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

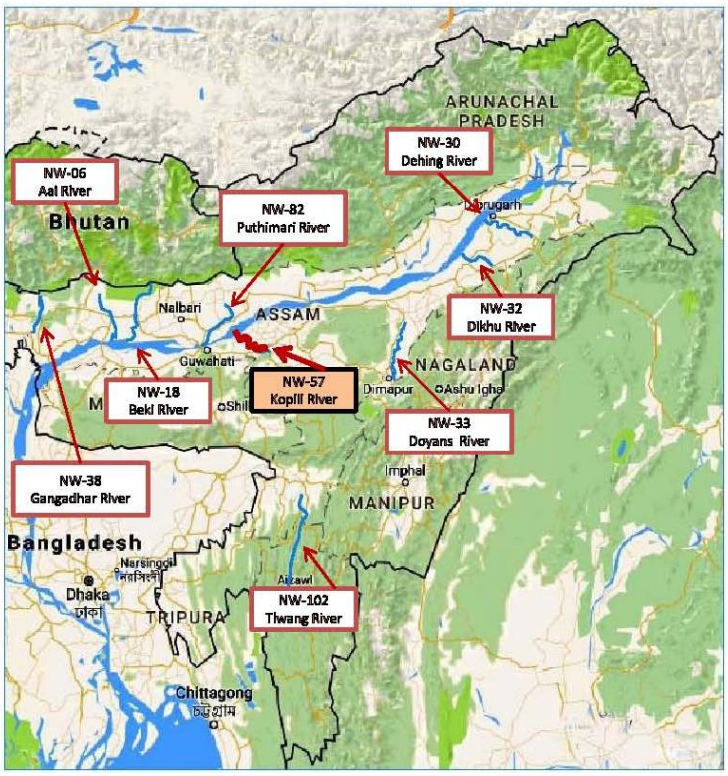
"FINAL FEASIBILITY REPORT ON HYDROGRAPHIC SURVEY

KOPILI RIVER (NW-57) (49.90 km)

"FROM CONFLUENCE WITH BRAHMAPUTRA RIVER TO

BANTHAI GAON TINALI BUS STOP"

Survey Period: 08.11.15 to 30.11.15



FINAL REPORT ON HYDROGRAPHICAL SURVEY OF KOPILI RIVER, ASSAM

REPORT SUBMISSION DATE- 03.10.2018

SUBMITTED BY:

PRECISION SURVEY CONSULTANCY

"Vichitra" SP -45, (Kolkata West International City)
Salap Junction, Howrah Amta Road &
Bombay Road Crossing,
NH- 6, Howrah – 711 403
e-mail – info@precisionsurvey.co.in
Visit us –www.precisionsurvey.co.in

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- (Kopili River)** From Confluence with Brahmaputra River to Banthai gaon Tinali Bus stop (49.90 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 Kopili 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).**

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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 Kopili 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) Kopili River b) NW-57 c) From Confluence with Brahmaputra River (Chainage 0.00 km) to Banthai Gaon Tinali Bus stop (Chainage 49.90 km). d) 08th November, 2015 to 30th November, 2015
4.	Tidal & non tidal portions (from… to, length, average tidal variation)	There are no Tidal influences or portions found in this zone of River.
5.	LAD status (Least Available 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	**Observed 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)
3.3	3.4	1.0
0.7	0.7	0.7
0.6	0.5	0.4
0.6	0.6	0.7
4.8	4.8	7.20
Total-10.0	Total-10.0	Total- 10.0

Sub Stretch-4 (30.00-40.00 km)	Sub Stretch-5 (40.00-49.90 km)	Total (km)
3.4	0.0	11.1
0.7	1.7	4.5
0.5	1.8	3.8
0.6	1.6	4.1
4.8	4.8	26.40
Total- 10.0	Total- 9.9	Total- 49.90 km

	LAD status (Least Available 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	**Reduced 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)
2.5	2.5	1.1
0.7	0.7	0.5
0.5	0.5	0.8
0.4	0.4	0.5
5.9	5.9	7.1
Total-10.0	Total-10.0	Total- 10.0

Sub Stretch-4 (30.00-40.00 km)	Sub Stretch-5 (40.00-49.90 km)	Total (km)
1.1	1.6	8.8
0.5	0.8	3.2
0.8	0.8	3.4
0.5	2.9	4.7
7.1	3.8	29.8
Total-10.0	Total-10.0	Total- 49.90 km

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

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 are no Dams, weirs or Barrages are found in this zone of river.

ii) Total number of RCC Bridges – 3 (Three)

Clearance w.r.t H.F.L	Min (m)	Max (m)
Horizontal Clearance (m)	24.990	35.440
Vertical Clearance w.r.t. H.F.L (m)	2.884	3.329

iii) Electric line- 12 (Twelve), High Tension line-2 (Two)

Clearance w.r.t H.F.L	Min (m)	Max (m)
Horizontal Clearance (m)	121.93	257.37
Vertical Clearance w.r.t. H.F.L (m)	1.090	13.559

7.	Slope	

Reach		River / Canal Bed Level Change (m)	Distance (km)	Slope (m/km)	Slope (cm/km)
From	To				
0.00 km	1.716	0.318	1.716	0.185	18.531
1.717	10.997	0.522	9.28	0.056	5.625
10.998	21.383	0.583	10.385	0.056	5.614
21.384	30.472	0.511	9.088	0.056	5.623
30.473	40.541	0.566	10.068	0.056	5.622
40.542	49.90	0.298	4.536	0.066	6.570
Total			45.073	Avg- 0.079	Avg-7.931

8.	Discharge Report	

Sl. No	Chainage (km)	Discharge (Cu.m/sec)	
1	14.949	23.448	**Dated 08.11.15 to 22.11.15**
2	34.424	60.944	
3	49.803	113.716	
Avg. Discharge		Avg- 66.036	

9.	i) Present IWT operations ii) Ferry services, tourism, cargo, if any	i) As follows ii) There are four numbers of passenger ferry services named Chowalkgowa Ferry ghat (Ch.-5.100 km) Digaru Ferry ghat (Ch.-7.666 km), Barak Ferry ghat (Ch.-30.665 km) and Ganesh Ferry Ghat (Ch.-34.753 km) available in this zone of River. There are two temporary cargo services available near at Chainage of 42.184 km and 45.500 km. Panbari forest, Boha Pahar etc. tourist places are located in this one of river.
10.	Approx distance of Rail & Road from waterway	Nearest Railway Station- i) Panbari Railway Station from the Riverside area- (1.73 km approx from waterway) ii) Thakurkuchi Railway Station from the Riverside area- (3.44 km approx from waterway) iii) Digaru Railway Station from the Riverside area- 5.90 km approx from waterway) Name of National highway close to the River- NH-31, NH-37, NH-40 SH- SH-3, SH-3A, SH- 3B
11.	Any other information/ comment	

Section-1: Introductory Considerations

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

The River Kopili is one of the important major tributaries of the Brahmaputra on its left bank. It originates from the Saipong Reserve Forest situated in south east of Meghalaya and passes through the borders of Meghalaya, North Cachar hills and karbi anglong and enters the plains in Nagaon district of Assam and finally joins the Brahmaputra at Kopilimukh. Its total length is 256 km of which 78 km from the common border of Meghalaya and Assam and the remaining 178 km lie in Assam.

Kopili River is an interstate river in Northeast India that flows through the states of Meghalaya and Assam and is the largest south bank tributary of the Brahmaputra in Assam. The river Kopili rises in the North Cachar Hills District in Borail Range at an altitude of 1525 meter. Then it passes through Kopili Ghat, Penumbra, Kheroni, Rajagoan, Kampur, Amsoi, Kumoi, and Mayang. The river covers a vast area of North Cachar Hill, Karbi Anglong, Nagaon, and Morigaon District.Here, mainly sixth types of crops produced at Kamrup district and surrounding area, like - Winter Rice, summer rice, rape seed, and wheat, Mustard, Autumn Rice etc.

Completed in 1975, the Kopili Flow Irrigation Scheme in Kamrup district irrigates 1,300 hectares (3,200 acres) of land across 14 revenue villages and facilitates paddy cultivation. The Kopili Hydro Electric Project, located across the districts of North Cachar Hills in Assam and Jaintia Hills in Meghalaya and run by the North Eastern Electric Power Corporation, consists of the Khandong and Umrongso dams and their reservoirs and three power houses that have a total installed capacity of 275m.

Figure 1- Kopili site map

1.2 Tributaries / Network of River/ Basin

The three streams create a river basin in this zone of river:-

i) Gangadhar

ii) Kopili

iii) Puthimari

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

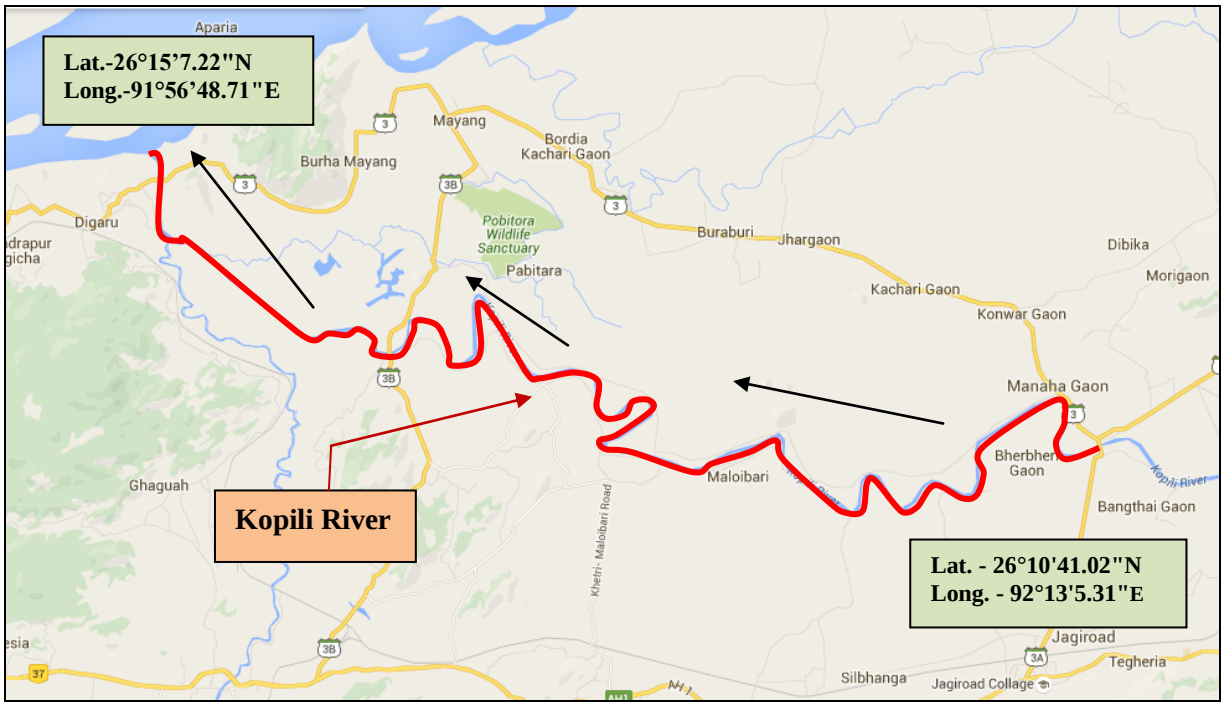


Figure 2 Project Site Location Map

1.5 River Key Map

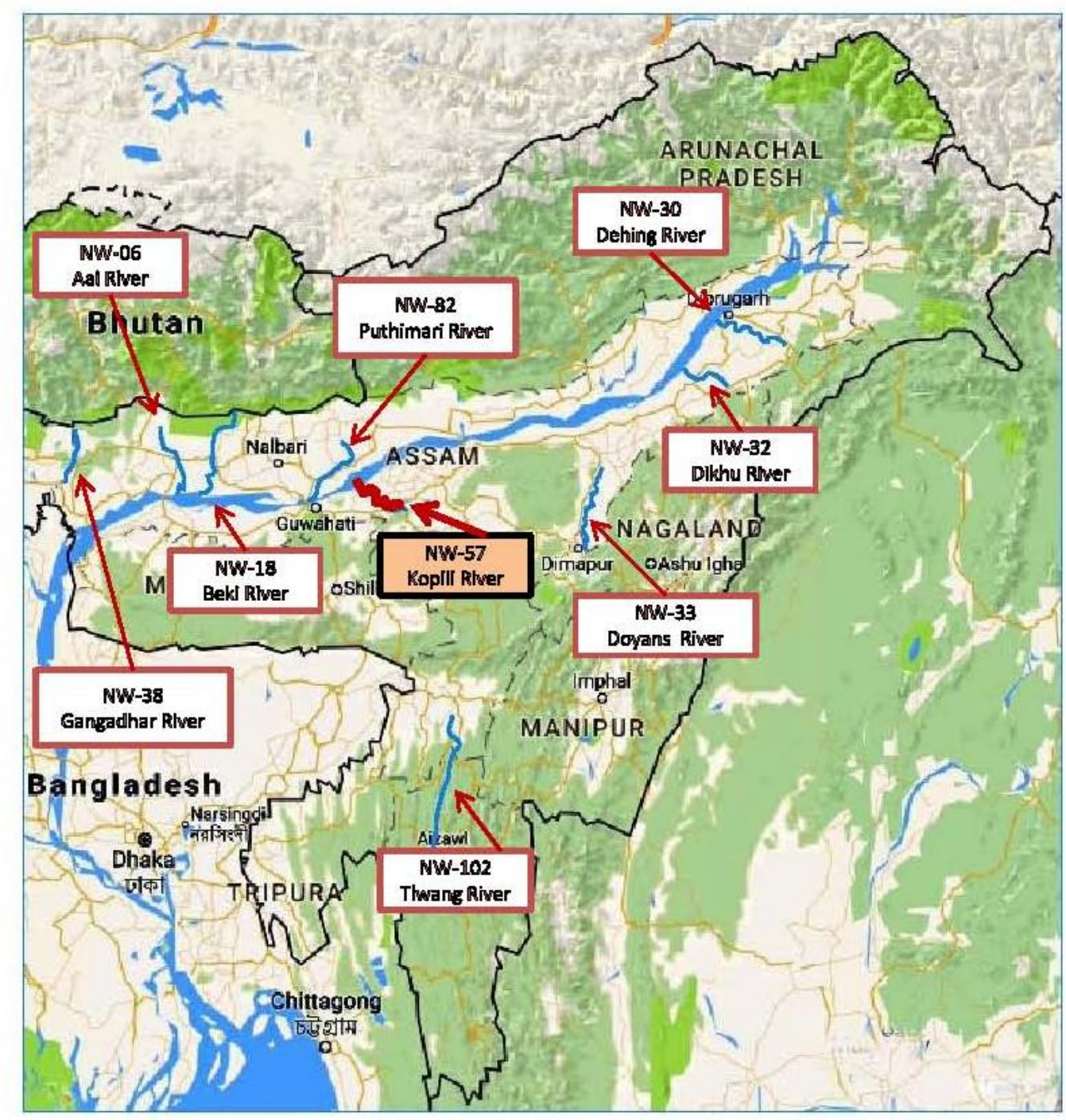


Figure 3- River Key Map

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 kopili River waterway and to provide an appropriate economic and organizational framework for restoring trade and navigation (cargo and passengers) on the kopili River with an aim to do as follows:
- Improve public and private investments into transport on the kopili 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 kopili 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 Equipment List

- **Conduct of survey work**

  - **Topographic Survey**

    - The Topographic survey has been carried out from "Confluence with Brahmaputra River at Chandrapur No.2 (Lat 26°15'7.22"N, Long 91°56'48.71"E") to Bridge at Banthai Gaon Tinali Bus Stop (Lat 26°10'41.02"N, Long 92°13'5.31"E). The length of the Topography survey is from Chainage 0.00 km to Chainage 49.90 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 has been carried out from Chainage 0.00 km to Chainage 49.90 km. The water level is appropriate for the entire length (Chainage 0.00 km to Chainage 49.90 km) of the River.

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.0

The sound velocity was set to 1300 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 Kopili 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 Kopili 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 the Topographic Survey, the Horizontal control has been carried out from the Bench mark no. - BM-6. The BM position of Bangtha Gaon was established by using the DGPS receiver in different mode. The value of BM at Bangthai Gaon is-

	Geographic position		UTM position		
Location Name	**Latitude (N)**	**Longitude (E)**	**Northing**	**Easting**	**Elevation (m)**
Bangthai Gaon	26°10'37.87"	92°13'3.02"	2895541.88	421806.14	53.622 m. w.r.t. M.S.L

Figure 5 - G.T.S Location Site

2.3 Tidal Influence Zone and tidal variation in different stretches

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

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

IWAI had provided Sounding Datum at Dharamtul 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)
1	Dharamtul (Chainage-66.141 km)	48.343 meter
2	Confluence with Brahmaputra River (Chainage- 0.00 km)	44.405 meter

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

The CD levels of Kopili River are-

i) Dharamtul - 48.343 meter (Chainage-66.141 km)

ii) Confluence - 44.405 meter (Chainage-0.00 km)

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

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

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

There is no tidal influence or tidal effects have been 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:-

Sl. No	Station	Chainage (Km)	Latitude (N)	Longitude (E)	Easting (m)	Northing (m)	BM Height above MSL (m)	BM Height above SD (m)
1	BM 1	5.668	26° 14'38.8880"	91° 57' 23.2051"	395776.813	2903140.498	59.820	12.619
2	BM 2	14.949	26° 12' 07.5361"	92° 01' 16.9484"	402226.708	2898433.421	58.626	11.721
3	BM 3	25.335	26° 11' 31.7448"	92° 04' 47.5227"	408063.172	2897289.526	51.315	4.971
4	BM 4	34.424	26° 10' 50.2103"	92° 07' 31.2177"	412598.091	2895980.298	54.710	8.88
5	BM 5	44.493	26° 10' 47.8946"	92° 10' 57.5434"	418324.949	2895871.741	54.465	9.221
6	BM 6	49.803	26° 10' 37.8921"	92° 13' 03.0168"	421806.05	2895542.562	53.622	8.897

Table 2 Details of Bench Mark

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

Chainage (km)	Gauge station	Location	Easting	Northing	Latitude (N)	Longitude (E)	W. L w.r.t M.S.L (m)	Period of observation
45.807	Gauge Station- (TP)- 1	Tinali Bus stop near Rcc Bridge	421755.5	2895539.4	26°10'37.7796"	92°13'1.1964"	49.002	24 hrs
44.493	Gauge Station (TP)- 2	Saru kuloi village	418468.9	2895785.2	26°10'45.1122"	92°11'2.7286"	48.998	24 hrs
40.541	Gauge Station (TP)- 3	Boha pahar village	412719.4	2895927.7	26°10'48.5292"	92° 7'35.601"	48.005	24 hrs
21.419	Gauge Station (TP)- 4	Boha Dalani village	408034.1	2897255.2	26°11'30.6234"	92° 4'46.4838"	47.930	24 hrs
10.977	Gauge Station (TP)- 5	Near the Brick manufactur y	402218.5	2898386.4	26°12'6.0048"	92° 1'16.6656"	47.289	24 hrs
1.738	Gauge Station (TP)- 6	Chandrapur village	395811.7	2903120.3	26°14'38.2416"	91°57'24.4686"	46.018	24 hrs

Table 3 Water level at different Gauge station

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	Dharmtul	66.141		48.343			Kopili Reduced Topo.xyz
2	GS- (TP) - 1	45.807	47.1-49.90		47.201	-1.801	,,
3	GS- (TP) - 2	44.493	39.5-47.1		46.905	-2.093	,,
4	GS - (TP) - 3	40.541	29.9-39.5		46.344	-1.661	,,
5	GS- (TP) - 4	21.419	20.2-29.9		45.830	-2.100	,,
6	GS - (TP) - 5	10.977	10.3-20.2		45.244	-2.045	,,
7	GS - (TP) - 6	1.738	0.0-10.3		44.725	-1.293	,,
8	Confluence (288.2)	0.000		44.405	44.405		,,

Table 4- GS and reduction details

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

MHWS (Mean High Water Springs) is to be taken in tidal stretches and HFL in non-tidal stretches.

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.	Dharamtul		66.141	58.090	58.090
2.	Brahmaputra Confluence(288.2)		0.000		

Table 5-H.F.L Details

2.13 - Graph: Sounding Datum and HFL vs. Chainage:-

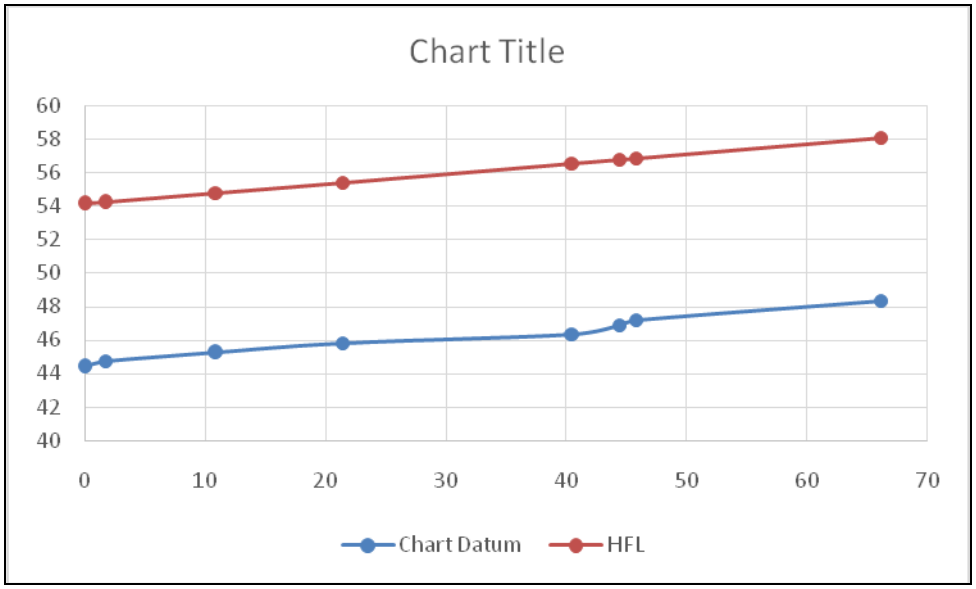


Figure 6- Graph: HFL vs Chainage

2.14 - Average Bed Slope:-

Reach		River / Canal Bed Level Change (m)	Distance (km)	Slope (m/km)	Slope (cm/km)
From	To				
0.00 km	1.716	0.318	1.716	0.185	18.531
1.717	10.997	0.522	9.28	0.056	5.625
10.998	21.383	0.583	10.385	0.056	5.614
21.384	30.472	0.511	9.088	0.056	5.623
30.473	40.541	0.566	10.068	0.056	5.622
40.542	49.90	0.298	4.536	0.066	6.570
Total			45.073	Avg-0.079	Avg-7.931

Table 6- Average bed slope

2.15 -Details of Dam, Barrages, Weirs, Anicut, etc. w.r.t. M.S.L:-

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

2.16 Details of Locks:-

There are no locks found in this zone of river.

2.17 Details of Aqueducts:-

There are no aqueducts found in this zone of River.

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

Sl. No	Chainage (km)	Location	Cross-Structure details	Latitude (N)	Longitude (E)	Northing	Easting	Length	Width	No. of Piers	Horizontal Clearance (m)	Vertical Clearance (m) w.r.t H.F.L	Remarks
1	5.658	Chandrapur village	Gobordhan RCC Bridge	26°14'38.45"	91°57'27.90"	2903134.084	395907.856	259.49	8.44	6	35.440	4.098	Complete
2	14.944	Kolongpar village	RCC Bridge	26°12'4.73"	92° 1'17.56"	2898347.686	402243.641	152.96	3.96	3	34.29	2.884	Complete
3	49.893	Bhakatgaon village	RCC Bridge	26°10'41.04"	92°13'5.34"	2895639.575	421871.674	173.4	4.55	6	24.990	3.329	Complete

Table 7 Details of Bridge

2.19 - 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.

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

Sl. no	Structure Name	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	HT Line	6.233	Chandrapur Village	26°14'20.11"	91°57'31.67"	396007.130	2902561.614	8	257.37	13.559	Complete
2	HT Line	7.036	Digaru Village	26°13'56.69"	91°57'33.61"	396055.07	2901839.90	8	214.67	11.628	Complete
3	Electrical Line	11.374	Barbila Village	26°12'35.03"	91°59'35.12"	399407.11	2899300.92	4	171.51	1.750	Complete
4	Electrical Line	18.728	Amgabi Village	26°12'2.02"	92° 2'37.35"	404456.93	2898247.08	4	144.03	1.820	Complete
5	Electrical Line	23.698	Etila Village	26°11'48.13"	92° 3'55.94"	406635.06	2897803.85	4	171.87	1.090	Complete
6	Electrical Line	31.135	Barpak Village	26°10'28.95"	92° 5'42.48"	409575.11	2895346.90	4	121.93	3.970	Complete
7	Electrical Line	32.333	Moliybari Village	26°10'17.84"	92° 6'23.88"	410722.03	2894997.14	4	144.0	2.025	Complete
8	Electrical Line	33.142	Moliybari Village	26°10'29.70"	92° 6'50.52"	411464.07	2895356.95	4	142.8	1.997	Complete
9	Electrical Line	36.438	Boha Village	26°10'10.90"	92° 8'14.37"	413787.91	2894762.90	4	128.01	2.420	Complete
10	Electrical Line	37.463	Gaurimuri Village	26° 9'48.54"	92° 8'42.06"	414552.09	2894069.92	4	167.37	1.890	Complete
11	Electrical Line	38.272	Atanoojari village	26° 9'46.39"	92° 9'8.04"	415272.93	2893999.04	4	167.13	1.900	Complete
12	Electrical Line	41.844	Barkuloi Village	26°10'12.10"	92°10'20.66"	417294.10	2894777.01	4	173.49	1.746	Complete
13	Electrical Line	47.435	Dimorguri Village	26°11'15.34"	92°12'37.33"	421100.01	2896698.95	4	133.12	2.035	Complete
14	Electrical Line	49.86	Bhakat Gaon	26°10'38.01"	92°13'4.74"	421853.91	2895545.90	4	163.58	2.035	Complete

Table 8-High Tension Line Details

2.21- Current Meter and Discharge Details:-

Stretch No.	Chainage (km)	Position				Observed Depth (m) (D)	Velocity (m/sec.)	Average Velocity (m/sec.)	X-Sectional area (sq. m.)	Discharge (Cu.m/sec)
		Latitude (N)	Longitude (E)	Easting (m)	Northing (m)		0.5 D			
1	14.949	26°12'04.223"	92°01'17.023"	402228.011	2898331.469	1.2	0.223	0.223	105.15	23.448
2	34.424	26°10'48.647"	92°07'39.473"	412826.912	2895930.651	1.8	0.185	0.185	329.43	60.944
3	49.803	26°10'37.04"	92°12'56.343"	421620.647	2895517.469	1.6	0.284	0.284	400.41	113.716

Table 9- Current Meter Details

2.22 - (a) Soil Sample Locations:-

Sample No.	Chainage (km)	Latitude (N)	Longitude (E)	Easting (m)	Northing (m)	Depth (m)
1	5.668	26°14'36.95"	91°57'26.344"	395863.408	2903080.165	3.74
2	14.949	26°12'04.223"	92°01'17.023"	402228.011	2898331.469	3.42
3	25.335	26°11'32.248"	92°04'45.088"	407995.713	2897305.481	4.97
4	34.424	26°10'48.647"	92°07'39.473"	412826.912	2895930.651	4.62
5	44.493	26°10'42.819"	92°11'03.22"	418481.541	2895714.598	7.91
6	49.803	26°10'37.04"	92°12'56.343"	421620.647	2895517.469	4.2

Table 10- Soil Sample Details

(b) Water Sample Locations:-

Sample No.	Chainage (km)	Latitude (N)	Longitude (E)	Easting (m)	Northing (m)	Total Depth (d) (m)	Mid-Depth (0.5d) (m)
1	5.668	26°14'36.95"	91°57'26.344"	395863.408	2903080.165	3.74	1.87
2	14.949	26°12'04.223"	92°01'17.023"	402228.011	2898331.469	3.42	1.71
3	25.335	26°11'32.248"	92°04'45.088"	407995.713	2897305.481	4.97	2.485
4	34.424	26°10'48.647"	92°07'39.473"	412826.912	2895930.651	4.62	2.31
5	44.493	26°10'42.819"	92°11'03.22"	418481.541	2895714.598	7.91	3.95
6	49.803	26°10'37.04"	92°12'56.343"	421620.647	2895517.469	4.2	2.1

Table 11-Water Sample Details

Section-3: Detailed Hydrographic Survey- Stretch Wise

Waterways Description:-

3.1 From Chainage. 0.00 Km to Chainage. 10.00 Km (Kaoli village to Refew Jibasti village)

Figure 7 Chainage 0.00 km to Chainage 10.00 km

The River width of Kopili River from Chainage 0.00 Km. to 10.00 Km is 140 m to 177m approximate width. The average width portion of the river is 140 m (approximately).

Kajoli Chowki village is situated at a distance of 815.52m approximate from Chainage 0.00 km approximate from the left side of the river. A RCC culvert is located on left side of the river bank near at Chainage of 5.472 km. The culvert location is (Lat-26°14'45.25"N, Long-85°57'32.92"E). The Gobordhan RCC Bridge is crossing over the river near at Chainage of 5.658 km, right side of the river .The bridge location is (Lat-26°14'38.45"N , Long-91°57'27.90"E). BM-1 is situated near at Chainage of 5.668 km. Chandrapur village is situated near at a distance of approximately 61.5m from the right side of the river and Right side of the river is located as a habitation area. The Most important things is Chandrapur Thermal Power Plant is located at a distance of approximately 56.72m from the right side of the river. Two irrigation canals are located near at Chainage of 0.768 km and 1.52 km at left bank side of the river and two irrigation canal are also located right side bank of the river near at Chainage of 3.442 Km.and 4.514 Km. The power plant location is 26°14'25.69"N, 91°57'22.33"E. After 90.54m (approx) is located another power plant. The power plant location is 26°14'10.53"N, 91°57'21.63"E. Digaru village is located right bank side of the river. Two high tension lines are situated near at Chainage of 6.223 km and 7.036 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	2.2	26.2	0	0	1.0	24.9	2000	3407.56
II	0.00	10.00	1.0	26.2	2000	12621.51	1.0	25.1	1200	7892.47
III	0.00	10.00	0.8	26.4	2000	27132.72	0.8	25.3	2200	18370.29
IV	0.00	10.00	0.6	26.4	2000	40060.22	0.6	25.3	1000	27270.08

Figure 8 Digaru Ghat (Chainage-4.600 km)

Figure 9 Gobordhon RCC bridge (Chainage-5.658 km)

3.2 From Chainage. 10.00 Km to Chainage. 20.00 Km (Refew Jibasti village to Hatimara village)

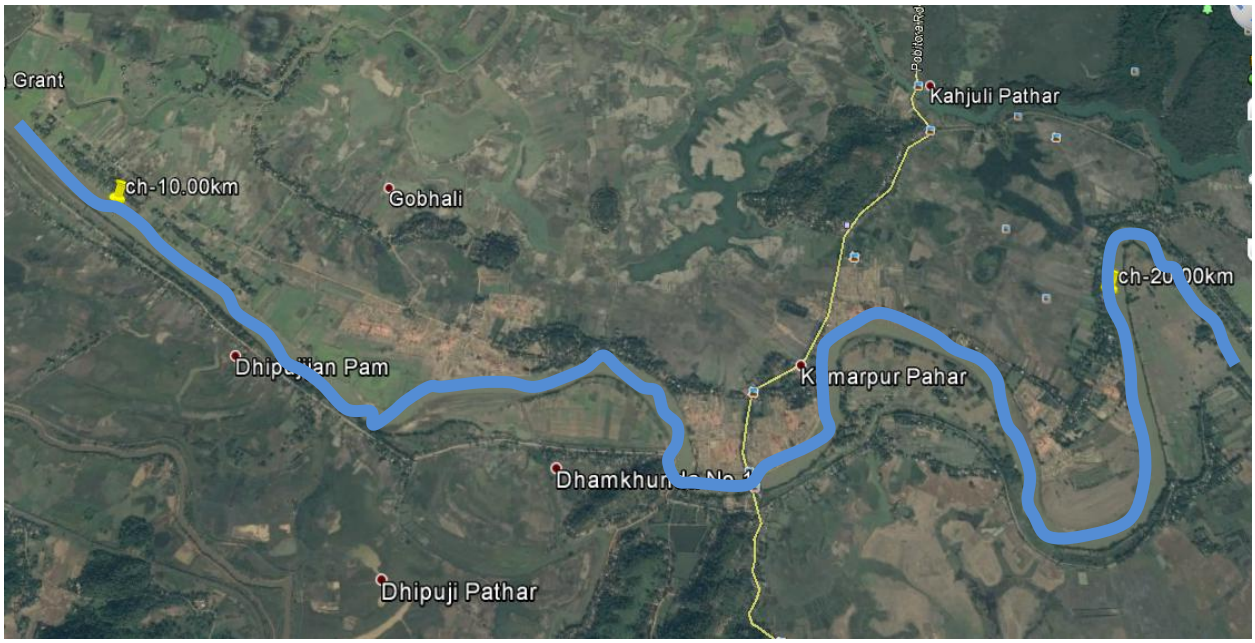


Figure 10 Chainage 10.00 km to Chainage 20.00 km

The River width of Kopili River from Chainage10.00 Km. to 20.00 Km is 80m to 120m approximate width. The average width portion of the river is 100m. BM- 2 is situated near at Chainage of 10.997 Km. where Kalang Bridge is situated near at Chainage 14.944 Km**.** The Bridge location is (Lat.-26°12'4.54"N, Long.- 92° 1'17.60"E)**.** Kolongpar village is located near about BM- 2; during the survey the surveyor noticed that both side of the river is located agricultural land. An irrigation canal is situated near at Chainage of 19.722 Km.

After at a distance of 386m, Kamarpur Pahar is located from the BM- 2, Near about Chainage 14.949 Km. Kamarpur Pahar, Pabitara, Changmari pathar, kahjuli Pathar villages are situated left bank side of the river and Kamarpur, Dhamkhanda, Thengbhanga villages are situated right bank side of the river. Two Electrical lines are situated near at Chainage of 11.374 km and 18.728 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	1.1	14.9	3500	5741.78	1.0	13.5	2200	7654.01
II	10.00	20.00	1.4	14.9	0.00	0.00	1.0	13.6	4200	16452.44
III	10.00	20.00	1.4	15.0	200	441.41	0.8	13.7	5300	38217.85
IV	10.00	20.00	0.8	15.0	800	1188.07	0.5	13.7	6500	55709.36

Figure 11 –Kalang RCC Bridge (Chainage- 14.944 km)

3.3 From Chainage 20.00 Km to Chainage. 30.00 Km (Hatimara village to Keourpur village)

Figure 12 Chainage 20.00 km to Chainage 30.00 km

The river width of Kopili River from Chainage 20.00 Km. to 30.00 Km is 82m to 105m approximate width .The average water portion of the river is 90 m.

During the survey, the surveyor noticed that from the Chainage 21.00 km, Diprang village is situated at a distance of 179.28m from the left side of the river bank. BM-3 is located near about Diprang village near at Chainage of 25.335 km. The pump house is located nearby river bank. Malabari village is situated at a distance of 66.78m from the left side of the river bank. Keourpara village is situated near about 22.548 km Chainage left side of the river. Barpak village is situated at a distance 168.39 m from the right side of the river, the bituminous road crossing Barpak village. One electrical line is situated near at Chainage of 23.698 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	20.00	30.00	1.6	14.3	0.00	0.00	1.3	13.1	0.00	0.00
II	20.00	30.00	1.3	14.3	200	205.55	1.2	13.4	1100	1174.66
III	20.00	30.00	1.2	14.6	1400	2606.27	1.0	13.7	4800	9583.77
IV	20.00	30.00	1.0	14.6	1300	3107.56	0.7	13.7	6800	21267.76

3.4 From Chainage 30.00 Km to Chainage. 40.00 Km (Keourpur village to Sankarpur village)

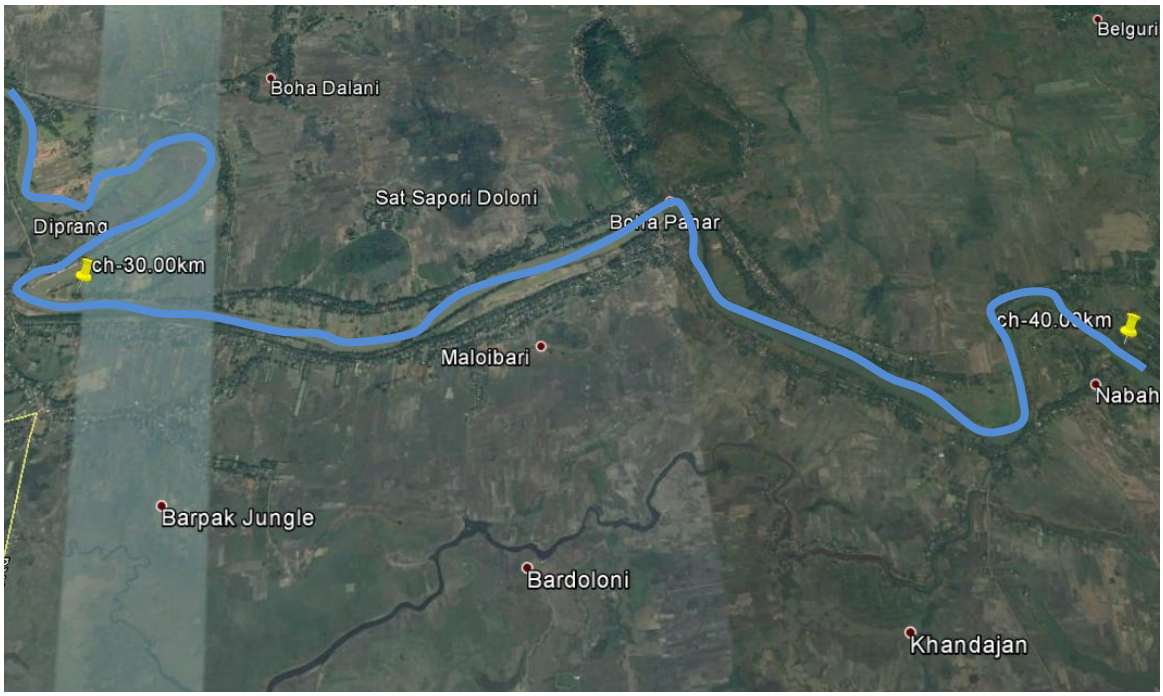


Figure 13 Chainage 30.00 km to Chainage 40.00 km

The river width of Kopili River from Chainage 30.00 Km. to 40.00 Km is 79m to 152m approximate width. The average width portion of the river is 90 m. From this Chainage, BM - 4 is located at near about Bordoloni village near at Chainage of 34.424 Km, left bank side of the river. One market which is known Boha market has been situated in this zone of river. Maloibari village is situated at a distance of approximately 37.500m from the left side of the river.

During the survey it was noticed that Boha Dalani village, Nakara Habi village, Kholoni Beel village, Kukuwari village, Hatigarh V.G.R village, Borkuloi Pathar, saru kuloi, Bornalani Pathar, Pabitara village, Buraburi village are situated at the left bank side of the river and Diprang village, Bangalbori, Khutradal, Nabahatia, Thengbhanga village, barpak jungle are situated right bank side of the river. During the survey, the surveyor seen one high-tension tower is situated near about 29.548 Km. Chainage. The height of the Electric pole is 5.6 m. Again near 30.548km Chainage is located one High-tension tower and 2 electric poles .The height of the poles are 5.8m.Nabahatia village is situated at a distance of 350.2m from the river. Sankarpur village is situated nearby left side of the river bank. Barkuloi village is situated 34.548 km Chainage, left side of the river bank. Six electrical lines are situated near at Chainage of 31.135 km, 32.333 km, 33.142 km, 36.438 km, 37.463 km and 38.272 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	30.00	40.00	1.6	11.4	0.0	0.00	1.0	10.2	1350	1271.44
II	30.00	40.00	1.4	11.4	0.0	0.00	1.0	10.4	3100	4561.93
III	30.00	40.00	1.2	11.6	200	33.15	0.9	10.6	5100	15382.32
IV	30.00	40.00	1.0	11.6	400	446.84	0.7	9.6	5800	29416.4

Figure 14 Boha Pahar

3.5 From Chainage 40.00 Km to Chainage 49.90 Km (Sankarpur village to Bhakat Gaon village)

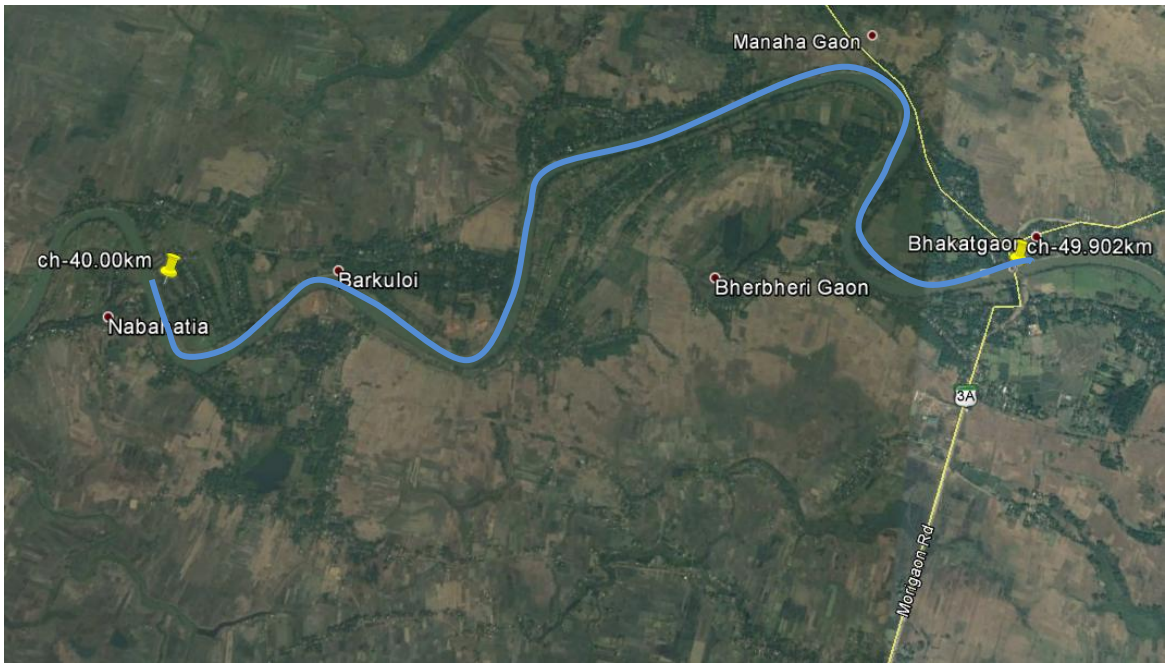


Figure 15 Chainage 40.00 km to 49.90 km

The river width of Kopili River from Chainage 40.00 Km. to 49.90 Km is 71m to 102 m approximate width. The average width portion of the river is 100m.

Sotabari village is situated nearby river bank. Saratpur pump house is located 41.5 km Chainage left side of the river bank and right side of the river bank is located one pump house. Dimorguri village is located at the right side of the river bank; which is known as agricultural land, mainly well produce for different rice. BM-5 is situated near at Chainage of 44.493 Km. from 43.00 km Chainage, it was noticed one high-tension tower and two electric poles are located which is 6m height. An RCC Bridge (from Bangthai-Gaon Road to Kumoi Gaon Road) is situated near at Chainage of 49.893 Km. The Bridge Location is (Lat. - 26°10'39.22"N, Long. - 92°13'6.10"E) Chatabori, Natun Bangalbori, Bherbheri Gaon, Baghjap, Bangthai Gaon are situated right bank side of the river and Belguri, Manaha Gaon, Bhakot Gaon are situated left bank side of the river. Tinali Bus stop is also located at the right side bank of the river beside the Bangthai gaon. Three electrical lines are situated near at Chainage of 41.844 km, 47.435 km and 49.86 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	40.00	49.90	1.6	10.8	0.00	0.00	1.4	9.2	0.00	0.00
II	40.00	49.90	1.3	10.8	300	133.76	1.3	9.4	0.00	0.00
III	40.00	49.90	1.0	11.0	2000	2220.36	1.0	9.6	900	939.59
IV	40.00	49.90	0.7	11.0	1400	3127.04	0.7	9.6	900	1399.9

Figure 16 RCC Bridge (Chainage- 49.893 km)

- **Bathymetry Survey:-**

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

The layer of water in the river Kopili is sufficient for carrying out the Bathymetric survey. The Length of the Bathymetric survey of the river is 0.00 km to 49.90 km. The layer of water is enough in this zone of river for the Bathymetry Survey.

Date of Survey	Type of survey	Chainage	
		From (km)	To (km)
14.10.15	Bathymetry Survey	0.00	7.228
06.10.15	Bathymetry Survey	7.228	20.493
05.10.15	Bathymetry Survey	20.493	35.097
04.10.15	Bathymetry Survey	35.097	49.90

- **Topographic Survey:-**

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

The Topography survey of Kopili River has been carried out from confluence with Brahmaputra River to Banthai Gaon Tinali Bus stop about to 0.00 km to 49.90 km.

a) Prominent Dams / Barrage:-

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

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

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

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

Kopili 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 Chainage 32.938 Km. to 45.95 Km. (Nepali Patti village to Bhakat Gaon village) the left bank side are protected by Bituminus Roads. Chainage 44.628 Km. to 45.95km (Bherbheri Gaon-Bangthai gaon) the right bank side are protected by bituminous road. From Chainage 16.628 Km. to 30.838 Km. (Hatimara village to Boha Boro Raji village) the left bank sides are also protected by roadside.

d) Hindrances - Hyacinth, rocks, rapid waterfalls, forest, wild-life sanctuary, security issues:

There are no rocks, wildlife sanctuary or Rapid waterfalls have been seen in this part of region.

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

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

f) Details of Protected Area- Wildlife Defence: -

The river Kopili is very close to border of India and Bhutan, so numbers of security clearance will be required for water ways development. The Additional Clearance may be required in the vicinity of the Orang Wild life sanctuary, Pobitora wildlife sanctuary and Laokhowa Wildlife Sanctuary.

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

The NH 15, NH 31, NH36, NH 37 A, NH 37, NH 40, NH 51, NH127E, NH62, NH44E, NH40, NH44. NH35, NH 54 are the major road which are close to the river Kopili.

h) Railway Line and Stations in the vicinity:-

There were no Railway line or railway stations in between Banthai Gaon Tinali Bus stop and Chandrapur district.

i) 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.

j) 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.

k) Availability of Bulk / Construction Material: -

There were numbers of cement factories and the brick fields are located and the sand is available from the river.

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

The Number of Industries are situated on the bank of the river, like cement, wood, and other small industries like small foundries are available. JDI Bricks industry is found near at Chainage of 42.184 km.The location of this industry is- (Lat.- 26° 9'59.56"N, Long. - 92°11'2.17"E).

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

Sl no	Chainage (Km)	Easting	Northing	Latitude (N)	Longitude (E)	Location	Extra Temporary Jetty for Cargo Transportation
1	42.184	418444.542	2894384.669	26° 9'59.56"	92°11'2.17"	Near JDI Bricks Industry	
2	45.500	419288.316	2896167.357	26°10'57.69"	92°11'32.17"	Chatabori	
3	5.100	395980.12	2903272.19	26°14'43.22"	91°57'30.49"	Chowalkhowa ghat	Permanent Jetty
4	7.666	395923.29	2901697.03	26°13'52.01"	91°57'28.89"	Digaru ghat	
5	34.753	412825.21	2895952.81	26°10'49.34"	92° 7'39.40"	Ganesh ghat	

n) Existing Cargo Movement: -

There are four numbers of ferry ghats are available in this zone of river. Chowalkgowa, Digaru, Barpak and Ganesh ferry ghats are located near at Chainage of 5.100 km, 7.666 km, 30.665 km, and 34.753 km. There are two temporary jetty ghats located for the cargo transportation near at Chainage of 42.184 km and 45.500 km respectively. The first jetty where the cargo transport is available located near at JDI Bricks Industry and the remaining one is located near at Chatabori area.

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

The Prominent cities situated near the bank of river kopili are Kamrup, Guwahati, Pabitara, Kamarpur pahar 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 Pobitora Wildlife Sanctuary, Jaintia Hill are also the famous Historical and Tourist places.

p) Availability of Passenger Ferry Services: -

There are Three Ferry services available in the Kopili River named Digaru Ghat near at Chainage of 0.843 Km. Barpak Ghat near at Chainage 23.908 Km. Gonash Ghat near at Chainage 26.781Km. Besides, Puja Ghat is also situated near at Chainage of 41.761Km.

Sl. No	Name of Ferry Ghat	Chainage (km)	Location	Easting	Northing	Latitude (N)	Longitude (E)
1	Chowalkgowa	5.100	Digaru market	395996.00	2903280.00	26°14'43.48"	91°57'31.06"
2	Digaru ghat	7.666	Kajali Chowki	396090.00	2901717.00	26°13'52.70"	91°57'34.90"
3	Barpak Ghat	30.665	Maloibari	409534.00	2895365.00	26°10'29.53"	92° 5'40.99"
4	Ganesh ghat	34.753	Borjari No-1	412923.00	2896023.00	26°10'51.67"	92° 7'42.91"

q) Available and probable Water Sport Recreational Facilities: -

No water sports and other facilities available in this river.

r) Proposed Terminal Locations with description: -

No Railway line or stations have been found near the bank side of the river.

s) Fishing activities:-

Kopili River is the lifeline of the people of Guwahati, Pabitara, and Kamarpur districts. Kopili provides diverse habitat in its downstream for living biota such as stream, riparian zones and wetlands etc. Kopili 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 Kopili is very famous among the people. The common fish at Kopili is the Golden Mahseer and some small fishes. Kopili 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 Kopili 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 three streams create a river basin in this zone of river: -

i) Gangadhar.

ii) Puthimari.

iii) Digaru River

v) Details of Irrigation Canals and Outlets:-

The Irrigation canals and outlets have been found near at Chainage of 0.808 Km, 1.508 Km. in the left bank side of the river and 3.468 Km., 4.518 Km. and 19.638 Km. right bank side of the river.

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

This RCC Bridge is situated near at Chainage of 49.893 Km.which is communicated between Bangthai Gaon to Kumoi Gaon. **.** The Bridge location is **(Lat.- 26°10'39.22", Long.- 92°13'6.10"E).**

The Name of the Bridge is Gobordhon RCC Bridge. This Bridge is located near the Chainage 1.706Km.This bridge location is **(Lat- 26°14'38.45"N**, **Long- 91°57'27.90"E)**. This Bridge is communicated between Narangi to Mauing Bazar.

This Bridge is located near at Chainage of 10.992Km**.** The Bridge location is **(Lat.-26°12'4.54"N, Long. - 92° 1'17.60"E).** This Bridge is communicated between Sonarpur to Kamarpur PHC.

Section 4: Terminals

There is no existing Terminal found in this zone of river.

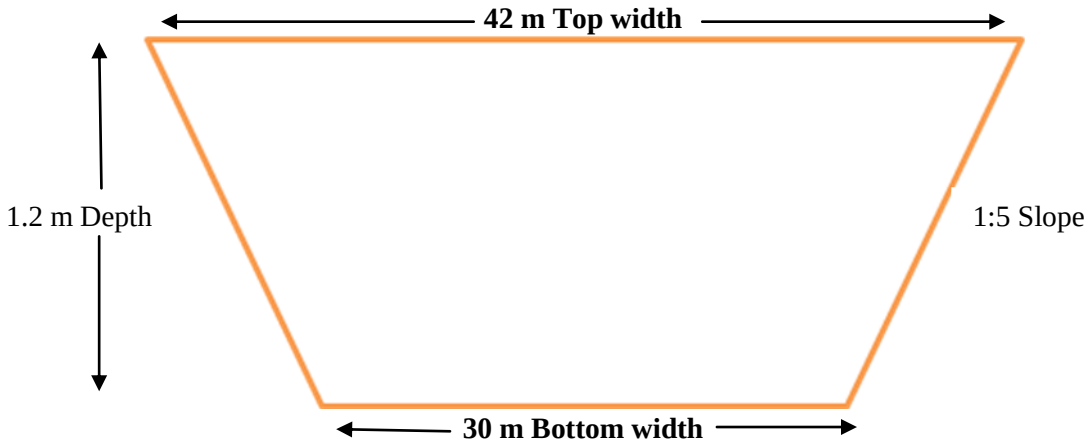
4.1 Details of Land use, owner etc.:-

The both side bank of the River Kopili used for 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)

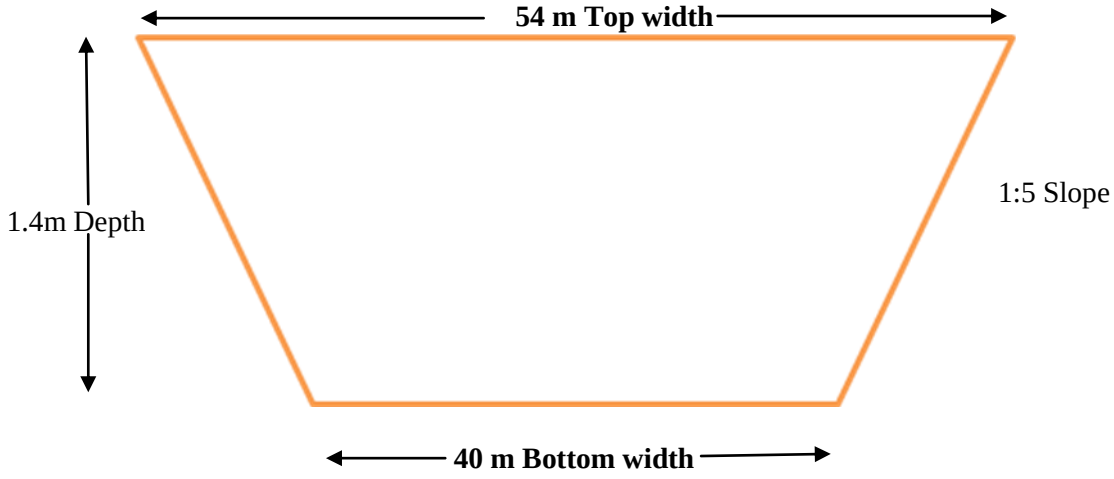
Class-I:- (Channel design: - Bottom width- 30 meter, Top width- 42 meter)



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)
Kaoli village	Refew Jibasti village	0.00	10.00	2.2	26.2	0	0	0	0	1.0	24.9	2000	0.05	3407.56	3407.56
Refew Jibasti village	Hatimara village	10.00	20.00	1.1	14.9	3500	0.05	5741.78	5741.78	1.0	13.5	2200	0.105	7654.01	11061.57
Hatimara village	Keourpara village	20.00	30.00	1.6	14.3	0.0	0	0	5741.78	1.3	13.1	0.0	0	0	11061.57
Keourpara village	Sankarpur village	30.00	40.00	1.6	11.4	0.0	0	0	5741.78	1.0	10.2	1350	0.03	1271.44	12333.01
Sankarpur village	Bhakatgaon village	40.00	49.90	1.6	10.8	0.0	0	0	5741.78	1.4	9.2	0.0	0	0	12333.01
Total						3500		5741.78		Total		5550		12333.01	

Table 12- Dredging Calculation of Class-I

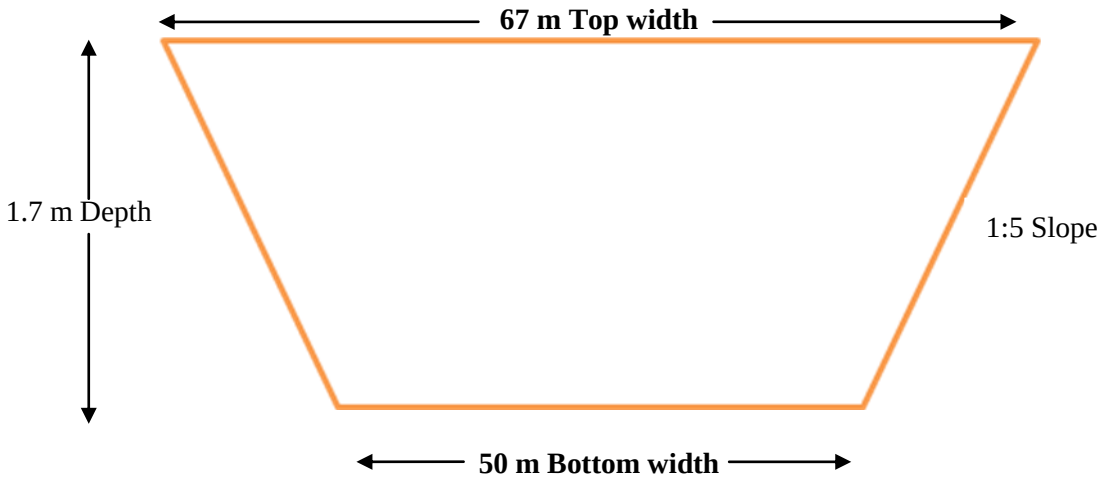
Class-II:- **(Channel design: - Bottom width- 40 meter, Top width- 54 meter)**



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)
Kaoli village	Refew Jibasti village	0.00	10.00	1.0	26.2	2000	0.143	12621.51	12621.51	1.0	25.1	1200	0.149	7892.47	7892.47
Refew Jibasti village	Hatimara village	10.00	20.00	1.6	14.9	0	0	0	12621.51	1.0	13.6	4200	0.08	16452.44	24344.91
Hatimara village	Keourpara village	20.00	30.00	1.3	14.3	200	0.02	205.55	12827.06	1.2	13.4	1100	0.03	1174.66	25519.57
Keour para village	Sankarpur village	30.00	40.00	1.4	11.4	0.0	0	0	12827.06	1	10.4	3100	0.04	4561.93	30081.5
Sankar pur village	Bhakat gaon village	40.00	49.90	1.3	10.8	300	0.01	133.76	12960.82	1.3	9.4	0.0	0	0	30081.5
Total						2500		12960.82		Total		9600		30081.5	

Table 13- Dredging Calculation of Class-II

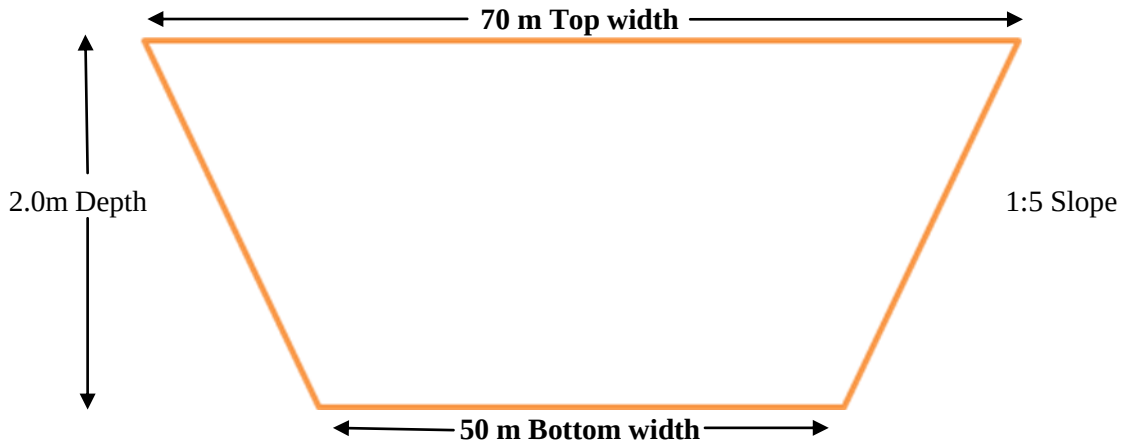
Class-III: - (Channel design: - Bottom width- 50 meter, Top width- 67 meter)



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)	MinDepth (m)	Max. Depth (m)	Length of Shoal (m)	Avg. Depth of cut (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Qty (cubic meter)
Kaoli village	Refew Jibasti village	0.00	10.00	0.8	26.4	2000	0.245	27132.72	27132.72	0.8	25.3	2200	0.151	18370.29	18370.29
Refew Jibasti village	Hatimara village	10.00	20.00	1.4	15.0	200	0.039	441.41	27574.13	0.8	13.7	5300	0.130	38217.85	56588.14
Hatimara village	Keourpara village	20.00	30.00	1.2	14.6	1400	0.033	2606.27	30180.4	1.0	13.7	4800	0.0789	9583.77	66171.91
Keourpara village	Sankarpur village	30.00	40.00	1.2	11.6	200	0.003	33.15	30213.55	0.9	10.6	5100	0.0546	15382.32	81554.23
Sankarpur village	Bhakatgaon village	40.00	49.90	1.4	11.0	2000	0.02	2220.36	32433.91	1.3	9.6	900	0.0189	939.59	82493.82
Total						5800		32433.91		Total		18300		82493.82	

Table 14- Dredging Calculation of 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)
Kaoli village	Refew Jibasti village	0.00	10.00	0.6	26.4	2000	0.364	40060.22	40060.22	0.6	25.3	2700	0.366	27270.08	27270.08
Refew Jibasti village	Hatimara village	10.00	20.00	0.8	15.0	800	0.053	1188.07	41248.29	0.5	13.7	6500	0.311	55709.36	82979.44
Hatimara village	Keourpara village	20.00	30.00	1.0	14.6	1300	0.086	3107.56	44355.85	0.7	13.7	6800	0.113	21267.76	104247.2
Keourpara village	Sankarpur village	30.00	40.00	1.0	11.6	400	0.040	446.84	44802.69	0.7	10.6	5800	0.184	29416.4	133663.6
Sankarpur village	Bhakat gaon village	40.00	49.90	0.7	11.0	2400	0.047	3127.04	47929.73	0.7	9.6	900	0.056	1399.9	135063.50
Total						6900		47929.73		Total		22700		135063.50	

Table 15- Dredging Calculation of Class-IV

Section 6: Conclusion:

The surveyed stretch of Kopili River is 49.90 km in length and was not explored for any navigational possibility in earlier time. As much as four major and minor ferry services were being operated along the survey stretch by private concerns. There are some major industries existed in the nearby area. The right bank of the river is moderately connected with roads and other infrastructures than the left bank. 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 Kopili. The river banks of entire stretch are covered with vegetation and beyond that cultivation is prominent. Encroachment was observed in some 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. Some important Railway stations- Dharamatul Railway station, Panbari Railway station, Sonuwabari Railway station are located near the river side. NH-36, NH-37, NH-40 are located also near the river side area.

Pabitara village and Pabitara wildlife sanctuary is located near the bank side of this river. Chandrapur Road Bridge is located near at Chainage of 0.00 km which is linked with pobitora Road. Gobordhon Grant village, Kajali chowki, Dhekiabari, Chengamari gaon etc. located near the bank side of the river. Kalang river bridge is located near the Kamarpur Pahar village which is linked with 3B sub road. An old bridge is situated near at Bhakatgaon village where Tinali Bus stop is located.

6.1 Dredging Summery

Class	As per Observed Soundings (Cubic meter)	As per Reduced Soundings (Cubic meter)
Class-I	5741.78	12333.01
Class-II	12960.82	30081.50
Class-III	32433.91	82493.82
Class-IV	47929.73	135063.50

Annexure:-

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

The Chart Datum value and HFL values of Dharamtul and Confluence with Brahmaputra River have been 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. (Cubic meter)	Cumulative Dredging Quantity (Cubic meter)
0	1	3.8	8.8	0	0	0	2.4	5.1	0	0	0
1	2	2.8	25.3	0	0	0	2.2	22.3	0	0	0
2	3	2.2	8.5	0	0	0	2.1	5.5	0	0	0
3	4	2.2	7.5	0	0	0	2.1	6.2	0	0	0
4	5	2.3	26.2	0	0	0	2.1	24.9	0	0	0
5	6	2.7	25.1	0	0	0	2	24.9	0	0	0
6	7	2.3	11.4	0	0	0	2	10.1	0	0	0
7	8	2.3	18.8	0	0	0	1	17.5	1000	996.25	996.25
8	9	2.7	8.5	0	0	0	1	7.2	1000	2411.31	3407.56
9	10	2.5	5.8	0	0	0	1.3	4.5	0	0	3407.56
10	11	2	4.9	0	0	0	1.1	4.6	100	79.71	3487.27
11	12	2	7.8	0	0	0	1.8	7.4	0	0	3487.27
12	13	1.1	14.9	150	369.83	369.83	1	13.5	1000	4011.24	7498.51
13	14	1.1	8.1	1000	1471.23	1841.06	1.1	7.5	1000	3360.07	10858.58
14	15	1.1	13.9	1000	1939.68	3780.74	1.2	12.2	0	0	10858.58
15	16	1.1	9.8	1000	1399.02	5179.76	1.2	9.2	0	0	10858.58
16	17	1	9.7	350	562.02	5741.78	1.2	6	0	0	10858.58
17	18	1.9	8.8	0	0	5741.78	1.4	8.2	0	0	10858.58
18	19	1.8	9.1	0	0	5741.78	1.5	8.2	0	0	10858.58
19	20	2	6.2	0	0	5741.78	1	4.8	100	202.99	11061.57
20	21	2.5	14.3	0	0	5741.78	1.3	13.1	0	0	11061.57
21	22	2.3	4.2	0	0	5741.78	1.3	3.9	0	0	11061.57
22	23	2.3	7.3	0	0	5741.78	1.4	3.8	0	0	11061.57
23	24	1.8	14.3	0	0	5741.78	1.4	12.4	0	0	11061.57
24	25	2.2	7.5	0	0	5741.78	1.4	6.3	0	0	11061.57
25	26	2.2	7.1	0	0	5741.78	1.7	6.9	0	0	11061.57
26	27	1.6	8.4	0	0	5741.78	1.4	7.2	0	0	11061.57
27	28	1.6	7.3	0	0	5741.78	1.4	7	0	0	11061.57
28	29	2.4	3.8	0	0	5741.78	1.7	3.3	0	0	11061.57

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)
29	30	2.2	12.1	0	0	5741.78	1.8	11.5	0	0	11061.57
30	31	2.1	4.5	0	0	5741.78	2.1	3.9	0	0	11061.57
31	32	2.2	7.1	0	0	5741.78	1.7	5.2	0	0	11061.57
32	33	2.1	7.1	0	0	5741.78	1.7	5.3	0	0	11061.57
33	34	2	3.9	0	0	5741.78	1.5	3.2	0	0	11061.57
34	35	2.5	11.4	0	0	5741.78	1.2	10.2	0	0	11061.57
35	36	2.2	6.8	0	0	5741.78	1.3	6.3	0	0	11061.57
36	37	2.2	4.2	0	0	5741.78	1	3.9	550	636.87	11698.44
37	38	2.7	7	0	0	5741.78	1.1	6.2	700	614.59	12313.03
38	39	1.8	7	0	0	5741.78	1.1	6.2	100	19.98	12333.01
39	40	1.6	7.3	0	0	5741.78	1.4	6.2	0	0	12333.01
40	41	1.6	9.4	0	0	5741.78	1.5	8.2	0	0	12333.01
41	42	1.9	8.5	0	0	5741.78	1.4	8	0	0	12333.01
42	43	2.2	10.4	0	0	5741.78	1.4	9.2	0	0	12333.01
43	44	1.8	7.2	0	0	5741.78	1.4	6.3	0	0	12333.01
44	45	2	7.8	0	0	5741.78	1.6	6.3	0	0	12333.01
45	46	2.3	4.8	0	0	5741.78	1.7	3.5	0	0	12333.01
46	47	2	6.9	0	0	5741.78	1.7	5.3	0	0	12333.01
47	48	2.1	9.7	0	0	5741.78	1.7	8.2	0	0	12333.01
48	49	2.2	10.8	0	0	5741.78	1.8	9.2	0	0	12333.01
49	49.9	1.9	8.4	0	0	5741.78	1.8	6.3	0	0	12333.01
Total				3500	5741.78		Total		5550	12333.01	

Table 16 Minimum & Maximum Depth 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	3.6	8.8	0	0	0	2.1	5.3	0	0	0
1	2	2.7	25.3	0	0	0	2	22.5	0	0	0
2	3	1.3	8.5	1000	1211.45	1211.45	2	5.6	0	0	0
3	4	1	7.5	1000	11410.06	12621.51	2.1	6.5	0	0	0
4	5	2.2	26.2	0	0	12621.51	2.1	25.1	0	0	0
5	6	2.6	26.2	0	0	12621.51	2	25.1	0	0	0
6	7	2.2	11.4	0	0	12621.51	2	10.3	0	0	0
7	8	2.2	18.8	0	0	12621.51	1	17.6	1000	2202.55	2202.55
8	9	2.5	8.5	0	0	12621.51	1	7.4	1000	5689.92	7892.47
9	10	2.4	5.8	0	0	12621.51	1.4	4.8	0	0	7892.47
10	11	1.7	4.9	0	0	12621.51	1.1	4.9	1000	1842.6	9735.07
11	12	1.8	7.8	0	0	12621.51	1.7	7.5	0	0	9735.07
12	13	2.1	14.9	0	0	12621.51	1	13.6	1000	7445.99	17181.06
13	14	1.8	8.1	0	0	12621.51	1.1	7.6	1000	5256.71	22437.77
14	15	2	13.9	0	0	12621.51	1.4	12.3	0	0	22437.77
15	16	1.8	9.8	0	0	12621.51	1.8	9.3	0	0	22437.77
16	17	2	9.7	0	0	12621.51	1.8	9.3	0	0	22437.77
17	18	1.6	6.8	0	0	12621.51	1.4	8.4	0	0	22437.77
18	19	1.6	9.1	0	0	12621.51	1.3	8.4	200	184.73	22622.5
19	20	1.8	6.2	0	0	12621.51	1	4.9	1000	1722.41	24344.91
20	21	2.2	14.3	0	0	12621.51	1.4	13.4	0	0	24344.91
21	22	2.2	4.2	0	0	12621.51	1.2	4.1	1000	1090.19	25435.1
22	23	2.2	7.3	0	0	12621.51	1.4	4.1	0	0	25435.1
23	24	1.6	14.3	0	0	12621.51	1.4	12.5	0	0	25435.1
24	25	2	7.5	0	0	12621.51	1.3	6.4	100	84.47	25519.57
25	26	2	7.1	0	0	12621.51	1.7	7	0	0	25519.57
26	27	1.3	8.4	200	205.55	12827.06	1.4	7.3	0	0	25519.57
27	28	2.1	7.3	0	0	12827.06	1.4	7.1	0	0	25519.57
28	29	2.2	3.8	0	0	12827.06	1.7	3.4	0	0	25519.57
29	30	1.9	12.1	0	0	12827.06	1.4	11.7	0	0	25519.57
30	31	2	4.5	0	0	12827.06	2	4.1	0	0	25519.57
31	32	2	7.1	0	0	12827.06	1.7	5.3	0	0	25519.57
32	33	1.9	7.1	0	0	12827.06	1.4	5.5	0	0	25519.57
33	34	1.9	3.9	0	0	12827.06	1.4	3.4	0	0	25519.57
34	35	2.2	11.4	0	0	12827.06	1.2	10.4	100	8.94	25528.51
35	36	2.1	6.8	0	0	12827.06	1.3	6.5	1000	1406.41	26934.92

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	2.1	4.2	0	0	12827.06	1	4	1000	2059.21	28994.13
37	38	2.4	7	0	0	12827.06	1.1	6.3	1000	1087.37	30081.5
38	39	1.7	7	0	0	12827.06	1.4	6.4	0	0	30081.5
39	40	1.4	7.3	0	0	12827.06	1.4	6.4	0	0	30081.5
40	41	1.3	9.4	100	31.9	12858.96	1.4	8.4	0	0	30081.5
41	42	1.3	8.5	200	101.86	12960.82	1.4	8.2	0	0	30081.5
42	43	1.4	10.4	0	0	12960.82	1.3	9.3	0	0	30081.5
43	44	1.5	7.2	0	0	12960.82	1.4	6.5	0	0	30081.5
44	45	1.8	7.8	0	0	12960.82	1.4	6.4	0	0	30081.5
45	46	2.1	4.8	0	0	12960.82	1.7	3.6	0	0	30081.5
46	47	1.9	6.9	0	0	12960.82	1.7	5.5	0	0	30081.5
47	48	1.9	9.7	0	0	12960.82	1.7	8.3	0	0	30081.5
48	49	1.9	10.8	0	0	12960.82	1.7	9.4	0	0	30081.5
49	49.902	1.7	8.4	0	0	12960.82	1.6	8.4	0	0	30081.5
Total				2500	12960.82				10400	30081.5	

Table 17 Minimum & Maximum Depth 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	3.3	9	0	0	0	2.1	5.5	0	0	0
1	2	2.6	25.5	0	0	0	2	22.7	0	0	0
2	3	1.2	8.6	1000	3253.36	3253.36	2	5.7	0	0	0
3	4	0.8	7.8	1000	23879.36	27132.72	2.1	6.8	0	0	0
4	5	2	26.4	0	0	27132.72	2	25.3	0	0	0
5	6	2.3	26.4	0	0	27132.72	2	25.3	0	0	0
6	7	2.1	11.6	0	0	27132.72	1.8	10.5	0	0	0
7	8	2.1	18.9	0	0	27132.72	0.8	17.7	1000	4230.84	4230.84
8	9	2.3	8.7	0	0	27132.72	0.8	7.6	1000	13715.95	17946.79
9	10	2.3	6.1	0	0	27132.72	1	5.1	200	423.5	18370.29
10	11	1.4	5.1	0	0	27132.72	0.9	5.2	1000	8893.85	27264.14
11	12	1.6	7.9	0	0	27132.72	1.6	7.6	100	134.4	27398.54
12	13	2	15	0	0	27132.72	0.9	13.7	1000	12970.43	40368.97
13	14	1.6	8.2	0	0	27132.72	1	7.7	1000	10273.42	50642.39
14	15	1.8	14.1	0	0	27132.72	1.3	12.4	100	0.03	50642.42
15	16	1.7	13.1	0	0	27132.72	1.7	9.4	0	0	50642.42
16	17	1.8	9.8	0	0	27132.72	1.7	9.4	0	0	50642.42
17	18	1.7	7	0	0	27132.72	1.1	8.6	100	10.57	50652.99
18	19	1.4	9.2	200	441.41	27574.13	1.1	8.6	1000	2421.21	53074.2
19	20	1.7	7.5	0	0	27574.13	0.8	5	1000	3513.94	56588.14
20	21	1.9	14.6	0	0	27574.13	1	13.7	100	35.63	56623.77
21	22	2.1	4.4	0	0	27574.13	1	4.4	1000	3997.3	60621.07
22	23	2.1	7.5	0	0	27574.13	1	4.4	1000	1197.11	61818.18
23	24	1.4	14.4	200	369.08	27943.21	1.1	12.6	500	898.74	62716.92
24	25	1.7	7.6	0	0	27943.21	1.1	6.5	1000	1263.04	63979.96
25	26	1.8	7.3	0	0	27943.21	1.7	7.1	0	0	63979.96
26	27	1.2	8.5	1000	2237.19	30180.4	1.2	7.4	100	252.02	64231.98
27	28	1.7	7.5	0	0	30180.4	1.2	7.2	1000	1939.91	66171.89
28	29	2	3.9	0	0	30180.4	1.7	3.5	0	0	66171.89
29	30	1.7	12.3	0	0	30180.4	1	11.9	100	0.02	66171.91
30	31	2	4.7	0	0	30180.4	2	4.3	0	0	66171.91
31	32	1.8	7.2	0	0	30180.4	1.7	5.4	0	0	66171.91
32	33	1.7	7.2	0	0	30180.4	1.7	5.7	0	0	66171.91
33	34	1.7	4	0	0	30180.4	1	3.6	100	23.93	66195.84
34	35	1.9	11.6	0	0	30180.4	1	10.6	1000	1804.85	68000.69
35	36	1.9	7	0	0	30180.4	1	6.7	1000	2783.1	70783.79
36	37	2	4.4	0	0	30180.4	0.9	4.2	1000	4700.91	75484.7
37	38	2.1	7.1	0	0	30180.4	1	6.4	1000	4606.87	80091.57

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)
38	39	1.6	7.3	100	17.79	30198.19	1	6.6	500	807.89	80899.46
39	40	1.2	7.5	100	15.36	30213.55	1.2	6.6	500	654.77	81554.23
40	41	1.4	9.6	1000	1015.49	31229.04	1.7	8.6	0	0	81554.23
41	42	1.3	8.7	200	463.05	31692.09	1.3	8.4	200	115.87	81670.1
42	43	1.5	10.5	100	20.23	31712.32	1.3	9.4	200	117.37	81787.47
43	44	1.4	7.4	100	15.16	31727.48	1.4	6.7	500	706.35	82493.82
44	45	1.6	7.9	100	0.08	31727.56	2	6.6	0	0	82493.82
45	46	1.8	4.9	0	0	31727.56	1.7	3.7	0	0	82493.82
46	47	1.8	7	0	0	31727.56	1.7	5.7	0	0	82493.82
47	48	1.7	9.8	0	0	31727.56	1.7	8.4	0	0	82493.82
48	49	1.6	11	500	706.35	32433.91	1.7	9.6	0	0	82493.82
49	49.9	1.7	8.6	0	0	32433.91	1.7	6.5	0	0	82493.82
Total				5600	32433.91				18300	82493.82	

Table 18 Minimum & Maximum Depth 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	3	9	0	0	0	2.1	5.5	0	0	0
1	2	2.3	25.5	0	0	0	2	22.7	0	0	0
2	3	1.1	8.6	1000	5012.82	5012.82	2	5.7	0	0	0
3	4	0.6	7.8	1000	35047.4	40060.22	2.1	6.8	0	0	0
4	5	2	26.4	0	0	40060.22	2	25.3	0	0	0
5	6	2	26.4	0	0	40060.22	1.7	25.3	100	13.15	13.15
6	7	2	11.6	0	0	40060.22	1.2	10.5	100	4.22	17.37
7	8	2	18.9	0	0	40060.22	0.6	17.7	1000	5826.2	5843.57
8	9	2	8.7	0	0	40060.22	0.6	7.6	1000	20601.04	26444.61
9	10	2.2	6.1	0	0	40060.22	0.7	5.1	500	825.47	27270.08
10	11	2	5.1	0	0	40060.22	0.6	5.2	1000	13101.4	40371.48
11	12	2	15	0	0	40060.22	1.2	7.6	500	978.93	41350.41
12	13	2	15	0	0	40060.22	0.8	13.7	1000	16816.01	58166.42
13	14	2.1	8.2	0	0	40060.22	0.8	7.7	1000	14895.04	73061.46
14	15	2	14.1	0	0	40060.22	1	12.4	500	827.59	73889.05
15	16	0.8	10.1	100	86.06	40146.28	1.2	9.4	200	248.37	74137.42
16	17	2	9.8	0	0	40146.28	1.2	9.4	100	52.23	74189.65
17	18	1	7	200	285.34	40431.62	0.8	8.6	200	250.64	74440.29
18	19	1.2	9.2	500	816.67	41248.29	0.8	8.6	1000	3250.84	77691.13
19	20	2	6.5	0	0	41248.29	0.6	5	1000	5288.31	82979.44
20	21	2	14.6	0	0	41248.29	0.7	13.7	200	407.59	83387.03
21	22	2	4.4	0	0	41248.29	0.7	4.4	1000	6804.83	90191.86
22	23	2	7.5	0	0	41248.29	0.7	4.4	1000	2774.77	92966.63
23	24	1.2	14.4	200	204	41452.29	0.9	12.6	1000	3783.97	96750.6
24	25	2	7.6	0	0	41452.29	0.8	6.5	1000	2622.72	99373.32
25	26	2	7.3	0	0	41452.29	2	7.1	0	0	99373.32
26	27	1	8.5	1000	2851.51	44303.8	1	7.4	500	637.03	100010.4
27	28	1	7.5	100	52.05	44355.85	0.9	7.2	1000	1785.86	101796.2
28	29	2	3.9	0	0	44355.85	1.1	3.5	100	31.52	101827.7
29	30	2	12.3	0	0	44355.85	0.7	11.9	1000	2419.45	104247.2
30	31	2	4.7	0	0	44355.85	2	4.3	0	0.98	104248.2
31	32	2	7.2	0	0	44355.85	2	5.4	0	0	104248.2
32	33	2	7.2	0	0	44355.85	1	5.7	200	324.45	104572.6
33	34	2	4	0	0	44355.85	0.7	3.6	500	709.98	105282.6
34	35	2	11.6	0	0	44355.85	0.7	10.6	1000	3592.67	108875.3
35	36	2	7	0	0	44355.85	0.7	6.7	1000	4153.47	113028.7

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	2	4.4	0	0	44355.85	0.8	4.2	1000	6489.31	119518
37	38	2	7.1	0	0	44355.85	1	6.4	1000	10045.3	129563.3
38	39	1.5	7.3	200	240.33	44596.18	1	6.6	600	2180.84	131744.2
39	40	1	7.5	200	206.51	44802.69	1.1	6.6	500	1919.41	133663.6
40	41	0.7	9.6	1000	1967.74	46770.43	0.7	8.6	100	19.2	133682.8
41	42	1.3	8.7	100	22.68	46793.11	1	8.4	200	352.91	134035.7
42	43	1.5	10.5	100	63.88	46856.99	1.2	9.4	100	3.24	134038.9
43	44	1.3	7.4	100	47.9	46904.89	1	6.7	500	1024.51	135063.5
44	45	1.4	7.9	100	0.33	46905.22	2	6.6	0	0	135063.5
45	46	2	4.9	0	0	46905.22	2	3.7	0	0	135063.5
46	47	2	7	0	0	46905.22	2	5.7	0	0	135063.5
47	48	2	9.8	0	0	46905.22	2	8.4	0	0	135063.5
48	49	1.3	11	1000	1024.51	47929.73	2	9.6	0	0	135063.5
49	49.9	2	8.6	0	0	47929.73	2	6.5	0	0	135063.5
Total				6900	47929.73				22700	135063.5	

Table 19- Minimum & Maximum Depth for Class –IV

Annexure-3 -Observed depth in 200 meter 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	4.2	7.9	4.1	7.9	4	8	3.9	8
200	4.1	8.8	3.9	8.8	3.7	9	3.5	9
400	3.9	4.9	3.6	4.9	3.3	5.2	3	5.2
600	4	4.5	3.7	4.5	3.4	4.8	3.1	4.8
800	3.8	5.1	3.6	5.1	3.4	5.3	3.2	5.3
1000	4.9	6.6	4.7	6.6	4.5	6.8	4.3	6.8
1200	3.8	7.1	3.7	7.1	3.6	7.2	3.5	7.2
1400	2.8	10.4	2.7	10.4	2.6	10.5	2.5	10.5
1600	3.1	25.3	2.9	25.3	2.7	25.5	2.5	25.5
1800	3.2	17.1	2.9	17.1	2.6	17.4	2.3	17.4
2000	2.9	6.2	2.8	6.2	2.7	6.3	2.6	6.3
2200	2.3	6.1	2	6.1	1.9	6.2	1.8	6.2
2400	5.2	7.5	5	7.5	4.8	7.7	4.6	7.7
2600	4.4	8.5	4.3	8.5	4.2	8.6	4.1	8.6
2800	2.3	3.3	1.3	3.3	1.2	3.4	1.1	3.4
3000	2.2	3.5	1.9	3.5	1.8	3.6	1.7	3.6
3200	2.2	4	1	4	0.8	4.2	0.6	4.2
3400	2.8	4.4	2.7	4.4	2.6	4.5	2.5	4.5
3600	3.4	4.9	3.3	4.9	3.2	5	3.1	5
3800	3.5	6.9	3.3	6.9	3.1	7.1	2.9	7.1
4000	3.4	7.5	3.1	7.5	2.8	7.8	2.5	7.8
4200	4.2	7.7	4.1	7.7	4	7.8	3.9	7.8
4400	3.3	8.5	3.2	8.5	3.1	8.6	3	8.6
4600	2.3	7.3	2	7.3	2	7.5	2	7.5
4800	3	9	2.9	9	2.8	9.1	2.7	9.1
5000	5.4	26.2	5.2	26.2	5	26.4	4.8	26.4
5200	2.9	25.1	2.6	25.1	2.3	25.1	2	25.1
5400	2.7	6.9	2.6	6.9	2.5	7	2.4	7
5600	3	9.8	2.9	9.8	2.8	9.9	2.7	9.9
5800	3.4	3.9	3.2	3.9	3	4.1	2.8	4.1
6000	3.8	4.1	3.7	4.1	3.6	4.2	3.5	4.2
6200	4	5	3.9	5	3.8	5.1	3.7	5.1
6400	2.3	6.9	2.2	6.9	2.1	7	2	7
6600	3.8	11.4	3.6	11.4	3.4	11.6	3.2	11.6
6800	4	9.1	3.9	9.1	3.8	9.2	3.7	9.2
7000	2.3	6.8	2.2	6.8	2.1	6.9	2	6.9
7200	3.8	6.6	3.6	6.6	3.4	6.8	3.2	6.8
7400	3.2	17	2.9	17	2.6	17.3	2.3	17.3
7600	4.3	18.8	4.2	18.8	4.1	18.9	4	18.9
7800	3.5	17	3.4	17	3.3	17.1	3.2	17.1
8000	2.7	8.5	2.5	8.5	2.3	8.7	2.1	8.7
8200	2.9	8.5	2.8	8.5	2.7	8.6	2.6	8.6

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Observed		Observed		Observed		Observed	
	Min	Max	Min	Max	Min	Max	Min	Max
8400	3.1	8.1	3	8.1	2.9	8.2	2.8	8.2
8600	2.7	6.4	2.5	6.4	2.3	6.6	2.1	6.6
8800	2.9	5.8	2.6	5.8	2.3	6.1	2	6.1
9000	3.3	5.8	3	5.8	2.7	6.1	2.4	6.1
9200	3.8	5.7	3.6	5.7	3.4	5.9	3.2	5.9
9400	3	5.2	2.8	5.2	2.6	5.4	2.4	5.4
9600	3.4	4.8	3.3	4.8	3.2	4.9	3.1	4.9
9800	2.5	5.1	2.4	5.1	2.3	5.2	2.2	5.2
10000	3.6	4.8	3.5	4.8	3.4	4.9	3.3	4.9
10200	2.4	4.9	2.2	4.9	2	5.1	2	5.1
10400	2.2	4.8	2	4.8	2	5.1	2	5.1
10600	2	4.7	2	4.7	2	5	2	5
10800	2.9	4.8	2.7	4.8	2.5	5	2.3	5
11000	3	4.8	2.8	4.8	2.6	5	2.4	5
11200	2.1	5	2	5	2	5.1	2	5.1
11400	2.9	5.8	2.8	5.8	2.7	5.9	2.6	5.9
11600	2	5.8	2	5.8	2	6	2	6
11800	3.4	5.9	3.1	5.9	2.8	6.2	2.5	6.2
12000	2.2	7.8	2.1	7.8	2	7.9	2	7.9
12200	2.7	14.9	2.6	14.9	2.5	15	2.4	15
12400	2.4	7.8	2.2	7.8	2	8	2	8
12600	2.8	7.4	2.7	7.4	2.6	7.5	2.5	7.5
12800	3.1	4.7	3	4.7	2.9	4.8	2.8	4.8
13000	2.2	5.5	2.1	5.5	2	5.6	2	5.6
13200	2	6.1	2	6.1	2	6.3	2	6.3
13400	3.2	8.1	3.1	8.1	3	8.2	2.9	8.2
13600	2.1	8	2	8	2	8.1	2	8.1
13800	3.7	8	3.5	8	3.3	8.2	3.1	8.2
14000	2.8	6.2	2.5	6.2	2.2	6.5	2.1	6.5
14200	2.4	5.3	2.3	5.3	2.2	5.4	2.1	5.4
14400	2.2	5.1	2.1	5.1	2	5.2	2	5.2
14600	2.7	13.9	2.5	13.9	2.3	14.1	2.1	14.1
14800	3.2	7.6	3.1	7.6	3	7.7	2.9	7.7
15000	2.2	8.4	2	8.4	2	8.6	2	8.6
15200	1.1	9.8	1.1	9.8	0.8	10.1	0.5	10.1
15400	2.6	8.1	2.5	8.1	2.4	8.2	2.3	8.2
15600	3.4	9	3.3	9	3.2	9.1	3.1	9.1
15800	3	7.8	2.8	7.8	2.6	8	2.4	8
16000	2.3	8.5	2.2	8.5	2.1	8.6	2	8.6
16200	4.8	9.7	4.7	9.7	4.6	9.8	4.5	9.8
16400	2.2	6.3	2.1	6.3	2	6.4	2	6.4
16600	2.2	5.8	2	5.8	2	6	2	6
16800	2.8	6.3	2.7	6.3	2.6	6.4	2.5	6.4

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Observed		Observed		Observed		Observed	
	Min	Max	Min	Max	Min	Max	Min	Max
17000	3.7	5.7	3.6	5.7	3.5	5.8	3.4	5.8
17200	3.8	6	3.6	6	3.4	6.2	3.2	6.2
17400	1.9	5.5	1.6	5.5	1.3	5.8	1	5.8
17600	2	3.6	1.9	3.6	1.8	3.7	1.7	3.7
17800	3	4.3	2.9	4.3	2.8	4.4	2.7	4.4
18000	2.4	8.8	2.2	8.8	2	8.8	1.8	8.8
18200	2.5	9.1	2.4	9.1	2.3	9.2	2.2	9.2
18400	3.1	6.2	3	6.2	2.9	6.3	2.8	6.3
18600	1.8	5.8	1.6	5.8	1.4	6	1.2	6
18800	3.2	5.5	2.9	5.5	2.6	5.8	2.3	5.8
19000	2.5	6.2	2.2	6.2	2.1	6.5	2	6.5
19200	3.4	2.1	3.2	2.1	3	2.3	2.8	2.3
19400	2	2.6	2	2.6	2	2.8	2	2.8
19600	3.3	2.8	3.2	2.8	3.1	2.9	3	2.9
19800	3	3	2.9	3	2.8	3.1	2.7	3.1
20000	3	5	2.9	5	2.8	5.1	2.7	5.1
20200	3.2	4.1	3	4.1	2.8	4.3	2.6	4.3
20400	2.8	3.7	2.5	3.7	2.2	4	2.1	4
20600	2.5	14.3	2.2	14.3	2.1	14.6	2	14.6
20800	2.8	7.5	2.5	7.5	2.2	7.8	2.1	7.8
21000	3.7	4.1	3.4	4.1	3.1	4.4	2.8	4.4
21200	3	4	2.8	4	2.6	4.2	2.4	4.2
21400	2.5	3.9	2.3	3.9	2.1	4.1	2	4.1
21600	2.5	3.5	2.4	3.5	2.3	3.6	2.2	3.6
21800	2.3	4.1	2.2	4.1	2.1	4.2	2	4.2
22000	2.8	4.2	2.6	4.2	2.4	4.4	2.2	4.4
22200	2.7	4	2.4	4	2.1	4.3	2	4.3
22400	2.3	2.9	2.2	2.9	2.1	3	2	3
22600	2.5	2.9	2.4	2.9	2.3	3	2.2	3
22800	3	7.3	2.8	7.3	2.6	7.5	2.4	7.5
23000	4.1	5.4	4	5.4	3.9	5.5	3.8	5.5
23200	2.1	14.3	2	14.3	1.9	14.4	1.8	14.4
23400	2.6	6.3	2.5	6.3	2.4	6.4	2.3	6.4
23600	1.8	3.1	1.6	3.1	1.4	3.3	1.2	3.3
23800	2.7	4.1	2.6	4.1	2.5	4.2	2.4	4.2
24000	2.2	5.1	2.1	5.1	2	5.2	2	5.2
24200	2.8	3.5	2.6	3.5	2.4	3.7	2.2	3.7
24400	2.3	3.7	2	3.7	2	4	2	4
24600	3.2	5.5	3.1	5.5	3	5.6	2.9	5.6
24800	5.1	7.5	5	7.5	4.9	7.6	4.8	7.6
25000	2.5	7.1	2.3	7.1	2.1	7.3	2.1	7.3
25200	2.9	2.6	2.8	2.6	2.7	2.7	2.6	2.7
25400	2.2	3.8	2	3.8	2	4	2	4

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Observed		Observed		Observed		Observed	
	Min	Max	Min	Max	Min	Max	Min	Max
25600	3.2	6	2.9	6	2.6	6.3	2.3	6.3
25800	3.3	6.1	3.2	6.1	3.1	6.2	3	6.2
26000	4.7	7.1	4.6	7.1	4.5	7.2	4.4	7.2
26200	2.9	7.3	2.7	7.3	2.5	7.5	2.3	7.5
26400	3.4	6.3	3.3	6.3	3.2	6.4	3.1	6.4
26600	2.8	3.3	2.7	3.3	2.6	3.4	2.5	3.4
26800	2.1	8.4	2	8.4	1.9	8.5	1.8	8.5
27000	1.6	3	1.3	3	1.2	3.2	1	3.2
27200	2.1	6.8	2	6.8	1.9	6.9	1.8	6.9
27400	2.2	7.2	2.1	7.2	2	7.3	1.9	7.3
27600	2.4	7.3	2.2	7.3	2	7.5	1.8	7.5
27800	1.9	5.9	1.6	5.9	1.3	6.2	1	6.2
28000	3.3	3.8	3.2	3.8	3.1	3.9	3	3.9
28200	2.7	3	2.6	3	2.5	3.1	2.4	3.1
28400	2.8	3.2	2.6	3.2	2.4	3.4	2.2	3.4
28600	2.8	3.6	2.7	3.6	2.6	3.7	2.5	3.7
28800	3.7	3.7	3.6	3.7	3.5	3.8	3.4	3.8
29000	2.4	3.3	2.2	3.3	2	3.5	2	3.5
29200	2.9	3.5	2.6	3.5	2.3	3.8	2	3.8
29400	2.2	7.1	2.1	7.1	2	7.4	2	7.4
29600	2.2	12.1	2	12.1	2	12.3	2	12.3
29800	3.7	4.8	3.6	4.8	3.5	4.9	3.4	4.9
30000	3.6	3.3	3.4	3.3	3.2	3.5	3	3.5
30200	3.7	3.6	3.4	3.6	3.1	3.9	2.8	3.9
30400	3.2	3.8	2.9	3.8	2.6	4.1	2.3	4.1
30600	2.1	4.5	2	4.5	2	4.7	2	4.7
30800	2.7	3.5	2.5	3.5	2.3	3.7	2.1	3.7
31000	3	4.2	2.9	4.2	2.8	4.3	2.7	4.3
31200	2.7	3.8	2.6	3.8	2.5	3.9	2.4	3.9
31400	2.2	4.3	2	4.3	2	4.5	2	4.5
31600	3	4.2	2.7	4.2	2.4	4.5	2.1	4.5
31800	2.9	5.1	2.8	5.1	2.7	5.2	2.6	5.2
32000	2.5	7.1	2.4	7.1	2.3	7.2	2.2	7.2
32200	2.4	7	2.2	7	2	7.2	2	7.2
32400	2.2	6.2	2.1	6.2	2	6.3	2	6.3
32600	2.1	4.5	2	4.5	2	4.6	2	4.6
32800	2.9	2.9	2.8	2.9	2.7	3	2.6	3
33000	2.1	3.5	2	3.5	2	3.7	2	3.7
33200	2	3.9	2	3.9	2	4	2	4
33400	2.2	3.2	2.1	3.2	2	3.3	2	3.3
33600	2.4	3.8	2.2	3.8	2	4	2	4
33800	2.4	3.5	2.1	3.5	2	3.8	2	3.8
34000	3	3.2	2.9	3.2	2.8	3.3	2.7	3.3

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Observed		Observed		Observed		Observed	
	Min	Max	Min	Max	Min	Max	Min	Max
34200	2.7	2.9	2.6	2.9	2.5	3	2.4	3
34400	3.1	2.5	2.9	2.5	2.7	2.7	2.5	2.7
34600	3.7	3.7	3.6	3.7	3.5	3.8	3.4	3.8
34800	2.8	11.4	2.6	11.4	2.4	11.6	2.2	11.6
35000	2.5	4.3	2.2	4.3	2.1	4.6	2	4.6
35200	2.4	4.5	2.3	4.5	2.2	4.6	2.1	4.6
35400	3.1	4.7	3	4.7	2.9	4.8	2.8	4.8
35600	2.8	6.8	2.6	6.8	2.4	7	2.2	7
35800	2.2	6.1	2.1	6.1	2	6.2	2	6.2
36000	2.8	4.2	2.7	4.2	2.6	4.3	2.5	4.3
36200	2.3	3.8	2.2	3.8	2.1	3.9	2	3.9
36400	2.6	4.2	2.4	4.2	2.2	4.4	2	4.4
36600	2.3	4	2.2	4	2.1	4.1	2	4.1
36800	2.2	4	2.1	4	2	4.1	2	4.1
37000	3.8	4.1	3.6	4.1	3.4	4.3	3.2	4.3
37200	2.7	3.3	2.4	3.3	2.1	3.6	2	3.6
37400	3.1	3.1	3	3.1	2.9	3.2	2.8	3.2
37600	3.8	2.9	3.7	2.9	3.6	3	3.5	3
37800	2.8	5.8	2.6	5.8	2.4	6	2.2	6
38000	3.5	7	3.4	7	3.3	7.1	3.2	7.1
38200	1.8	4.9	1.7	4.9	1.6	5	1.5	5
38400	2.9	3.4	2.7	3.4	2.5	3.6	2.3	3.6
38600	2.5	7	2.2	7	1.9	7.3	1.6	7.3
38800	4.4	5.5	4.1	5.5	3.8	5.8	3.5	5.8
39000	2.8	6.8	2.6	6.8	2.4	7	2.2	7
39200	1.6	7.3	1.4	7.3	1.2	7.5	1	7.5
39400	3.1	7	3	7	2.9	7.1	2.8	7.1
39600	2.3	3.1	2.2	3.1	2.1	3.2	2	3.2
39800	2.5	3.8	2.4	3.8	2.3	3.9	2.2	3.9
40000	2.8	3.7	2.6	3.7	2.4	3.9	2.2	3.9
40200	1.6	4.4	1.3	4.4	1	4.7	0.7	4.7
40400	3.7	8	3.4	8	3.1	8.3	2.8	8.3
40600	2.6	9.4	2.4	9.4	2.2	9.6	2	9.6
40800	3	4.1	2.8	4.1	2.6	4.3	2.4	4.3
41000	3.7	4.2	3.6	4.2	3.5	4.3	3.4	4.3
41200	1.9	5	1.3	5	1.3	5.1	1.3	5.1
41400	2.4	8.5	2.2	8.5	2	8.7	1.8	8.7
41600	3.2	7.4	2.9	7.4	2.6	7.7	2.3	7.7
41800	2.8	5.7	2.7	5.7	2.6	5.8	2.5	5.8
42000	2.5	3.5	2.4	3.5	2.3	3.6	2.2	3.6
42200	2.9	2.8	2.7	2.8	1.5	3	1.5	3
42400	3	2.9	2.9	2.9	2.8	3	2.7	3
42600	2.7	3.3	2.6	3.3	2.5	3.4	2.4	3.4

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Observed		Observed		Observed		Observed	
	Min	Max	Min	Max	Min	Max	Min	Max
42800	2.2	10.4	2.1	10.4	2	10.5	1.9	10.5
43000	2.7	7.2	2.5	7.2	2.3	7.4	2.1	7.4
43200	2.2	3.7	2.1	3.7	2	3.8	1.9	3.8
43400	2.7	3.7	2.6	3.7	2.5	3.8	2.4	3.8
43600	2.2	3.1	2	3.1	1.8	3.3	1.6	3.3
43800	1.8	3.8	1.5	3.8	1.2	4.1	0.9	4.1
44000	3.4	3.3	3.3	3.3	3.2	3.4	3.1	3.4
44200	2.2	7.8	2.1	7.8	2	7.9	1.9	7.9
44400	2	6.8	1.8	6.8	1.6	7	1.4	7
44600	3.1	3.9	3	3.9	2.9	4	2.8	4
44800	2.2	3.5	2	3.5	1.8	3.7	1.6	3.7
45000	2.4	3.1	2.1	3.1	1.8	3.4	1.5	3.4
45200	2.3	3.3	2.2	3.3	2.1	3.4	2	3.4
45400	2.9	3.1	2.8	3.1	2.7	3.2	2.6	3.2
45600	2.8	3.8	2.6	3.8	2.4	4	2.2	4
45800	2.7	3.8	2.6	3.8	2.5	3.9	2.4	3.9
46000	3	4.8	2.9	4.8	2.8	4.9	2.7	4.9
46200	2.1	4.5	2	4.5	1.9	4.6	1.8	4.6
46400	3	4.3	2.8	4.3	2.6	4.5	2.4	4.5
46600	2	5.8	2	5.8	2	5.9	2	5.9
46800	3.1	6.9	3	6.9	2.9	7	2.8	7
47000	2.9	4.5	2.7	4.5	2.5	4.7	2.3	4.7
47200	3.2	9.1	2.9	9.1	2.6	9.4	2.3	9.4
47400	2.4	9.7	2.3	9.7	2.2	9.8	2.1	9.8
47600	2.7	5.8	2.6	5.8	2.5	5.9	2.4	5.9
47800	2.1	5.5	2	5.5	2	5.7	2	5.7
48000	2.4	4.8	2.3	4.8	2.2	4.9	2.1	4.9
48200	3.2	6.1	3.1	6.1	3	6.2	2.9	6.2
48400	2.7	10.8	2.5	10.8	2.3	11	2.1	11
48600	2.2	8.8	1.9	8.8	1.6	9.1	1.3	9.1
48800	3.2	9.1	2.9	9.1	2.6	9.4	2.3	9.4
49000	3.8	8.4	3.6	8.4	3.4	8.6	3.2	8.6
49200	2.1	5.8	1.9	5.8	1.7	6	1.5	6
49400	2	5.4	1.9	5.4	1.8	5.5	1.7	5.5
49600	2.1	4.8	2	4.8	1.9	4.9	1.8	4.9
49800	2	6.5	1.9	6.5	1.8	6.6	1.7	6.6
49.900.00	1.9	6.7	1.7	6.7	1.5	6.9	1.3	6.9

Table 20-200 meter interval observed depth calculation

Annexure-4-Reduced Depth in 200 meter 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	2.9	5.1	2.1	5.2	2.1	5.3	2.1	5.3
200	2.8	5.1	2.3	5.3	2.3	5.5	2.3	5.5
400	2.4	3	2.1	3.3	2.1	3.6	2.1	3.6
600	2.7	3.1	2.2	3.4	2.2	3.7	2.2	3.7
800	2.5	3.3	2.1	3.5	2.1	3.7	2.1	3.7
1000	3	4.7	2.1	4.9	2.1	5.1	2.1	5.1
1200	2.8	5.7	2.2	5.8	2.2	5.9	2.2	5.9
1400	2.5	10	2.1	10.1	2.1	10.2	2.1	10.2
1600	2.2	22.3	2.1	22.5	2.1	22.7	2.1	22.7
1800	2.5	15.8	2.2	16.1	2.2	16.4	2.2	16.4
2000	3.5	4.5	2	4.6	2	4.7	2	4.7
2200	2.7	4.1	2.3	4.2	2.3	4.3	2.3	4.3
2400	2.2	4.3	2.1	4.5	2.1	4.7	2.1	4.7
2600	2.1	5.5	2	5.6	2	5.7	2	5.7
2800	2.1	2.4	2.1	2.5	2.1	2.6	2.1	2.6
3000	2.1	2.2	2.1	2.3	2.1	2.4	2.1	2.4
3200	2.1	2.4	2.1	2.6	2.1	2.8	2.1	2.8
3400	2.1	3	2.1	3.1	2.1	3.2	2.1	3.2
3600	2.2	2.7	2.1	2.8	2.1	2.9	2.1	2.9
3800	2.3	4.2	2.2	4.4	2.2	4.6	2.2	4.6
4000	2.2	6.2	2.1	6.5	2.1	6.8	2.1	6.8
4200	2.1	7	2.1	7.1	2.1	7.2	2.1	7.2
4400	2.2	7.2	2.1	7.3	2.1	7.4	2.1	7.4
4600	2.1	7.1	2.1	7.3	2.1	7.5	2.1	7.5
4800	2.3	8.2	2.2	8.3	2.2	8.4	2.2	8.4
5000	2.2	24.9	2.1	25.1	2	25.3	1.8	25.3
5200	3.9	17.2	2.5	15	2.2	15.3	2.2	15.3
5400	2	5.8	2	5.9	2	6	1.8	6
5600	3.4	8.5	2.6	8.6	2.1	8.7	1.9	8.7
5800	2.3	2.5	2.1	2.7	2	2.9	1.7	2.9
6000	2.1	2.6	2	2.7	2	2.8	1.8	2.8
6200	2.2	3.8	2.1	3.9	1.8	4	1.2	4
6400	2	5.8	2	5.9	1.8	6	1.8	6
6600	2.4	10.1	2.2	10.3	1.9	10.5	1.7	10.5
6800	2.1	7.8	2.1	7.9	2	8	1.3	8
7000	2	5.8	2	5.9	1.9	6	1.8	6
7200	1	5.8	1	6	0.8	6.2	0.6	6.2
7400	2.5	12.3	2.1	12.6	1.8	12.9	1.5	12.9
7600	2.4	17.5	1.2	17.6	1.1	17.7	1	17.7

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Reduced		Reduced		Reduced		Reduced	
	Min	Max	Min	Max	Min	Max	Min	Max
7800	3	12.9	2.1	13	2	13.1	1.9	13.1
8000	2.5	7.2	2.1	7.4	1.9	7.6	1.7	7.6
8200	2	7.2	2	7.3	1.9	7.4	1.8	7.4
8400	2.5	6.1	2.1	6.2	2	6.3	1.9	6.3
8600	1	4.8	1	5	0.8	5.2	0.6	5.2
8800	2.1	4.9	1.4	5.2	1.1	5.5	0.8	5.5
9000	2	4.5	1.3	4.8	1	5.1	0.7	5.1
9200	2.5	4.4	1.5	4.6	1.3	4.8	1.1	4.8
9400	2.4	3.8	2.1	4	1.9	4.2	1.7	4.2
9600	1.3	3.5	1.3	3.6	1.2	3.7	1.1	3.7
9800	1.8	3.8	1.4	3.9	1.3	4	1.2	4
10000	1.9	3.5	1.4	3.6	1.3	3.7	1.2	3.7
10200	1.1	4.5	1.1	4.7	0.9	4.9	0.7	4.9
10400	2.1	4.6	1.5	4.9	1.2	5.2	0.9	5.2
10600	1.5	4.5	1.2	4.8	0.9	5.1	0.6	5.1
10800	2.1	4.6	2	4.8	1.8	5	1.6	5
11000	1.9	4.4	1.8	4.6	1.8	4.8	1.6	4.8
11200	1.8	4.9	1.7	5	1.7	5.1	1.2	5.1
11400	2.4	5.5	2.1	5.6	1.9	5.7	1.2	5.7
11600	2	5.4	1.8	5.6	1.8	5.8	1.3	5.8
11800	2	5.4	1.8	5.7	1.7	6	1.5	6
12000	2.4	7.4	2.1	7.5	1.9	7.6	1.2	7.6
12200	2	13.5	2	13.6	1.9	13.7	1.8	13.7
12400	2.1	7.5	2	7.7	1.8	7.9	1.6	7.9
12600	2	6.9	1.2	7	1.1	7.1	1	7.1
12800	1	4.2	1	4.3	0.9	4.4	0.8	4.4
13000	2	5.1	1.2	5.2	1.1	5.3	1	5.3
13200	1.1	5.2	1.1	5.4	1.1	5.6	1.1	5.6
13400	2.5	7.3	2	7.4	1.9	7.5	1.8	7.5
13600	1.7	7.5	1.5	7.6	1.4	7.7	1.3	7.7
13800	1.8	5.9	1.2	6.1	1	6.3	0.8	6.3
14000	1.7	4.7	1.6	5	1.3	5.3	1	5.3
14200	2.3	3.4	1.4	3.5	1.3	3.6	1.2	3.6
14400	3.8	12.2	3	12.3	2.9	12.4	2.8	12.4
14600	2.2	7.2	2.1	7.4	1.9	7.6	1.7	7.6
14800	3	8	1.5	8.1	1.4	8.2	1.3	8.2
15000	2.1	7.2	2.1	7.4	2	7.6	1.8	7.6
15200	2.1	6.9	2	7.2	1.9	7.5	1.7	7.5
15400	1.8	8.2	1.8	8.3	1.7	8.4	1.2	8.4
15600	2	5.8	2	5.9	1.9	6	1.8	6
15800	2	8.2	2	8.4	1.8	8.6	1.6	8.6

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Reduced		Reduced		Reduced		Reduced	
	Min	Max	Min	Max	Min	Max	Min	Max
16000	2.1	9.2	2	9.3	1.9	9.4	1.5	9.4
16200	2.1	5.9	1.8	6	1.7	6.1	1.2	6.1
16400	2.2	4.9	2.1	5	2	5.1	1.2	5.1
16600	2.1	6	2	6.2	1.8	6.4	1.6	6.4
16800	2	5.1	1.9	5.2	1.7	5.3	1.2	5.3
17000	2	5.8	1.8	5.9	1.7	6	1.5	6
17200	1.8	5.1	1.5	5.3	1.3	5.5	1.1	5.5
17400	1.5	3.2	1.4	3.5	1.1	3.8	0.8	3.8
17600	1.6	4.1	1.5	4.2	1.4	4.3	1.3	4.3
17800	1.4	5.8	1.4	5.9	1.2	6	1.1	6
18000	1.6	8.2	1.5	8.4	1.3	8.6	1.1	8.6
18200	2.1	5.8	2.1	5.9	2	6	1.9	6
18400	1.6	5.6	1.5	5.7	1.4	5.8	1.3	5.8
18600	2.2	4.8	1.7	5	1.5	5.2	1.3	5.2
18800	1.5	5.5	1.5	5.8	1.2	6.1	0.9	6.1
19000	1.5	2	1.4	2.3	1.1	2.6	0.8	2.6
19200	1.5	2.4	1.5	2.6	1.3	2.8	1.1	2.8
19400	1	2.6	1	2.8	0.8	3	0.6	3
19600	1.4	2.7	1.3	2.8	1.2	2.9	1.1	2.9
19800	2.4	4.8	1.3	4.9	1.2	5	1.1	5
20000	1.7	3.8	1.4	3.9	1.3	4	1.2	4
20200	1.3	3.2	1.3	3.4	1.1	3.6	0.9	3.6
20400	1.9	13.1	1.6	13.4	1.3	13.7	1	13.7
20600	1.8	3.8	1.5	4.1	1.2	4.4	0.9	4.4
20800	1.5	3.8	1.4	4.1	1.1	4.4	0.8	4.4
21000	1.4	3.8	1.3	4.1	1	4.4	0.7	4.4
21200	1.5	3.9	1.5	4.1	1.3	4.3	1.1	4.3
21400	1.6	3.8	1.5	4	1.3	4.2	1.1	4.2
21600	1.3	3.3	1.2	3.4	1.1	3.5	1	3.5
21800	1.3	3.9	1.3	4	1.2	4.1	1.1	4.1
22000	2	3.7	1.7	3.9	1.3	4.1	1.1	4.1
22200	1.5	3.8	1.4	4.1	1	4.4	0.7	4.4
22400	1.4	2.6	1.4	2.7	1.1	2.8	1	2.8
22600	1.5	2.6	1.5	2.7	1.4	2.8	1.3	2.8
22800	1.5	3.1	1.4	3.3	1.1	3.5	0.9	3.5
23000	1.4	3.5	1.4	3.6	1.3	3.7	1.2	3.7
23200	1.5	12.4	1.5	12.5	1.4	12.6	1.3	12.6
23400	1.6	3.9	1.4	4	1.3	4.1	1.2	4.1
23600	1.4	2.9	1.4	3.1	1.1	3.3	0.9	3.3
23800	1.8	3.5	1.4	3.6	1.3	3.7	1.2	3.7
24000	1.7	3.7	1.5	3.8	1.4	3.9	1.3	3.9

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Reduced		Reduced		Reduced		Reduced	
	Min	Max	Min	Max	Min	Max	Min	Max
24200	1.7	2.9	1.3	3.1	1.1	3.3	0.9	3.3
24400	1.4	3.5	1.4	3.8	1.1	4.1	0.8	4.1
24600	2	4.3	1.7	4.4	1.6	4.5	1.5	4.5
24800	2	6.3	1.5	6.4	1.4	6.5	1.3	6.5
25000	1.8	6.1	1.7	6.3	1.7	6.5	1.6	6.5
25200	2.1	2.5	2	2.6	2	2.7	1.1	2.7
25400	2.2	3.5	2.2	3.7	2.1	3.9	1	3.9
25600	2.2	5.8	2.1	6.1	2	6.4	1	6.4
25800	1.8	5.9	1.8	6	1.7	6.1	1.1	6.1
26000	1.7	6.9	1.7	7	1.7	7.1	1.2	7.1
26200	1.5	6.5	1.5	6.7	1.3	6.9	1.1	6.9
26400	1.9	5.5	1.6	5.6	1.5	5.7	1.4	5.7
26600	1.8	2.8	1.7	2.9	1.6	3	1.5	3
26800	1.5	7.2	1.5	7.3	1.4	7.4	1.3	7.4
27000	1.4	3	1.4	3.2	1.2	3.4	1	3.4
27200	1.5	6.5	1.5	6.6	1.4	6.7	1.3	6.7
27400	1.7	7	1.7	7.1	1.6	7.2	1.5	7.2
27600	1.9	6.5	1.5	6.7	1.3	6.9	1.1	6.9
27800	1.5	5.8	1.5	6.1	1.2	6.4	0.9	6.4
28000	2	3.3	1.8	3.4	1.7	3.5	1.4	3.5
28200	2	2.2	1.9	2.3	1.8	2.4	1.2	2.4
28400	1.8	3.1	1.8	3.3	1.8	3.5	1.1	3.5
28600	1.7	3.3	1.7	3.4	1.7	3.5	1.4	3.5
28800	2.1	3.3	1.9	3.4	1.8	3.5	1.5	3.5
29000	1.9	2.4	1.7	2.6	1.7	2.8	1.1	2.8
29200	2.1	3.3	1.5	3.6	1	3.9	0.7	3.9
29400	2.3	6.9	1.4	7.2	1	7.5	0.7	7.5
29600	2.4	11.5	1.5	11.7	1.3	11.9	1.1	11.9
29800	2	4.5	1.4	4.6	1.3	4.7	1.2	4.7
30000	2.1	3.1	2	3.3	2	3.5	2	3.5
30200	2.3	2.8	2.3	3.1	2.1	3.4	2	3.4
30400	2.1	2.9	2.1	3.2	2.1	3.5	2.1	3.5
30600	2.3	3.9	2.3	4.1	2.1	4.3	2.1	4.3
30800	2.1	3.4	2.1	3.6	2.1	3.8	2.1	3.8
31000	2.1	3.2	2.1	3.3	2.1	3.4	2.1	3.4
31200	1.7	3.6	1.7	3.7	1.7	3.8	1.1	3.8
31400	1.8	4.1	1.7	4.3	1.7	4.5	1	4.5
31600	2.1	3.5	2	3.8	2	4.1	1.8	4.1
31800	2.2	4.2	2.1	4.3	2	4.4	1.1	4.4
32000	1.8	5.2	1.7	5.3	1.7	5.4	1.2	5.4
32200	1.7	5.3	1.7	5.5	1.7	5.7	1.5	5.7

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Reduced		Reduced		Reduced		Reduced	
	Min	Max	Min	Max	Min	Max	Min	Max
32400	1.8	4.5	1.8	4.6	1.7	4.7	1.2	4.7
32600	1.8	3.2	1.7	3.3	1.7	3.4	1	3.4
32800	2.1	2.3	2	2.4	1.8	2.5	1.1	2.5
33000	1.8	2.6	1.4	2.8	1.2	3	1	3
33200	1.7	3.2	1.5	3.3	1.4	3.4	1.3	3.4
33400	1.8	2.6	1.4	2.7	1.2	2.8	1.1	2.8
33600	1.7	3.2	1.5	3.4	1.3	3.6	1.1	3.6
33800	1.5	2.6	1.4	2.9	1	3.2	0.7	3.2
34000	1.5	3.2	1.5	3.3	1.4	3.4	1.3	3.4
34200	1.4	2.5	1.4	2.6	1.3	2.7	1.2	2.7
34400	1.2	2.3	1.2	2.5	1	2.7	0.8	2.7
34600	1.3	3.3	1.3	3.4	1.2	3.5	1.1	3.5
34800	2.2	10.2	1.9	10.4	1.7	10.6	1.5	10.6
35000	1.3	2.8	1.3	3.1	1	3.4	0.7	3.4
35200	2	4.1	1.5	4.2	1.4	4.3	1.3	4.3
35400	1.3	4.2	1.3	4.3	1.2	4.4	1.1	4.4
35600	1.3	6.3	1.3	6.5	1.1	6.7	0.9	6.7
35800	1.9	5.1	1.5	5.2	1.4	5.3	1.3	5.3
36000	2.1	3.8	1.7	3.9	1.6	4	1.5	4
36200	1	2.9	1	3	0.9	3.1	0.8	3.1
36400	2.1	3.5	1.5	3.7	1.3	3.9	1.1	3.9
36600	1.7	3.9	1.3	4	1.2	4.1	1.1	4.1
36800	1.4	3.2	1.4	3.3	1.3	3.4	1.2	3.4
37000	1.6	3.8	1.5	4	1.3	4.2	1.1	4.2
37200	1.5	3	1.5	3.3	1.2	3.6	1.1	3.6
37400	1.4	2.8	1.4	2.9	1.3	3	1.2	3
37600	1.4	2.5	1.3	2.6	1.2	2.7	1.1	2.7
37800	1.7	5	1.4	5.2	1.2	5.4	1	5.4
38000	1.1	6.2	1.1	6.3	1	6.4	1	6.4
38200	2.1	4.2	2	4.3	1.7	4.4	1.1	4.4
38400	1.8	3.1	1.7	3.3	1.5	3.5	1.3	3.5
38600	1.7	5.2	1.5	5.5	1.3	5.8	1.2	5.8
38800	1.9	5.2	1.4	5.5	1.2	5.8	1	5.8
39000	1.8	6.2	1.7	6.4	1.5	6.6	1.2	6.6
39200	1.7	6.2	1.5	6.4	1.3	6.6	1.1	6.6
39400	1.4	5.3	1.4	5.4	1.2	5.5	1.2	5.5
39600	1.5	2.8	1.5	2.9	1.2	3	1.3	3
39800	1.4	3.2	1.4	3.3	1.2	3.4	1.1	3.4
40000	1.5	3.3	1.4	3.5	1.2	3.7	1.2	3.7
40200	2.1	3.8	2	4.1	1.8	4.4	1.5	4.4
40400	1.8	5.2	1.7	5.5	1.7	5.8	1.4	5.8

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Reduced		Reduced		Reduced		Reduced	
	Min	Max	Min	Max	Min	Max	Min	Max
40600	1.7	8.2	1.7	8.4	1.7	8.6	1.4	8.6
40800	1.8	3.2	1.7	3.4	1.7	3.6	1.5	3.6
41000	1.5	3.3	1.4	3.4	1.3	3.5	1	3.5
41200	1.4	4	1.4	4.1	1.4	4.2	1.3	4.2
41400	1.5	8	1.4	8.2	1.3	8.4	1.1	8.4
41600	1.6	7	1.4	7.3	1.4	7.6	1.2	7.6
41800	1.7	5.3	1.5	5.4	1.5	5.5	1.1	5.5
42000	1.6	2.8	1.5	2.9	1.4	3	1.2	3
42200	1.5	2.3	1.4	2.5	1.4	2.7	1.2	2.7
42400	1.4	2.5	1.3	2.6	1.3	2.7	1.2	2.7
42600	2.1	3.1	2	3.2	1.7	3.3	1.5	3.3
42800	1.5	9.2	1.4	9.3	1.3	9.4	1.8	9.4
43000	1.4	6.3	1.4	6.5	1.4	6.7	1.7	6.7
43200	1.7	3.3	1.5	3.4	1.5	3.5	1.2	3.5
43400	1.8	3.2	1.7	3.3	1.5	3.4	1	3.4
43600	1.7	2.5	1.6	2.7	1.5	2.9	1.4	2.9
43800	1.5	3.5	1.4	3.8	1.4	4.1	1.3	4.1
44000	2	3.5	2	3.6	2	3.7	2	3.7
44200	2.1	2.5	2.1	2.6	2.1	2.7	2.1	2.7
44400	2.1	6.2	2.1	6.4	2.1	6.6	2.1	6.6
44600	2.2	6.3	2.2	6.4	2.2	6.5	2.2	6.5
44800	2	3.5	2	3.7	2	3.9	2	3.9
45000	2.1	3.1	2.1	3.4	2.1	3.7	2.1	3.7
45200	2.1	2.9	2.1	3	2.1	3.1	2.1	3.1
45400	2.1	2.5	2.1	2.6	2.1	2.7	2.1	2.7
45600	2.2	2.5	2.2	2.7	2.2	2.9	2.2	2.9
45800	2.1	3.5	2.1	3.6	2.1	3.7	2.1	3.7
46000	2.2	3.1	2.2	3.2	2.2	3.3	2.2	3.3
46200	1.8	4	1.8	4.1	1.8	4.2	1.8	4.2
46400	2.1	3.1	2.1	3.3	2.1	3.5	2.1	3.5
46600	2.1	4.1	2.1	4.2	2.1	4.3	2.1	4.3
46800	2.2	5.2	2.2	5.3	2.2	5.4	2.2	5.4
47000	2.2	5.3	2.2	5.5	2.2	5.7	2.2	5.7
47200	2.3	5.6	2.3	5.9	2.3	6.2	2.3	6.2
47400	2.1	8.2	2.1	8.3	2.1	8.4	2.1	8.4
47600	2.2	5.2	2.2	5.3	2.2	5.4	2.2	5.4
47800	2.1	5.2	2.1	5.4	2.1	5.6	2.1	5.6
48000	2.2	4.2	2.2	4.3	2.2	4.4	2.2	4.4
48200	2.1	5.2	2.1	5.3	2.1	5.4	2.1	5.4
48400	2.1	9.2	2.1	9.4	2.1	9.6	2.1	9.6
48600	2.2	7.2	2.2	7.5	2.2	7.8	2.2	7.8

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Reduced		Reduced		Reduced		Reduced	
	Min	Max	Min	Max	Min	Max	Min	Max
48800	2.1	5.3	2.1	5.6	2.1	5.9	2.1	5.9
49000	2.2	5.4	2.2	5.6	2.2	5.8	2.2	5.8
49200	2.2	5.6	2.2	5.8	2.2	6	2.2	6
49400	2.1	6.2	2.1	6.3	2.1	6.4	2.1	6.4
49600	2.2	6.3	2.2	6.4	2.2	6.5	2.2	6.5
49800	2.1	5.3	2.1	5.4	2.1	5.5	2.1	5.5
49900	2.1	5.6	2.1	5.8	2.1	6	2.1	6

Table 21-200 meter interval Reduced depth calculation

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
29.11.15	GS-(TP)- 1	49.759	24hrs	0.28	48.722	49.002	47.201	-1.801
29.11.15	GS-(TP)- 2	44.493	24hrs	0.30	48.698	48.998	46.905	-2.093
30.11.15	GS-(TP)- 3	34.521	24hrs	0.52	47.485	48.005	46.344	-1.661
30.11.15	GS-(TP)- 4	25.371	24hrs	0.38	47.550	47.930	45.830	-2.100
20.01.16	GS-(TP)- 5	14.929	24hrs	0.45	46.839	47.289	45.244	-2.045
20.01.16	GS-(TP)- 6	5.690	24hrs	0.50	45.518	46.018	44.725	-1.293

Table 22-Detailed collected water level at different Gauge stations

Annexure-6-Details of Bathymetric surveys carried out:-

Date of Survey	Type of survey	Chainage	
		From (km)	To (km)
14.10.15	Bathymetry Survey	0.00	7.228
06.10.15	Bathymetry Survey	7.228	20.493
05.10.15	Bathymetry Survey	20.493	35.097
04.10.15	Bathymetry Survey	35.097	49.90

Table 23- Details of Bathymetry survey

Annexure-7- Bank Protection along the Bank:-

The River had a tendency to break its boundary. So for this reason some short and as well as long embankments are needed in the both banks of the river. From Chainage1.048 Km. to 1.716 Km., the Brick road are found which are protected the right side of the river bank. Gobordhon RCC Bridge to Mauing Bazar area is also highly protected in this zone of river. Narangi to Burha Mayang par area are also protected for roadside. Near Chainage 10.992 Km, Sonarpur to Kamarpur PHC are communicated through the RCC Bridge. Kolong Bazar is situated in this zone of river. From Chainage 16.048 Km. to 30.548 Km. (Hatimara village-Boha Boro Raji village) are also highly protected in the left side of the river bank. Besides, from Chainage 32.548 Km. to 45.941 Km. (Nepali Patti village-Kumoi Gaon) are also protected in the left side of the river bank.

Annexure -8-Details of Features across the Bank:-

The bank of the river includes villages, Ferry ghat, Irrigation canals and outlets, H.T. Lines, RCC Culvert, RCC Bridges and Forest etc. The both side river bank are highly protected by embankment and bolder pitching. The villagers are also situated near the bank side of the river. Recently different kinds of industries are also located near the bank side of the river.

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

○ Establishment of Horizontal Control:-

The Horizontal control for Topography survey: - 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 Bathymetry survey: - DGPS is receiving corrections from Beacons.

○ Establishment of Vertical Control:-

Vertical control from BM-6 is used for the entire survey work. Its value is 53.622 meter w.r.t. MSL has been considered for calculating the vertical levels. Total 6 no. BM was established along the 49.90 Km. of Kopili River the reference of BM-6.

○ Topography Survey:-

The survey was commenced on 29 th August 2015 and completed on 12th September 2015. The days become shorter because of winter season and the climate become cold which reached about 10◦ 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 17- RTK 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 18-Bathymetry data collection

Technical Specifications		
Depth Ranges	0-320 m	
Phasing	60-100/ Auto (displays 40m range at 20m increments up to 600-640) m.	
Chart Record	8.5 inch X 90 Feet High-Contrast Thermal Paper	
Digital Display	LCD (4 lines x 16 characters) 0.25 inch characters (Depth Display: 0.75 inch characters) (Back-lighting: Electro-luminescent)	
Resolution	0.1 for depths greater than 100 meters;	
Accuracy	At 33 Khz= 5 cm +/- 0.1% of depth At 200Khz= 1cm +/- 0.1% of depth	
Frequency	Any single frequency (user selectable & changeable via keypad) from these: 33 Khz, 40Khz, 50Khz, 200Khz (Acoustic output=600 watts)	
Sound Velocity	1393-1590 meters/second (user selected via keypad)	
Geographic position	NMEA-0183 GGA or GLL Format from GPS/DGPS	
Data I/O compatibility	COM 1 provides bi-directional interface to PC or other peripheral device; This port accepts external annotation from external sources such as hydrographic software. COM 2 accepts GPS/DGPS inputs and provides additional (from COM1) data outputs.	
Data Outputs	• ODEC PMC dt (True Depth & Status) • Atlas DESO-25 • Odom Digitrace	• Odom Echotrac • NMEA DBT • NMEA DBS
Input Power	11-30 volts DC. (1.5 amps @ 12v. 0.5 amp @30v.)	
Dimensions	Height (including handle) 19 inches; Width 17.5 inches; Depth 9 inches	
Weight	35 lbs approximately.	

Table 24- Technical Specification

Annexure-10- Photographs of equipment:-

- **Positioning System:-**
- 1 no Trimble DGPS system (SPS361)

Figure 19- DGPS Survey Instrument

- **Navigation & Data Logging System:-**

- To provide on-line route guidance, log navigation data, provide QC of navigation data, etc. The system comprises the following equipment:
- 1 no. DELL Laptop
- 1 no. Hypack version 2014 Navigation & Data Logging Software
- 1 no. Positioning & sensor interfaces
- Sufficient Paper Rolls

- **Single Beam Echo Sounder System:-**

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

Figure 20- Echo Sounder Instrument

- **Current Meter:-**

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

Figure 21- Current Meter

Survey Vessel:-

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

Figure 22- Survey Vessel

Annexure -11-Bench Mark Forms:-

BM Name	Northing (m)	Easting (m)	Latitude (N)	Longitude (E)	RL (m)
BM 1	2903140.498	395776.813	26°14'38.87"	91°57'23.18"	59.820
Pillar Established by: - Precision Survey Consultancy. Surveyor – Mr. Debasis Mondal; Date of Establishment – 10/11/15					
Station Description :-					
Benchmark is located near Chandrapur 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 number can be seen on the face of the pillar. The measurements of the bench mark pillar from notable locations / edges as follows: East from Chandrapur Road–9.00m.					
Life of Station : 15Yrs		**Datum:** - WGS 84		**ZONE :**46 N	

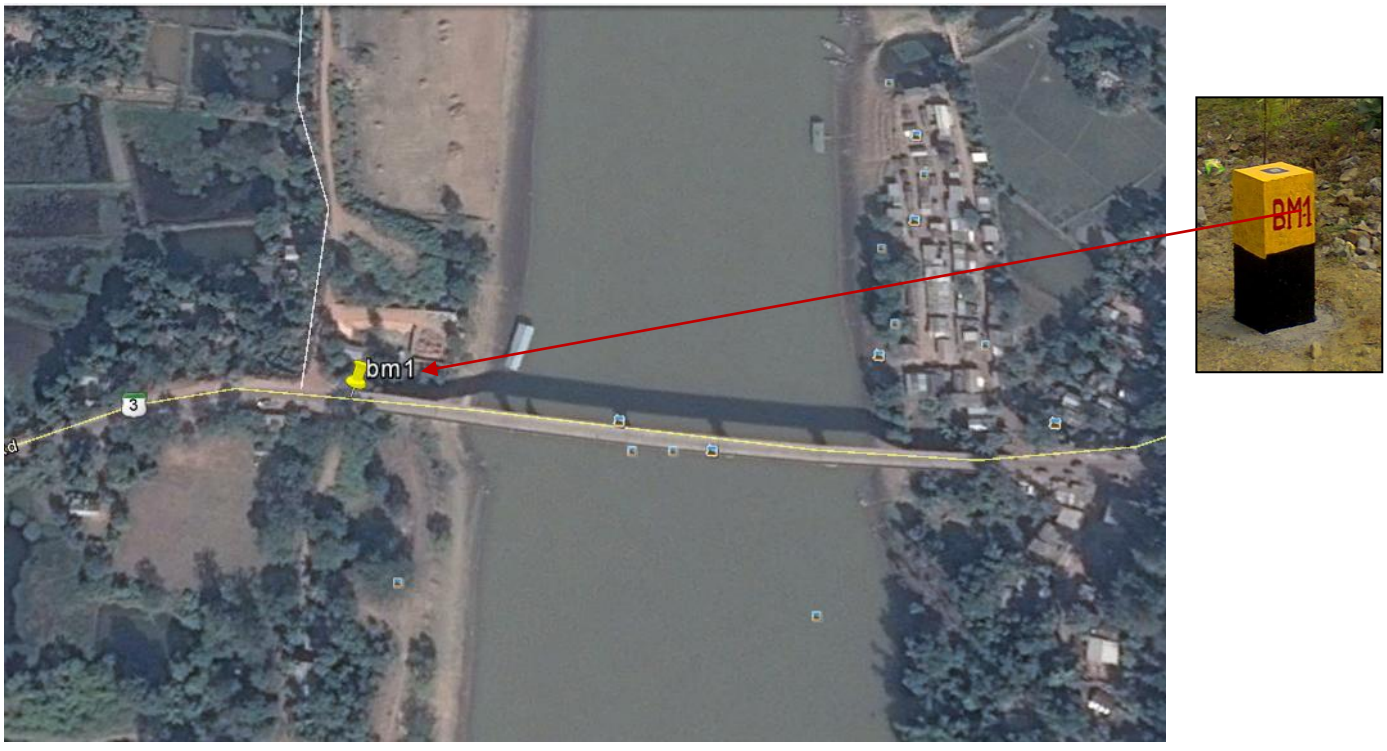


Figure 23- Bench Mark Form & Google image view of BM-1

BM Name	Northing (m)	Easting (m)	Latitude (N)	Longitude (E)	RL (m)
BM 2	2898433.421	402226.708	26°12'7.52"	92° 1'16.92"	58.626
Pillar Established by: - Precision Survey Consultancy. Surveyor – Mr. Debasis Mondal; Date of Establishment – 10/11/15					
Station Description :-					
Benchmark is located near Kamarpur Pahar 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 number can be seen on the face of the pillar. The measurements of the bench mark pillar from notable locations / edges as follows: South to North From kamarpur Road–7.44m.					
Life of Station : 15Yrs	**Datum:** - WGS 84		**ZONE :**46 N		

Figure 24-Bench Mark Form & Google image view of BM-2

BM Name	Northing (m)	Easting (m)	Latitude (N)	Longitude (E)	RL (m)
BM 3	2897289.526	408063.172	26°11'31.73"	86° 4'47.52"E	51.315
Pillar Established by: - Precision Survey Consultancy. Surveyor – Mr. Debasis Mondal; Date of Establishment – 12/11/2015					
Station Description :-					
Benchmark is located Diprung 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: West from E.C. Road - 3.25 m East From Bridge–35.4 m.					
Life of Station : 15Yrs	**Datum**: - WGS 84		**ZONE :**46 N		

Figure 25-Bench Mark Form & Google image view of BM-3

BM Name	Northing (m)	Easting (m)	Latitude (N)	Longitude (E)	RL (m)
BM 4	2895980.298	412598.091	26°10'50.20"	92° 7'31.21"	54.71
Pillar Established by : - Precision Survey Consultancy. Surveyor – Mr. Debasis Mondal; Date of Establishment – 12/11/2015					
Station Description :-					
Benchmark is located near sat sapori Doloni. 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 pillarfrom notable locations / edges as follows: North East corner from road –3.00 m.					
Life of Station : 15Yrs	**Datum:** - WGS 84		**ZONE :**46 N		

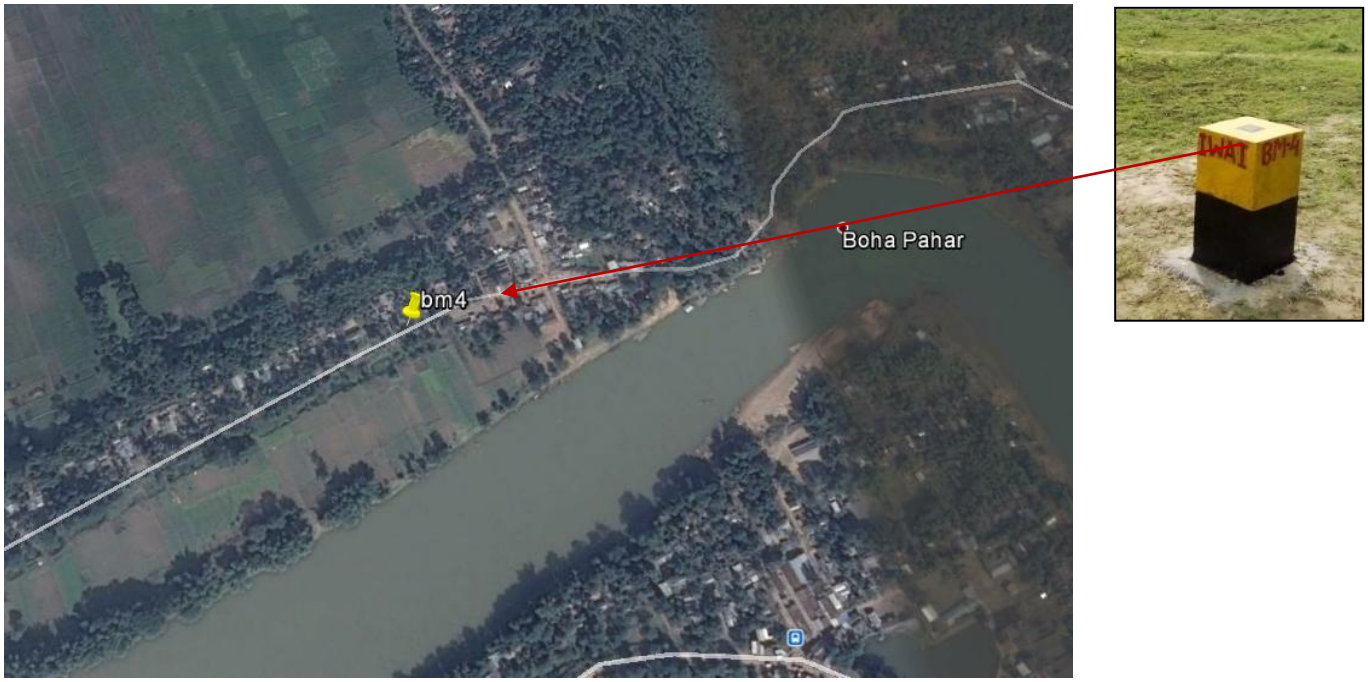


Figure 26- Bench Mark Form & Google image view of BM-4

BM Name	Northing (m)	Easting (m)	Latitude (N)	Longitude (E)	RL (m)
BM 5	2895871.741	418324.949	26°10'47.87"	92°10'57.51"	54.465

Pillar Established by: - Precision Survey Consultancy. Surveyor – Mr. Debasis Mondal;
Date of Establishment – 13/11//2015

Station Description :-

Benchmark is located near Korukulowi 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 N

Figure 27- Bench Mark Form & Google image view of BM-5

BM Name	Northing (m)	Easting (m)	Latitude (N)	Longitude (E)	RL (m)
BM 6	2895542.562	421806.05	26°10'37.87"	92°13'3.02"	53.622
Pillar Established by: - Precision Survey Consultancy. Surveyor – Mr. Debasis Mondal; Date of Establishment – 14/11/2015					
Station Description :-					
Benchmark is located beside Bhakatgaon 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 number can be seen on the face of the pillar. The measurements of the bench mark pillar from notable locations / edges as follows: West from Morigaon road –121.28 m.					
Life of Station : 15Yrs	**Datum**: - WGS 84		**ZONE :**46 N		

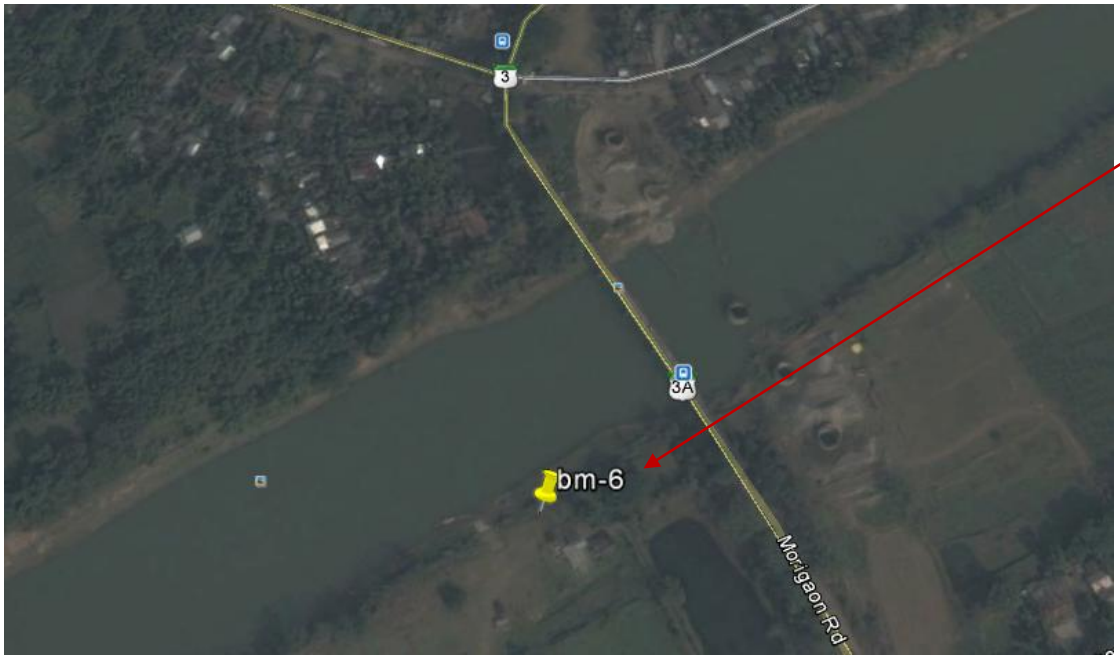


Figure 28- Bench Mark Form & Google image view of BM-6

Annexure- 12-Levelling calculations:-

Levelling from BM-1 to GS-6

BS	IS	FS	RISE(+)	FALL(-)	RL(m)	REMARKS
0.560					59.820	BM 1
0.235		3.165		2.605	57.215	
0.738		3.885		3.650	53.565	
0.328		2.982		2.244	51.321	
0.284		3.675		3.347	47.974	
		2.240		1.956	46.018	Gauge station-6

Levelling from BM-2 to GS-5

BS	IS	FS	RISE(+)	FALL(-)	RL(m)	REMARKS
0.382					58.626	BM 2
0.553		2.985		2.603	56.023	
0.430		3.695		3.142	52.881	
0.334		3.582		3.152	49.729	
0.734		1.958		1.624	48.105	
		1.550		0.816	47.289	Gauge station-5

Levelling from BM-3 to GS-4

BS	IS	FS	RISE(+)	FALL(-)	RL(m)	REMARKS
0.825					51.315	BM 3
0.335		1.865		1.040	50.275	
0.385		1.650		1.315	48.960	
		1.415		1.030	47.930	Gauge station-4

Levelling from BM-4 to GS-3

BS	IS	FS	RISE(+)	FALL(-)	RL(m)	REMARKS
0.495					54.710	BM 4
0.672		2.843		2.348	52.362	
0.675		2.285		1.613	50.749	
0.383		1.865		1.190	49.559	
		1.937		1.554	48.005	Gauge station-3

Levelling from BM-5 to GS-2

BS	IS	FS	RISE(+)	FALL(-)	RL(m)	REMARKS
0.642					54.465	BM 5
0.286		2.885		2.243	52.222	
0.920		2.850		2.564	49.658	
		1.580		0.660	48.998	Gauge station-2

Levelling from BM-6 to GS-1

BS	IS	FS	RISE(+)	FALL(-)	RL(m)	REMARKS
0.285					53.622	BM 6
0.585		2.648		2.363	51.259	
0.465		2.127		1.542	49.717	
		1.180		0.715	49.002	Gauge station-1

Table 25 Leveling Calculation of Kopili River

Annexure-13- Soil Sample:-

RESULT OF TEST OF SOIL SAMPLES

SITE: KOPILI RIVER

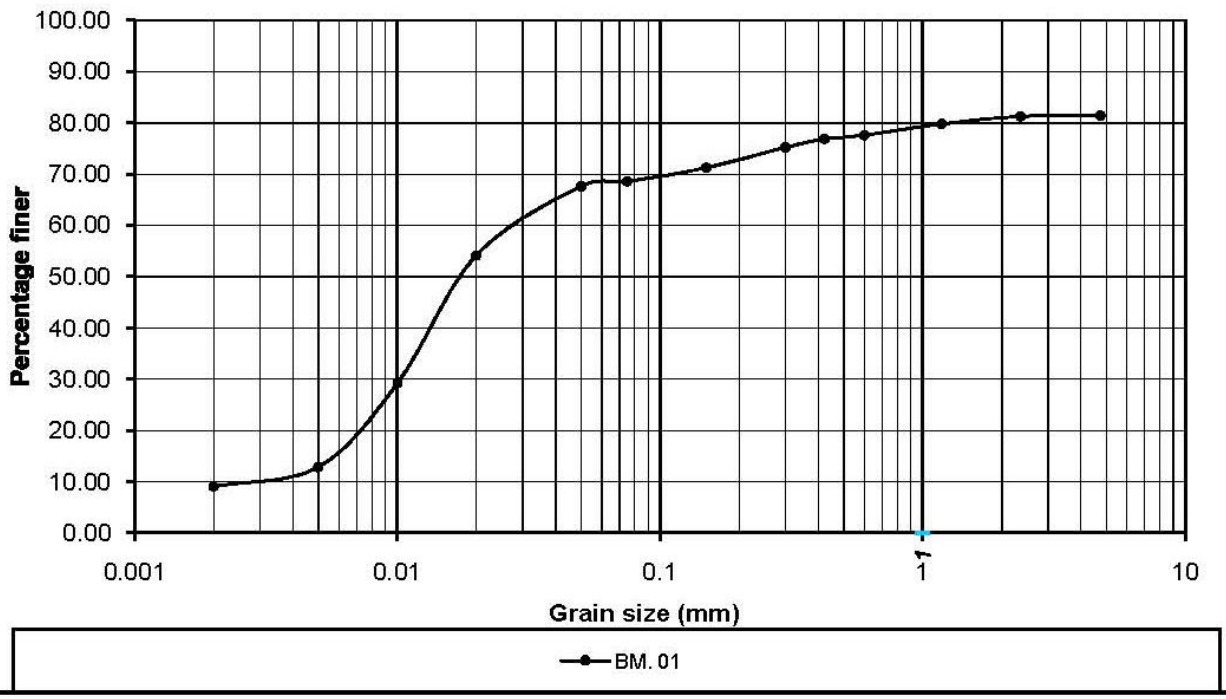
RESULTS OF TEST OF SOIL SAMPLES

SITE – KOPILI RIVER

PHYSICAL ANALYSIS OF SOIL

Sl.No.	BM.	GRAVEL (%)	SAND (%)	SILT+CLAY (%)	SPECIFIC GRAVITY	pH VALUE	SILT (%)	CLAY (%)	Cu	Cc
1	1.00	18.62	29.86	51.52	2.62	7.40	42.50	9.02	7.58	1.04
2	2.00	7.20	10.50	82.30	2.60	7.10	74.50	7.80	7.03	2.00
3	3.00	21.50	26.30	52.20	2.61	7.30	43.60	8.60	6.67	1.67
4	4.00	28.14	23.89	47.97	2.63	7.50	38.00	9.97	11.00	1.38
5	5.00	17.86	32.56	49.58	2.62	7.00	40.00	9.58	10.42	2.34
6	6.00	20.35	28.49	51.16	2.63	7.20	41.50	9.66	10.39	1.05

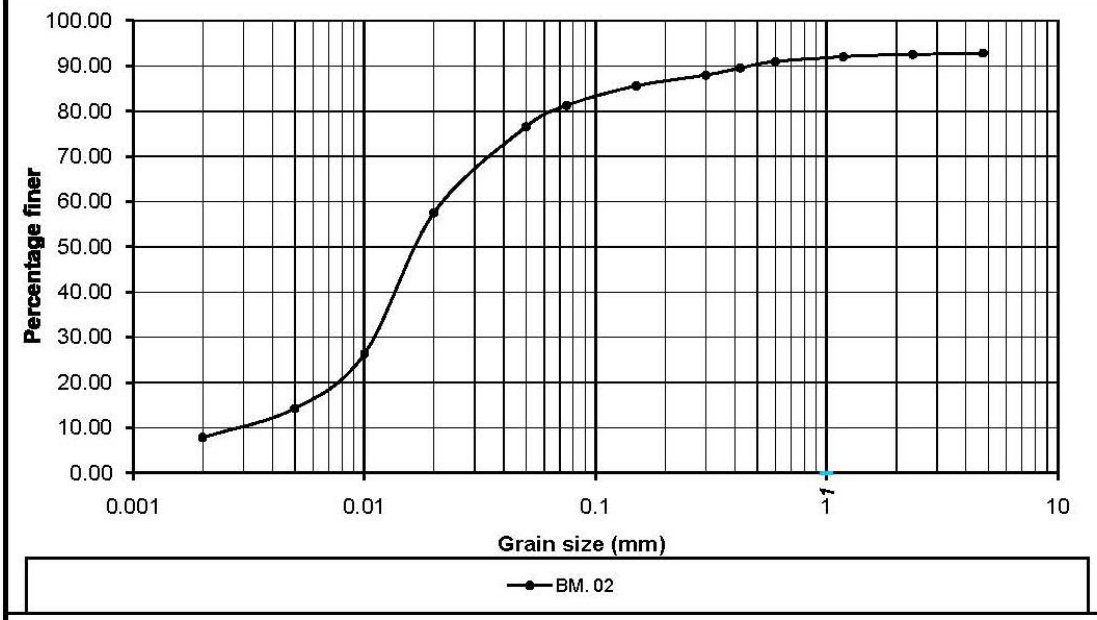
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-4.75*	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Sand (%)**	**Gravel (%)**
BM. 01	9.02	42.50	29.86	18.62

*Silt & Clay

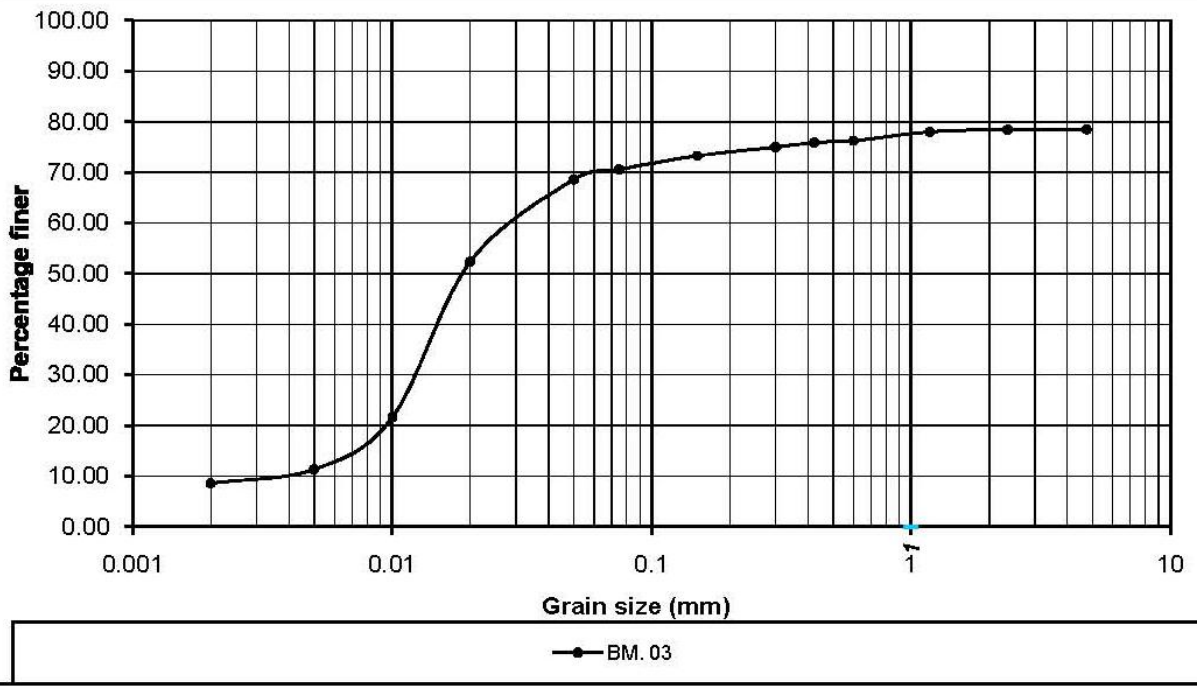
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-4.75*	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Sand (%)**	**Gravel (%)**
BM. 02	7.80	74.50	10.50	7.20

*Silt & Clay

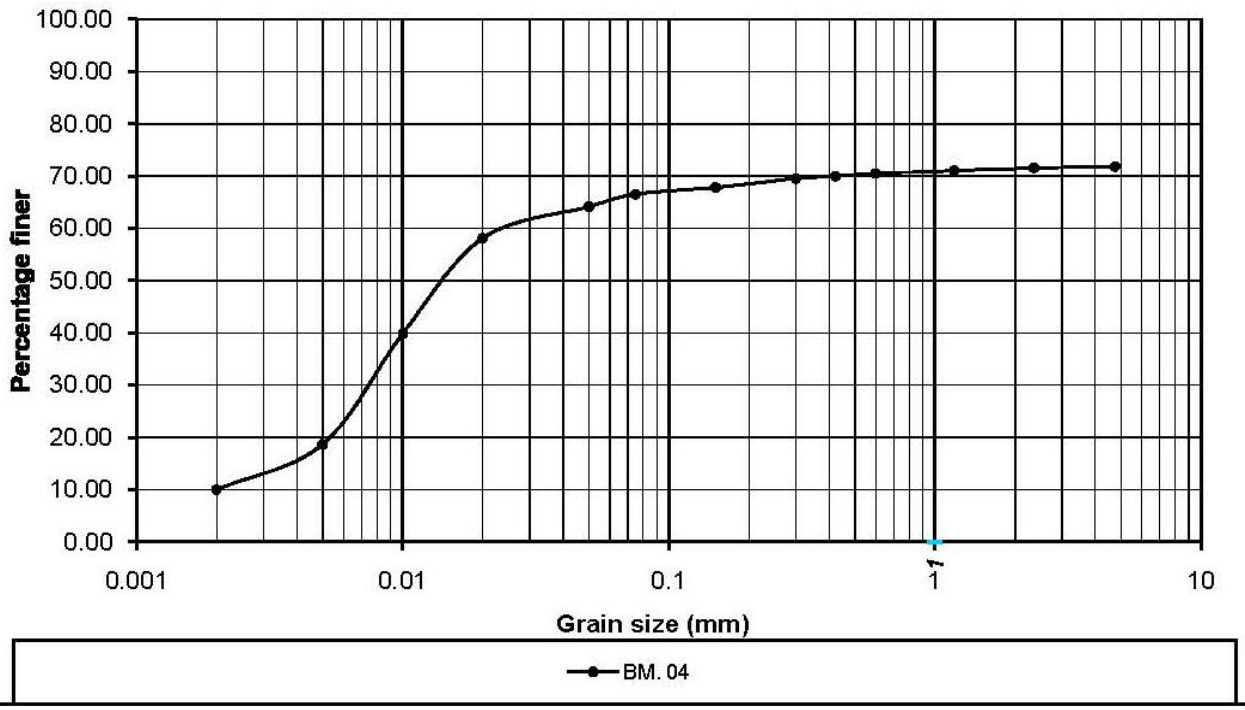
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-4.75*	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Sand (%)**	**Gravel (%)**
BM. 03	8.60	43.60	26.30	21.50

*Silt & Clay

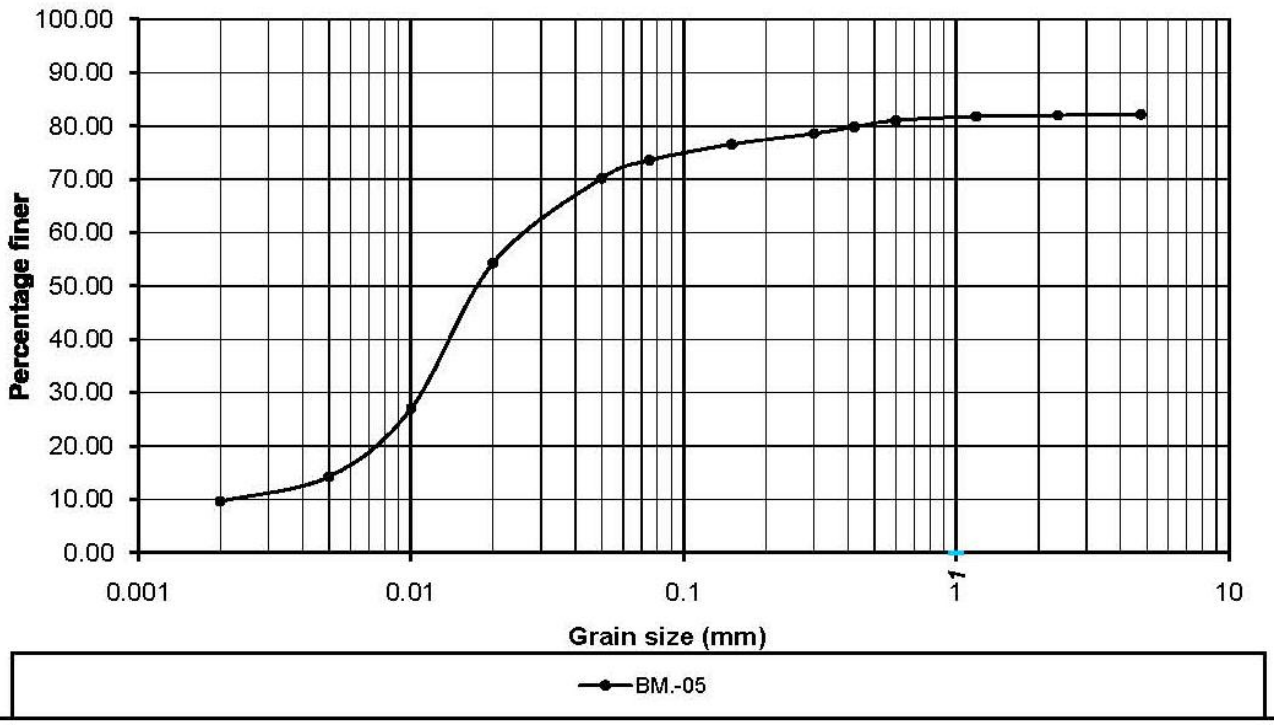
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-4.75*	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Sand (%)**	**Gravel (%)**
BM. 04	9.97	38.00	23.89	28.14

*Silt & Clay

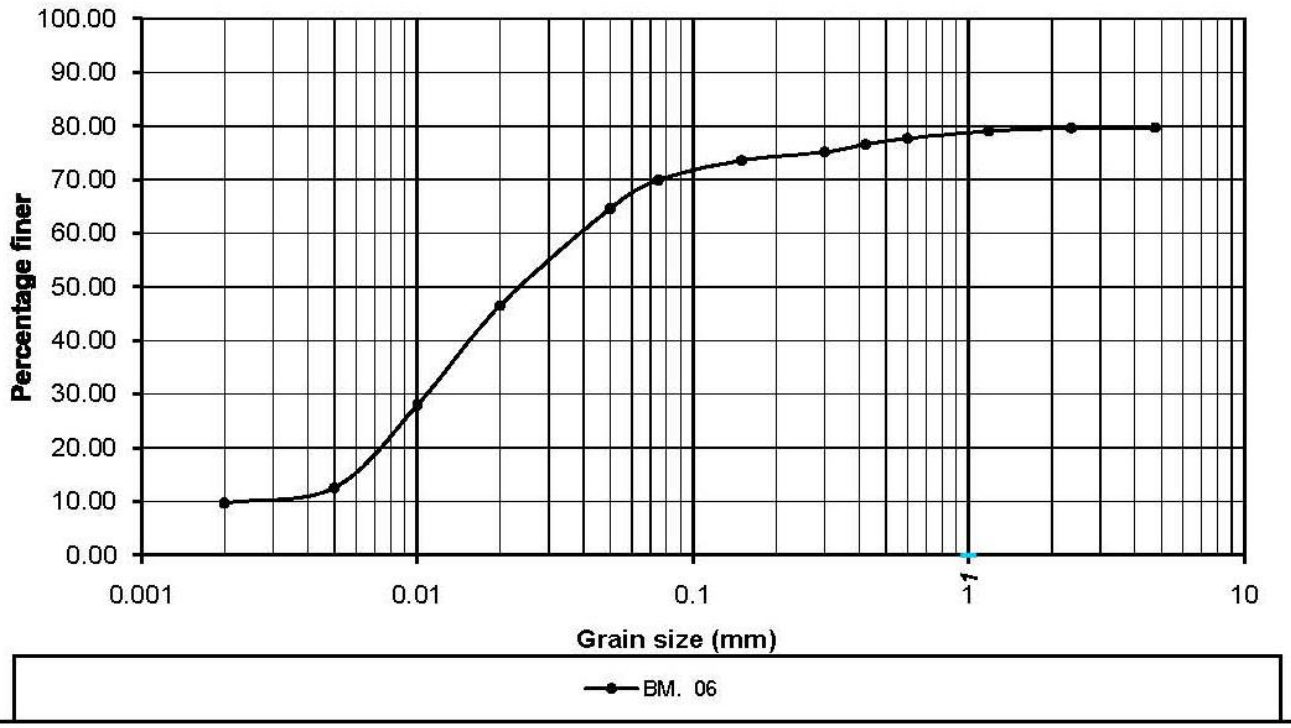
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-4.75*	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Sand (%)**	**Gravel (%)**
BM.-05	9.58	40.00	32.56	17.86

*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. 06	9.66	41.50	28.49	20.35

*Silt & Clay

Annexure -14-Water Samples:-

RESULTS OF EXAMINATION OF SAMPLES OF WATER

SITE- RIVER KOPILI

PARAMETER – pH Value at 25° C

SL.NO;	B.M	LOCATION	PARAMETER	WATER SAMPLE RESULTS	PERMISSIBLE LIMIT IS:456-2000
1	1	UPER(0D)		6.3	
		MIDDLE(3D)		6.5	
		LOWER(5D)		6.4	
2	2	UPER(5D)		6.2	
		MIDDLE(3D)		6.5	
		LOWER(0D)		6.5	
3	3	UPER(0D)	pH Value at 25° C	6.4	6.5 – 8.5
		MIDDLE(3D)		6.5	
		LOWER(5D)		6.3	
4	4	UPER(0D)		6.3	
		MIDDLE(3D)		6.5	
		LOWER(5D)		6.4	
5	5	UPER(5D)		6.5	
		MIDDLE(3D)		6.4	
		LOWER(0D)		6.3	
6	6	UPER(0D)		6.2	
		MIDDLE(3D)		6.5	
		LOWER(5D)		6.5	

PARAMETER –Chloride as Cl (mg/l)					
SL.NO;	B.M	LOCATION	PARAMETER	WATER SAMPLE RESULTS	PERMISSIBLE LIMIT IS:456-2000
1	1	UPER(0D)		6	
		MIDDLE(3D)		7	
		LOWER(5D)		8	
2	2	UPER(5D)		8	
		MIDDLE(3D)		7	
		LOWER(0D)		7	
3	3	UPER(0D)	Chloride as Cl (mg/l)	6	2000 mg/l for concrete not containing embedded steel and 500 mg/l for reinforced concrete work.
		MIDDLE(3D)		8	
		LOWER(5D)		7	
4	4	UPER(0D)		6	
		MIDDLE(3D)		7	
		LOWER(5D)		8	
5	5	UPER(5D)		6	
		MIDDLE(3D)		7	
		LOWER(0D)		6	
6	6	UPER(0D)		6	
		MIDDLE(3D)		8	
		LOWER(5D)		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(0D)		63	
		MIDDLE(3D)		69	
		LOWER(5D)		65	
2	2	UPER(5D)		87	
		MIDDLE(3D)		68	
		LOWER(0D)		64	
3	3	UPER(0D)		62	400 (mg/l)
		MIDDLE(3D)	Sulphates as SO_4 (mg/l)	68	
		LOWER(5D)		72	
4	4	UPER(0D)		63	
		MIDDLE(3D)		68	
		LOWER(5D)		72	
5	5	UPER(5D)		86	
		MIDDLE(3D)		69	
		LOWER(0D)		63	
6	6	UPER(0D)		64	
		MIDDLE(3D)		70	
		LOWER(5D)		65	

PARAMETER –Sediment Concentration (mg/l)					
SL.NO;	B.M	LOCATION	PARAMETER	WATER SAMPLE RESULTS	PERMISSIBLE LIMIT IS:456-2000
1	1	UPER(0D)		50	
		MIDDLE(3D)		40	
		LOWER(5D)		240	
2	2	UPER(5D)		50	
		MIDDLE(3D)		40	
		LOWER(0D)		50	
3	3	UPER(0D)	Sediment Concentration (mg/l)	50	2000 (mg/l)
		MIDDLE(3D)		40	
		LOWER(5D)		240	
4	4	UPER(0D)		50	
		MIDDLE(3D)		40	
		LOWER(5D)		240	
5	5	UPER(5D)		50	
		MIDDLE(3D)		40	
		LOWER(0D)		380	
6	6	UPER(0D)		50	
		MIDDLE(3D)		40	
		LOWER(5D)		250	

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 CONSUTLANCY
ADDRESS	:	P.O. –SALAP (Jatin Xerox Center) Dist. –Howrah Pin: 711 409
INSTRUMENT	:	DGPS EQUIPMENT
SERIES	:	SPS-361
SERIAL NUMBER	:	5308K59587
CALIBRATION DATE	:	12/01/2015
VALIDITY	:	11/01/2016

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 29 Calibration of DGPS Equipment

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 30 Calibration 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 31 Calibration of GPS RTK

Annexure -16-Field Photographs:-

Figure 32-Bathymetry instruments

Figure 33 Site Picture of the Gobordhon RCC Bridge

Figure 34 Gauge near the Bank side

Figure 35- Topography instrument

Annexure -17-Survey Charts:-

LIST OF SURVEY CHARTS OF KOPILI RIVER (NW-57)								
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	Confluence with Brahmaputra to Kaoli Village	0.00 km to 3.768 km	5.690	44.725	46.018	-1.293	GS-6
2	P_02	Kaoli village to Narumari village	3.768 km to 8.729 km	5.690	44.725	46.018	-1.293	GS-6
3	P_03	Narumari village to Malobasti village	8.729 km to 11.815 km	5.690	44.725	46.018	-1.293	GS-6
				14.929	45.244	47.289	-2.045	GS-5
4	P_04	Grubandha village to Diprung village	11.815 km to 17.116 km	14.929	45.244	47.289	-2.045	GS-5
5	P_05	Diprung village to Barpak village	17.116 km to 24.487 km	14.929	45.244	47.289	-2.045	GS-5
				25.371	45.830	47.930	-2.100	GS-4
6	P_06	Diprung village to Barpak village	24.487 km to 31.526 km	25.371	45.830	47.930	-2.100	GS-4
				34.521	46.344	48.005	-1.661	GS-3
7	P_07	Barpak village to Nepali patti village	31.526 km to 36.465 km	34.521	46.344	48.005	-1.661	GS-3
8	P_08	Nepali patti village to Barkuloi village	36.465 km to 42.287 km	34.521	46.344	48.005	-1.661	GS-3
				44.493	46.905	48.998	-2.093	GS-2
9	P_09	Barkuloi village to Dimorguri village	42.287 km to 46.386 km	44.493	46.905	48.998	-2.093	GS-2
10	P_10	Dimorguri village to Banthai Gaon	46.386 km to 49.90 km	44.493	46.905	48.998	-2.093	GS-2
				49.759	47.201	49.002	-1.801	GS-1

Table 26 Survey Charts details

Note: Scale: - 1:5000 in each survey Chart
Survey period: - 08th November, 2015 to 30th November, 2015
G.S:- Gauge Station