# FINAL FEASIBILITY REPORT ON DETAILED HYDROGRAPHIC SURVEY

# PUNPUN RIVER

# FROM GANGA CONFLUENCE AT FATUHA (CH 0 KM),

# TO DUDHAILA BRIDGE NH-83 (CH 34.61 KM)

# NATIONAL WATERWAY NO- 81

## VOLUME – I

## Submitted To

| | |
|---|---|
| | **INLAND WATERWAYS AUTHORITY OF INDIA**<br>**A-13, Sector-1,**<br>**NOIDA**<br>**DIST-Gautam Buddha Nagar**<br>**UTTAR PRADESH**<br>**PIN- 201 301(UP)**<br>**Email: hc.iwai@nic.in**<br>**Web: www.iwai.nic.in** |

## Submitted By

| | |
|---|---|
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## ACKNOWLEDGEMENT

STRABAG India Pvt. Ltd. (SIPL) express their gratitude to **Shri S. K. Gangwar, Member (Technical)** and Ms**. Nutan Guha Biswas, IAS, Ex-Chairperson, IWAI** for providing us the opportunity for "Detailed Hydrographic and Topography Survey of Punpun River in Region VII of National waterways, a dream and very important part of **Nation Development**".

We would like to use this opportunity to pen down our profound gratitude and appreciations to **Shri Pravir Pandey, IA & AS, Chairman, Shri Alok Ranjan, ICAS, Member (Finance)** and **Shri Shashi Bhushan Shukla, Member (Traffic).**

SIPL wishes to express their gratitude to **Capt. Ashish Arya, Hydrographic Chief** and **Cdr. P.K. Srivastava, Ex Hydrographic Chief, IWAI** for his guidance and technical inputs in this project. SIPL would also like to thank **Sh. Rajiv Singhal, A.H.S., IWAI** for his valuable support and suggestions provided through out the survey period. SIPL is pleased to place on record their sincere thanks to other staff and officers of IWAI and CWC Department.

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**List of Annexure**

List of Abbreviations

| | |
|---|---|
| SD | Sounding Datum |
| CD | Chart Datum |
| RTK | Real time Kinematic |
| DGPS | Differential Global Positioning Systems |
| TS | Total Station |
| GPS | Global Positioning Systems |
| BM | Bench Mark |
| MSL | Mean Sea Level |
| RL | Reference Level |
| HFL | Highest Flood Level |
| HTL | High Tension Line |
| CH | Chainage |
| WGS | World Geodetic System |
| UTM | Universal Transverse Mercator |
| LAD | Least Available Depth |

## SALIENT FEATURES AT A GLANCE

| **Consultant: STRABAG INDIA PVT LTD.** | | | | | |
|---|---|---|---|---|---|
| **Name** | PUNPUN RIVER | | **NW -81** | | |
| **Length** | 34.61 km From **Ganga Confluence** at Fatuha to Dudhaila Bridge, NH-83 | | | | |
| **State** | Bihar | | | | |
| **Survey Period** | 17th January 2016 to 24th January 2016 | | | | |
| **Tidal / Non-tidal** | Non tidal | | | | |
| **Availability of Depth (reduced) (mtrs)** | | | | | |
| | **(0-25 KM)** | **(25-34.61 KM)** | **TOTAL** | | |
| **<1.2** | 18.8 | 5.4 | 24.2 | | |
| **1.2-1.4** | 2.55 | 1.85 | 4.4 | | |
| **1.5-1.7** | 1.8 | 0.96 | 2.76 | | |
| **1.8-2** | 1.1 | 0.85 | 1.95 | | |
| **>2.0** | 0.75 | 0.55 | 1.3 | | |
| **TOTAL** | **25** | **9.61** | **34.61** | | |
| **Average Slope per KM (m)** | **0.352** | **0.146** | | | |
| **Width Range (m)** | **50** | **30** | | | |
| **Bathy Survey conducted for Length (Km)** | **34.61 km** | | | | |
| **Dredging Quantity (Observed) Cu.m** | | | | | |
| | **(0-25 KM)** | **(25-34.61 KM)** | **TOTAL** | | |
| **Class 1** | 2,16,234.91 | 88,028.60 | 3,04,263.51 | | |
| **Class 2** | 5,03,551.20 | 2,15,674.10 | 7,19,225.30 | | |
| **Class 3** | 10,81,291.06 | 4,58,900.30 | 15,40,191.36 | | |
| **Class 4** | 15,13,564.48 | 6,34,560.40 | 21,48,124.88 | | |
| **Dredging Quantity (Reduced) Cu.m** | | | | | |
| | **(0-25 KM)** | **(25-34.61 KM)** | **TOTAL** | | |
| **Class 1** | 7,40,363.70 | 3,69,535.10 | 11,09,898.80 | | |
| **Class 2** | 12,13,238.80 | 5,81,581.20 | 17,94,820.00 | | |
| **Class 3** | 19,76,081.70 | 9,01,912.83 | 28,77,994.53 | | |
| **Class 4** | 24,56,722.10 | 10,95,076.47 | 35,51,798.57 | | |
| **No. of Bridge** | | | | | |

| 7 | | | | | |
|---|---|---|---|---|---|
| **Clearances less than Class (no.)** | | | | | |
| **Class** | **Horizontal** | **Vertical** | | | |
| **Class 1** | **5** | **2** | | | |
| **Class 2** | **6** | **4** | | | |
| **Class 3** | **7** | **5** | **Vertical clearance of <u>01 no.</u> HT line is less than required 19m.** | | |
| **Class 4** | **7** | **7** | | | |
| **No. of Dams, Barrages, Weirs, Anicut etc.** | | | | | |
| **NA** | | | | | |
| **Number of days Water not available** | | | | | |
| **CWC Gauge** | **Sripalpur** | | | | |
| **Chainage (km)** | 36.907 | | | | |
| **<1.2** | 247 | | | | |
| **<1.4** | 254 | | | | |
| **<1.7** | 268 | | | | |
| **<2.0** | 276 | | | | |
| **Cargo availability** | | | | | |
| **Nil** | | | | | |
| **Passenger Movement** | | | | | |
| **Yes (Across the river)** | | | | | |
| **Present IWT use** | | | | | |
| **Nil** | | | | | |
| **Recommendation of the Consultant** | | | | | |
| 1. The whole river is non-tidal and is one of the tributary of Ganga.<br>2. Punpun River is utilized by small boat for ferry services across the river or for fishing purpose.<br>3. The availability of navigable water is only during monsoon season<br>4. Tourism facilities are present at Trivani sangam at fatuha and Patna. Cities along the river are Fatuha, Simra, and Patna.<br>5. No cargo along the river.<br>6. The average width of the river is 20-40 mtr, so widening of the river is required at many places. | | | | | |
| **Viable or not-viable** | | | | | |
| Further TEF/DPR study is recommended. | | | | | |

(Signature)

Date: Name of Consultant

## SECTION – I: INTRODUCTORY CONSIDERATIONS

1.1 **River Course**. Inland Waterways Authority of India has awarded contract of detailed Hydrographic Survey and feasibility report in Region VII, the National Waterways including assessment of river training works and further development cost, for eco-friendly navigation in the waterways, to Strabag India Pvt. Ltd.

The Punpun River is a minor tributary of the Ganga. The River is originated from Palamu district of Jharkhand and flow through Chatra, Aurangabad, Gaya and Patna district of both Jharkhand and Bihar. The river mostly flows in north-east direction and join the Ganga at Fatuha. Detailed hydrographic and topographic survey of Punpun River was carried out from confluence at Ganga Fatuha to bridge on NH83, Dudhaila near Pakri village.

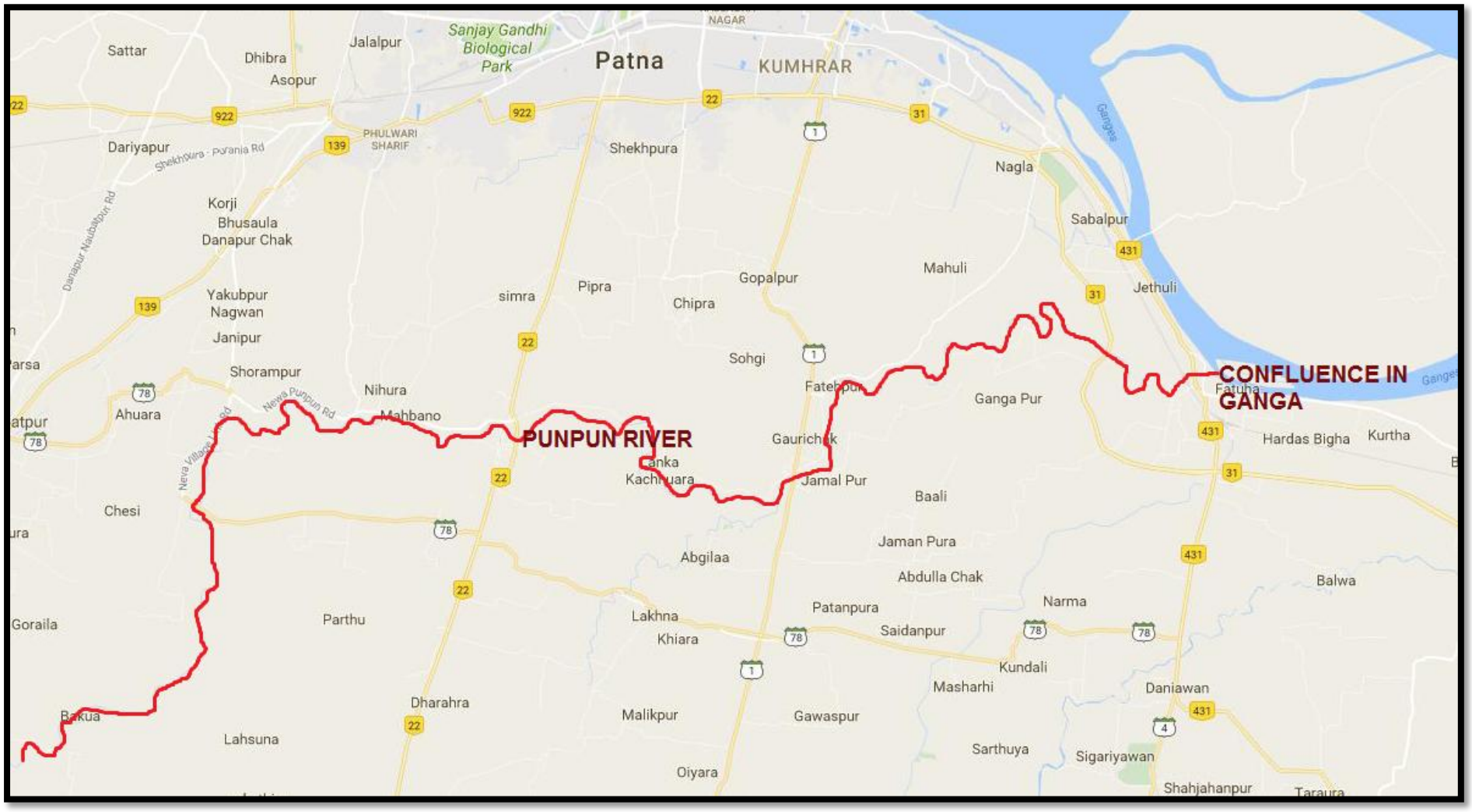
The feasibility study of Punpun River being envisaged for the development the waterway navigation. It is expected to boost the much needed irrigation projects and water way transportation in and around the river, which will provide a better living standards of the local populace

Mata Seeta has spent some time near Punpun village at the bank of Punpun River. For Pind-dan Gaya and Punpun are the most important/ auspicious place in Hindu Dharma. Every year from Nepal and all over India Hindus come here to do pind-dan. It is saying that first pind-dan is done in Punpun after than Gaya.

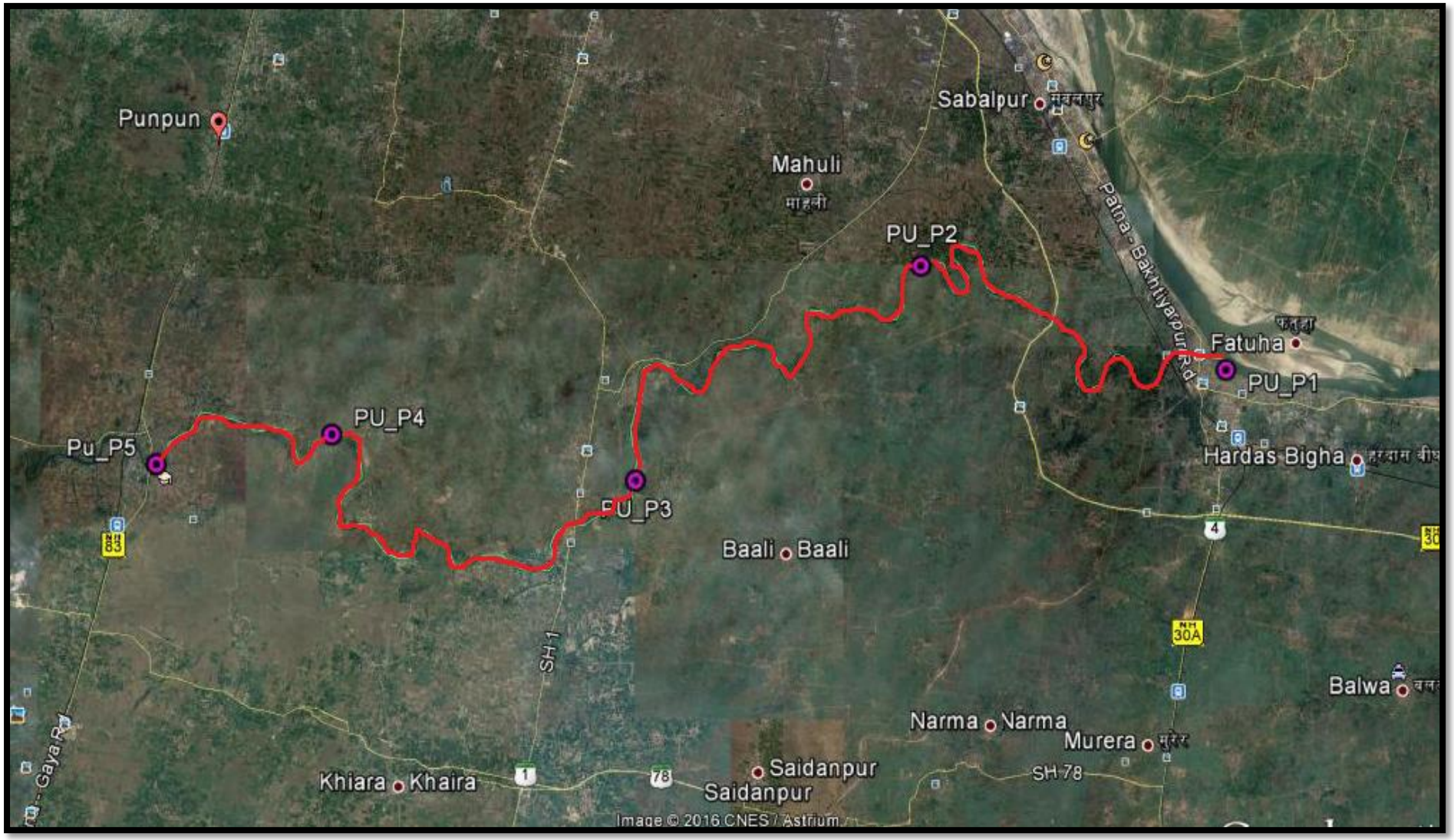
1.2 **Tributaries**. No tributary was noticed in the surveyed river stretch.

1.3 **States & Districts**. Punpun Riveroriginates from Palamu district of Jharkhand and flows through Chatra, Aurangabad, Gaya and Patna district of the Indian state of Jharkhand and Bihar. The course of waterway understudy of Punpun River is 34.61 km length of the river from Ganga confluence to upstream

1.4 (a) **Full Course of Waterway**.



1.4 (b) **Course of Waterway under study**.



1.5 **Scope of Works** Strabag India Pvt Ltd. conducted hydrographic and topographic survey of Punpun River from the confluence of Ganga at FatuhaLat 25°30'50.37"N Long 85°18'16.72" E to Bridge on NH83, Dudhaila Near Pakri Village, Lat 25°29'49.79"N, Long 85° 6'19.44"E was carried out 07th Jan 2016 to 24thJan 2016. The scope of the work for the conduct of survey of Punpun River includes: -

- Undertake bathymetric and topographic survey of National waterway.
- Establishing horizontal and vertical control stations
- Construction of benchmark pillars and establishing its reduced level w.r.to Mean Sea Level
- Setting up and deployment of water level gauges
- Current velocity and discharge measurements
- Collection and analysis of water and bottom samples.
- A collection of topographic features including existing cross structures.
- Analysis of survey data, including assessment of water availability for navigation.
- Preparation of survey charts and feasibility report

## SECTION – 2: METHODOLOGY ADOPTED TO UNDERTAKE STUDY

2.1 **Methodology**. The detailed bathymetric and topographic survey of Punpun river (34.61 km) from Ganga confluence at Fatuha (Ch. 0 km), Lat 25°30'50.37"N Long 85°18'16.72" E to Bridge on NH 83, Dudhaila near Pakri Village (Ch.34.61 km),Lat 25°29'49.79"N, Long 85° 6'19.44"E was carried out from 07th Jan 2016 to 24th Jan 2016.Details of Horizontal and Vertical Control adopted for the survey of Punpun River is placed at Annexure 7 to this report. The survey was undertaken with cross-section corridor of 100m and line spacing of 100m.The plotting of chart was done on UTM projection at zone 45N as per specification. Details of survey chart scheming and sample fair sheet is placed at Annexure 15 to this report

2.1(a) **Personnel and Resources**. Total 32 personnel were involved which includes Party Chief, Sr. Surveyors, surveyors, helpers, cooks and drivers for the task in addition to resources viz. vehicles, logistics, etc.

2.1(b) **Equipment Used**. Various equipment's were used during the survey operations which is tabulated below as well as elaborately described in the succeeding paragraphs.

### HYDROGRAPHIC SURVEY EQUIPMENTS

| **Equipment** | **Make** | **Qty. Deployed** |
|---|---|---|
| Echo sounder | 500 DF dual Frequency | 2 |
| DGPS | Trimble SPS 356/461 | 2 |
| Current Meter | Vertical Axis-Cup Type | 1 |
| Grab Sampler | Vanveen grab | 1 |
| Software | HYPACK data acquisition | 1 |
| Tide Pole | Manual | 06 |

## TOPOGRAPHIC SURVEY EQUIPMENTS

| Equipment | Make | Qty. Deployed |
|---|---|---|
| GPS Sets | Trimble Spectra | 5 |
| Auto Level | Leica | 2 |
| Total Station | Topcon | 1 |
| Total Station | Leica | 1 |
| Software | HYPACK data acquisition | 1 |
| Software | AutoCAD | 1 |
| Software | Trimble Spectra Survey office v.8 | 1 |

2.1(c) **Topographic Survey.** The Topographic survey was carried out between 07th Jan 2016 to 24thJan 2016. The weather was cold and fog, for most of the survey period. The survey was undertaken as per the approved line provided by IWAI. The spot level points in the crossline were spaced at 5 m interval. The plotting of the chart was done on UTM Projection at Zone 45N. The spot levels along the river banks and dry river beds were obtained by using Trimble DGPS in RTK mode. The topographic survey for the entire survey stretch was conducted to collect the following data: -

- Spot levels of the River bed and Banks
- 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 Spot Levelling by Trimble DGPS***

The details of all spot levels are provided in the respective sheets being presented along with this report. The details of bank protection and features across the river are Placed at Annexure 5 & 6 respectively. Additionally, a soft copy of the same in XYZ format is being handed over as deliverable data.

2.1(d) **Bathymetric Survey.** Bathy 500 DF Echo Sounder was used to obtain soundings onboard the survey boat. The working frequency of 210 and 33 kHz was used for sounding operations. Trimble SP 461/ 356 DGPS was used for positioning. The digital output from the echo sounder and DGPS were automatically fed to the HYPACK data logging software on a real-time basis for the acquisition of survey data. No breakdown of equipment was reported and the performance of the equipment was found to be satisfactory during the entire duration of the survey. The 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/Topographic Spot leveling was also carried out in the area where the survey boat cannot be operated due to the low depth.


***Bathymetric Survey operation***

**2.1(e) Calibration.** The equipment used for the survey was calibrated by the equipment supplier. The equipment calibration certificates are placed at Annexure - 13 to this report.

2.2 **Description of Bench Mark**. Trimble Spectra Precision DGPS system was used in standalone static observation mode for 24 hrs. For establishment of geodetic control in the survey area. Extension of the geodetic control was achieved by setting up BM pillars throughout the river stretches at every 10km chainage. Co-ordinates of such pillars were established by simultaneous Static observations between established and new stations. The data was processed using Spectra Precision Survey Office software. Details of these BM pillars along with stationed recovery descriptions is mentioned at Annexure 9. Benchmark was recovered near Gaurichak Punpun Bridge. Height of LBM at Gaurichak Punpun Bridge is 44.160m wrt MSL. Simultaneous GPS observation and levelling were carried out for establishing vertical control.

Local Bench Mark was established near Gaurichak Punpun Bridge, leveling and simultaneous GPS observation were carried out with the help of Trimble Spectra Precision Positioning System for transferring of Benchmark. Tide gauges were established at 10 km interval approximately. Bench Marks were connected with the '0' of the tide pole by leveling using Auto Level. After discussion with the IWAI authorities, sounding datum were established for the total surveyed length.

***Bench Mark at Gaurichak Punpun Bridge***

2.3 **Tidal Influence Zone and Tidal Variation**. Total 34.61 km length of river stretch was completely non-tidal. However, tidal observations were undertaken as per tender document for the entire duration of the survey. Tidal data being attached at **Annexure- 3** along with this report.

2.4 **Methodology to Fix Sounding Datum**. The datum is adopted as per the gradient of the River and the average water level observed for the River. Last six year average of minimum water level data of CWC gauge is to be taken for fixing the sounding datum. Shallow and of dry stretches of waterway, lowest MSL value at every km is to be taken for fixing Sounding Datum. The Details of established datum value for stretches are tabulated below:-

| **Stretch (km)** | | **Established SD wrt MSL (m)** |
|---|---|---|
| **From** | **To** | |
| 0.00 | 5.91 | 40.523 |
| 5.91 | 16.08 | 41.905 |
| 16.08 | 24.81 | 43.018 |
| 24.81 | 31.70 | 44.047 |
| 31.70 | 34.61 | 44.710 |

2.5 **Maximum and Minimum Water Level**. Data being classified, not included in the report.

2.6 **Salient Features of Dam, Barrages, Weirs, Anicut, Locks and Aqueducts, etc**. There is no any Barrage, Dam, Anicut, and Aqueduct in the stretch.

2.7 **Description of Erected Bench Mark Pillars**. New Bench Mark Pillar (05 Nos) were constructed as per the Specification of Tender Documents. The Extension of Horizontal and Vertical Control was carry out by base line processing with the nearest reference station. Details of erected BM pillars is Place at **Annexure 9**. The final accepted co-ordinate and Reference Level value of Punpun BM Pillar are as below: -

| S.No | Name | Chainage (KM) | Latitude (N) | Longitude (E) | Northing (m) | Easting (m) | Height above MSL (m) | BM Ht above SD (m) |
|---|---|---|---|---|---|---|---|---|
| 1 | BASE PUNPUN | BASE PUNPUN | 25°29'22.598" | 85°10'59.883" | 2820409.582 | 317391.181 | 54.418 | |
| 2 | PU P1 | 0.27 | 25°30'52.79" | 85°18'7.16" | 2823027.98 | 329359.122 | 47.591 | 7.068 |
| 3 | PU P2 | 11.54 | 25°31'15.55" | 85°14'25.49" | 2823808.115 | 323179.746 | 47.33 | 5.425 |
| 4 | PU P3 | 20.610 | 25°29'26.39" | 85°11'37.60" | 2820512.336 | 318446.049 | 51.686 | 8.668 |
| 5 | PU P4 | 29.02 | 25°29'49.42" | 85° 8'42.36" | 2821288.972 | 313562.188 | 49.841 | 5.794 |
| 6 | PU P5 | 34.40 | 25°29'53.39" | 85° 6'25.29" | 2821464.091 | 309736.394 | 52.907 | 8.197 |

2.8 **Description of Erected Tide Gauges**. Tide gauges were erected throughout the river stretch. Water level reading as per prescribed format along with chainage is mentioned at **Annexure 3**. The Detail of erected tide pole which are used for reduction of Sounding is as follows.

| Tide Gauge No | Location | Chainage (km) | Easting /Northing (m) | Zero of Tide Gauge W.r.t MSL (m) | Period of Observation |
|---|---|---|---|---|---|
| TP1 | Trivani Ghat | 0.27 | 329352.480E 2822999.386N | 40.276 | During the Conduct of Bathy Survey |
| TP2 | Hiranandpur | 11.54 | 323195.623E 2823766.580N | 41.783 | During the Conduct of Bathy Survey |
| TP3 | Gori Chak | 20.61 | 318433.770E 2820482.700N | 42.804 | During the Conduct of Bathy Survey |
| TP4 | Sirpalpur | 29 | 313543.773E 2821297.020N | 43.998 | During the Conduct of Bathy Survey |
| TP5 | Zahidpur | 34.4 | 309764.542E 2821423.933N | 44.615 | During the Conduct of Bathy Survey |

***Tidal Observation at Ch. 11.54 and at Ch. 20.61 km***

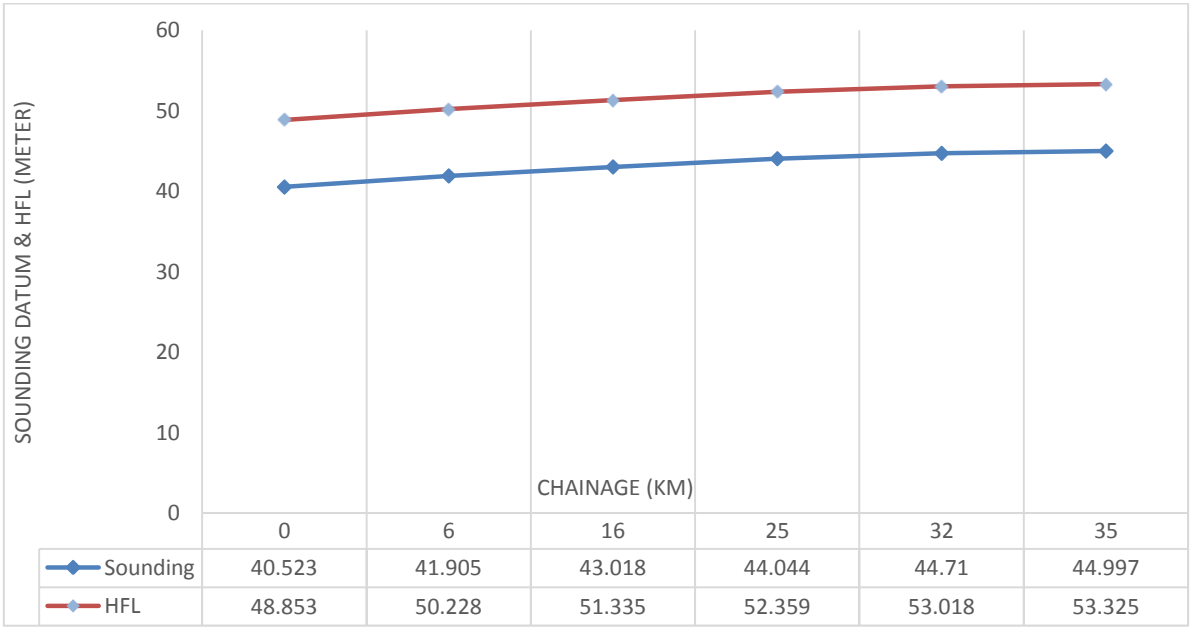
2.9 **Chart Datum/ Sounding Datum and Reduction Details.** Sounding Datum reduction table being mentioned below:-

| Location of CWC gauge / Dam / Barrage / Weir / Anicut / Bench Mark / tide gauges | Chainage (km) | AvgCh. (km) | Stretch for corrected soundings and topo levels (km) | | Established Sounding Datum w.r.t. MSL (m) at col. A. | Sounding Datum of Tide Gauge wrt MSL (m) | Correction in WL data for Bathymetric survey (m) | Topo level data converted as depth for volume calculation wrt SD (m) | HFL (m) |
|---|---|---|---|---|---|---|---|---|---|
| A | B | | C | | D<br>+ve indicates above MSL | E | F = (E- WL data in MSL) | G = (E-topo levels in MSL) | |
| | | | FROM | | -ve indicates below MSL | | | | |
| **Sripalpur** | 36.907 | | | | 44.997 | | **Details at Annexure3.** | **A separate xyz file is created.** | 53.325 |
| PU_P5 | 34.40 | 35.653 | 31.70 | 34.61 | | 44.710 | | | 53.018 |
| PU_P4 | 29.00 | 31.7 | 24.81 | 31.70 | | 44.047 | | | 52.359 |
| PU_P3 | 20.61 | 24.805 | 16.08 | 24.81 | | 43.018 | | | 51.335 |
| PU_P2 | 11.54 | 16.075 | 5.91 | 16.08 | | 41.905 | | | 50.228 |
| PU_P1 | 0.27 | 5.905 | 0.00 | 5.91 | | 40.523 | | | 48.853 |

2.10 **HFL at Gauge Stations and Cross-Structures**. HFL at CWC Gauge station Sripalpur has already been established by the CWC department and HFL for the waterway was derived as per change in the ground profile of the river.

| Sl | Location and Description of CWC Gauge/ Dam/etc. | Cross-Structure Details | Chainage (km) | Established HFL wrt MSL (m) | Computed HFL at Cross – Structure wrt MSL (m) |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| 1 | Sripalpur | | | 53.325 | |
| 2 | | Loha Bridge | 0.57 | | 48.893 |
| 3 | | New Bridge | 0.877 | | 48.929 |
| 4 | | Fatuha Rail Bridge | 1.17 | | 48.965 |
| 5 | | Naryan Bridge | 5.32 | | 49.471 |
| 6 | | Fatehpur Bridge | 18.12 | | 51.033 |
| 7 | | Gourichak Bridge | 21.8 | | 51.482 |
| 8 | | Zahidpur Bridge | 34.61 | | 53.018 |

2.11 **Graph: Sounding Datum and HFL vs Chainage**.



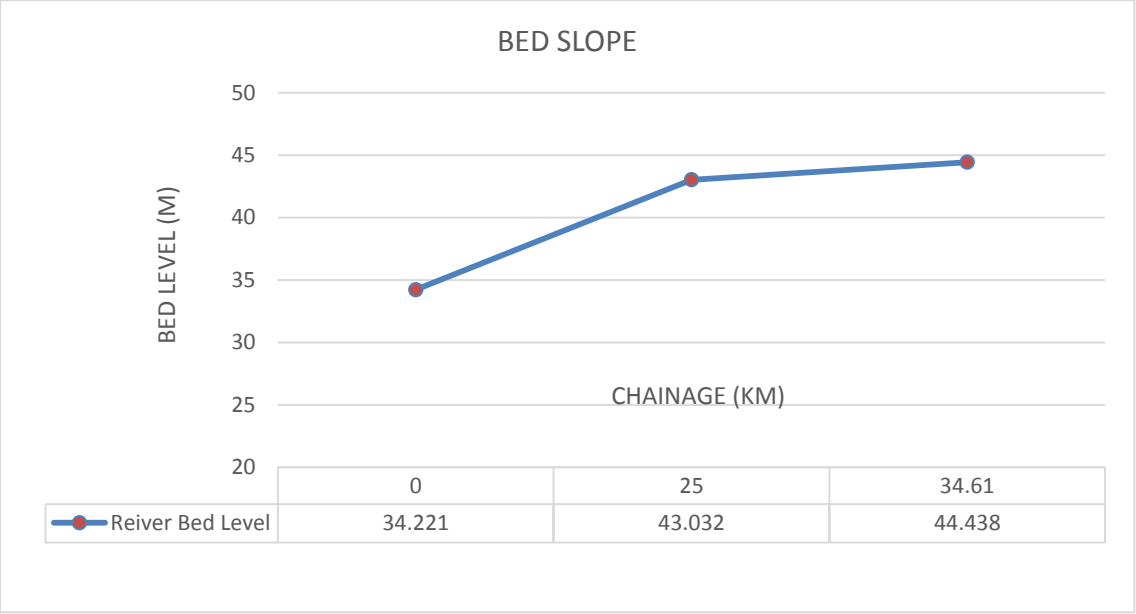
## HFL AND SOUNDING DATUM TABLE

| GAUGE NAME | CHAINAGE (KM) | SOUNDING DATUM(M) | HFL(M) |
|---|---|---|---|
| Ganga Confl. (1262) | 0 | 40.523 | 48.853 |
| TP_PU 01 | 5.91 | 41.905 | 50.228 |
| TP_PU 02 | 16.08 | 43.018 | 51.335 |
| TP_PU 03 | 24.81 | 44.044 | 52.359 |
| TP_PU 04 | 31.7 | 44.71 | 53.018 |
| TP_PU 05 | 34.61 | 44.997 | 53.325 |

2.12 **Average Bed Slope**. Average bed slope of the whole river stretch being tabulated below: -

| Chainage (KM) | | River Bed Level (m) | | River Bed Level Change (m) | Distance (km) | Slope |
|---|---|---|---|---|---|---|
| From (km) | To (m) | From(m) | To(m) | | | |
| Ch. 0.0 km | Ch. 25.0 km | 34.221m | 43.032m | 8.811 | 25 | 1:2837 |
| Ch. 25.0 km | Ch. 34.61 km | 43.032m | 44.438m | 1.406 | 9.61 | 1:6835 |

## BED SLOPE VS CHAINAGE GRAPH



2.13 **Details of Dam, Barrages, Weirs, Anicut, etc**. There is no Barrage, Dam, weirs, Anicuts in thesurvey stretch.

2.14 **Details of Locks**. There is no Barrage in this portion of the river

2.15 **Details of Aqueducts**. There is no aqueduct in this portion of the river.

2.16 **Details of Existing Bridges & Crossings**. There are total 07 in no's bridges are present across the river. Details is tabulated below:-

| Sl No | Structure Name | Chainage (km) | Position (Lat Long) | | Position (UTM) | | Length (m) | Width (m) | No of Piers | Horizontal clearance (Distance Between piers) (m) | Vertical clearance wrt HFL (m) | Present condition |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Left Bank | Right Bank | Left Bank | Right Bank | | | | | | |
| 1 | Loha Bridge | 0.57 | 25°30'51.69"N 85°17'56.36"E | 25°30'55.69"N 85°17'56.88"E | 329057.081E 2822997.035N | 329073.936E 2823120.430N | 124.5 | 3.8 | 5 | 28.62 | 3.55 | Completed |
| 2 | New Bridge | 0.87 | 25°30'52.25"N 85°17'45.96"E | 25°30'56.40"N 85°17'45.58"E | 328767.395E 2823018.498N | 328758.482E 2823146.936N | 128.7 | 10 | 4 | 41.9 | 6.9 | Completed |
| 3 | Fatuha Rail Bridge | 1.17 | 25°30'49.83"N 85°17'36.72"E | 25°30'53.93"N 85°17'34.30"E | 328508.917E 2822947.084N | 328442.005E 2823074.045N | 143.5 | 9.5 | 10 | 12.44 | 4.37 | Completed |
| 4 | Naryan Bridge | 5.32 | 25°31'12.12"N 85°16'18.75"E | 25°31'16.04"N 85°16'20.20"E | 326340.073E 2823661.643N | 326382.944E 2823781.171N | 127 | 26 | 5 | 30.55 | 4.52 | Completed |
| 5 | Fatehpur Bridge | 18.12 | 25°30'44.32"N 85°11'47.82"E | 25°30'46.82"N 85°11'44.88"E | 318764.657E 2822906.063N | 318683.783E 2822984.100N | 112 | 7 | 6 | 21.2 | 3.52 | Completed |
| 6 | Gouricha k Bridge | 21.8 | 25°29'15.73"N 85°11'0.80"E | 25°29'20.35"N 85°11'1.27"E | 317414.629E 2820198.245N | 317429.832E 2820340.263N | 143 | 8 | 8 | 18.93 | 5.33 | Completed |
| 7 | Zahidpur Bridge | 34.61 | 25°29'48.22"N 85° 6'19.50"E | 25°29'52.51"N 85° 6'20.12"E | 309572.536E 2821307.091N | 309591.212E 2821439.904N | 134 | 10.2 | 7 | 21.13 | 6.38 | Completed |

2.17 **Details of Other Cross Structures**. There is no other cross structure, in this river stretch.

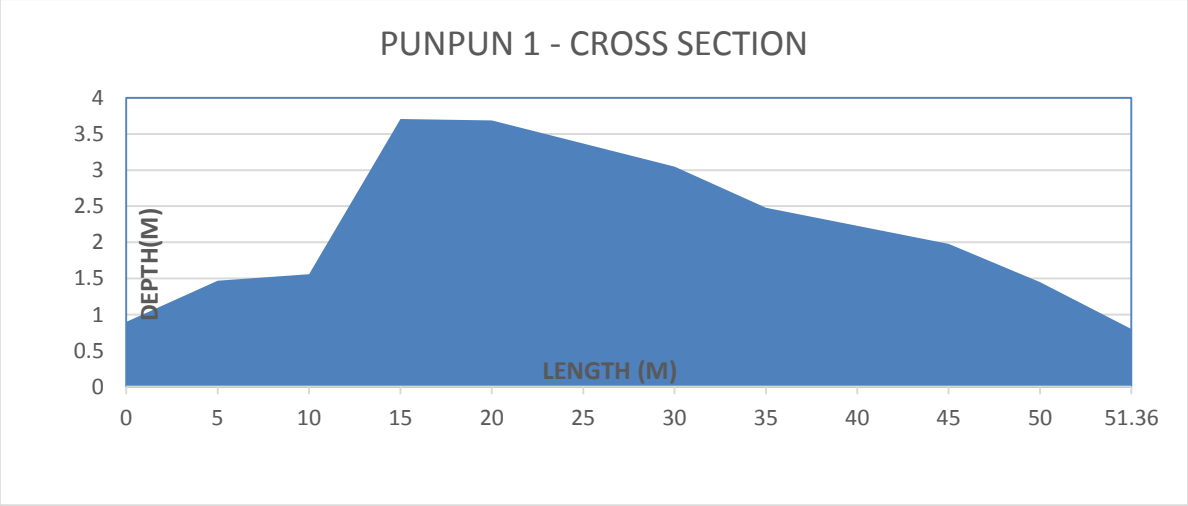
2.18 **High Tension Lines / Electric Lines / Tele-Communication Lines**. Details of HT lines and electric pole is tabulated below:-

| Sl No | Cross-Structure Name | Chainage (km) | Position (Lat Long) | | Position (UTM) | | Vertical clearance w.r.t HFL (m) | Remarks (Completed or not-completed) |
|---|---|---|---|---|---|---|---|---|
| 1 | HT Line | 5 | 25°31'9.62"N 85°16'29.36"E | 25°31'7.64"N 85°16'27.41"E | 326635.022E 2823580.909N | 326580.354E 2823520.990N | 18 | completed |
| 2 | HT Line | 6.18 | 25°31'28.46"N 85°15'53.12"E | 25°31'25.72"N 85°15'52.45"E | 325631.038E 2824173.173N | 325611.817E 2824089.6267N | 20 | completed |
| 3 | HT Line | 11.47 | 25°31'15.03"N 85°14'27.71"E | 25°31'11.42"N 85°14'27.23"E | 323241.638E 2823791.640N | 323226.308E 2823680.674N | 20 | completed |
| 4 | HT Line | 27.1 | 25°29'12.91"N 85° 8'51.05"E | 25°29'12.08"N 85° 8'47.12"E | 313789.901E 2820161.593N | 313679.509E 2820137.266N | 22 | completed |

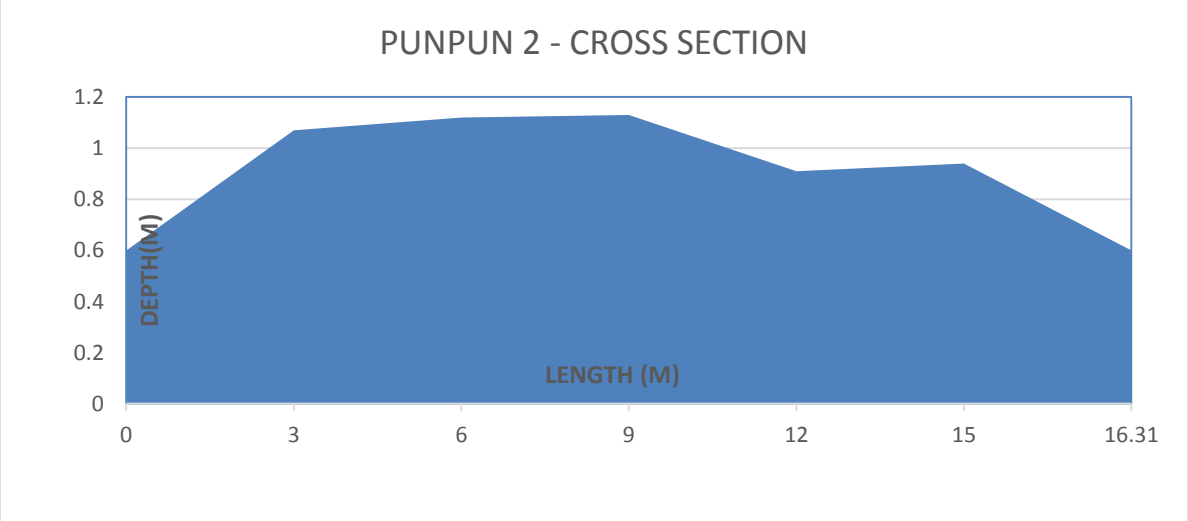
2.19 **Current Meter and Discharge Details**. Current meter observations and discharge calculations were undertaken at every 10 km interval approximately. Details of the same is tabulated below:-

| S.No | Chainage (km) | EASTING (m) | NORTNING (m) | Latitude (N) | Longitude (E) | Observed Depth(m) | Velocity mtrs/sec | X-Sectional Area (Sq.M) | Discharge M3/Sec |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.18 | 329508.202 | 2822976.806 | 25°30'51.19" | 85°18'12.52" | 3.7 | 0.5 | 125.105 | 62.553 |
| 2 | 9.98 | 323923.978 | 2824760.832 | 25°31'46.81" | 85°14'51.68" | 1.13 | 0.55 | 16.009 | 8.805 |
| 3 | 20.05 | 318507.656 | 2821064.5 | 25°29'44.36" | 85°11'39.51" | 2.38 | 0.32 | 78.751 | 25.200 |
| 4 | 30.43 | 312582.114 | 2821667.558 | 25°30'1.29" | 85° 8'7.08" | 3.08 | 0 | 100.845 | 0.00 |
| 5 | 34.41 | 309763.007 | 2821392.775 | 25°29'51.07" | 85° 6'26.30" | 1.14 | 0 | 19.685 | 0.00 |

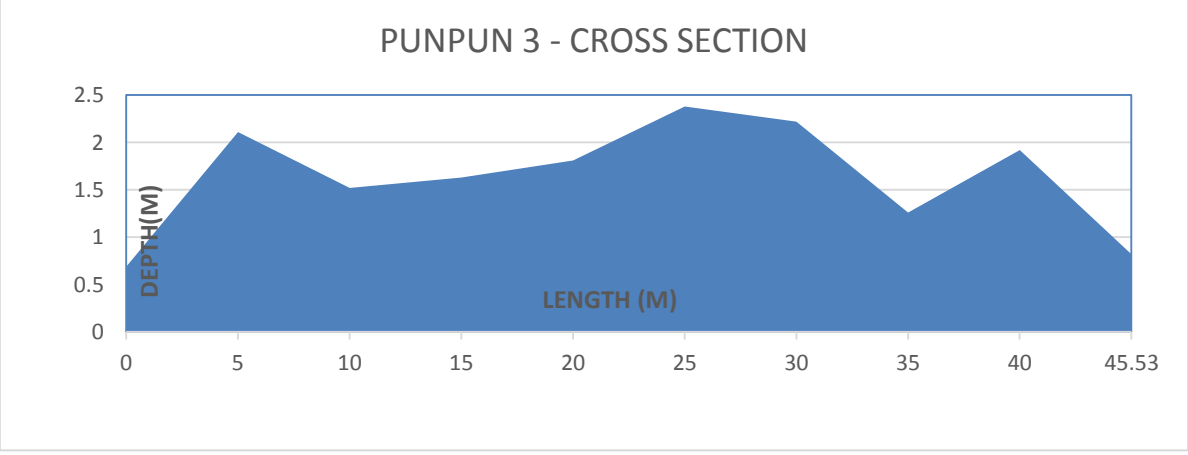
## PUNPUN 1- CROSS SECTION



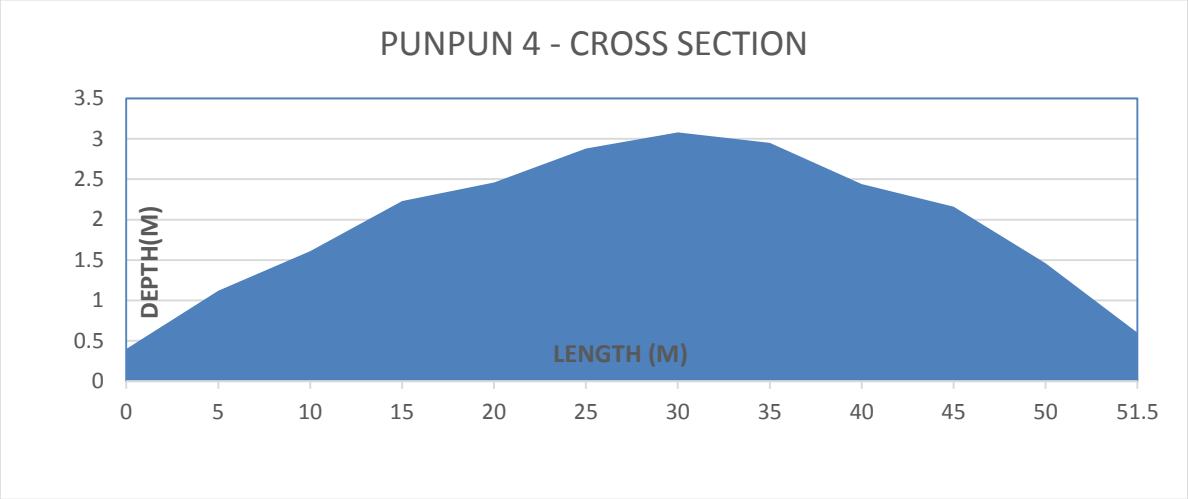

## PUNPUN 2- CROSS SECTION



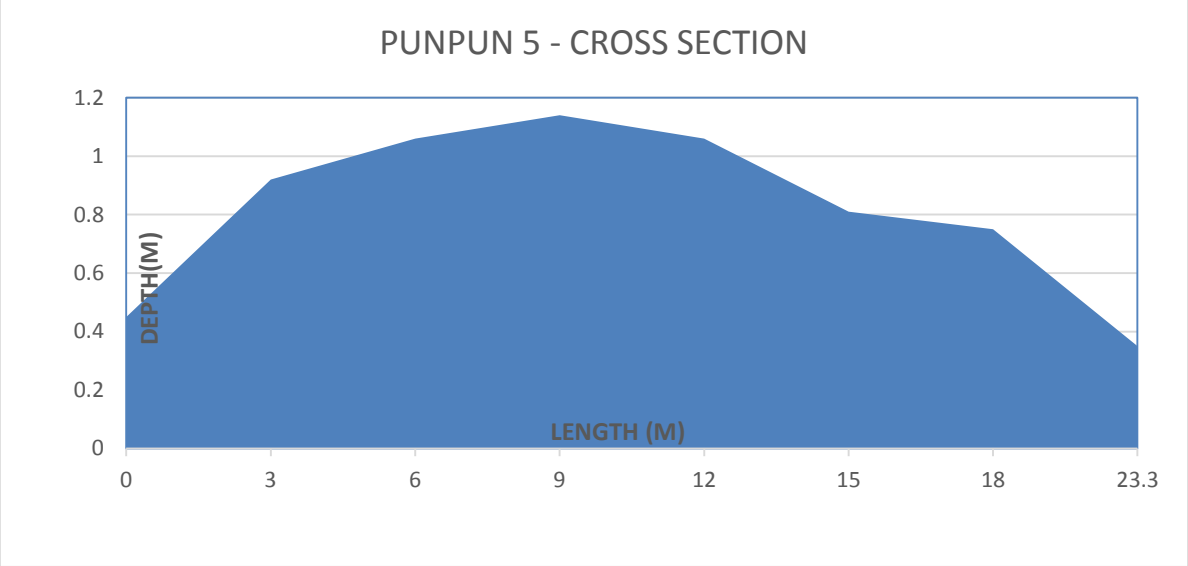

## PUNPUN 3- CROSS SECTION



## PUNPUN4- CROSS SECTION




## PUNPUN5- CROSS SECTION




2.20(a) **Soil Sample Locations**. Details of soil sample location being appended below:-

| Sr.No | Chainage (KM) | Easting (m) | Northing (m) | Latitude | Longitude | Depth (m) |
|---|---|---|---|---|---|---|
| 1 | 0.19 | 329508.243 | 2822976.807 | 25°30'51.19" | 85°18'12.52" | 5.5 |
| 2 | 9.98 | 323922.910 | 2824761.120 | 25°31'46.84" | 85°14'51.64" | 1.13 |
| 3 | 20.06 | 318507.657 | 2821064.501 | 25°29'44.36" | 85°11'39.51" | 2.2 |
| 4 | 30.46 | 312582.114 | 2821667.559 | 25°30'1.29" | 85° 8'7.08" | 2.3 |
| 5 | 34.43 | 309763.008 | 2821392.776 | 25°29'51.07" | 85° 6'26.30" | 0.9 |

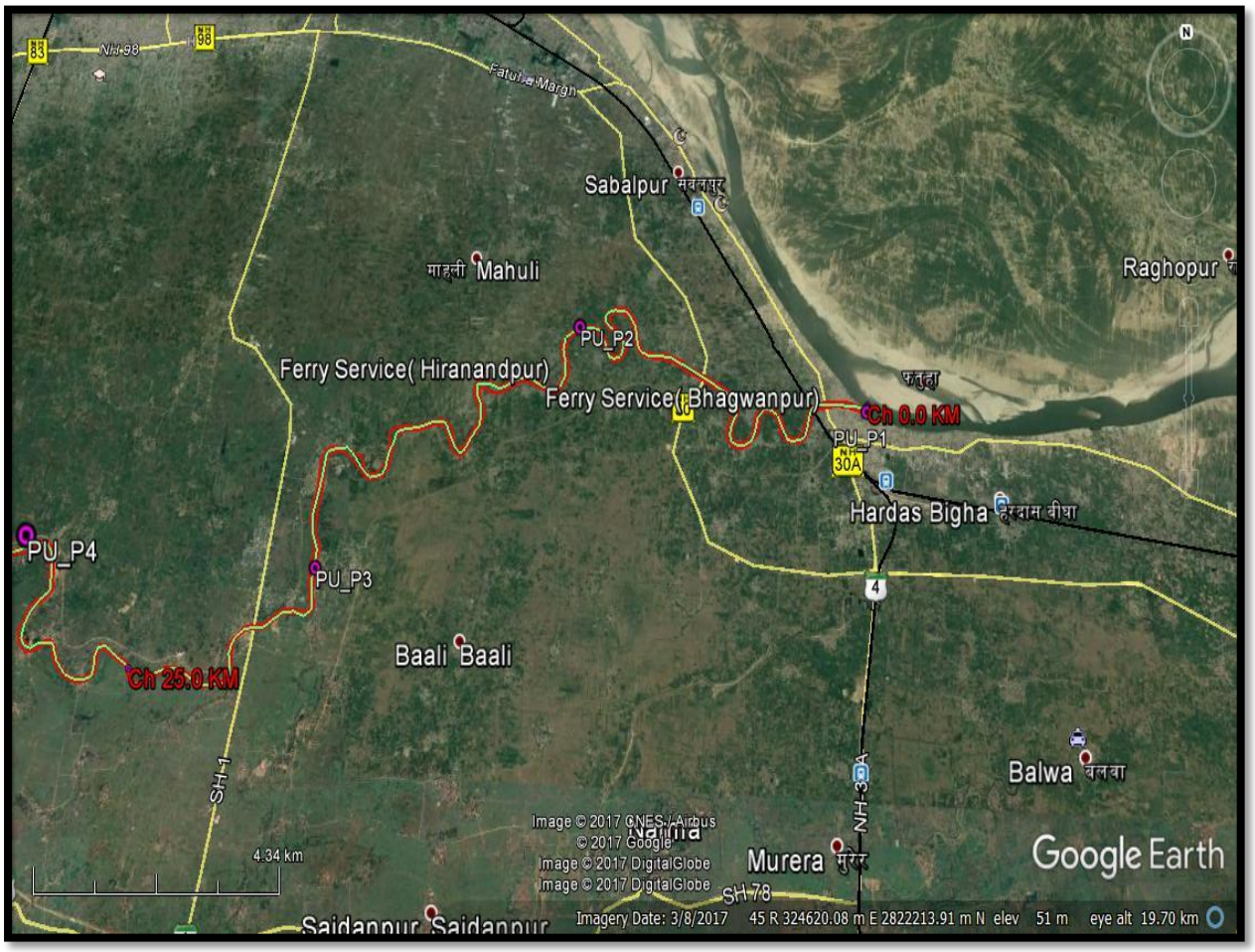
2.20(b) **Water Samples**. Water sample locations are tabulated below:-

| Sr.No | Chainage (KM) | Easting (m) | Northing (m) | Latitude | Longitude | Depth (m) | Mid-Depth (0.5d) (m) |
|---|---|---|---|---|---|---|---|
| 1 | 0.19 | 329508.243 | 2822976.807 | 25°30'51.19" | 85°18'12.52" | 5.5 | 2.75 |
| 2 | 9.98 | 323922.910 | 2824761.120 | 25°31'46.84" | 85°14'51.64" | 1.13 | 0.56 |
| 3 | 20.06 | 318507.657 | 2821064.501 | 25°29'44.36" | 85°11'39.51" | 2.2 | 1.1 |
| 4 | 30.46 | 312582.114 | 2821667.559 | 25°30'1.29" | 85° 8'7.08" | 2.3 | 1.15 |
| 5 | 34.43 | 309763.008 | 2821392.776 | 25°29'51.07" | 85° 6'26.30" | 0.9 | 0.45 |

## SECTION-3

3.**Description of Waterway**.

3.1 **Sub-Stretch 1: From Ch 0 km to Ch 25 km**. This stretch of the surveyed river is having length of 25 km and average width of 30 m to 50 m. Current meter observation and discharge measurement were carried out at Ch.0.18 km, Ch.9.98 km and Ch.20.05 km chainage. Small wooden boats were engaging in ferry service at Ch. 10.75 km (Hiranandpur ferry Ghat), Ch.11.50 km (Bhagwanpur Ferry Ghat) and fishing activities. Bamboo barrier is at ch.20.55 and 21.50 in this section. There is neither any forest zone nor restricted zone. Farmers were seen engaging in agricultural activities. Primary crops are mustard, wheat, cauliflower, potato, tomato, cabbage, carrot, radish, etc.




***From Ch 0 km to 25 km***

**Dredging quantity for substretch-1**

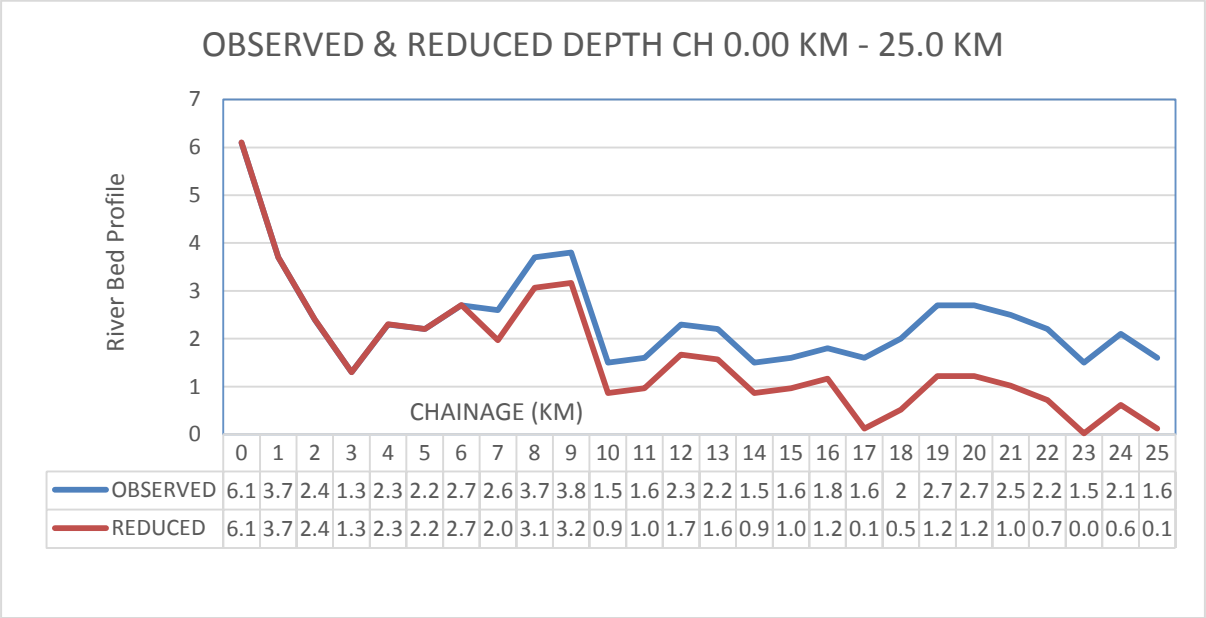
| | Chainage (km) | | Observed | | | | Reduced wrt Sounding Datum | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Type** | **From** | **To** | **Min Depth (m)** | **Max Depth (m)** | **Length of Shoal (m)** | **Dredging Qty (cu.m)** | **Min Depth (m)** | **Max Depth (m)** | **Length of Shoal (m)** | **Dredging Qty (cu.m)** |
| Class-I | 0 | 25 | 0 | 6.1 | 5,700 | 2,16,234.91 | -0.3 | 6.1 | 18,000 | 7,40,363.70 |
| Class-II | 0 | 25 | 0 | 6.1 | 8,600 | 5,03,551.20 | -0.3 | 6.1 | 19,400 | 12,13,238.80 |
| Class-III | 0 | 25 | 0 | 6.1 | 14,300 | 10,81,291.06 | -0.3 | 6.1 | 20,800 | 19,76,081.69 |
| Class-IV | 0 | 25 | 0 | 6.1 | 16,200 | 15,13,564.48 | -0.3 | 6.1 | 21,100 | 24,56,722.12 |

(a) **Bathymetry Survey & Topographic Survey**.

| **SUB-STRETCH-1 (0-25 KM)** | | |
|---|---|---|
| **Type of Survey** | **Chainage (km)** | **Remarks** |
| Bathymetry Survey | 0.0 km to 20.40 km | covered by bathymetric survey |
| | 20.75 km to 25.0km | covered by bathymetric survey |
| Topographic Survey | 20.40 km to 20.75 km | Being Dry/Very Shallow covered by topographic method |
| | 0.0 km to 25.0 km | Riverbank, prominent features along the bank. |


***Ganga Confluence at Ch 0.0 km***

(c) **Observed & Reduced Depth Profile of the Stretch**. Both observed and reduced depth along with slope being mentioned below:-




| Chainage (km) | | River Bed Level (m) | | River Bed Level Change (m) | Slope |
|---|---|---|---|---|---|
| From | To | From | To | | |
| 0.0 | 25.0 | 34.221 | 43.032 | 8.811 | 1:2837 |

(d) **Prominent Dam/ Barrage**. There is no Barrage/Dam in this stretch of the river.

(d) **Tidal Stretch**. This 25 km of river stretch is completely non-tidal.

(e) **Bank**. The river bank of Punpun is mainly unprotected throughout the river. But in some places, bank concrete or Pitch Protected was noticed especially in and around the bridges (New Bridge at Ch. 0.87 km, Naryan Bridge at Ch. 5.32 km, Fatehpur Bridge at Ch. 18.12 km,) Ghat (Ch. 0.0 km confluence in Ganga at Trivanighat, Subhas Nagar Sri Ghat, Ch. 18.55 km) and Ch. 11.0 km to 11.20 bank protection with gunny bags.


***TrivaniGhat at Ch 0.00 km & Subhas Nagar Sri Ghat at Ch18.55 km***

***Bank Protection at Ch. 11.0 km & Naryan Bridge at Ch.5.32 km***

(f) **Hindrances**. The surveyed river stretch is having hindrances for navigation, Bamboo barrier across the river at Ch. 20.50 km & Ch. 21.50, the RCC pipe stack in the river at Ch.18.0 km and one big I-land at Ch.12.4 to 12.95 and some local people also prepare local wine on the I-land.Under water plants & Phytoplankton were seen in many places which may cause significant hindrance for navigation. Which may cause navigational interference for boats and vessels.

***RCC pipe at Ch.18.00 &Bamboo barrier at Ch. 20.50 km***


***Bamboo barrier at Ch. 21.55 km & Phytoplankton Ch. 20.7 km***

(g) **Encroachment**. Encroachment on the river bank is prominent on numerous ocassions.

***Houses at Ch 0.56 km & Ch 21.8 km***

(h) **Protected Area**. There is no wildlife, Defence, Atomic power plant and any other procted areas in this stretch.

(i) **NH/ SH**. NH 30, NH 30A, and SH 1a cross the river in thisstrech.

(j) **Railway Station**. Railway stations in this stretch are Fatuha and Bankaghat station.

(k) **Land Use Pattern**. Land on either banks of the river being utilised for either agricultural or residential purpose.

(l) **Crops**. Both the banks of Punpun River are very fertile. Primary crops are mustard and wheat but seasonal vegetable crops are also cultivated viz. cauliflower, potato, tomato, cabbage, carrot, radish, etc. (winter crops).

***Crop Cultivation on the Bank of Punpun at Ch. 11.50 km and Ch. 20.6 km***

(m) **Bulk Construction Material**. There is neither any factory for construction material nor any raw material available along the corridor of the river stretch.

(n) **Existing Industry**. Minor industries are pulses, shoes, masur, electrical, cotton, iron, food grains, Wooden & Clay toys, Musical Instruments, etc. Above are in Patna city.

o) **Existing Ghats, Jetties and Terminals**. There is no jetty and terminal was observed in this portion. Ghats located in this river portion is subhash Nagar SriGhat and Trivanighat at fatuha.

***Subhas Nagar Sri Ghat at Ch. 18.55 km &Trivani Ghat at Ch. 0.0 km***

(p) **Cargo Movement**. There is no cargo movement observed in this portion of the water way during the course of survey.

(q) **Prominent City/ town or Place of Worship**. The only city fatuha is situated on the bank of rivers Punpun Ganga and from Patna. Fatuha is an important industrial center known for small industries and its handloom industries. The city's name is said to come from its status as a center of textile manufacturing, etc. Fatuha is a major rural market, catering to the needs of numerous villages which produce all kinds of agrarian and other rural produces like handicrafts, etc. Remarkable tourist influx can be noticed in the city.

(r) **Ferry**. Total two in nos. ferry Ghats were observed at Ch. 10.7 km Hiranandpur ferry Ghat and Ch.11.50 km (Bhagwanpur Ferry Ghat.Small wooden boats were utilised for the ferry services across the river.

***Hiranandpur ferry Ghat at Ch 10.7 km& Bhagwanpur Ferry Ghat at Ch 11.50 km***

(s) **Water Sports Recreational Facilities**. There is no facility for water sports along the surveyed river stretch. In future, developed of the same is not viable throughout the river stretch. However, at Ganga confluence it can be developed due to water availability throughout the year.

(t) **Fishing Activity**. Small wooden boats were seen engaging in fishing activity in this river portion.


***Fishing Activity at Ch 20.05 km***

(u) **Sand Mining**. No sand mining activity was found in this stretch.

(v) **Tributaries**. There is no tributary is present in this portion.

(w) **Details of Irrigational Canals**. There is no irrigational canal present in this section.

(x) **Details of Nalas**. There is no any Nalas was found in this stretch.

(y) **Usage of Water**. Water in this portion primarily irrigation purpose.

(Z) **Details of Cross-Structures**. There are total 06 in no's bridges are present across the river. Details is tabulated below:-

| Sl No | Structure Name | Chainage (km) | Position (Lat Long) | | Position (UTM) | | Length (m) | Width (m) | No of Piers | Horizontal clearance (Distance Between piers) (m) | Vertical clearance wrt HFL (m) | Present condition |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Left Bank | Right Bank | Left Bank | Right Bank | | | | | | |
| 1 | Loha Bridge | 0.57 | 25°30'51.69"N 85°17'56.36"E | 25°30'55.69"N 85°17'56.88"E | 329057.081E 2822997.035N | 329073.936E 2823120.430N | 124.5 | 3.8 | 5 | 28.62 | 3.55 | Completed |
| 2 | New Bridge | 0.87 | 25°30'52.25"N 85°17'45.96"E | 25°30'56.40"N 85°17'45.58"E | 328767.395E 2823018.498N | 328758.482E 2823146.936N | 128.7 | 10 | 4 | 41.9 | 6.9 | Completed |
| 3 | Fatuha Rail Bridge | 1.17 | 25°30'49.83"N 85°17'36.72"E | 25°30'53.93"N 85°17'34.30"E | 328508.917E 2822947.084N | 328442.005E 2823074.045N | 143.5 | 9.5 | 10 | 12.44 | 4.37 | Completed |
| 4 | Naryan Bridge | 5.32 | 25°31'12.12"N 85°16'18.75"E | 25°31'16.04"N 85°16'20.20"E | 326340.073E 2823661.643N | 326382.944E 2823781.171N | 127 | 26 | 5 | 30.55 | 4.52 | Completed |
| 5 | Fatehpur Bridge | 18.12 | 25°30'44.32"N 85°11'47.82"E | 25°30'46.82"N 85°11'44.88"E | 318764.657E 2822906.0638N | 318683.783E 2822984.100N | 112 | 7 | 6 | 21.2 | 3.52 | Completed |
| 6 | Gourichak Bridge | 21.8 | 25°29'15.73"N 85°11'0.80"E | 25°29'20.35"N 85°11'1.27"E | 317414.629E 2820198.245N | 317429.832E 2820340.263N | 143 | 8 | 8 | 18.93 | 5.33 | Completed |

***Loha Bridge at Ch 0.57 km& New Bridge at Ch 0.87 km***

***Fatuha Rail Bridge at Ch 1.17 km & Naryan Bridge at Ch 5.32 km***

***Fatehpur Bridge at Ch 18.12 km& Gourichak Bridge at Ch 21.8 km***

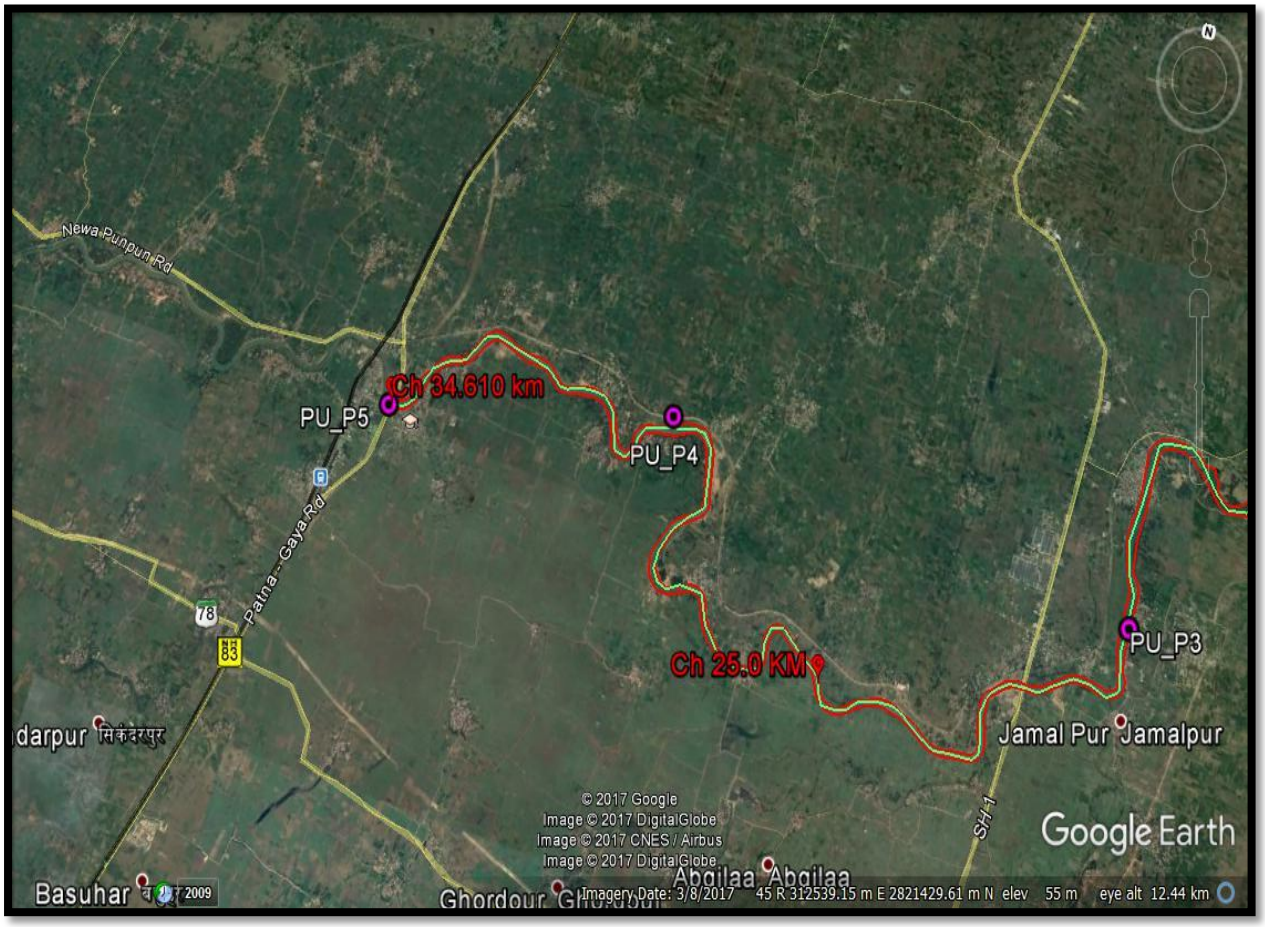
Three HT line was present in this section. Details of HT line is tabulated below:-

| S.No | Cross-Structure Name | Chainage (km) | Position (Lat Long) | | Position (UTM) | | Vertical clearance w.r.t HFL (m) | Remarks (Completed or not-completed) |
|---|---|---|---|---|---|---|---|---|
| 1 | HT Line | 5.0 | 25°31'9.62"N 85°16'29.36"E | 25°31'7.64"N 85°16'27.41"E | 326635.022E 2823580.909N | 326580.354E 2823520.990N | 18 | completed |
| 2 | HT Line | 6.18 | 25°31'28.46"N 85°15'53.12"E | 25°31'25.72"N 85°15'52.45"E | 325631.038E 2824173.173N | 325611.817E 2824089.6267N | 20 | completed |
| 3 | HT Line | 11.47 | 25°31'15.03"N 85°14'27.71"E | 25°31'11.42"N 85°14'27.23"E | 323241.638E 2823791.640N | 323226.308E 2823680.674N | 20 | completed |

***HT Line at Ch 5.00 km& Ch. 6.18 km***

***HT Line at Ch 11.47 km***

3.2 **Sub-Stretch 2: From Ch 25 km to Ch 34.61 km**. This stretch of the river is having length of 9.61 km and average width of 30 m. Current meter observation and discharge measurement were carried out at Ch.30.43 km andCh.34.41 km. and. There is neither any forest zone nor restricted zone in this stretch. Cultivated crops are mustard, wheat, cauliflower, potato, tomato, cabbage, carrot, radish, etc.




***Ch. 25 km to Ch. 34.61 km***

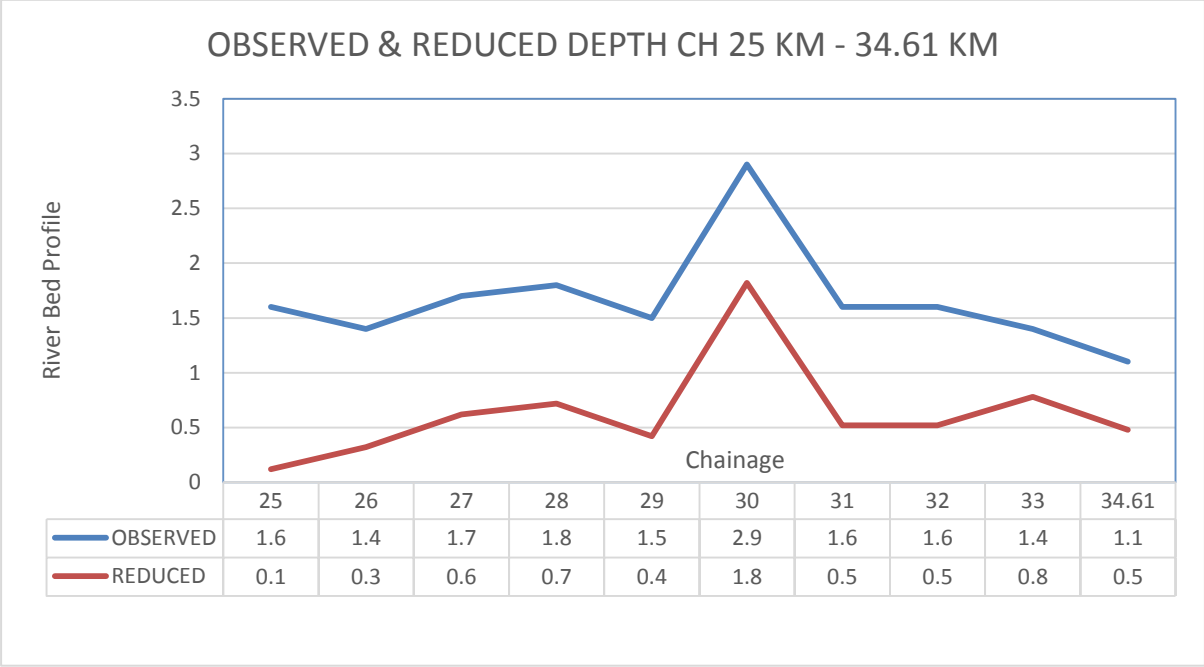
**Dredging quantity for substretch-2**

| | Chainage (km) | | Observed | | | | Reduced wrt Sounding Datum | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Type** | **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)** |
| Class-I | 25 | 34.6 | 0 | 2.9 | 2,600 | 88,028.60 | -0.3 | 1.8 | 9,400 | 3,69,535.10 |
| Class-II | 25 | 34.6 | 0 | 2.9 | 3,600 | 2,15,674.10 | -0.3 | 1.8 | 9,500 | 5,81,581.20 |
| Class-III | 25 | 34.6 | 0 | 2.9 | 8,000 | 4,58,900.28 | -0.3 | 1.8 | 9,400 | 9,01,912.83 |
| Class-IV | 25 | 34.6 | 0 | 2.9 | 9,100 | 6,34,560.44 | -0.3 | 1.8 | 9,600 | 10,95,076.47 |

(a) **Bathymetry Survey & Topographic Survey**.

| **SUB-STRETCH-2 (25-34.61 KM)** | | |
|---|---|---|
| **Type of Survey** | **Chainage (km)** | **Remarks** |
| Bathymetry Survey | 25.0 km to 34.61 km | covered by bathymetric survey |
| Topographic Survey | 25.0 km to 34.61 km | Riverbank, prominent features along the bank. |

(c) **Observed & Reduced Depth Profile of the Stretch**. Both observed and reduced depth along with slope being mentioned below:-




| **Chainage (km)** | | **River Bed Level (m)** | | **River Bed Level Change (m)** | **Slope** |
|---|---|---|---|---|---|
| **From** | **To** | **From** | **To** | | |
| 25.0 | 34.61 | 43.032 | 44.438 | 1.406 | 1:6835 |

(d) **Prominent Dam/ Barrage**. There is neither any dam nor any barrage exists in this stretch.

(d) **Tidal Stretch**. This river stretch is completely non-tidal.

(e) **Bank**. The river bank of Punpun is mainly unprotected throughout the river. But in some places, bank protection was noticed especially in and around the bridge (Zahidpur Bridge at Ch. 34.60 km) and Temple ghat at Ch.27.30 at Lankakachura pitch Protected.

***Pitch protected at Ch. 27.30 km***

(f) **Hindrances**. The surveyed river stretch is having hindrances for navigation on numerous occasions. Under water plankton and Bamboo barrier across the river and house on the river bank are also prominent, which may cause navigational interference for boats and vessels. Remarkable navigational threats can be perceived along the river stretch. Safe navigational route can be developed by significant amount of dredging and diverting the sewage drains towards the treatment plants.

***Underwater phytoplankton at Ch. 31.50 km & Bamboo barrier at Ch. 28.9 km***

(g) **Encroachment**. No encroachment was observed in this stretch.

(h) **Protected Area**. There is no wildlife, Defence, Atomic power plant and any other protected area present in this river stretch.

(i) **NH/ SH**. Only NH83 are located around the river strech.

***House on river Bank at Ch. 33.90 to 34.0 km***

(j) **Railway Station**. There is parsa railway station and punpun railway station situated in this section.

(k) **Land Use Pattern**. Land on either banks of the river being utilised for either agricultural or residential purpose.

(l) **Crops**. Both the banks of Punpun River are very fertile. Primary crops are mustard and wheat but seasonal vegetable crops are also cultivated viz. cauliflower, potato, tomato, cabbage, carrot, radish, etc. (winter crops).

***Cultivation at Ch. 32.50 km***

(m) **Bulk Construction Material**. There is neither any factory for construction material nor any raw material available along the corridor of the river stretch.

(n) **Existing Industry**. Minor industries are pulses, shoes, shooter, masur, electrical, cotton, iron, food grains, Wooden & Clay toys, Musical Instruments, etc.

.

(o) **Existing Ghats, Jetties and Terminals**. There is no jetty and terminal was observed in this portion. Ghats located in this river portion is Lanka kachura Ghat at Ch. 27.30 km.

(p) **Cargo Movement**. There is no cargo movement observed in this portion of the water way during the course of survey.

(q) **Prominent City/ town or Place of Worship**. There is only Patna city form 12.0 km east side of the river in this stretch.

(r) **Ferry**. There is no any ferry services in this stretch.

(s) **Water Sports Recreational Facilities**. There is no facility for water sports along the surveyed river stretch. In future, developed of the same is not viable throughout the river stretch.

(t) **Fishing Activity**. Small wooden boats were seen engaging in fishing activity in this river portion.

(u) **Sand Mining**. No sand mining activity was found in this stretch.

(v) **Tributaries**. There is no tributary is present in this portion.

(w) **Details of Irrigational Canals**. There is no irrigational canal present in this section.

(x) **Details of Nalas**. There is no any nala in this stretch.

(y) **Usage of Water**. Water in this portion primarily irrigation purpose.

(Z) **Details of Cross-Structures**. Only one bridges are present across the river. Details is tabulated below:-

| Sl No | Structure Name | Chainage (km) | Position (Lat Long) | | Position (UTM) | | Length (m) | Width (m) | No of Piers | Horizontal clearance (Distance Between piers) (m) | Vertical clearance wrt HFL (m) | Present condition |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Left Bank | Right Bank | Left Bank | Right Bank | | | | | | |
| 7 | Zahidpur Bridge | 34.61 | 25°29'48.22"N 85° 6'19.50"E | 25°29'52.51"N 85° 6'20.12"E | 309572.536E 2821307.091N | 309591.212E 2821439.904N | 134 | 10.2 | 7 | 21.13 | 6.38 | Completed |

***Zahidpur Bridge at Ch. 34.61 km***

There is only one HT lines present in this section. Details is tabulated below:-

| S.No | Cross-Structure Name | Chainage (km) | Position (Lat Long) | | Position (UTM) | | Vertical clearance w.r.t HFL (m) | Remarks (Completed or not-completed) |
|---|---|---|---|---|---|---|---|---|
| 1 | HT Line | 27.10 | 25°29'12.91"N<br>85° 8'51.05"E | 25°29'12.08"N<br>85° 8'47.12"E | 313789.901E<br>2820161.593N | 313679.509E<br>2820137.266N | 25 | completed |

***HT Line at Ch 27.10 km***

## SECTION – 4

4.1**Terminals.** There is no terminal present in this waterway. However, development of terminal at Naryanpur is recommended due to depth availability throughout the year proximity to the road rail networks. NH30 across the Punpun River. Fatwah Railway stations are located 3.60 km away from the proposed terminal respectively. This proposed terminal will cater for passenger as well as cargo movement throughout the river. Details of the proposed terminal being tabulated below:-

| Sl No | Ch. (km) | Location | Position (Lat/ long) | | Position (UTM) | | Length (m) | Width (m) | Area (sq.m) | Present Land Use |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Start | End | Start | End | | | | |
| 1 | 5.15 | NaryanPur | 25°31'13.03"N 85°16'23.50"E | 25°31'10.59"N 85°16'28.14"E | 326472.660E 2823686.480N | 326600.350E 2823607.240N | 150 | 20 | 3,000 | Agricultural Land |


**Proposed Terminal at Ch. 5.15 km**

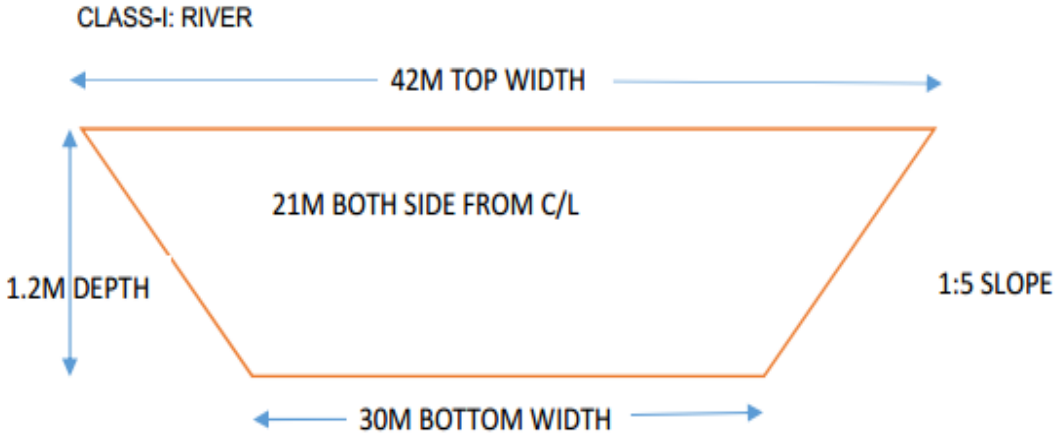
## SECTION – 5

**5.1 Fairway Development** The dredging channel is designed by linking deepest sounding of each cross sections and the dredging quantity is estimated for developing a navigable channel with the following dimension. The best suitable dredging channel class for the survey stretch of Punpun River is identified as Class-I and the dredge volume for the Class I to Class-IV were also calculated for the entire survey stretch. The details of Fairway channel dimension used for the dredging calculation are as follows: -

| Class of Channel Depth (m) Bottom | Depth (m) | Bottom width (m) | Slope |
|---|---|---|---|
| Class -I | 1.2 | 30 | 1:5 |
| Class -II | 1.4 | 40 | 1:5 |
| Class -III | 1.7 | 50 | 1:5 |
| Class -IV | 2 | 50 | 1:5 |

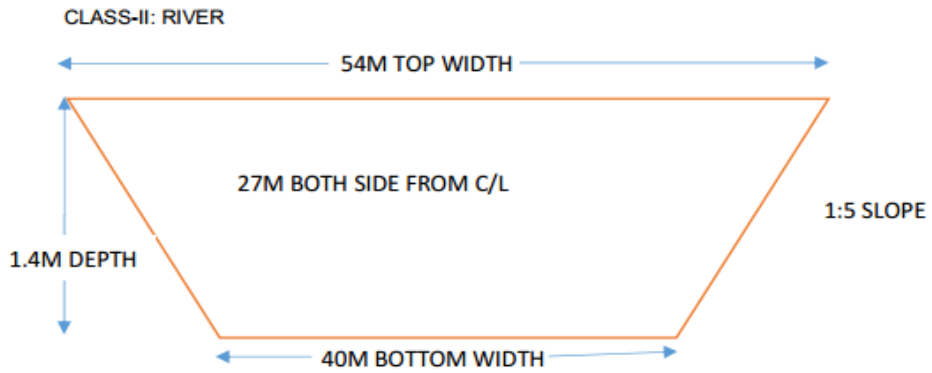
**5.2 Calculation of Dredging Quantity** The dredge volume calculations were accomplished using the HYPACK dredge volume computation utility. For clarity and ease of calculations, the complete channel profile was divided into segments of 1 km each (enclosed at Annexure-2). The Tin v/s Channel volume with Hypack Standard algorithm was used to calculate the dredge volume. The stretch wise summary of the dredge volume for a different class of fairway is as follows: -

1) 30m x 1.2m with side slope 1:5, along the deepest route.



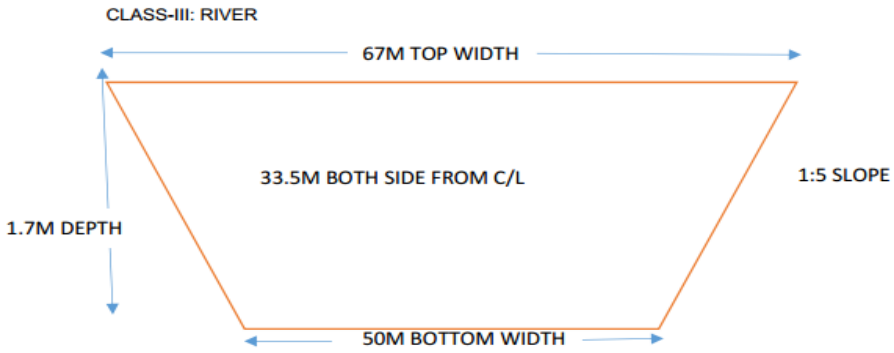

| CLASS - I | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Chainage (km)** | | **Observed** | | | | | **Reduced w.r.t Sounding Datum** | | | | |
| **From** | **To** | **Min. Depth (m)** | **Max. Depth (m)** | **Length of Shoal (m)** | **Dredging Qty (Cu.m)** | **Cumulative Drg. Qty. (cu.m)** | **Min. Depth (m)** | **Max. Depth (m)** | **Length of Shoal (m)** | **Dredging Qty (Cu.m)** | **Cumulative Drg. Qty. (cu.m)** |
| Fatuha Ch.0 km | Nadghat Ch. 25 KM | 0 | 6.1 | 5,700 | 2,16,234.91 | 2,16,234.91 | -0.3 | 6.1 | 18,000 | 7,40,363.70 | 7,40,363.70 |
| Nadghat Ch. 25 KM | Dudhaila Ch. 34.6 Km | 0 | 2.9 | 2,600 | 88,028.60 | 3,04,263.51 | -0.3 | 1.8 | 9,400 | 3,69,535.10 | 11,09,898.80 |

2) 40m x 1.4m with side slope 1:5, along the deepest route.



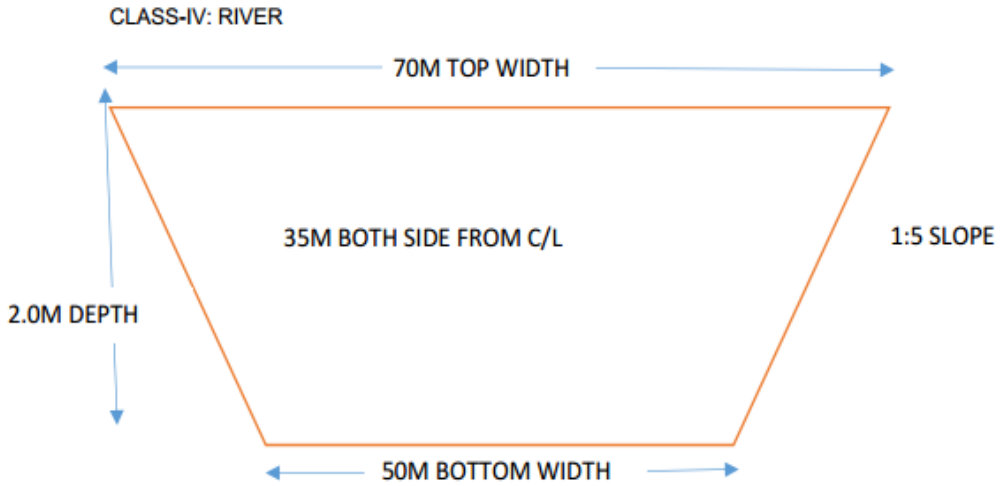

| CLASS - II | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Chainage (km)** | | **Observed** | | | | | **Reduced w.r.t Sounding Datum** | | | | |
| **From** | **To** | **Min. Depth (m)** | **Max. Depth (m)** | **Length of Shoal (m)** | **Dredging Qty (Cu.m)** | **Cumulative Drg. Qty. (cu.m)** | **Min. Depth (m)** | **Max. Depth (m)** | **Length of Shoal (m)** | **Dredging Qty (Cu.m)** | **Cumulative Drg. Qty. (cu.m)** |
| Fatuha Ch.0 km | Nadghat Ch. 25 KM | 0 | 6.1 | 8,600 | 5,03,551.20 | 5,03,551.20 | -0.3 | 6.1 | 19,400 | 12,13,238.80 | 12,13,238.80 |
| Nadghat Ch. 25 KM | Dudhaila Ch. 34.6 Km | 0 | 2.9 | 3,600 | 2,15,674.10 | 7,19,225.30 | -0.3 | 1.8 | 9,500 | 5,81,581.20 | 17,94,820.00 |

3) 50m x 1.7m with side slope 1:5, along the deepest route.




| CLASS - III | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **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)** | **Cumulative Drg. Qty. (cu.m)** | **Min. Depth (m)** | **Max. Depth (m)** | **Length of Shoal (m)** | **Dredging Qty (Cu.m)** | **Cumulative Drg. Qty. (cu.m)** |
| Fatuha Ch.0 km | Nadghat Ch. 25 KM | 0 | 6.1 | 14,300 | 10,81,291.10 | 10,81,291.10 | -0.3 | 6.1 | 20,800 | 19,76,081.70 | 19,76,081.70 |
| Nadghat Ch. 25 KM | Dudhaila Ch. 34.6 Km | 0 | 2.9 | 8,000 | 4,58,900.30 | 15,40,191.30 | -0.3 | 1.8 | 9,400 | 9,01,912.80 | 28,77,994.50 |

4) 50m x 2.0m with side slope 1:5, along the deepest route.




| CLASS - IV | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **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)** | **Cumulative Drg. Qty. (cu.m)** | **Min. Depth (m)** | **Max. Depth (m)** | **Length of Shoal (m)** | **Dredging Qty (Cu.m)** | **Cumulative Drg. Qty. (cu.m)** |
| Fatuha Ch.0 km | Nadghat Ch. 25 KM | 0 | 6.1 | 16,200 | 15,13,564.50 | 15,13,564.50 | -0.3 | 6.1 | 21,100 | 24,56,722.10 | 24,56,722.10 |
| Nadghat Ch. 25 KM | Dudhaila Ch. 34.6 Km | 0 | 2.9 | 9,100 | 6,34,560.40 | 21,48,124.90 | -0.3 | 1.8 | 9,600 | 10,95,076.50 | 35,51,798.60 |

## SECTION – 6

6.1 **Conclusion**. The river corridor consists of a length of 34.61 km from trivani sangam, fatuha at Ganga confluence (Ch. 0.0 km) to Bridge on NH 83, dudhaila Near pakri village (Ch. 34.610 km). The whole river is non-tidal and is one of the tributary of Ganga. The surveyed stretch of Punpun River is utilized by small boat for ferry services and the waterway can be best utilized for cargo transfer and passenger ferry service on improving the depth of existing waterway. There are seven cross structures and four high-tension line exist in the waterway, which are presently in use. The dredging on the Waterway will improve the depth of the channel for any navigational requirement. The River banks are well connected with the road network and are moderately connected with Railway Network. The road is near parallel on both sides throughout the river stretch.

The 24.20 km of river length is having depth below 1.2 m, 4.40 km of river length is having depth between1.2 m to 1.4 m, 2.76 km of river length is having depth between 1.5 m to 1.7 m and 1.95 km of river length is having depth between 1.8 m to 2.0 m. The length of river having depth more than 2 m is 1.30 km only. There is neither any dam nor any barrage exists in theSurvey stretch.Minimum and maximum horizontal clearance of cross structures are 12.44m and 41.90m respectively. Minimum and maximum vertical clearances of cross structures are 3.52m & 6.90m wrt HFL respectively. Min & max vertical clearance of power cables are 18.0m & 22.0m wrt HFL respectively.

There is neither any protected area (Atomic/ Port/ Wildlife/ Research) nor any hindrance exist in the whole waterway. Information gather from local populace that the availability of maximum water is only during monsoon season. There is no cargo, passenger ferry and tourism facility is available in the river stretch. Both banks of the Punpun River is very much fertile. Cultivation of wheat, mustard, peas, potato and carrot etc. has been noticed during the course of survey. Land along the river is mainly utilized for agricultural purpose. However, in some places, it is also used as residential purposes. The whole river stretch is well connected with the rail and road networks within 5 to 10 Km. Prominent cities are Fatuha, Simra, and Patna.

Small wooden boats being utilized for ferry services across the river at following locations: - Ch. 10.70 km (Hiranandpur) and Ch.11.50 km (Bhagwanpur). There is no water sport facility available in the whole river portion. Tourism facilities are present at Trivani sangam at fatuha and Patna. Cities along the river viz. Fatuha, Simra, and Patna, etc. are well connected with both rail and road networks.

There is no terminal present in this waterway. However, development of terminals at Naryan pur (Ch. 5.15 km seems viable. These places are well connected by rail and road networks. These proposed terminals will cater for passenger as well as cargo movement throughout the river.

The feasibility survey were carried out at river Punpun (length 34.61 km) from trivani sangam, fatuha at Ganga confluence (Ch. 0.0 km) to Bridge on NH 83, dudhaila Near pakri village (Ch. 34.610 km). The Dredging quantity being tabulated below: -

| Class | Drg. Qty. (cu.m) |
|---|---|
| Class I | 11,09,898.81 |
| Class II | 17,94,819.98 |
| Class III | 28,77,994.52 |
| Class IV | 35,51,798.59 |

**Consultant Recommendation**

- The whole river is non-tidal and is one of the tributary of Ganga.
- Punpun River is utilized by small boat for ferry services across the river or for fishing purpose.
- The availability of navigable water is only during monsoon season
- Tourism facilities are present at Trivani sangam at fatuha and Patna. Cities along the river are Fatuha, Simra, and Patna.
- No cargo along the river.
- The average width of the river is 20-40 mtr, so widening of the river is required at many places.
- Further TEF/DPR study is recommended.