	0.1	0.8
38600	0.2	0.4	0.1	0.9	0.1	1	0.1	1.2
38800	0.3	0.7	0.2	0.8	0.2	0.9	0.1	1
39000	0.3	0.7	0.2	0.8	0.1	1	0.1	1.2
39200	0.3	0.6	0.2	0.8	0.2	0.9	0.2	1
39400	0.2	0.4	0.1	0.5	0.1	0.4	0.1	0.5

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Reduced		Reduced		Reduced		Reduced	
	Min	Max	Min	Max	Min	Max	Min	Max
39600	1.2	2.9	1	3.1	0.7	3.2	0.6	3.5
39800	1	2.2	0.7	2.3	0.5	2.4	0.4	2.6
40000	0.2	0.3	0.1	0.4	0.1	0.6	0.1	0.7
40200	0.5	0.9	0.4	1	0.3	1.2	0.2	1.3
40400	1	1.6	0.8	1.7	0.7	1.7	0.5	1.7
40600	0.7	1.1	0.5	1.2	0.4	1.3	0.1	1.4
40800	1	1.1	0.8	1.2	0.5	1.3	0.5	1.3
41000	0.2	1	0.1	1.2	0.1	1.3	0.1	1.4
41200	0.5	1	0.4	1.1	0.3	1.3	0.3	1.4
41400	0.4	0.9	0.3	0.9	0.2	0.9	0.2	1
41600	0.1	1.6	0.1	1.2	0.1	1.5	0.1	1.6
41800	0.5	1.1	0.4	1.8	0.3	2	0.3	2.1
42000	0.5	1.2	0.4	1.2	0.3	1.4	0.3	1.5
42200	0.5	1	0.4	1.3	0.3	1.5	0.3	1.7
42400	0.6	1	0.5	1.4	0.4	1.7	0.4	1.8
42600	0.5	1.2	0.4	1.3	0.3	1.4	0.3	1.5
42800	0.7	1.2	0.6	1.3	0.5	1.4	0.5	1.6
43000	0.8	1	0.7	1.2	0.6	1.5	0.6	1.7
43200	0.5	1.3	0.4	1.4	0.3	1.6	0.3	1.8
43400	0.5	1.2	0.4	1.3	0.3	1.3	0.3	1.4
43600	0.4	1.1	0.3	1.3	0.2	1.4	0.2	1.4
43800	0.6	1	0.5	1.2	0.4	1.3	0.4	1.3
44000	0.6	1.3	0.5	1.5	0.4	1.5	0.4	1.6
44200	0.5	1	0.4	1.2	0.3	1.3	0.3	1.4
44400	0.5	1.6	0.4	1.8	0.3	1.8	0.3	1.8
44600	0.5	1.6	0.4	1.8	0.3	2.7	0.3	2.8
44800	0.3	1.9	0.2	2.1	0.1	2.1	0.1	2.1
45000	0.5	1.9	0.4	2.1	0.3	2.1	0.3	2.2
45200	0.7	2.1	0.6	2.1	0.5	2.1	0.5	2.2
45400	0.3	1.2	0.2	1.2	0.1	1.2	0.1	1.2
45600	0.4	2.3	0.3	2.3	0.2	2.3	0.2	2.3
45800	0.3	1.2	0.2	1.2	0.1	1.2	0.1	1.2
46000	0.3	2.1	0.2	2.1	0.1	2.1	0.1	2.1
46200	0.8	1.3	0.7	1.3	0.6	1.3	0.6	1.3
46400	0.3	0.8	0.2	0.8	0.1	0.8	0.1	0.8
46600	0.3	0.6	0.2	0.6	0.1	0.6	0.1	0.6
46800	0.4	0.8	0.3	0.8	0.2	0.8	0.2	0.8
47000	0.4	1.5	0.3	1.5	0.2	1.5	0.2	1.5
47200	0.3	0.6	0.2	0.6	0.1	0.6	0.1	0.6
47400	0.5	0.8	0.4	0.8	0.3	0.8	0.3	0.8
47600	0.5	0.8	0.4	0.8	0.3	0.8	0.3	0.8
47800	0.3	0.6	0.2	0.6	0.1	0.6	0.1	0.6

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Reduced		Reduced		Reduced		Reduced	
	Min	Max	Min	Max	Min	Max	Min	Max
48000	0.4	2.1	0.3	2.1	0.2	2.1	0.2	2.1
48200	0.3	1.3	0.2	1.3	0.1	1.3	0.1	1.3
48400	0.4	2.1	0.3	2.1	0.2	2.1	0.2	2.1
48600	0.5	1.3	0.4	1.3	0.3	1.3	0.3	1.3
48800	0.5	1.1	0.4	1.1	0.3	1.1	0.3	1.1
49000	0.4	2.5	0.3	2.5	0.2	2.5	0.2	2.5
49200	0.3	2.2	0.2	2.2	0.1	2.2	0.1	2.2
49400	1.2	2.1	1.1	2.1	1	2.1	1	2.1
49600	0.5	0.9	0.4	0.9	0.3	0.9	0.3	0.9
49800	0.5	1.3	0.4	1.3	0.3	1.3	0.3	1.3
50000	0.3	1.2	0.2	1.2	0.1	1.2	0.1	1.2
50200	0.7	3.1	0.6	3.1	0.5	3.1	0.5	3.1
50400	1	1.3	0.9	1.3	0.8	1.3	0.8	1.3
50600	0.5	2.3	0.4	2.3	0.3	2.3	0.3	2.3
50800	0.5	2.1	0.4	2.1	0.3	2.1	0.3	2.1
51000	0.3	0.7	0.2	0.7	0.1	0.7	0.1	0.7
51200	0.5	3.1	0.4	3.1	0.3	3.1	0.3	3.1
51400	0.3	1.3	0.2	1.3	0.1	1.3	0.1	1.3
51600	0.5	1.3	0.4	1.3	0.3	1.3	0.3	1.3
51800	0.3	1.2	0.2	1.2	0.1	1.2	0.1	1.2
52000	0.3	1.5	0.2	1.5	0.1	1.5	0.1	1.5
52200	0.5	1.5	0.4	1.5	0.3	1.5	0.3	1.5
52400	0.7	1	0.6	1	0.5	1	0.5	1
52600	1	1.3	0.9	1.3	0.8	1.3	0.8	1.3
52800	0.3	0.8	0.2	0.8	0.1	0.8	0.1	0.8
53000	0.3	0.7	0.2	0.7	0.1	0.7	0.1	0.7
53200	0.2	0.5	0.1	0.5	0.1	0.5	0.1	0.5
53400	0.1	0.3	0.1	0.3	0.1	0.3	0.1	0.3
53600	0.2	0.5	0.1	0.5	0.01	0.5	0.01	0.5
53800	0.3	0.6	0.2	0.6	0.1	0.6	0.1	0.6
54000	0.2	0.5	0.1	0.5	0.02	0.5	0.02	0.5
54200	0.3	0.7	0.2	0.7	0.1	0.7	0.1	0.7
54400	0.2	0.5	0.1	0.5	0.02	0.5	0.02	0.5
54600	0.3	0.6	0.2	0.6	0.1	0.6	0.1	0.6
54800	0.2	0.6	0.1	0.6	0.03	0.6	0.03	0.6
55000	0.3	0.7	0.2	0.7	0.1	0.7	0.1	0.7
55200	0.2	0.4	0.1	0.4	0.02	0.4	0.02	0.4
55400	0.3	0.6	0.2	0.6	0.1	0.6	0.1	0.6
55600	0.2	0.3	0.1	0.3	0.03	0.3	0.03	0.3
55800	0.2	0.4	0.1	0.4	0.02	0.4	0.02	0.4
56000	0.3	0.5	0.2	0.5	0.1	0.5	0.1	0.5
56200	0.1	0.3	0.1	0.3	0.02	0.3	0.02	0.3

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Reduced		Reduced		Reduced		Reduced	
	Min	Max	Min	Max	Min	Max	Min	Max
56400	0.2	0.14	0.1	0.14	0.01	0.14	0.01	0.14
56600	0.2	0.4	0.1	0.4	0.03	0.4	0.03	0.4
56800	0.3	0.5	0.2	0.5	0.1	0.5	0.1	0.5
57000	0.2	0.4	0.1	0.4	0.01	0.4	0.01	0.4
57200	0.3	0.5	0.2	0.5	0.1	0.5	0.1	0.5
57400	0.1	0.3	0.1	0.3	0.02	0.3	0.02	0.3
57600	0.2	0.3	0.1	0.3	0.02	0.3	0.02	0.3
57800	0.2	0.4	0.1	0.4	0.01	0.4	0.01	0.4
58000	0.3	0.5	0.2	0.5	0.1	0.5	0.1	0.5
58234	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2

Table 21-Reduced depth at 200 m intervals

Annexure-5 Details of collected Water level of different gauge stations w.r.t. MSL (CWC, Irrigation, Ports, Maritime Boards, Observed stations during survey etc.) – Table indicating Chainage (zero at downstream) and following:-

Date	Tide Pole name	Chainage (km)	Time	T. Reading (m)	Zero of TP w.r.t. MSL (m)	W.L w.r.t. MSL (m)	SD value w.r.t. MSL (m)	Corrected Tide (m)
				A	B	C = A+B	D	E = D-C
18.10.15	Gauge Station-(TP)-1	54.990	24 hrs	0.25	49.714	49.964	49.866	-0.098
18.10.15	Gauge Station-(TP)- 2	48.546	24 hrs	0.29	47.461	47.751	48.252	0.501
17.10.15	Gauge Station-(TP)-3	48.471	24 hrs	0.32	47.841	48.161	48.234	0.073
17.10.15	Gauge Station-(TP)-4	35.342	24 hrs	0.37	45.232	45.602	44.945	-0.657
19.10.15	Gauge Station -(TP)-5	30.000	24 hrs	0.46	43.947	44.407	43.607	-0.800
19.10.15	Gauge Station -(TP)-6	25.000	24 hrs	0.51	42.454	42.964	42.355	-0.609
20.10.15	Gauge Station -(TP)-7	20.000	24 hrs	0.49	41.178	41.668	41.103	-0.564
20.10.15	Gauge Station-(TP)-8	15.000	24 hrs	0.57	40.709	41.279	39.851	-1.428
21.10.15	Gauge Station-(TP)-9	10.000	24 hrs	0.61	40.21	40.820	38.598	-2.222
21.10.15	Gauge Station-(TP)-10	5.000	24 hrs	0.65	38.927	39.577	37.346	-2.231

Table 22 Water level at different Gauge station

Annexure-6 Details of Bathymetric surveys carried out:-

Date of Survey	Type of survey	Chainage	
		From (km)	To (km)
03.11.15	Bathymetry Survey	35.000	42.135
04.11.15	Bathymetry Survey	42.135	48.300
05.11.15	Bathymetry Survey	48.300	58.234

Table 23 Details of Bathymetry Survey

Annexure-7 Bank Protection along the Bank:-

From Hazu village to Hadala villages are protected by Bituminus road near BM-3, right bank side of the river. From Rajabazar village to Ketekibari villages are also protected by Bituminus road, left bank side of the river. From Sarusulia village to Satdala villages are also protected by Bituminus road left bank side of the river. Bornadi wildlife sanctuary and forest area protects the bank. Bolder pitching is also protected in some places. Both side river banks protects by embankment also.

Annexure-8 Details of Features across the Bank:-

The bank of the river includes villages, Ferry Ghat, Irrigation canals and outlets, Rail Bridge, RCC Bridges, Burning Ghat and Forest etc. The both side river bank are highly protected by embankment and bolder pitching due to flood, erosion etc. The villages are also situated near the bank side of the river. Recently different kinds of industries like oil, Cement, Petro-Chemicals have been noticed in this zone of river.

Annexure-9 Detailed methodology adopted for carrying out survey. Horizontal Control and Vertical Details Control:-

- **Establishment of Horizontal Control:-**

The Horizontal control for Topography surveys: - High precision RTK DGPS in fix mode is using UHF Radio Modem with IHO accuracy standards, with minimum 24 hours observations at some permanent platform/base.

The Horizontal control for Bathy surveys: - DGPS is receiving corrections from Beacons.

Establishment of Vertical Control:-

Vertical control from Puthimari RCC Bridge (NH-31) is used for the entire Survey work. Its value is 55.262 m w.r.t. MSL has been considered for calculating the vertical levels. Total 5 no. of BM was established along the 58.234 kms stretch of the Puthimari River with the reference of G.T.S Level, which was fixed near at Puthimari RCC Bridge (NH-31).

Topography Survey:-

The survey was commenced on 24th October, 2015 and completed on 05th November, 2015. Then the time was autumn season and the climate become normal which reached approximately 20◦ C. Mostly day weather was sunny and was very favorable for the conduct of survey and the weather condition remains same for the entire duration of the survey.

The survey was undertaken as per the line plan provided and the spot level points in the cross line were spaced at 40 m interval. The plotting of the chart was done on UTM Projection at Zone - 46 N as directed in the contract specifications. The spot levels along the river were obtained by using Trimble DGPS. The data was post processed using Trimble Business Center to get the precise position and MSL height values of the rover locations. The topographic survey for the entire survey stretch was conducted to collect the following data:-

- Spot levels
-Delineation of Islands
-Fixing of bridges and marks
-Assess the type of river bank
-Extending the vertical and horizontal control throughout the survey area
-Collection of local information along the river Banks

Topographic survey Equipments: South (S86T) GNSS RTK, Total Station was used for conducting the topographic survey.

South RTK (S86T) satellite navigation is a technique used in land survey and in hydrographic survey based on the use of carrier phase measurements of the GPS, GLONASS and / or Galileo signals where a single reference station provides the real-time corrections, providing up to centimeter-level accuracy. When referring to GPS in particular, the system is also commonly referred to as Carrier-Phase Enhancement, CPGPS. RTK systems use a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier that it measured, and the mobile units compare their own phase measurements with the ones received from the base station. There are several ways to transmit a correction signal from base station to mobile station. The most popular way to achieve real-time, low-cost signal transmission is to use a radio modem, typically in the UHF band. This allows the units to calculate their relative position to millimeters, although their absolute position is accurate only to the same accuracy as the position of the base station.

RTK systems are available in dual-frequency and single-frequency versions. Dual-frequency systems deliver greater precision, faster and over longer baselines than single-frequency systems. Leica GS09 & GS12 GNSS RTK that used for the survey contains dual-frequency requires antenna and controller to suit any surveying task with a wide range of functionality. Leica GS09 & GS12 GNSS RTK Rover is extremely light-weight and cable free rover is comfortable to use and withstand even for rough use and topple over. It uses a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier that it measured, and the mobile units compare their own phase measurements with the ones received from the base station. So, that centimeter level accuracy can be achieved from latitude, longitude and altitude. RTK technique in terms of general navigation, it is perfectly suited to roles like surveying. In this case, the base station is located at a known surveyed location, often a benchmark, and the mobile units can then produce a highly accurate map by taking fixes relative to that point. RTK has also found uses in auto drive/autopilot systems, precision farming and similar roles.

Figure 25 Topography survey Instrument

- **Bathymetry Survey:-**

The bathymetry survey was carried out using Bathy 500 portable shallow water Echosounder supported by DGPS Beacon Receiver and HYPACK Data collection and processing software. The survey equipment was installed as per the standard procedure the survey vessel equipped with safety gears.

Bathy- 500MF Echosounder: The Bathy- 500MF echosounder is an electronic hydrographic survey instrument used for measuring depths with precision chart recordings and digital data output manufactured by Syqwest Incorporated, USA. The Bathy-500 echo sounding systems are based on the principle that when a sound signal is sent into the water it will be reflected back when it strikes an object. The Bathy-500 is technologically sophisticated, utilizing modern, micro processor based electronics and a thermal chart recorder mechanism. Digital processing enables the instrument to offer fully automatic digitizing capabilities. When interfaced to a NMEA 0183 compatible position sensor, it provides user with a complete, integrated hydrographic survey environment. The instrument front panel consists of a high contrast, backlit four line LCD displays and a fully sealed input keypad. The front panel encompassing system data, status and setup parameters with RS232/RS422 output format. All operating functions are set via the front panel interface. Setup selections are stored within internal, non-volatile memory for instant availability upon power-up. The instrument decodes and processes the NMEA 0183 formatted sentence GGA or GLL from GPS/DGPS using variable Baud rates for communication.

Figure 26 Bathymetry Survey Instrument

Annexure-10 Photographs of Equipment:-

i) Survey Boat -

The bathymetric survey was conducted using one motorized boat. This boat was also used to collect water sample, current velocity, soil sample etc.

Figure 27 Survey Boat

ii) Positioning system

1 no Trimble DGPS system (SPS361)

Figure 28 Positioning System

iii) Echo Sounder System:-

- 1 no.Bathy 500MF multi frequency Echo sounder
- 1 no. transducer 210 kHz + mounting bracket & base plate

Figure 29 Echo Sounder

iv) Current Meter:-

1 no. current meter (AEM 213-D) was used during water velocity observation

Figure 30 current Meter

Equipment	Make	Version	Qty Employed
Echo sounder	Bathy MF 500	……	1
Current Meter	AEM 213-D	……	1
Tide Gauge	Manual (Pole type)	-	4
RTK	South S86T		3
GPS Sets	Trimble –Becon Rover SPS 361		1
Software	HYPACK data acquisition	Version 14	1
Software	AUTOCAD	2013	1
Software	Microsoft Office	2013	1

Figure 31 Equipment lists

v) Water Sampler & Bottom Sampler: -

- **1 no. Water Sampler**
- **1 no. Van veen Grab**

vi) **Calibration Certificate:-**

The equipment used for the survey was calibrated by the equipment supplier. The equipment calibration certificates are placed at the **Annexure** to this report.

Annexure-11 Bench Mark Forms:-

BM Name	Northing	Easting	Latitude (N)	Longitude (E)	RL (m)
BM 1	2906253.887	329966.61	26°15'57.36"	91°17'50.21"	46.529
Pillar Established by: - Precision Survey Consultancy. Surveyor – Mr. Debasis Mondal; Date of Establishment – 25/10/2015					
Station Description :-					
Benchmark is located near NO.2 Bamunbori village. The BM is denoted by a "." mark engraved on a plate. The plate is fixed on a 5cm diameter GI pipe. The GI pipe is cemented with construction pillar of 30cmX30cmX150cm. The pillar extends 60.cms above ground level. Inscription "IWAI", "PSC" and BM No can be seen on the face of the pillar. North from Road-58.41km.					
Life of Station : 15Yrs	Datum: - WGS 84		**ZONE :**46 R		

Figure 32 Bench Mark Form & Google image view of BM-1

BM Name	Easting	Northing	Latitude (N)	Longitude (E)	RL (m)
BM 2	351720.584	2905995.847	26°15'57.36"	91°17'50.21"	52.159

Pillar Established by: - Precision Survey Consultancy. Surveyor – Mr. Debases Mondal;
Date of Establishment – 26/10/2015

Station Description :-

Benchmark is located near Gandheli Tari village.The Bench mark is on the west portion of the road and east portion canal.

The BM is denoted by a "." mark engraved on a plate. The plate is fixed on a 5cm diameter GI pipe. The GI pipe is cemented with construction pillar of 30cmX30cmX150cm.

The pillar extends 60.cms above ground level. Inscription "IWAI", "PSC" and BM No.can be seen on the face of the pillar.

The measurements of the bench mark pillar from notable locations / edges as follows:

North from Bornodi Wildlife sanctuary- 55.47km.

Life of Station : 15Yrs	Datum: - WGS 84	**ZONE :**46 R

Figure 33 Bench Mark Form & Google image view of BM-2

BM Name	Easting	Northing	Latitude (N)	Longitude (E)	RL (m)
BM 3	359116.051	2908344.164	26°17'16.70"	91°35'19.98"	52.909

Pillar Established by: - Precision Survey Consultancy. Surveyor – Mr. Debasis Mondal;
Date of Establishment – 27/10/2015

Station Description :-

Benchmark is located at Gerua village near the RCC Bridge.

The plate is fixed on a 5cm diameter GI pipe. The GI pipe is cemented with construction pillar of 30cmX30cmX150cm.

The pillar extends 60.cms above ground level. Inscription "IWAI", "PSC" and BM No.can is seen on the face of the pillar.

The measurements of the bench mark pillar from notable locations / edges as follows:

Northside from Road-53.38km.

Life of Station : 15Yrs	Datum: - WGS 84	**ZONE :**46 R

Figure 34 Bench Mark Form & Google image view of BM-3

BM Name	Easting	Northing	Latitude (N)	Longitude (E)	RL (m)
BM 4	364936.863	2914809.693	26°20'48.81"	91°38'47.35"	58.019
Pillar Established by : - Precision Survey Consultancy. Surveyor – Mr. Debasis Mondal ; Date of Establishment – 27/10/2015					
Station Description :-					
Benchmark is located near Soneswar village. The BM is denoted by a "." mark engraved on a plate. The plate is fixed on a 5cm diameter GI pipe. The GI pipe is cemented with construction pillar of 30cmX30cmX150cm. The pillar extends 60.cms above ground level. Inscription "IWAI", "PSC" and BM No.can be seen on the face of the pillar. The measurements of the bench mark pillar from notable locations / edges as follows: South Westside from Road - 3.0m North West corner from Canal Bridge –47.65 m.					
Life of Station : 15Yrs	Datum: - WGS 84		**ZONE :**46 R		

Figure 35 Bench Mark Form & Google image view of BM-4

BM Name	Easting	Northing	Latitude (N)	Longitude (E)	RL (m)
BM 5	365530.389	2917071.975	26°22'2.52"	91°39'7.92"	57.422

Pillar Established by : - Precision Survey Consultancy. Surveyor – Mr. Debasis Mondal;
Date of Establishment – 28/10/2015

Station Description :-

Benchmark is located near Kacharua village.

The BM is denoted by a "." mark engraved on a plate. The plate is fixed on a 5cm diameter GI pipe. The GI pipe is cemented with construction pillar of 30cmX30cmX150cm.

The pillar extends 60.cms above ground level. Inscription "IWAI", "PSC" and BM No.can be seen on the face of the pillar.

The measurements of the bench mark pillar from notable locations / edges as follows:

North from Light House Boundary –115.1 m.

Life of Station : 15Yrs	Datum: - WGS 84	**ZONE :**46 R

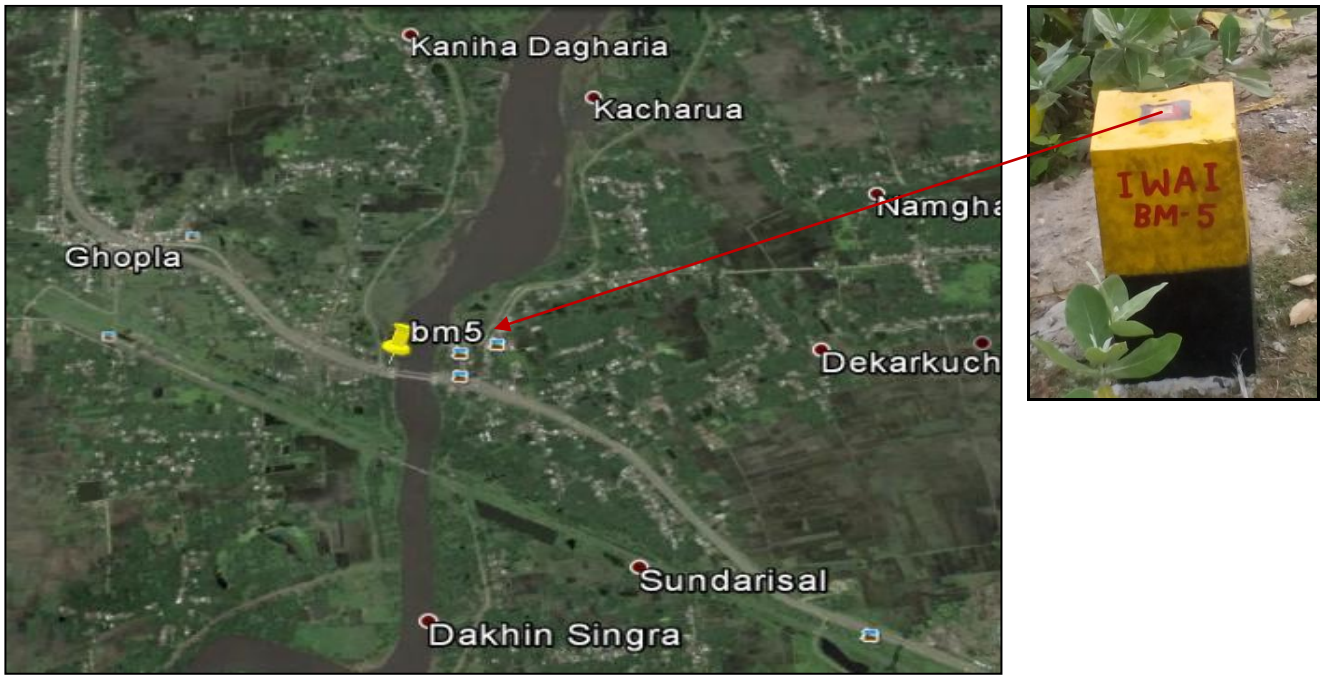


Figure 36 Bench Mark Form & Google image view of BM-5

Annexure-12 Levelling Calculation:

Leveling from GS-1 to BM-1

BS	IS	FS	RISE(+)	FALL(-)	RL(m)	REMARKS	DATE
0.528					58.019	BM-1	
0.385		3.550		3.022	54.997		
0.344		2.850		2.465	52.532		18.10.15
0.550		1.600		1.256	51.276		
		1.862		1.312	49.964	GS-1	

Leveling from GS-2 to CP-PR-5

BS	IS	FS	RISE(+)	FALL(-)	RL(m)	REMARKS	DATE
0.247					58.504	CP-PR5	
0.338		3.452		3.205	55.299		
0.455		2.985		2.647	52.652		18.10.15
0.352		3.470		3.015	49.637		
		2.238		1.886	47.751	GS-2	

Leveling from GS-3 to CP-PR-5

BS	IS	FS	RISE(+)	FALL(-)	RL(m)	REMARKS	DATE
0.357					58.504	CP-PR5	
0.575		3.880		3.523	54.981		
0.346		2.983		2.408	52.573		17.10.15
0.345		2.565		2.219	50.354		
		2.538		2.193	48.161	GS-3	

Leveling from GS-4 to CP-PR-2

BS	IS	FS	RISE(+)	FALL(-)	RL(m)	REMARKS	DATE
0.456					50.369	CP-PR2	
0.365		1.978		1.522	48.847		
0.275		2.188		1.823	47.024		17.10.15
		1.697		1.422	45.602	GS-4	

Table 24 Leveling Calculation Details

Annexure-13 Soil Sample:-

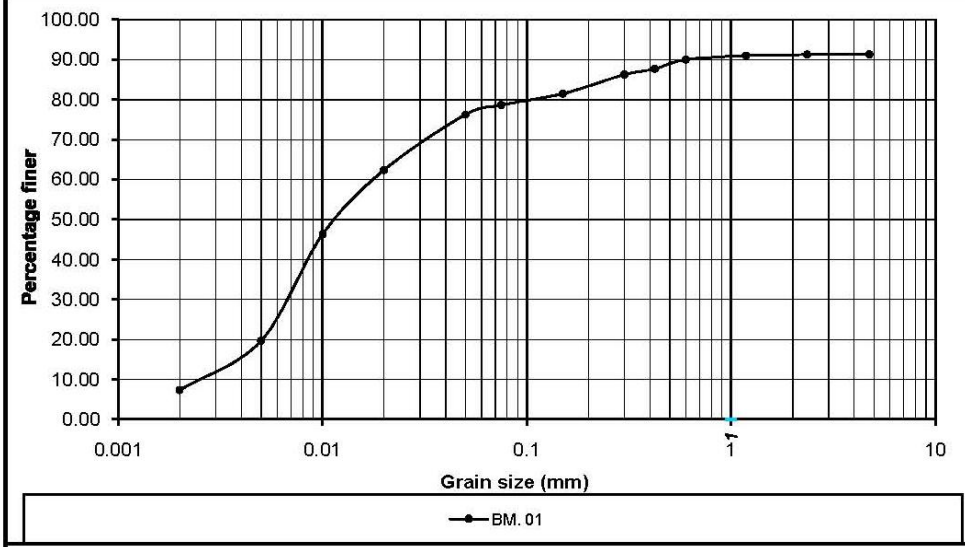
RESULTS OF TEST OF SOIL SAMPLES

SITE – PUTHIMARI RIVER

PHYSICAL ANALYSIS OF SOIL

Sl.No.	BM.	GRAVEL (%)	SAND (%)	SILT+CLAY (%)	SPECIFIC GRAVITY	pH VALUE	SILT (%)	CLAY (%)	Cu	Cc
1	1.00	8.65	16.80	74.55	2.61	7.00	67.20	7.35	6.65	0.93
2	2.00	6.98	11.40	81.62	2.63	7.20	76.20	5.42	4.07	0.89
3	3.00	19.96	28.65	51.39	2.60	7.40	41.60	9.79	8.98	1.12
4	4.00	7.90	17.50	74.60	2.62	7.30	69.00	5.60	5.16	1.00
5	5.00	9.25	14.00	76.75	2.63	7.10	70.40	6.35	3.17	0.86

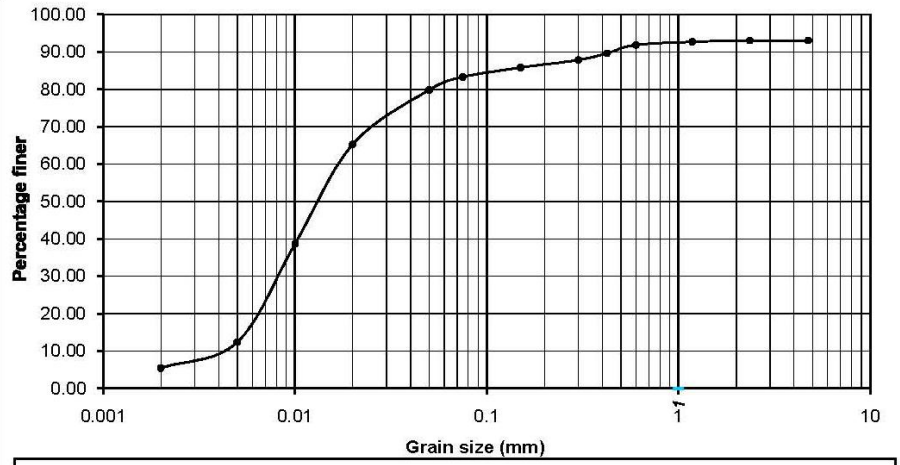
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-4.75*	*>4.75*
Sample No.	Clay (%)	Silt (%)	Sand (%)	Gravel (%)
BM. 01	7.35	67.20	16.80	8.65

*Silt & Clay

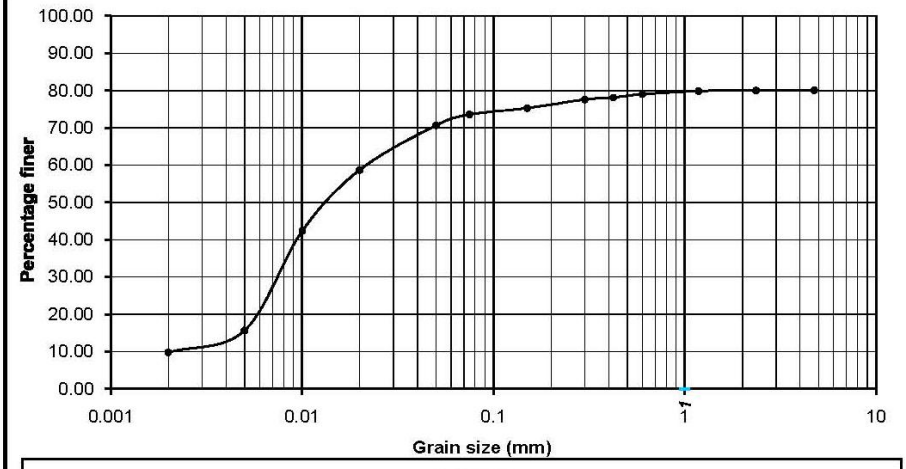
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-4.75*	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Sand (%)**	**Gravel (%)**
BM. 02	5.42	76.20	11.40	6.98

*Silt & Clay

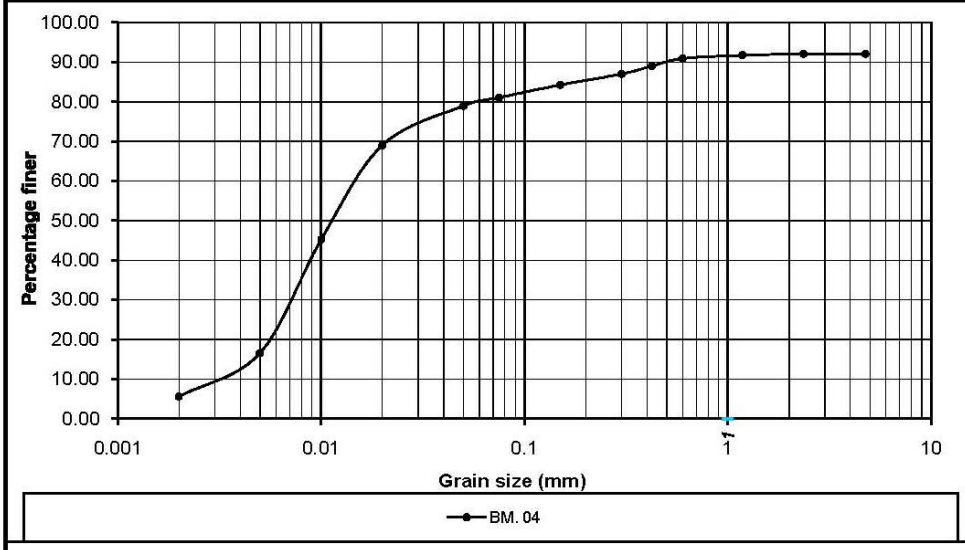
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-4.75*	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Sand (%)**	**Gravel (%)**
BM. 03	9.79	41.60	28.65	19.96

*Silt & Clay

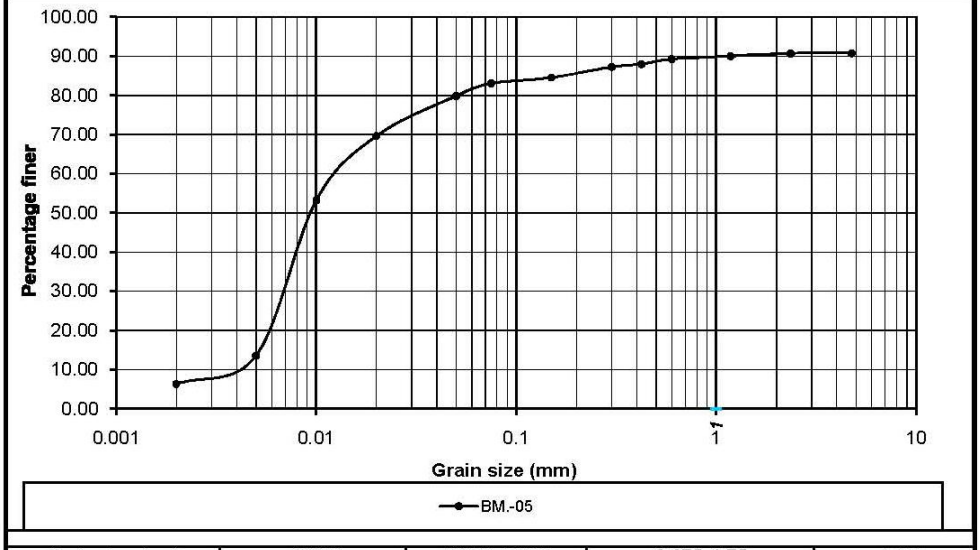
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-4.75*	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Sand (%)**	**Gravel (%)**
BM. 04	5.60	69.00	17.50	7.90

*Silt & Clay

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-4.75*	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Sand (%)**	**Gravel (%)**
BM.-05	6.35	70.40	14.00	9.25

*Silt & Clay

Annexure-14 Water sample:-

RESULTS OF EXAMINATION OF SAMPLES OF WATER

SITE- RIVER PUTHIMARI

PARAMETER – pH Value at 25° C

SL.NO;	B.M	LOCATION	PARAMETER	WATER SAMPLE RESULTS	PERMISSIBLE LIMIT IS:456-2000
1	1	UPER(5D)		7.1	
		MIDDLE(3D)		7.0	
		LOWER(0D)		7.3	
2	2	UPER(5D)		7.2	
		MIDDLE(3D)		7.0	
		LOWER(0D)		7.4	
3	3	UPER(5D)	pH Value at 25° C	7.1	6.5 – 8.5
		MIDDLE(3D)		6.9	
		LOWER(0D)		6.8	
4	4	UPER(5D)		7.2	
		MIDDLE(3D)		7.0	
		LOWER(0D)		6.9	
5	5	UPER(5D)		7.1	
		MIDDLE(3D)		7.0	
		LOWER(0D)		6.8	

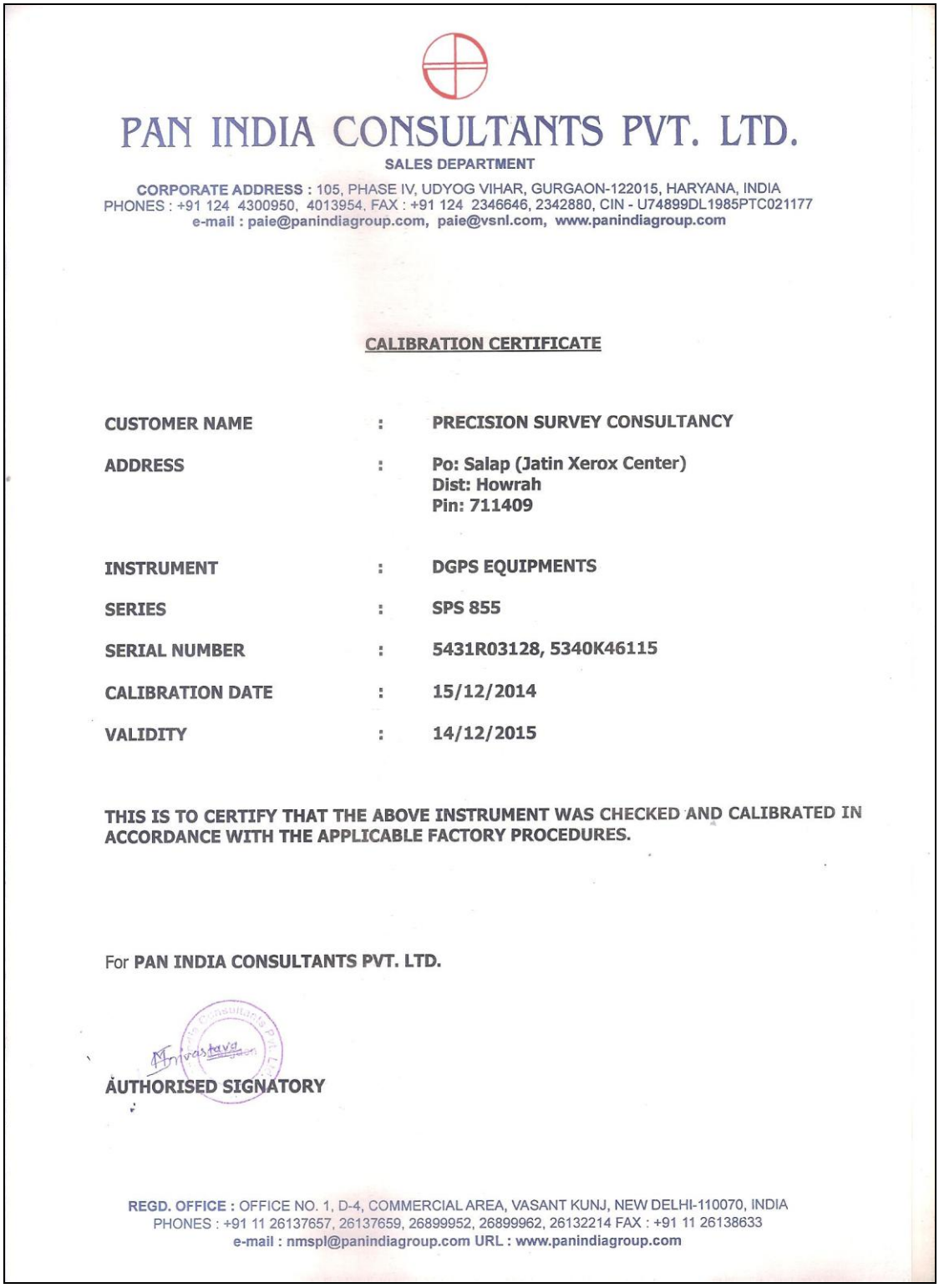
PARAMETER –Chloride as Cl (mg/l)

SL.NO;	B.M	LOCATION	PARAMETER	WATER SAMPLE RESULTS	PERMISSIBLE LIMIT IS:456-2000
1	1	UPER(5D)		7	
		MIDDLE(3D)		6	
		LOWER(0D)		6	
2	2	UPER(5D)		8	
		MIDDLE(3D)		5	
		LOWER(0D)		7	
3	3	UPER(5D)	Chloride as Cl (mg/l)	7	2000 mg/l for concrete not containing embedded steel and 500 mg/l for reinforced concrete work.
		MIDDLE(3D)		6	
		LOWER(0D)		7	
4	4	UPER(5D)		7	
		MIDDLE(3D)		6	
		LOWER(0D)		7	
5	5	UPER(5D)		7	
		MIDDLE(3D)		6	
		LOWER(0D)		7	

PARAMETER –Sulphates as SO_4 (mg/l)					
SL.NO;	B.M	LOCATION	PARAMETER	WATER SAMPLE RESULTS	PERMISSIBLE LIMIT IS:456-2000
1	1	UPER(5D)		62	
		MIDDLE(3D)		52	
		LOWER(0D)		48	
2	2	UPER(5D)		58	
		MIDDLE(3D)		82	
		LOWER(0D)		48	
3	3	UPER(5D)		59	400 (mg/l)
		MIDDLE(3D)	Sulphates as SO_4 (mg/l)	52	
		LOWER(0D)		49	
4	4	UPER(5D)		59	
		MIDDLE(3D)		88	
		LOWER(0D)		48	
5	5	UPER(5D)		57	
		MIDDLE(3D)		50	
		LOWER(0D)		49	

PARAMETER –Sediment Concentration (mg/l)					
SL.NO;	B.M	LOCATION	PARAMETER	WATER SAMPLE RESULTS	PERMISSIBLE LIMIT IS:456-2000
1	1	UPER(5D)		160	
		MIDDLE(3D)		49	
		LOWER(0D)		90	
2	2	UPER(5D)		50	
		MIDDLE(3D)		42	
		LOWER(0D)		35	
3	3	UPER(5D)	Sediment Concentration (mg/l)	58	2000 (mg/l)
		MIDDLE(3D)		43	
		LOWER(0D)		51	
4	4	UPER(5D)		59	
		MIDDLE(3D)		43	
		LOWER(0D)		55	
5	5	UPER(5D)		58	
		MIDDLE(3D)		42	
		LOWER(0D)		50	

Annexure-15 Calibration Certificate:-



PAN INDIA CONSULTANTS PVT. LTD.

SALES DEPARTMENT

CORPORATE ADDRESS : 105, PHASE IV, UDYOG VIHAR, GURGAON-122015, HARYANA, INDIA
PHONES : +91 124 4300950, 4013954, FAX : +91 124 2346646, 2342880, CIN - U74899DL1985PTC021177
e-mail : paie@panindiagroup.com, paie@vsnl.com, www.panindiagroup.com

CALIBRATION CERTIFICATE

CUSTOMER NAME	:	PRECISION SURVEY CONSULTANCY
ADDRESS	:	Po: Salap (Jatin Xerox Center) Dist: Howrah Pin: 711409
INSTRUMENT	:	DGPS EQUIPMENTS
SERIES	:	SPS 855
SERIAL NUMBER	:	5431R03128, 5340K46115
CALIBRATION DATE	:	15/12/2014
VALIDITY	:	14/12/2015

THIS IS TO CERTIFY THAT THE ABOVE INSTRUMENT WAS CHECKED AND CALIBRATED IN ACCORDANCE WITH THE APPLICABLE FACTORY PROCEDURES.

For PAN INDIA CONSULTANTS PVT. LTD.

AUTHORISED SIGNATORY

REGD. OFFICE : OFFICE NO. 1, D-4, COMMERCIAL AREA, VASANT KUNJ, NEW DELHI-110070, INDIA
PHONES : +91 11 26137657, 26137659, 26899952, 26899962, 26132214 FAX : +91 11 26138633
e-mail : nmspl@panindiagroup.com URL : www.panindiagroup.com

Figure 37 Calibration Certificate of DGPS

PAN INDIA CONSULTANTS PVT. LTD.
SALES DEPARTMENT
CORPORATE ADDRESS : 105, PHASE IV, UDYOG VIHAR, GURGAON-122015, HARYANA, INDIA
PHONES : +91 124 4300950, 4013954, FAX : +91 124 2346646, 2342880, CIN - U74899DL1985PTC021177
e-mail : paie@panindiagroup.com, paie@vsnl.com, www.panindiagroup.com

CALIBRATION CERTIFICATE

CUSTOMER NAME	:	PRECISION SURVEY CONSUTLANCY
ADDRESS	:	P.O. –SALAP (Jatin Xerox Center) Dist. –Howrah Pin: 711 409
INSTRUMENT	:	ECHO –SOUNDER
SERIES	:	500MF
SERIAL NUMBER	:	B5MF0560
CALIBRATION DATE	:	28/04/2015
VALIDITY	:	27/04/2016

THIS IS TO CERTIFY THAT THE ABOVE INSTRUMENT WAS CHECKED AND CALIBRATED IN ACCORDANCE WITH THE APPLICABLE FACTORY PROCEDURES.

For **PAN INDIA CONSULTANTS PVT. LTD.**

AUTHORISED SIGNATORY

REGD. OFFICE : OFFICE NO. 1, D-4, COMMERCIAL AREA, VASANT KUNJ, NEW DELHI-110070, INDIA
PHONES : +91 11 26137657, 26137659, 26899952, 26899962, 26132214 FAX : +91 11 26138633
e-mail : nmspl@panindiagroup.com URL : www.panindiagroup.com

Figure 38 Calibration Certificate of Echo Sounder

SOUTH

SOUTH PRECISION INSTRUMENT PVT. LTD.
FA - 229 B, Ground Floor, Mansarover Garden, New Delhi-110015
Ph. : 011- 45544114, 65568870 Fax: 011- 45530854 Mob.: 9999999255

Calibration Certificate

SOUTH Precision Instrument Pvt. Ltd. Calibration laboratory certifies that the instrument has been inspected, tested and calibrated in accordance with the documented procedures using measuring and test equipment, which are traceable to national standards and of the international accepted standard.

We hereby certify that the instrument mentioned below meet the specification and result of the traceability is carried out in accordance to our company's standard.

INSTRUMENT TYPE	:	GPS RTK
MODEL	:	S-86T
MAKE	:	SOUTH
INSTRUMENT SR. NO.	:	S86951117129438GEM W1286752342GM
CALIBRATION DATE	:	10/02/2015
VALID UPTO	:	09/02/2016
ISSUED TO	:	PRECISION SURVEY CONSULTANCY

For SOUTH PRECISION INSTRUMENT PVT. LTD.
For SOUTH PRECISION INSTRUMENT PVT. LTD.
Authorised Signatory

Authorised Signatory

Figure 39 Calibration Certificate of GPS- RTK

Annexure-16 Site Picture:-

Figure 40 Site Picture

Figure 41- Bathymetry Instrument

Figure 42-Topography Instrument

Figure 43-Mukalma Ghat (Chainage-12.777 km)

Figure 44-Pam Ghat (Chainage-18.598 km)

Figure 45-River-Bank side Pictures

Annexure-17 Survey Charts:-

LIST OF SURVEY CHARTS OF PUTHIMARI RIVER FINAL DWG (NW-82)								
Sl. No.	Chart No.	Location	Chainage (Form…….km. To…...km.)	Chart Datum And Water Level w.r.t. MSL			Value of Reduction	Remarks
				Chainage (km.)	CD (m.)	WL (m.)		
1	P_01	Pachim kazia to Kaltali	0.00 km to 3.431 km	5.000	37.346	39.577	-2.231	GS-10
2	P_02	Kaltali to No-1 Larkuchi	3.431 km to 6.260 km	5.000	37.346	39.577	-2.231	GS-10
3	P_03	No-1 Larkuchi to Belengimari	6.260 km to 10.318 km	10.000	38.598	40.820	-2.222	GS-9
4	P_04	Belengimari to Kalardia	10.318 km to 14.315 km	10.000	38.598	40.820	-2.222	GS-9
				15.000	39.851	41.279	-1.428	GS-8
5	P_05	Kalardia to No-1. Bhelamari	14.315 km to 18.294 km	15.000	39.851	41.279	-1.428	GS-8
6	P_06	No-1. Bhelamari to Parghat Of Khudabox Ali	18.294 km to 22.205 km	20.000	41.103	41.668	-0.565	GS-7
				25.000	42.355	42.964	-0.609	GS-6
7	P_07	Parghat Of Khudabox Ali to No-3. Dokania reserver	22.205 km to 27.964 km	25.000	42.355	42.964	-0.609	GS-6
8	P_08	No-3. Dokania reserver to Sastar	27.964 km to 32.102 km	30.000	43.607	44.407	-0.800	GS-5
9	P_09	Sastar to Barsapari	32.102 km to 37.287 km	35.342	44.945	45.602	-0.657	GS-4
10	P_10	Barsapari to Gerua	37.287 km to 42.505 km	35.342	44.945	45.602	-0.657	GS-4
				48.471	48.234	48.161	0.073	GS-3
11	P_11	Gerua to Ketekibari	42.505 km to 46.690 km	48.471	48.234	48.161	0.073	GS-3
12	P_12	Ketekibari to Barkha	46.690 km to 50.985 km	48.471	48.234	48.161	0.073	GS-3
				48.546	48.252	48.751	-0.499	GS-2

LIST OF SURVEY CHARTS OF PUTHIMARI RIVER FINAL DWG (NW-82)								
Sl. No.	**Chart No.**	**Location**	**Chainage (Form…….km. To…...km.)**	**Chart Datum And Water Level w.r.t. MSL**			**Value of Reduction**	**Remarks**
				Chainage (km.)	**CD (m.)**	**WL (m.)**		
13	P_13	Barkha to Maguri	50.985 km to 54.941 km	54.990	49.866	49.964	-0.098	GS-1
14	P_14	Maguri to Kacharua	54.985 km to 58.234 km	54.990	49.866	49.964	-0.098	GS-1

Table 25 Survey Charts

Note: Scale: - 1:5000 in each survey Chart

Survey period: - 24th October, 2015 to 05th November, 2015

✧ **G.S:-** Gauge Station