FINAL FEASIBILITY REPORT ON DETAILED HYDROGRAPHIC SURVEY

ASSI RIVER

FROM GANGA CONFLUENCE AT ASSI GHAT

(0.0 KM CH) TO NEWADA (5.50 KM CH)

NATIONAL WATERWAY NO- 12

VOLUME – I

Submitted To

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

Submitted By

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Submitted On

/09/ 2018

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 Assi River in Region VII of National waterways, a dream and very important part of **Nation Development**".

SIPL would also like to thanks **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.

CONTENTS

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
HT	High Tension Line
CH	Chainage
WGS	World Geodetic System
UTM	Universal Transverse Mercator
LAD	Least Available Depth

SALIENT FEATURES AT A GLANCE

REGION-VII					
Consultant: STRABAG INDIA PVT LTD.					
Name	**ASSI River**		**NW -12**		
Length	5.50 km from **Ganga Confluence** at Assi Ghat to Newada.				
State	Uttar Pradesh				
Survey Period	08th Dec 2015 to 06th Jan 2016				
Tidal / Non-tidal	Non tidal				
Availability of Depth (reduced) (mtrs)					
	(0-5.5) Km				
<1.2	5.50				
1.2-1.4	0.0				
1.5-1.7	0.0				
1.8-2	0.0				
>2.0	0.0				
TOTAL	**5.50**				
Average Slope per KM(m)	**2.602**				
Width Range (m)	**5-10**				
Bathy Survey conducted for Length (Km)	**Topo survey**				
Dredging Quantity (Observed) Cu.m					
	(0-5.50) Km				
Class 1	1,82,361.75				
Class 2	2,63,982.81				
Class 3	3,76,236.75				
Class 4	4,39,950.43				
Dredging Quantity (Reduced) Cu.m					
	(0-5.50) Km				
Class 1	2,10,793.00				
Class 2	2,86,908.88				
Class 3	3,86,322.36				
Class 4					

	4,50,280.25				
No. of Bridge					
02 Culvert					
Clearances less than Class (no.)					
Class	**Horizontal**	**Vertical**			
Class 1	**2**	**2**			
Class 2	**2**	**2**			
Class 3	**2**	**2**			
Class 4	**2**	**2**			
No. of Dams, Barrages, Weirs, Anicut etc.					
NA					
Number of days Water not available					
CWC Gauge	**No CWC gauge observed in the waterway.**				
Cargo availability					
Nil					
Passenger Movement					
Nil					
Present IWT use					
Nil					
Recommendation of the Consultant					
1. The Assi is nala passing through the city carrying the waste. 2. The average width of the Assi river is 5.5 m, due to which it cannot be viable for any type of navigation.					
Viable or not-viable					
Not found technically viable as of now.					

(Signature)

Date: __/____/ 2018

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 navigations in the waterways, to Strabag India Pvt. Ltd. The detailed topographic survey task was undertaken from Ganga confluence at Assi Ghat (Lat25°17'18.64"N, Long 83° 0'25.46"E) to Newada (Lat 25°16'37.28"N, Long82°58'17.60"E).

The river Assi is a minor tributary of the river Ganga and struggling for its existence. The surveyed river stretch has been converted to Nala due to Illegal construction works and encroachment on the whole river. The surveyed river length is now used as a part drainage system of Varanasi city.

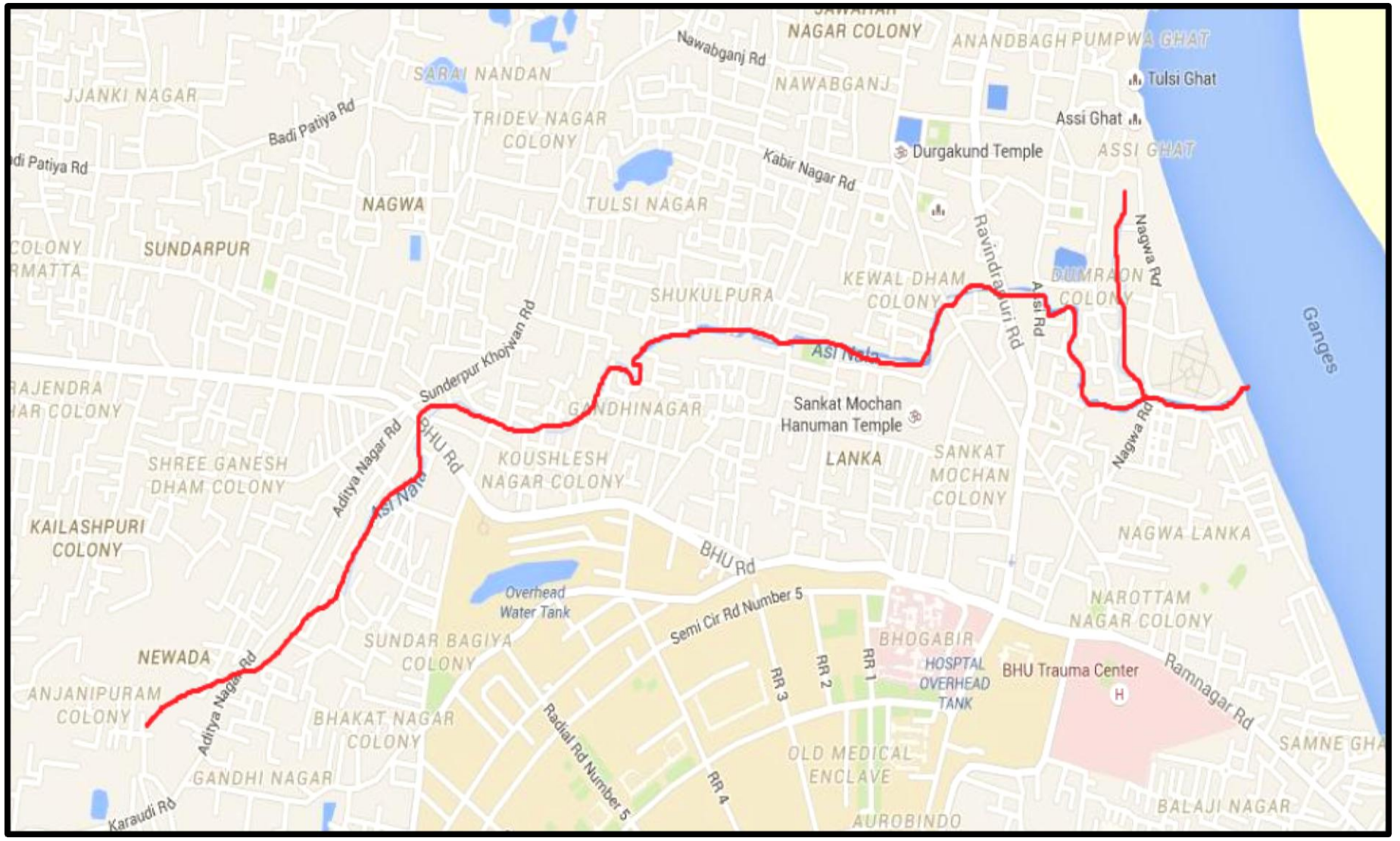
The total 5.5 km length of the river flows through the Varanasi city. Assi River is carrying drainage & sewage waste to Ganga. Numerous narrow nallas are being conjoined to Assi with untreated waste, for which the river is called as Assi Nala. The 6 to 10 meter wide river confluence at Assi Ghat, which has historical values. Assi Ghat is the southernmost Ghat in Varanasi, where pilgrims bathe before paying their homage to Lord Shiva in the form of huge lingam.

According to the ancient history, it is said that the Goddess Durga (consort of the Lord Shiva) had thrown her sword in the river after killing the demon Shumbha-Nishumbha. Assi Ghat is called as Assi Saimbeda Tirtha in Kashi Khand and is one of the five special Ghats visited by pilgrims during the ritual route called Panchtirthi Yatra. Thousands of Hindu pilgrims visit this place during the months of Chaitya (March and April) and Magh (January and February).

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

1.3 **States & Districts**. Assi River (Nala) originates from Newada, Varanasi district, Uttar Pradesh. It runs through the city of Varanasi and confluences with Ganga at Assi Ghat. Length of river is 5.50 km

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



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

1.5 **Scope of Works**. The Scope of the work is to conduct detailed hydrographic and topographic survey of 5.5 km length of the river from Ganga confluence at Assi Ghat (Lat 25°17'18.64"N, Long 83° 0'25.46"E) to Newada (Lat 25°16'37.28"N, Long 82°58'17.60"E).

The Scope of work for the conduct of survey of Assi River includes.

- Undertake Bathymetric and topographic survey of National waterway.
- Establishing horizontal and vertical control station.
- Construction of bench mark pillars and establishing its reduced level w.r.t to MSL
- Setting up deployment of water level gauges.
- Current velocity and discharge measurements
- Collection and analysis of water and bottom sample
- A collection of topographic features including existing cross structure
- Preparation of inventory of industries in the project influence area(PIA)
- Analysis of survey data, including assessment of water availability for navigation
- Preparation of survey charts and detailed hydrographic survey report.

SECTION – 2: METHODOLOGY ADOPTED TO UNDERTAKE STUDY

2.1 **Methodology**. The detailed topographic survey of Assi River from Ganga Confluence (Ch. 0 km) at Assi Ghat to Newada (Ch. 5.5 km) was carried out by dedicated topographic team with highest degree of professionalism, enthusiasm and quality from03rd Dec 2015 to 30th Dec 2015. Descriptive report is being rendered as annexure along with 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. which are tabulated below.

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.

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	Autocad	1
Software	Trimble Spectra Survey office v.8	1

2.1(c) **Topographic Survey.** The Topographic survey was carried out between 03rd Dec 2015 to 30th Dec 2015. 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 3m m interval. The plotting of the chart was done on UTM Projection at Zone 44N. 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 Total Station Leica

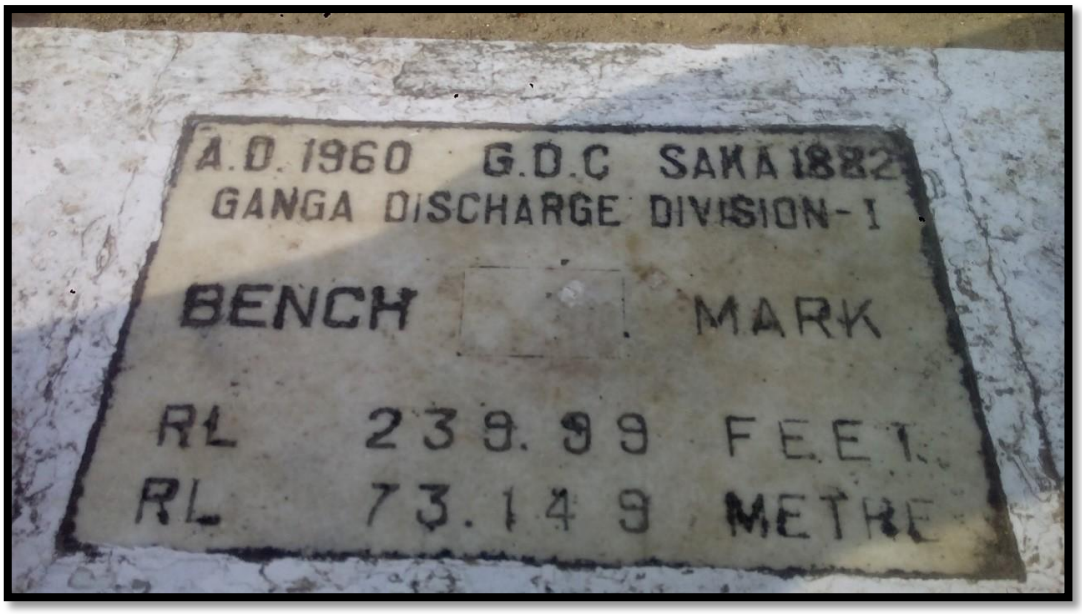
The details of all spot levels are provided in the respective sheets being presented along with this report. The details of bank protection and features across the river are Placed at Annexure 5 & 6 respectively. Additionally, a soft copy of the same in XYZ format is being handed over as deliverable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

2.1(d). **Calibration** The equipment used for 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 GPS system was used in standalone static observation mode for 24 hrs. at Ishan Tower Hotel Building rooftop (Approx. 300m distance from Madruadih Railway Station at Varanasi U.P) which is also denoted as **Base at roof top** (Control Point). Extension of the geodetic control was achieved by setting up BM Pillars throughout the river stretches at 0.5 and 5.5 km chainage approximately. Co-ordinates of these two pillars were established by simultaneous static observations between established and new stations. The data was processed by using Spectra Precision Survey Office software.

Two Tide pole was erected in Assi River as bathymetric survey was not carried out throughout stretch. Minimum levels at confluence and Indira Nagar Colony, Newada were considered for establishing Sounding Datum and in between datum of each km were calculated by interpolation method.

The vertical control was set up by transferring the value of BM provided by CWC gauge station at Rajghat (Value of CWC BM 73.149), Varanasi. Simultaneous GPS observations were carried out with the help of Trimble Spectra Precision Positioning System on Assi TBM (near CWC BM) and Base. CWC BM was connected to the Assi TBM using Auto Level (Levelling Calculations are given in Annexure 10). After discussion with the IWAI authorities, sounding datum were established for the total river length.



CWC BENCHMARK AT RAJGHAT

2.3 **Tidal Influence Zone and Tidal Variation**. Total 5.5 km length of river stretch was completely non-tidal. Only topographic survey was carried out in this river stretch. No tidal observation was carried out.

2.4 **Methodology to Fix Sounding Datum**. Ganga Confluence Sounding Datum was provided by IWAI. LAD being considered to calculate Sounding Datum of the whole river stretch.

2.5 **Maximum and Minimum Water Level**. There is no CWC Gauge located in Assi River stretch.

2.6 **Salient Features of Dam, Barrages, Weirs, Anicut, Locks and Aqueducts, etc**. There is no dam, barrage, weir, anicut, lock and aqueduct was noticed in this river.

2.7 **Description of Erected Bench Mark Pillars**. New Bench Mark Pillar (02 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 Assi BM Pillar are as below:-

CONTROL PILLERS COORDINATES

BM NO	Location	Chainage (km)	Latitude	Longitude	Northing (m)	Easting (m)	Value of Sounding Datum	BM height above MSL (m)	BM height above SD (m)
BASE ASSI	Roof top Varanasi	-	25°17'40.976"N	82°58'25.0755"E	698706.071	2799044.505	-	95.658	-
AR-P1	Assi River confluence	0.50	25°17'6.85"N	83° 0'29.59"E	2798046.041	702205.106	59.50	69.300	9.8
AR-P2	Indira Nagar Colony	5.50	25°16'33.38"N	82°58'16.69"E	2796961.967	698502.650	76.00	78.180	2.18

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	Sunder pur	4.03	699629.966E 2797466.714N	72.268	During the Conduct of Topographic Survey
TP2	Indra Nagar Colony	5.00	698814.010E 2797253.612N	75.688	During the Conduct of Topographic Survey

2.9 **Chart Datum/ Sounding Datum and Reduction Details**. Sounding Datum reduction table is appended below:-

SOUNDING DATUM FOR EACH KM

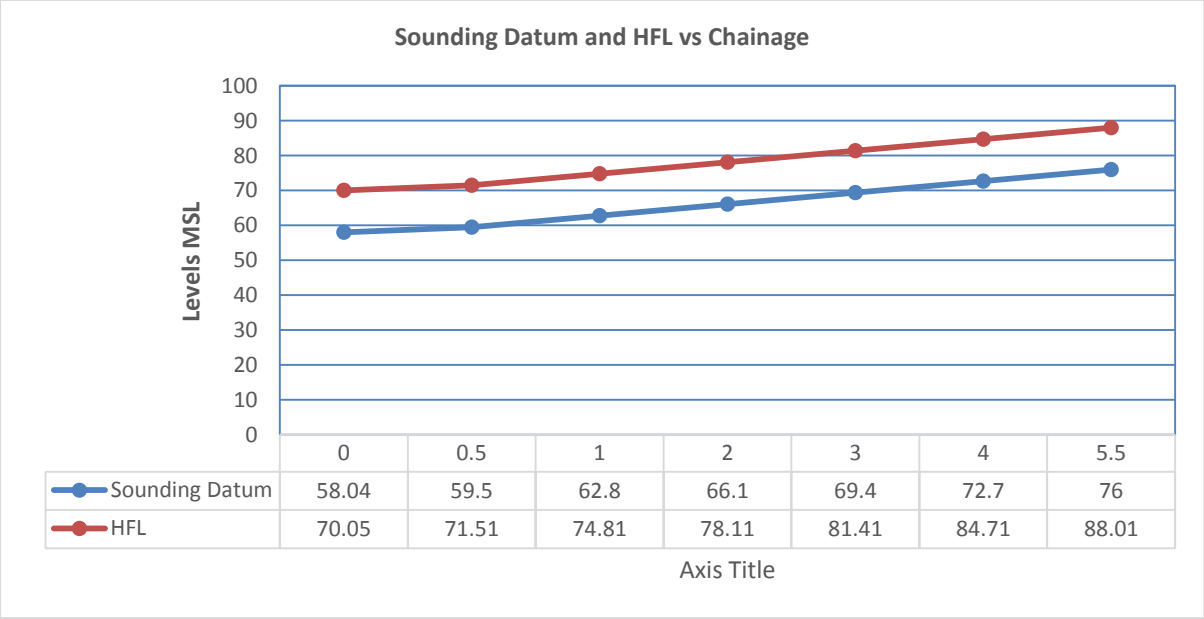
SL No.	Location	Chainage (km)	Established Sounding Datum w.r.t. MSL (m) at col. A.	Stretch for corrected soundings and topo levels (km)		Sounding Datum w.r.t MSL (m)	Correction in WL data for Bathymetric survey (m)	Topo level data converted as depth for volume calculation wrt SD (m)	HFL wrt MSL (m)
		(A)	(B)	(C)		(D)	(E)	(F= E-WL data in MSL)	(G= E-topo levels in MSL)
				From	To				
1	SD at Ganga Conf.	0	58.038						70.05
2	AR_P1	0.5		0	1	59.5	Details at Annexure 3	A separate xyz file is created and Soft copy Provided with report	71.51
3		1		1	2	62.8			74.81
4		2		2	3	66.1			78.11
5		3		3	4	69.4			81.41
6		4		4	5	72.7			84.71
7	AR_P2	5		5	5.5	76			88.01

2.10 **HFL at Gauge Stations and Cross-Structures**. This river is struggling for its existence and converted to a nala.2 No's Tide gauges were installed but bathymetric survey was not conducted. Sounding Datum at cross structures are tabulated below:-

Sl	Cross-Structure Details	Chainage (km)	Established HFL /MHWS/FSL/MWL/FRL w.r.t MSL (m)	Computed HFL /MHWS at Cross – Structure wrt MSL (m)
1	Ganga Confl.	0.0	70.050	
2	Culvert	1.44	-	76.262
3	Culvert	1.62	-	76.856

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

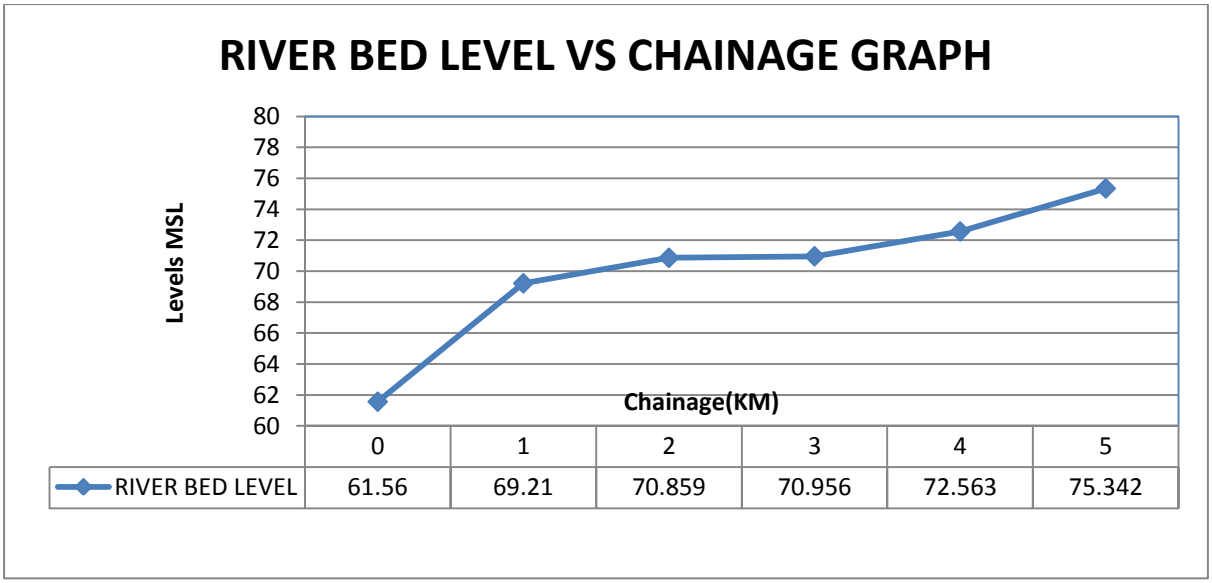
CHAINAGE (KM)	SOUNDING DATUM (M)	HFL/ MHWS (M)
0	58.04	70.05
0.5	59.5	71.51
1	62.8	74.81
2	66.1	78.11
3	69.4	81.41
4	72.7	84.71
5.5	76	88.01



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

Chainage (KM)		River Bed Level wrt MSL (M)		River Bed Level Change (m) (A)	Distance (B)	Slope (A/B)
From	**To**	**From**	**To**	**(m)**	**(km)**	
Ch. 0 km	Ch. 1 km	61.56m	69.21m	7.65	1	1:131
Ch. 1km	Ch. 2	69.21m	70.859m	1.649	1	1:606

Chainage (KM)		River Bed Level wrt MSL (M)		River Bed Level Change (m) (A)	Distance (B)	Slope (A/B)
Ch. 2 km	Ch. 3 km	70.859 m	70.956 m	0.097	1	1:1031
Ch. 3 km	Ch. 4 km	70.956 m	72.563m	1.607	1	1:622
Ch. 4 km	Ch.5 km	72.563m	75.342m	2.779	1	1:360
Ch.5 km	Ch.5.5 km	75.342m	75.869 m	0.527	0.5	1:949



2.13 **Details of Dam, Barrages, Weirs, Anicut, etc**. There is no dam, barrage, weirs or anicut in this river.

2.14 **Details of Locks**. No lock exists in this river stretch.

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

2.16 **Details of Existing Bridges & Crossings**. There is no bridge exist in this river. However, two culverts are present in this stretch and there is no HT line exists in this portion. Details are mentioned 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 Level	Remarks (Completed or not-completed)
			Left Bank	Right Bank	Left Bank	Right Bank						
1	Culvert	1.44	25°17'7.10"N 83° 0'8.72"E	25°17'7.75"N 83° 0'8.45"E	701621.467E 2798045.998N	701613.960E 2798065.628N	24.5	15.1	-	20	2.2	Completed
2	Culvert	1.62	25°17'6.14"N 83° 0'2.38"E	25°17'6.14"N 83° 0'2.38"E	701444.405E 2798013.388N	701444.405E 2798013.388N	24	7.6	2	5.5	-2.6	Completed

Culvert at Ch. 1.40 km &Ch. 1.60 km

2.17 **Details of Other Cross Structures**. There is no other cross structure, pipe-line and underwater cable present in this river stretch.

2.18 **High Tension Lines / Electric Lines / Tele-Communication Lines**. No HT line is present in this river portion.

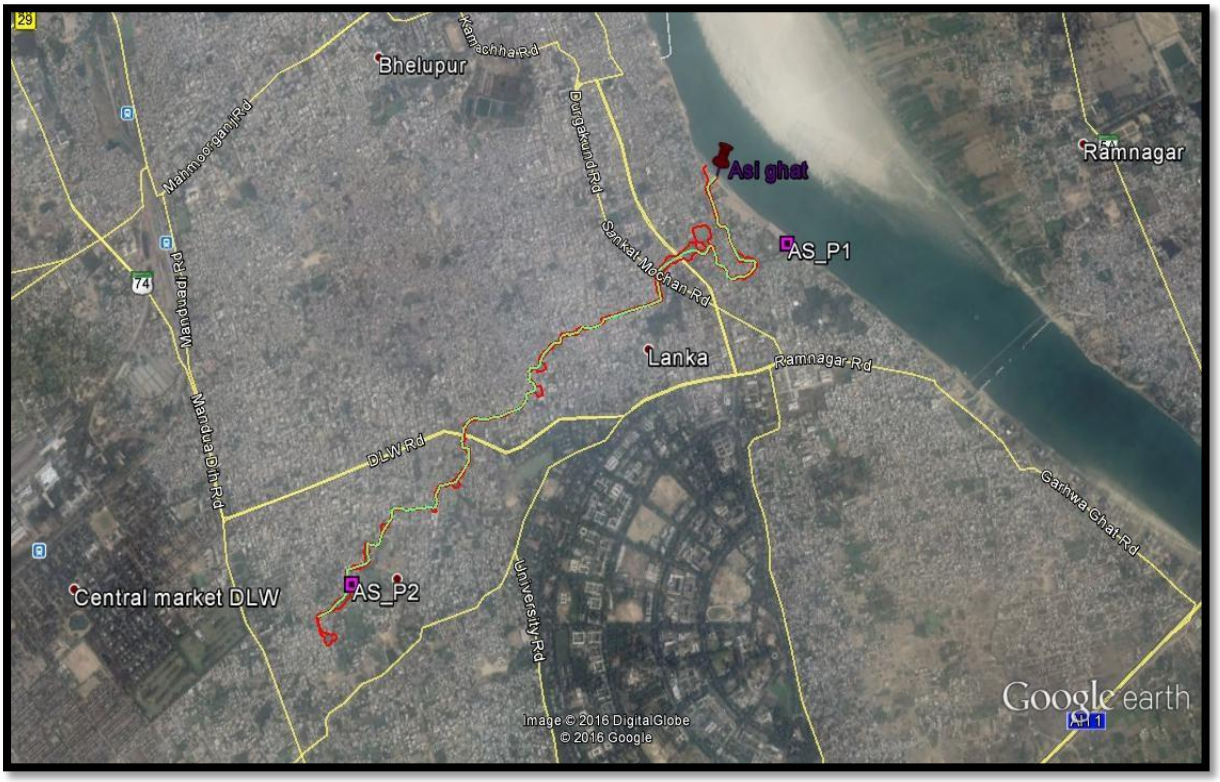
2.19 **Current Meter and Discharge Details**. Current meter observation was not carried out as the deployment was not feasible in the Assi Nala.

2.20(a) **Soil Sample & Water Sample**. No soil and water samples were collected from the Assi Nala.

SECTION-3

3. Description of Waterway

3.1 **Stretch 1: From Ch 0 km to Ch 5.50 km**. This stretch of the river is having length of 5.5 km and average width of 5m to 10m. The river has been converted to a nala. The most of the waste or sewage of the city being disposed into the river. The river being diverted to Nagwa nala from Ravidas Park to protect Assi ghat. Topographic survey was carried out for both earlier Assi river (provided by the client) and present flow at Nagwa nala.



From Ch 0 km to Ch 5.50 km

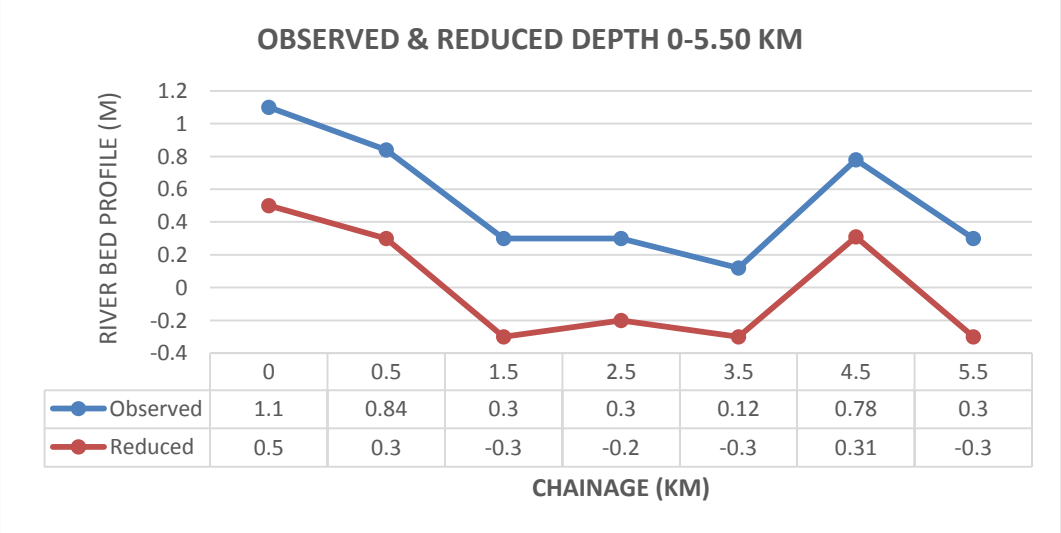
Dredging quantity for substretch-1

	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	5.5	0	1.0	5,500	1,82,361.75	-0.3	0.9	5,500	2,10,793.05
Class-II	0	5.5	0	1.0	5,500	2,63,982.81	-0.3	0.9	5,500	2,86,908.88
Class-III	0	5.5	0	1.0	5,500	3,76,236.75	-0.3	0.9	5,500	3,86,322.36
Class-IV	0	5.5	0	1.0	5,500	4,39,950.43	-0.3	0.9	5,500	4,50,280.25

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

SUB-STRETCH-1 (0-4.95 KM)		
Type of Survey	**Chainage (km)**	**Remarks**
Bathymetry Survey		No bathymetric survey
Topographic Survey	0.0 km to 5.50 km	Being Dry/Very Shallow covered by topographic method
	0.0 km to 5.50 km	Riverbank, prominent features along the bank.

(b) **Observed & Reduced Bed Profile of the Stretch**. Both observed and reduced bed profile being depicted below:-



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Chainage (km)		River Bed Level (m)		River Bed Level Change (m)	Slope
From	To	From	To		
0.0	5.50	61.560	75.869	14.309	1:384

(c) **Prominent Dam/ Barrage**. There is no barrage or dam exists in this section.

(d) **Tidal Stretch**. This 5.5 km of river stretch is completely non-tidal.

(e) **Conditions of Bank**. Bank of Assi Nala is either concrete or pitch protected in many places as the total 5.5 km river is passing through the Varanasi city area.

(f) **Hindrances**. The Assi is now converted to a nala which is carrying the wastage and drainage of the Varanasi city to Ganga. The river is very narrow and shallow due to which it is not suitable for the navigable channel. At some places, the width of the river is up to 2 or 3 metres only. At the Ch. 5 km and above the width of the river has been remarkably reduced. The mouth of the river as per the chainage provided by the client does not exist due to the illegal construction and encroachments. The water flow being diverted at Ravidas Park to the concrete Nagwanala.

(g) **Encroachment**. Encroachment on the river bank is prominent on numerous ocassions and the same has been covered in the previous paragraphs.

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

(i) **NH/ SH**. NH 7, NH 29, NH 56, NH 73 and SH 36 are located around the river strech.

(j) **Railway Station**. Railway stations in this stretch are Varanasi Jn, Sarnath Jn, Manduadih, Kashi and Mughalsarai station.

(k) **Land Use Pattern**. As the river passes through the Varanasi city, the most of the land along the river is utilised for residential purpose only.

(l) **Crops**. Assi Nala is passing through the congested residential areas of Varanasi city. There is neither any crop nor any cultivation activity observed along the stretch.

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

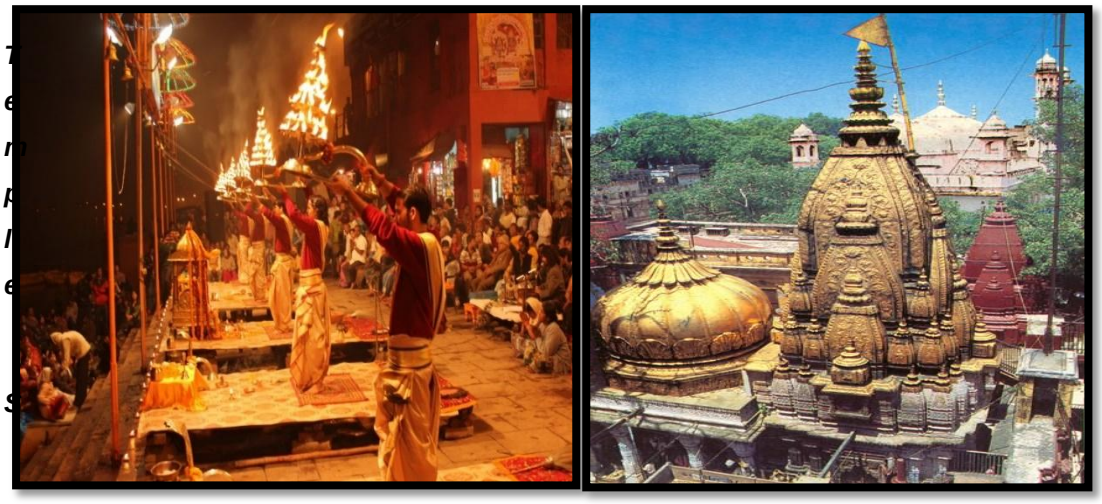
(n) **Existing Industry**. Major industries are silk, handloom. Handicrafts, Carpet, BHEL, Diesel Locomotive Works, Banarasi Saree, Brassware, Copperware, Wooden& Clay toys and Musical Instruments, etc.

(o) **Existing Ghats, Jetties and Terminals**. There is neither any jetty nor any ferry ghat was observed in the waterway. The Assi ghat is located at the Ch. 0.0 km. Small wooden/ fibre boats are being utilised for the tourists.

(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 river passes through the city Varanasi. Varanasi is growing as an important industrial centre, famous for its muslin and silk fabrics, perfumes, ivory works, and sculpture. The city's religious importance continued to grow in the 8th century, when AdiShankara established the worship of Shiva as an official sect of Varanasi. Tulsidas wrote his epic poem on Rama's life called Ram CharitManas in Varanasi.

Varanasi has been a cultural centre of North India for several thousand years, and is closely associated with the Ganges. Hindus believe that death in the city will bring salvation, making it a major centre for pilgrimage. The city is known worldwide for its many ghats, embankments made in steps of stone slabs along the river bank where pilgrims perform ritual ablutions.



D***ashashwamedh Ghat & Kashi Vishwanath Temple***

Sarnath Temple & Sankatmochan Temple

(r) **Ferry Services:** No ferry service is served at the Assi River.

(s) **Water Sports Recreational Facilities**. There is no facility available for water sports along the river stretch. However at Ganga confluence, water sport facility may be developed in future.

(t) **Fishing Activity**. No fishing activity was observed in the Assi Nala.

(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**. This surveyed river portion is a nala by itself and there is no other nala present in this portion. Water flowing through it is mostly polluted and sanitary water.

(y) **Usage of Water**. Discharged sewage water of this river cannot be utilised untreated.

(z) **Details of Cross-Structures**. There is no bridge exist in this river. However, two culverts are present in this stretch and there is no HT line exists in this portion. Details are mentioned 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
			Left Bank	Right Bank	Left Bank	Right Bank					
1	Culvert	1.44	25°17'7.10"N 83° 0'8.72"E	25°17'7.75"N 83° 0'8.45"E	701621.467E 2798045.998N	701613.960E 2798065.628N	24.5	15.1	-	20	2.2
2	Culvert	1.62	25°17'6.14"N 83° 0'2.38"E	25°17'6.14"N 83° 0'2.38"E	701444.405E 2798013.388N	701444.405E 2798013.388N	24	7.6	2	18.5	-2.6

Culvert at Ch. 1.44 km &Ch. 1.62 km

SECTION – 4

4.1 **Terminals.** There is no terminal exist in this surveyed river stretch. Development of terminal being not recommended for this river stretch due to steep gradient.

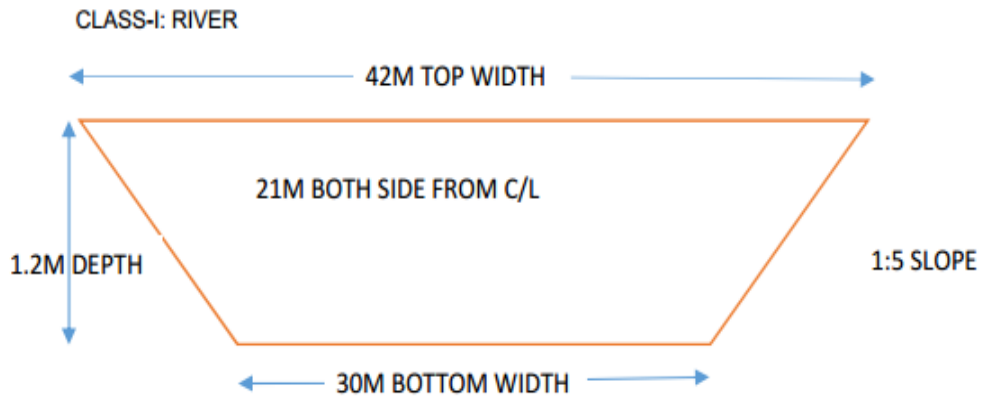
SECTION – 5

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 Assi 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)**	**Top Width (m)**	**Slope**
Class -I	1.2	30	42	1:5
Class -II	1.4	40	54	1:5
Class -III	1.7	50	67	1:5
Class -IV	2	50	70	1:5

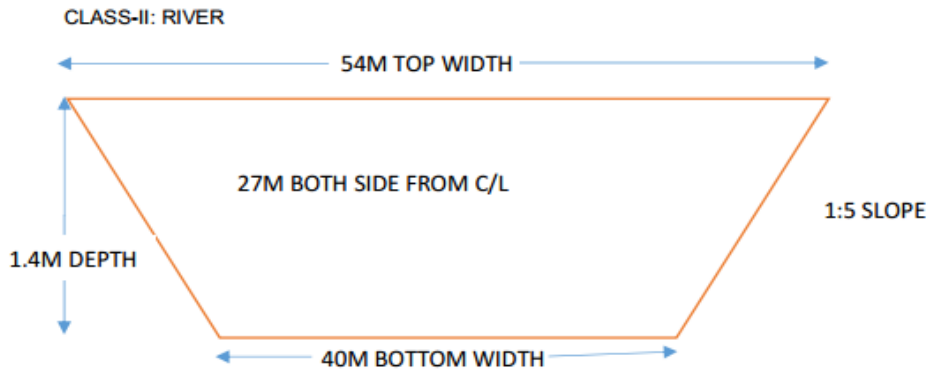
5.2 Calculation of Dredging Quantity The dredge volume calculations were accomplished using the HYPACK dredge volume computation utility. For clarity and ease of calculations, the complete channel profile was divided into segments of 1 km each (enclosed at Annexure-2). The Tin v/s Channel volume with 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.



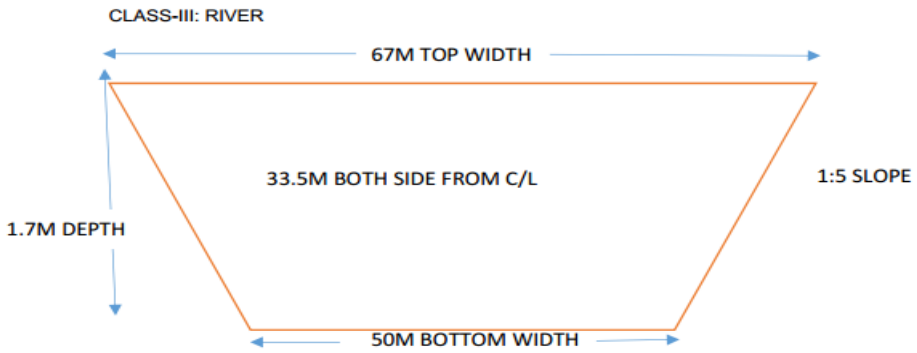
CLASS - I											
Chainage (km)		**Observed**					**Reduced w.r.t Sounding Datum**				
From	**To**	**Min. Depth (m)**	**Max. Depth (m)**	**Length of Shoal (m)**	**Dredging Qty (Cu.m)**	**Cumulative Drg. Qty. (cu.m)**	**Min. Depth (m)**	**Max. Depth (m)**	**Length of Shoal (m)**	**Dredging Qty (Cu.m)**	**Cumulative Drg. Qty. (cu.m)**
Assi Ghat Ch. 0 Km	Newada Ch. 5.5 km	0	1.1	5,500	1,82,361.75	1,82,361.75	-0.3	0.9	5,500	2,10,793.05	2,10,793.05

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



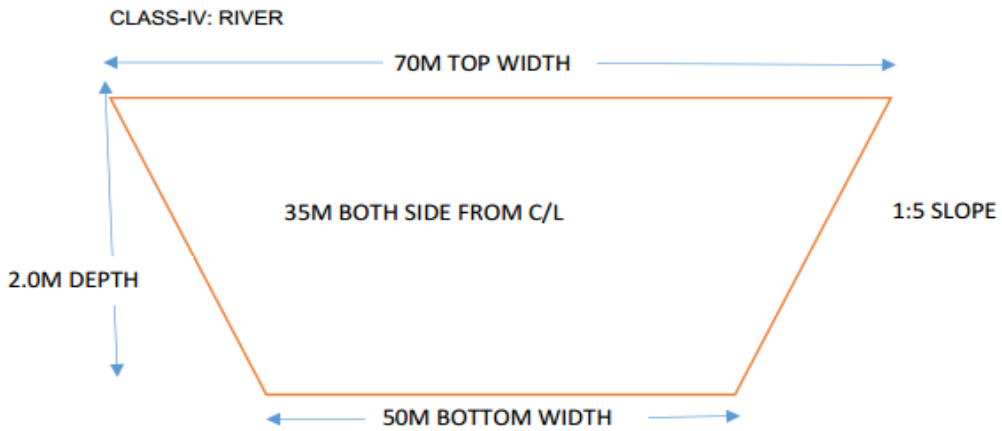
CLASS - II											
Chainage (km)		**Observed**					**Reduced w.r.t Sounding Datum**				
From	**To**	**Min. Depth (m)**	**Max. Depth (m)**	**Length of Shoal (m)**	**Dredging Qty (Cu.m)**	**Cumulative Drg. Qty. (cu.m)**	**Min. Depth (m)**	**Max. Depth (m)**	**Length of Shoal (m)**	**Dredging Qty (Cu.m)**	**Cumulative Drg. Qty. (cu.m)**
Assi Ghat Ch 0 Km	Newada Ch. 5.5 km	0	1.1	5,500	2,63,982.81	2,63,982.81	-0.3	0.9	5,500	2,86,908.88	2,86,908.88

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)**
Assi Ghat Ch.0 Km	Newada Ch. 5.5 km	0	1.1	5,500	3,76,236.75	3,76,236.75	-0.3	0.9	5,500	3,86,322.36	3,86,322.36

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)**
Assi Ghat Ch. 0 Km	Newada Ch. 5.5 km	0	1.1	5,500	4,39,950.43	4,39,950.43	-0.3	0.9	5,500	4,50,280.25	4,50,280.25

SECTION – 6

6.1 **Conclusion**. The river corridor consists of a length of 5.5 km from Assi Ghat, at Ganga confluence (Ch. 0 km) to Newada, Varanasi (Ch.5.5 km). The whole river is non-tidal and is one of the minor tributary of Ganga. Sounding operation was not feasible in the whole river stretch for shallow depth and narrow width. Topographic survey was carried out from Ch. 0 km to Ch.5.5 km. Total length of the waterway is having considerably steep gradient. Assi river neither being utilized for ferry service nor cargo movements. There is no bridge present in the river portion. However, two culverts are present in the water way which are presently in use. The dredging on the Waterway of Assi River will improve the depth of the channel for any navigational requirement. The river banks are well connected with the road as well as rail networks.

Total river length i.e. 5.5 km is having depth below 1.2m. There is no barrage, dam, weir, anicut, lock and aqueduct exists in the surveyed river stretch. Two culverts are present in the water way and range of Horizontal & Vertical Clearances are 5.5m to 20m and -2.6m to 2.2 m respectively. Vertical Clearances being considered wrt HFL. No power cable being crossing the entire river stretch.

There is neither any protected area (Atomic/ Port/ Wildlife/ Research) nor any hindrance exist in the whole waterway. Source of Assi Nala is mainly from the sewage water from the local residential area. There is no cargo, passenger ferry and tourism facility is available in the river stretch. Land along the river is mainly utilized for residential purpose. The whole river stretch is well connected with the rail and road networks within 2 to 3 Km. The only prominent city i.e. Varanasi is located along the river stretch.

No ferry service is available in the water way. Varanasi has been a cultural centre of North India for several thousand years, and is closely associated with the Ganges. Hindus believe that death in the city will bring salvation, making it a major centre for pilgrimage. The city is known worldwide for its many Ghats, embankments made in steps of stone slabs along the river bank where pilgrims perform ritual ablutions. Important places of mythological as well as historical values are Kashi Vishwanath Temple, Dasaswamedh Ghat, Sarnath, Assi Ghat, New Vishwanath Temple at BHU

Complex and Sankat Mochan Hanuman Temple, etc. Heavy tourist influx was observed at Varanasi city due to its mythological and historical importance. Varanasi is the only city present along the water way.

There is no terminal present in this waterway. Development of terminal being not recommended due to very steep gradient as well narrow width of the river corridor. Moreover, the river is passing through the dense residential areas.

The feasibility survey were carried out at river Assi River (length 5.5 km) from Assi Ghat, at Ganga confluence (Ch. 0 km) to Newada, Varanasi (Ch. 5.5 km). The Dredging quantity being tabulated below: -

	Drg. Qty. (cu.m)
Class I	2,10,793.05
Class II	2,86,908.88
Class III	3,86,322.36
Class IV	4,50,280.25

Average width of the whole river corridor is 5m – 10m. Steep gradient was observed in the Assi Nala (1:384). Huge residential buildings/ structures were observed throughout the water way. Hence, development of navigational channel for this water way seems to be non-viable.

Consultant Recommendation

- The Assi is nala passing through the city carrying the waste.
- The average width of the Assi River is 5.50 m, due to which it cannot be viable for any type of navigation.