Final Feasibility Report National Waterways-72, Region V - Nag River Confluence with River Kanhan to NIT Colony, Nagpur (58.7km)

SURVEY PERIOD: 31 JUL 2016 to 30 SEP 2016

Volume - I

Prepared for:

Inland Waterways Authority of India
(Ministry of Shipping, Govt. of India)
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ACKNOWLEDGEMENT

IIC Technologies Ltd. expresses its sincere gratitude to IWAI for awarding the work of carrying out detailed hydrographic surveys in the New National Waterways in NW-72 in Region V – Nag River from confluence with river Kanhan near Sawangi village to Bridge near NIT Colony, Nagpur.

We would like to use this opportunity to pen down our profound gratitude and appreciations **to Shri Pravir Pandey, IA&AS, Chairman IWAI** for spending his valuable time and guidance for completing this Project. IIC Technologies Ltd., would also like to thank, **Shri Alok Ranjan, ICAS, Member (Finance), Shri Shashi Bhushan Shukla, Member (Traffic), Shri S.K. Gangwar, Member (Technical)** for their valuable support during the execution of project**.**

IIC Technologies Ltd, wishes to express their gratitude to **Capt. Ashish Arya, Hydrographic Chief IWAI, Cdr. P.K. Srivastava ex-Hydrographic Chief and Shri SVK Reddy, Chief Engineer-I** for their guidance and inspiration for this project. IIC Technologies Ltd, would also like to thank **Sh. Rajiv Singhal, A.H.S., IWAI** for his invaluable support and suggestions provided throughout the survey period. IIC Technologies Ltd, is pleased to place on records its sincere thanks to other staff and officers of IWAI for their excellent support and cooperation throughout the survey period.

CONTENTS

List of Abbreviations

CD	Chart Datum
DGPS	Differential Global Positioning Systems
ETS	Electronic Total Station
NAG	Nag
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 Center
PIA	Project Influence Area
NH	National Highway
SH	State Highway

SALIENT FEATURES AT A GLANCE

<table>
<tr><th>#</th><th>Particulars</th><th>Details</th></tr>
<tr><td>1.</td><td>Name of Consultant</td><td>IIC Technologies Limited, Hyderabad</td></tr>
<tr><td>2.</td><td>Region number & State(s)</td><td>Region – V, Maharashtra</td></tr>
<tr><td>3.</td><td>Waterway stretch, NW #
(from…. to; total length)</td><td>National Waterway No – 72
Confluence with river Kanhan near Sawangi village to Bridge near NIT Colony, Nagpur. (58.7km)</td></tr>
<tr><td>4.</td><td>Navigability Status</td><td>At present, the river is in non-navigable condition</td></tr>
<tr><td>a)</td><td>Tidal & non tidal portions</td><td>The survey Stretch of Nag River is non-tidal.</td></tr>
<tr><td>b)</td><td>LAD status (w.r.t. CD)
i) Survey period (31 Jul to 30 Sep 2016.)
ii) < 1.2 m (km)
iii) 1.2 m to 1.4 m (km)
iv) 1.5 m to 1.7 m (km)
v) 1.8 m to 2.0 m (km)
vi) > 2.0 m (km)</td><td>
<table>
<tr><th>LAD (m)</th><th>0-16.4</th><th>16.4-44.6</th><th>44.6-58.7</th><th>Total</th></tr>
<tr><td>< 1.2</td><td>16.4</td><td>28.2</td><td>14.1</td><td>58.7</td></tr>
<tr><td>1.2 - 1.4</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1.5 - 1.7</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1.8 - 2.0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>> 2</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>16.4</td><td>28.2</td><td>14.1</td><td>58.7</td></tr>
</table>
</td></tr>
<tr><td>c)</td><td>Cross structures
i) Dams, weirs, barrages etc (total number; with navigation locks or not)
ii) Bridges, Power cables etc</td><td>i) Check Dam - 04 nos. (All damaged)
ii) Navigation Locks – Nil
iii) Bridges– 18 nos.
Horizontal Clearance – 1.359 – 30.16m
Vertical Clearance – 0 – 1.234 m
iv) High Tension Lines – 03 nos.
Vertical Clearance – 24.35 - 28.53m
v) Electric Lines – 07
Vertical Clearance – 16.23 - 25.35m</td></tr>
<tr><td>d)</td><td>Avg. discharge & no. of days</td><td>Discharge data not available from authorities</td></tr>
<tr><td>e)</td><td>Slope (1 in ….)</td><td>
<table>
<tr><th colspan="2">Chainage (km)</th><th rowspan="2">Slope (A/B)</th></tr>
<tr><th>From</th><th>To</th></tr>
<tr><td>0.00</td><td>16.4</td><td>1 : 0.622</td></tr>
<tr><td>16.4</td><td>44.6</td><td>1 : 0.635</td></tr>
<tr><td>44.6</td><td>58.7</td><td>1 : 1.649</td></tr>
</table>
Average slope is 1 : 0.875 for entire river stretch
</td></tr>
<tr><td>5.</td><td>Traffic potential</td><td>No Navigational traffic is present in the survey stretch of Nag River.</td></tr>
<tr><td>a)</td><td>Present IWT operations, ferry services, tourism, cargo, if any</td><td>IWT operations, ferry services, tourism, cargo operations are not available in Nag river.</td></tr>
<tr><td>b)</td><td>Important industries within 50 km</td><td>The industries near to the area of interest are Govt. Milk Scheme, Civil Lines, Nagpur, Dinshaw’s Dairy, Gittikhadan, Shree Baidyanath Ayurved Bhavan, Great Nag Road, Haldiram Food International, Bhandara Road, Murli Industries Ltd., Wadoda.</td></tr>
</table>

#	Particulars	Details
c)	Distance of Rail & Road from Industry	The industrial areas are well connected with Nagpur City by road networks.
6.	Consultant's recommendation for going ahead with TEF / DPR preparation	Improvement measures for design and to maintain navigable depth are required on the first phase of the development. River banks being very prominently structured and found no signs of erosion of the banks in the entire stretch of Nag River. The limitation for improvement of navigational aspects includes the gradient of the river, non-availability of the water throughout the period and the presence of various check dams. In view of this, the survey stretch of Nag river is not-viable for development as navigational channel.
7.	Any other information/ comment	-Nil-

(Signature)

Date: Name of Consultant

1 Introduction

1.1 Background

The Nag River is a river flowing through the city of Nagpur in Maharashtra and the city of Nagpur is named after the Nag River. Nag River originates from a lake called Ambazari, which is located to the west of Nagpur City. The discharge of untreated wastewater into the Nag River near the city area causes the deterioration of water quality. The river serves as drainage for Nagpur and as a result its ecosystem is heavily polluted by urban waste from the city. The Nag river confluence with Kanhan River near Sawangi village. To assess the feasibility of water transportation, over this stretch of river a bathymetric survey and topographic survey was carried out by IIC Technologies Ltd. on behalf of IWAI.

1.2 Tributaries of Nag River

Nag River originates from a lake called Ambazari, which is located to the west of Nagpur City and the overflow of lake constitutes the river Nag. There is another lake called Gorewada, which is to the north-west of the city and its overflow constitutes the origin of another river called Pili and this river ultimately meets the river Nag. The city of Nagpur has experienced very fast urbanization during the past 50 years. The exponential and rapid rate of growth has resulted in increased use of water, which has increased generation of sewage. Due to this the wastewater is not being treated adequately thereby resulting in the discharge of untreated wastewater into Nag River.

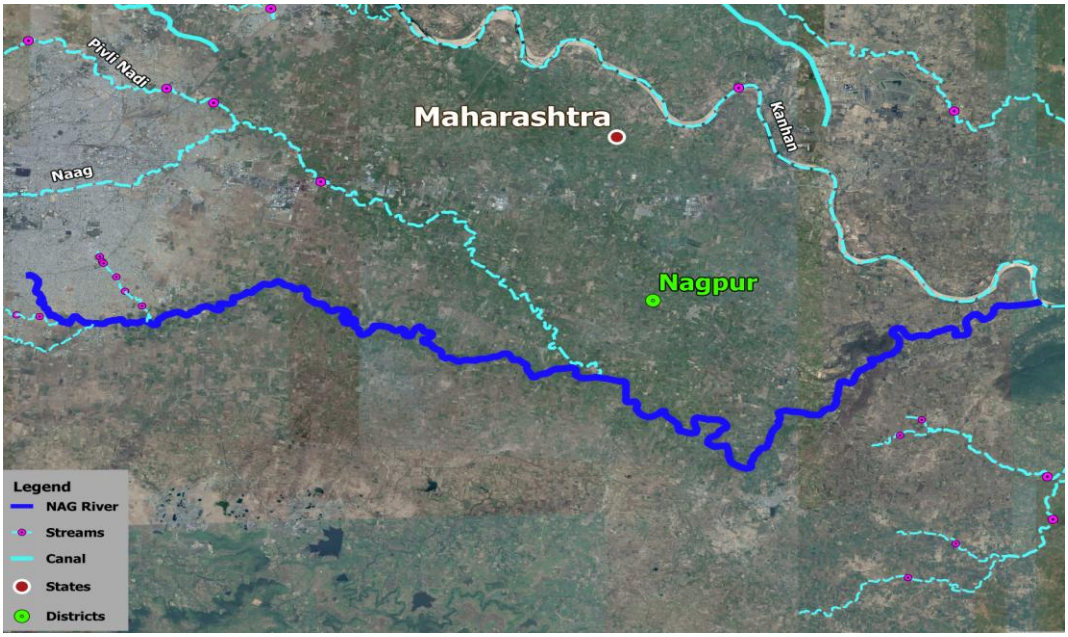


Figure 1 - Nag River Tributaries

1.3 State/District through which Nag River passes

The Survey stretch of Nag River Passes through the Nagpur administrative district of Maharashtra State.

State Name	Chainage (km)		Length in km
	From	To	
Maharashtra	0.0	58.7	58.7

Table 1 - State wise Waterway

1.4 Map

1.4.1 Full course of the waterway

The Nag River is said to be originating from a lake called Ambazari, which is located to the west of Nagpur City. The upstream area of the survey stretch of Nag River is very narrow and is not traceable due to urbanization and the encroachment of river banks.

1.4.2 Course of the waterway under study

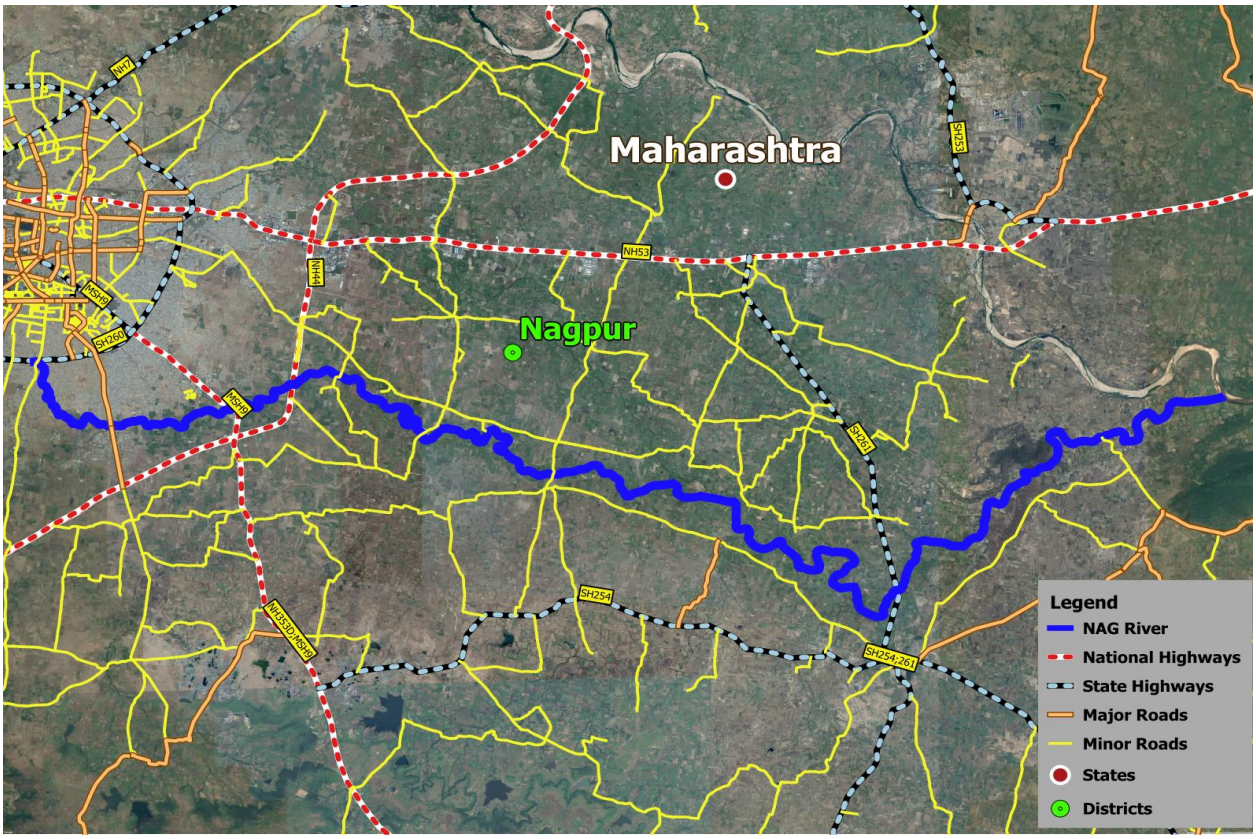


Figure 2 - Map of Nag River

1.5 Scope of Work

The major part of the work is to conduct detailed hydrographic and topographic survey of 58.7 kms length of the Nag river from confluence with river Kanhan near Sawangi village at Lat 21° 5'38.27"N, Long 79°27'53.84"E to Bridge near NIT Colony, Nagpur at Lat 21° 6'17.25"N, Long 79° 6'2.62"E.

The scope of the work for the conduct of a survey of Nag River includes:

- Undertake bathymetric and topographic survey of proposed 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.
- 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 feasibility report

2 Methodology Adopted to Undertake Study

2.1 Recce

Advance recce of the survey area was undertaken on 24 Jun 2016. The Recee commenced from the Nagpur city area (upstream) towards the confluence of the Nag River with Kanhan near Sawangi. The upstream portion of the Nag River is Nagpur city area and are densely populated in nature. The downstream of Nag River mainly consists of cultivatable lands with high rise river banks and dense shrubs. The loss of lock for the DGPS is expected more on these stretches of Nag River and observation time needs to be selected cautiously by the DGPS operators according to the PDOP and Satellite availability. The auto leveling is also expected to be difficult due to the terrain of the area and non-availability of a clear line of sight.

2.2 Survey Resources and Methodology

The survey commenced on 31 Jul 2016 and completed on 30 Sep 2016. The survey was undertaken on a scale of 1:5000, with Cross-section line spacing, kept at 100m. The

Plotting of the chart was done on UTM Projection at Zone 44N as directed in the contract specifications.

2.2.1 Survey Launch

The bathymetric survey was unable to conduct due to the unavailability of sufficient water in the River stretch.

2.2.2 Survey Equipment

Following equipment were employed for the topographic survey.

Equipment	Make	Eqpt. Serial No.	Qty. Employed
GPS Sets	Trimble R3/R4	-	05
Auto Level	Sokkia Auto level & Accessories	120775, 120799	02
ETS	Trimble M3	-	01
Current Meter	Valeport801	23447	1
Grab Sampler	Vanveen Grab	-	1
Water sampler	Naaskin Water sampler	-	1
Software	AUTOCAD	2012	1
Software	Microsoft Office	2013	1

Table 2 - Survey Equipment Used

2.2.3 Topographic Survey

The actual survey was commenced on 31st Jul 2016 and completed on 30th Sep 2016. The weather was sunny/cold throughout the period during survey operations. The weather was favorable with moderate hot climate 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 20 m interval. The plotting of the chart was done on UTM Projection at Zone 44N 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 were compared with the Auto level spot heights on daily basis at 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

The details of all spot levels are provided in the respective sheets being presented along-with this report. Additionally, a soft copy of the same in XYZ format is being handed over as deliverable data.

Figure 3 - Spot leveling by DGPS

2.2.4 Bathymetric Survey and Survey Launch

The upstream area for the survey stretch of Nag River is starting near to the city area and the wastage dumped and the sewage water from the city area is flowing in to this river. There is no sufficient water level available on survey stretch to conduct a bathymetric survey. The shallow depths, sewage and garbage deposition and various cross structures across the river are present in the entire stretch of the river. Due to a shallow depth, the operation of survey boat in the Nag River is not feasible. All survey points as per the line planning are attempted by the DGPS spot leveling only.

2.2.5 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.

2.3 Description of Bench Marks/Authentic Reference Level Used

There are no CWC gauges or other benchmarks in the vicinity of the survey area. The attempt was made to recover the any Reference Level Value from the Public Works Department office situated at Kuhi. As per Assistant Engineer, PWD office, Kuhi the construction works across the Nag River is carried out on the basis of local arbitrary value and all reference values like Maximum Flood level and other elevations are referred to this arbitrary value.

The Mean Sea level value of the Titur Railway station was then obtained from the office of the Senior Section Engineer at Itwari Railway station, Nagpur. The MSL value of the Titur Railway station was recovered and the same was also crosschecked with the MSL value of Kuhi Railways station by Auto leveling Method. The MSL value of both stations were found to be within tolerance limits.

Titur Railway Station	**Lat:-** 21° 3'35.61"N	**Long:-** 79°17'21.04"E
(a)	MSL Value of Titur Station	270.894 mtr from MSL
Source:-	**The office of Senior Section Engineer at Itwari Railway Station, Nagpur**	
		

Table 3 - Details of Reference Level used

The value of 270.894 mtr above MSL for Titur Railway station was accepted as the Reference Level value. This Reference Level value of 270.894 mtr above MSL was accepted as the initial reference value for vertical control point and this Reference Level value was transferred to the remaining control points (IWAI BM Pillars) through Auto Level (optical leveling) method. All values of spot leveling during the topographic survey are referred to Mean Sea Level. The leveling data for establishing the reference level for the newly constructed benchmark pillars are placed at Annexure –16 to this report. The final accepted WGS 84 coordinates and details of IWAI Benchmark established during the conduct of the survey are as follows:-

Sl. No.	Station	Chainage (km)	Latitude	Longitude	Ht. above MSL (m)	Source/ Type
01	IWAI_BM_NAG_01	2.04	21°05'14.58090"N	79°27'01.02377"E	259.691	Baseline processed
02	IWAI_BM_NAG_02	12.73	21°03'00.10124"N	79°23'18.45675"E	260.136	Online processed
03	IWAI_BM_NAG_03	24.31	21°02'56.57075"N	79°19'46.38266"E	260.846	Baseline processed
04	IWAI_BM_NAG_04	34.037	21°04'12.34506"N	79°15'36.36643"E	266.614	Baseline processed
05	IWAI_BM_NAG_05	45.21	21°06'02.17606"N	79°11'41.63296"E	271.944	Baseline processed
06	IWAI_BM_NAG_06	57.32	21°05'44.08967"N	79°06'20.50128"E	288.987	Baseline processed

Table 4 - Accepted Station coordinates (WGS-84)

2.4 Tidal influence Zone and Tidal Variation

The survey stretch of Nag River is non-tidal water body and no influence of tidal force was observed throughout the survey period.

2.5 Methodology to fix Chart Datum / Sounding Datum

The Nag River is a 58.7 km stretch which is between the confluence with river Kanhan near Sawangi village to Bridge near NIT Colony, Nagpur. As per the inputs from Assistant Engineer, PWD office, Kuhi who is also the construction in-charge for ongoing construction of the New Bridge across Nag River at Titur, in summers the water level on an entire survey stretch of Nag River will be very low and only city wastewater, will be discharged to the Nag River.

2.5.1 Sounding Datum

The established chart datum values is not available for the Nag River and there is no CWC tide gauge in the entire stretch of the Nag River. The water level of Nag River primarily depends upon the spillage from the Ambazari Lake and waste water discharge. The water level in Nag River is very less, the least bed level value obtained during the conduct of topographic survey is accepted chart datum for dredging volume calculations.

2.5.2 Datum Calculation

The datum for calculation of dredge volume needs to be adopted as per the gradient of the river and the average water level of the river. The water availability in Nag River is very less and the least available bed level value for per km stretch is accepted as the Datum value for Nag River. The newly established Chart Datum by assuming the least level w.r.t. MSL of spot sounding for Per-km stretches is as tabulated below:

Km Stretch	Least Level w.r.t. MSL (m)	Established CD (m)		Km Stretch	Least Level w.r.t. MSL(m)	Established CD (m)
0-1	241.147	241.147		32-33	259.125	259.125
1-2	241.156	241.156		33-33.3	259.258	259.258
2-3	241.147	241.147		33.3-34	259.369	259.369

Km Stretch	Least Level w.r.t. MSL (m)	Established CD (m)		Km Stretch	Least Level w.r.t. MSL(m)	Established CD (m)
3-4	242.069	242.069		34-35	261.047	261.047
4-5	242.159	242.159		35-36	262.147	262.147
5-6	243.147	243.147		36-37	262.898	262.898
6-7	244.057	244.057		37-38	264.147	264.147
7-8	244.147	244.147		38-39	264.224	264.224
8-9	245.125	245.125		39-39.1	267.196	267.196
9-10	246.125	246.125		39.1-40	264.858	264.858
10-11	247.125	247.125		40-41	265.185	265.185
11-12	248.125	248.125		41-41.1	268.236	268.236
12-13	247.926	247.926		41.1-42	267.258	267.258
13-14	249.147	249.147		42-42.5	267.221	267.221
14-15	249.147	249.147		42.5-43	268.125	268.125
15-16	250.147	250.147		43-44	268.125	268.125
16-17	250.214	250.214		44-45	268.777	268.777
17-18	252.014	252.014		45-46	269.245	269.245
18-19	252.159	252.159		46-47	270.214	270.214
19-20	253.115	253.115		47-48	271.125	271.125
20-21	253.12	253.12		48-49	272.125	272.125
21-22	253.159	253.159		49-50	272.158	272.158
22-23	254.147	254.147		50-51	272.485	272.485
23-24	254.159	254.159		51-52	275.236	275.236
24-25	255.125	255.125		52-53	276.125	276.125
25-26	255.156	255.156		53-54	277.125	277.125
26-27	256.012	256.012		54-55	277.245	277.245
27-28	257.147	257.147		55-56	280.412	280.412
28-29	257.156	257.156		56-57	282.881	282.881
29-30	257.147	257.147		57-58	286.508	286.508
30-31	258.125	258.125		58-58.7	288.325	288.325
31-32	259.15	259.150				

Table 5 - Established CD for per kilometer stretch

2.6 Average of 06 years minimum Water Levels to arrive at Chart Datum (CD)

Nag River is non-tidal river body having the primary source of water receiving from Ambazari Lake and ends up in a nearly drying situation during summer. There are no CWC/state government gauge water level data available for the average of last 06 years of Nag River.

2.7 Transfer of Sounding Datum

The Nag River is a non-tidal river and least MSL level for the Per-km stretch is considered in establishing a new datum at different stretches.

2.8 Table indicating Tidal Variation at Different Observation Points

The survey stretch of Nag River is a non-tidal river and the river dries during the summer season.

2.9 Salient features of Dam, Barrages etc.

There are no prominent Dam or barrages present in the survey stretch of the Nag River. The small check dams constructed across the Nag River for irrigation purpose are presently in damaged condition.

2.10 Erected IWAI Benchmark Pillars

New bench Mark Pillars were constructed as per specification at suitable locations as specified in the contract. The extension of horizontal control was made by the baseline processing of 06 hourly DGPS observations carried out with the nearest reference station. The Reference level value of these benchmarks w.r.t. MSL was obtained by Auto leveling from Titur Railway station (270.894 mtr above MSL, Source: - Senior Section Engineer at Itwari Railway station, Nagpur). The description of all IWAI Benchmarks established for the survey of Nag River is placed at Annexure - 10 to this report. The final accepted co-ordinates and a Reference Level value of IWAI BM Pillars are as below:-

Station	Chainage (km)	Latitude (N) Longitude (E)	Easting Northing	Ellipsoidal Height (m)	Height above MSL (m)	Established CD (m)	BM Height w.r.t. Established CD (m)
IWAI_BM_NAG_01	2.04	21°05'14.58090"N 79°27'01.02377"E	339019.176 2332602.094	200.487	259.691	241.147	18.544
IWAI_BM_NAG_02	12.73	21°03'00.10124"N 79°23'18.45675"E	332553.960 2328530.381	198.739	260.136	247.926	12.210
IWAI_BM_NAG_03	24.31	21°02'56.57075"N 79°19'46.38266"E	326430.598 2328484.809	199.456	260.846	255.125	5.721
IWAI_BM_NAG_04	34.037	21°04'12.34506"N 79°15'36.36643"E	319238.260 2330892.288	205.293	266.614	261.047	5.567
IWAI_BM_NAG_05	45.21	21°06'02.17606"N 79°11'41.63296"E	312500.758 2334345.428	213.242	271.944	269.245	2.699
IWAI_BM_NAG_06	57.32	21°05'44.08967"N 79°06'20.50128"E	303225.972 2333896.930	226.574	288.987	286.508	2.479

Table 6 - Accepted BM coordinates w.r.t. established CD

2.11 Chart Datum / Sounding Datum and Reductions Details

The water availability in Nag River is very less and the spot leveling by topographic method was attempted for the entire survey stretch of Nag River. The least MSL level for the per-Kilometer stretch was obtained as the established chart Datum. The details of

Topographic level converted as Depth for volume calculation are forwarded as soft copy along with the report.

2.12 HFL/MHWS values of Bridges/Cross Structures

The established HFL value for the survey stretch of the Nag River is not available with state authorities and CWC gauges were also not available in the survey stretch. As discussed with Assistant Engineer at Itwari Railway station, Nagpur, the HFL level marking at the pillar of the Titur Railway Bridge was co-related to its MSL value through ETS observation and is found to be 265.107m from MSL. This computed value from the railway authority marking was accepted as established HFL value for that chainage.

Figure 4 - HFL Marking on Titur Railway Bridge (30.53 km chainage)

The HFL value for the remaining survey stretch is computed for the Nag River as per the topography and the details of established and computed HFL values for the entire stretch are as follows:-

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)
	A	B	C	D	E
1	Bridge_18	Chapegadi	5.340	-	251.107
2	Bridge_17	Kuhi Wadoda Road	16.418	-	257.259
3	Titur Railway Bridge	Titur	30.534	265.107	-
4	Check Dam - 04	Titur	33.328	-	267.368
5	Bridge_15	Titur	34.032	-	267.935
6	Bridge_14	Adaka	37.745	-	270.907
7	Check Dam - 03	Adaka	39.122	-	272.01
8	Bridge_13	Temsana	39.866	-	272.609
9	Bridge_12	Temsana	40.617	-	273.216
10	Check Dam - 02	Temsana	41.176	-	273.336

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)
	A	B	C	D	E
11	Check Dam - 01	Parsodi	42.536	-	274.79
12	Bridge_11	Khedi	45.219	-	275.986
13	Bridge_10	Outer Ring Road	46.983	-	278.274
14	Bridge_9	Chandrapur to Nagpur Highway	49.628	-	280.383
15	Bridge_8	Vhirgoan	50.181	-	280.823
16	Bridge_7	Narsala	53.154	-	283.196
17	Bridge_6	Hudkeshwar Road	54.131	-	283.987
18	Bridge_5	Shyamnagar	54.277	-	284.107
19	Bridge_4	Nagpur	57.323	-	294.368
20	Bridge_3	Nagpur	58.129	-	297.075
21	Bridge_2	Nagpur	58.561	-	298.546
22	Bridge_1	Nagpur	58.683	-	299.014

Table 7 - Established and Computed HFL values for Nag River

2.13 Graph: Sounding Datum and HFL vs Chainage

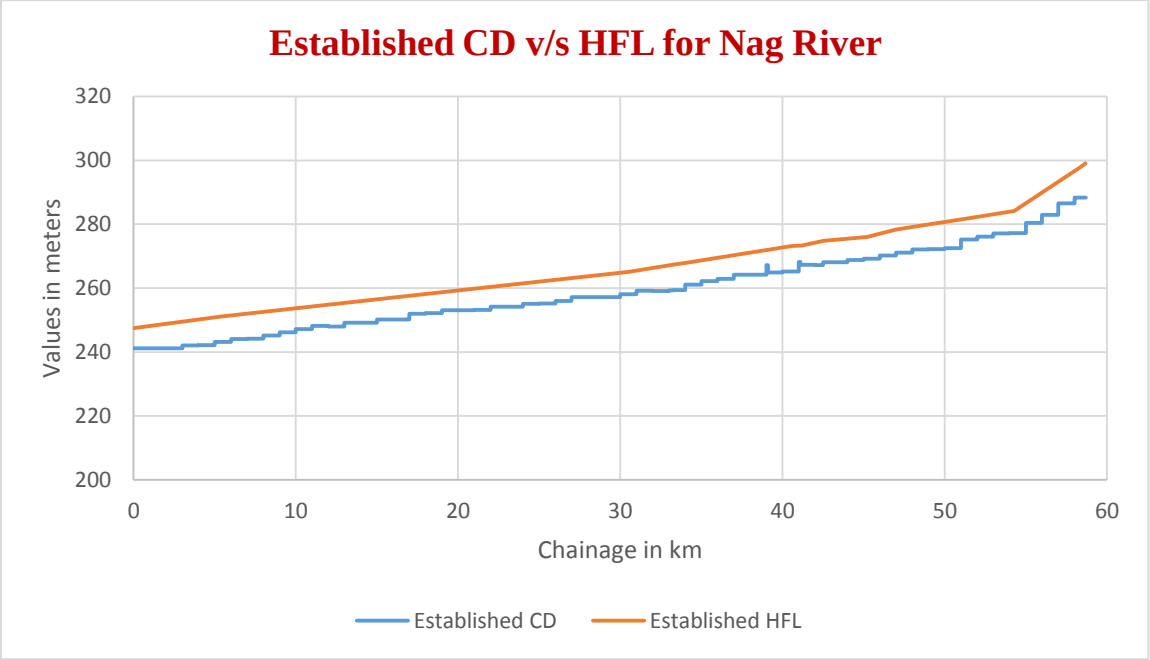


Figure 5 - CD and HFL vs Chainage

2.14 Average Bed Slope

The average bed slope for the Nag river is as follows:-

Reach and River-bed Level (RBL)		River-bed Level Change (m) (A)	Distance (km) (B)	Slope (A/B)
From	To			
Ch. 0.0 - RBL_241.259	Ch. 16.4 - RBL_251.458	10.199	16.4	1 : 0.622
Ch. 16.4 - RBL_251.458	Ch. 44.6 - RBL_269.357	17.899	28.2	1 : 0.635
Ch. 44.6 - RBL_269.357	Ch. 58.7 - RBL_292.607	23.25	14.1	1 : 1.649

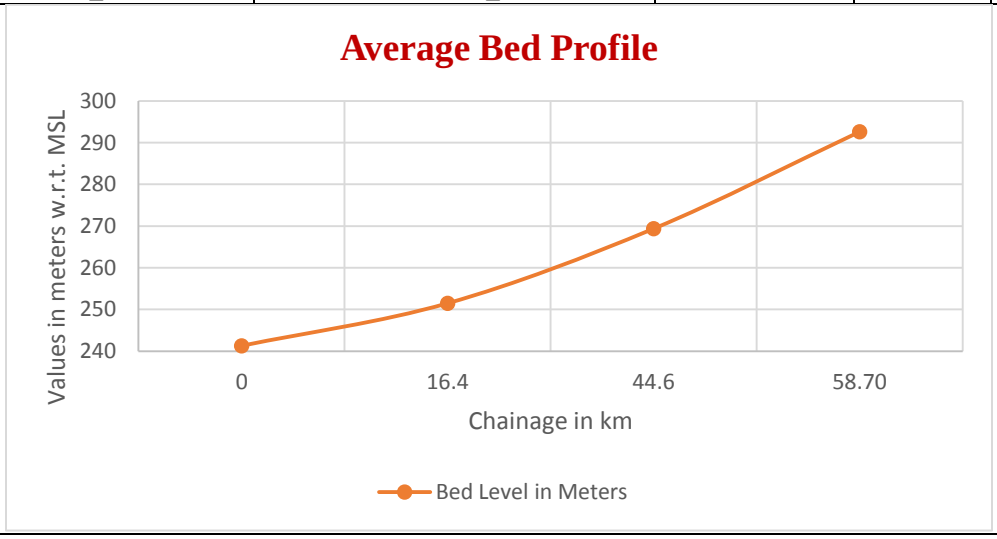


Table 8 - Average Bed Slope

2.15 Details of Dam, Barrages, Weirs, Anicut, etc

There are 04 check dams present in the survey stretch of Nag River. These check Dams are built for storing the available water in Nag River, presently all check dams are un-attended and damaged conditions.

Sl.No.	Structure Name	Ch. (km)	Location	Position (Lat Long)	Position (UTM)	Length (m)	Width (m)	Height w.r.t MSL(m)	Present Condition
1	Check Dam - 04	33.32	Titur	**Left Bank:** 21°04'17.33"N 79°16'0.62"E **Right Bank:** 21°04'18.22"N 79°16'0.34"E	**Left Bank:** 319940.019 2331037.96 **Right Bank:** 319932.235 2331065.49	23.1	2.4	263.6	Damaged
2	Check Dam - 03	39.12	Adaka	**Left Bank:** 21°05'1.86"N 79°13'51.44"E **Right Bank:** 21°05'2.55"N 79°13'51.80"E	**Left Bank:** 316226.397 2332448.47 **Right Bank:** 316237.023 2332469.511	27.1	2.7	266.8	Damaged
3	Check Dam - 02	41.17	Temsana	**Left Bank:** 21°05'13.57"N 79°13'5.44"E **Right Bank**: 21°05'14.11"N 79°13'5.88"E	**Left Bank:** 314902.716 2332823.39 **Right Bank:** 314915.601 2332839.84	16	1	269.4	Damaged
4	Check Dam - 01	42.53	Parsodi	**Left Bank:** 21°05'27.10"N 79°12'51.56"E **Right Bank:** 21°05'27.94"N 79°12'51.88"E	**Left Bank:** 314506.76 2333243.92 **Right Bank:** 314516.294 2333269.68	27.4	2	268.8	Damaged

Table 9 - Details of Check Dams

2.16 Details of Locks

There are no Locks present in the entire survey stretch of Nag River.

2.17 Details of Aqueducts

There are no Aqueducts present in the survey stretch of Nag River.

2.18 Details of existing Bridges and Crossings over Waterway

Sl. No	Structure Name and	Chainage (km	Type of Structure	Location	Position (Lat Long)	Position (UTM)	Length (m)	Width (m)	No of Piers	HC (clear	VC w.r.t.	Remarks (complete /

	for road / rail		(RCC / Iron / Wooden)		Left Bank Right Bank	Left Bank Right Bank				distance Between piers) (m)	HFL / MHWS (m)	under - construction), in use or not, condition
1	Bridge_1	58.68	RCC	Nagpur	**Left Bank:** 21°06'16.76"N 79°06'2.48"E **Right Bank:** 21°06'17.33"N 79°06'2.55"E	**Left Bank**: 302717.828 2334907.919 **Right Bank:** 302720.058 2334925.426	9.0	7.71	1	4.528	0.508	Completed
2	Bridge_2	58.56	RCC	Nagpur	**Left Bank:** 21°06'16.35"N 79°06'6.86"E **Right Bank:** 21°06'17.10"N 79°06'7.410"E	**Left Bank**: 302844.088 2334893.8 **Right Bank:** 302860.236 2334916.678	20.5	8.00	2	6.087	0.584	Completed
3	Bridge_3	58.12	RCC	Nagpur	**Left Bank:** 21°06'6.410"N 79°06'15.02"E **Right Bank:** 21°06'6.37"N 79°06'15.41"E	**Left Bank:** 303075.948 2334585.284 **Right Bank:** 303087.189 2334583.919	7.0	6.0	1	3.021	0.600	Completed
4	Bridge_4	57.32	RCC	Nagpur	**Left Bank:** 21°05'43.99"N 79°06'20.51"E **Right Bank:** 21°05'44.08"N 79°06'21.02"E	**Left Bank:** 303226.187 2333893.862 **Right Bank:** 303240.94 2333896.45	8.6	6.0	1	3.637	0.592	Completed
5	Bridge_5	54.27	RCC	Shyamnagar	**Left Bank:** 21°05'7.380"N 79°07'23.52"E **Right Bank:** 21°05'8.33"N 79°07'23.85"E	**Left Bank:** 305031.528 2332746.37 **Right Bank:** 305041.397 2332775.475	30.2	6	4	5.946	0.453	Completed
6	Bridge_6	54.13	RCC	Hudkeshwar Road	**Left Bank:** 21°05'6.75"N 79°07'28.92"E **Right Bank:** 21°05'9.68"N 79°07'28.39"E	**Left Bank:** 305187.166 2332725.158 **Right Bank:** 305172.93 2332815.45	86.5	8.0	6	9.094	0.729	Completed
7	Bridge_7	53.15	RCC	Narsala	**Left Bank:** 21°05'13.27"N 79°08'0.93"E **Right Bank:** 21°05'14.54"N 79°08'1.44"E	**Left Bank:** 306113.46 2332914.822 **Right Bank:** 306128.638 2332953.708	38.0	8.0	4	6.016	0.143	Completed
8	Bridge_8	50.18	RCC	Vhirgoan	**Left Bank:** 21°05'19.43"N 79°09'26.78"E **Right Bank:** 21°05'19.93"N 79°09'26.85"E	**Left Bank:** 308593.595 2333075.404 **Right Bank:** 308595.793 2333090.758	16.5	4.21	9	1.522	0.000	Damaged
9	Bridge_9	49.62	RCC	Chandrapur to Nagpur Highway	**Left Bank:** 21°05'26.51"N 79°09'43.52"E **Right Bank:** 21°05'28.52"N 79°09'41.82"E	**Left Bank:** 309079.278 2333287.561 **Right Bank:** 309030.925 2333349.944	60.5	7.74	2	14.877	1.234	Completed

Sl. No.	Structure Name and for road / rail	Chainage (km)	Type of Structure (RCC / Iron / Wooden)	Location	Position (Lat Long)	Position (UTM)	Length (m)	Width (m)	No of Piers	HC (clear distance Between piers) (m)	VC w.r.t. HFL / MHWS (m)	Remarks (complete / under - construction), in use or not, condition
					Left Bank Right Bank	Left Bank Right Bank						
10	Bridge_10	46.98	RCC	Outer Ring Road	**Left Bank:** 21°05'49.98"N 79°10'48.69"E **Right Bank:** 21°05'54.16"N 79°10'49.28"E	**Left Bank:** 310968.508 2333987.753 **Right Bank:** 310987.006 2334116.111	96.0	28.0	2	30.164	0.856	Completed
11	Bridge_11	45.21	RCC	Khedi	**Left Bank:** 21°06'0.81"N 79°11'41.19"E **Right Bank:** 21°06'2.04"N 79°11'41.73"E	**Left Bank:** 312487.497 2334303.561 **Right Bank:** 312503.511 2334341.212	35.5	7.85	12	2.355	0.329	Completed
12	Bridge_12	40.61	RCC	Temsana	**Left Bank:** 21°04'58.07"N 79°13'11.62"E **Right Bank:** 21°04'58.67"N 79°13'12.74"E	**Left Bank:** 315075.758 2332344.66 **Right Bank:** 315108.291 2332362.75	30.5	7.79	12	2.421	0.000	Completed
13	Bridge_13	39.86	RCC	Temsana	**Left Bank:** 21°04'59.63"N 79°13'29.76"E **Right Bank:** 21°04'59.88"N 79°13'29.40"E	**Left Bank:** 315599.877 2332386.79 **Right Bank:** 315589.572 2332394.595	9.0	3.5	5	1.359	0.000	Completed
14	Bridge_14	37.74	RCC	Adaka	**Left Bank:** 21°04'55.86"N 79°14'23.19"E **Right Bank:** 21°04'56.52"N 79°14'22.51"E	**Left Bank:** 317140.763 2332253.729 **Right Bank:** 317121.36 2332274.243	30.0	7.5	13	1.544	0.245	Completed
15	Bridge_15	34.03	RCC	Titur	**Left Bank:** 21°04'13.24"N 79°15'36.38"E **Right Bank:** 21°04'15.97"N 79°15'37.23"E	**Left Bank:** 319238.952 2330919.806 **Right Bank:** 319264.405 2331003.495	98.0	7.72	10	7.106	1.023	Under construction
16	Bridge_16	30.53	RCC	Titur	**Left Bank:** 21°03'53.69"N 79°17'16.31"E **Right Bank:** 21°03'57.52"N 79°17'15.40"E	**Left Bank:** 322117.006 2330287.337 **Right Bank:** 322092.003 2330405.403	121.3	3.7	8	13.562	1.213	Completed
17	Bridge_17	16.41	RCC	Kuhi Wadoda Road	**Left Bank:** 21°02'6.77"N 79°21'55.98"E **Right Bank:** 21°02'8.33"N 79°21'55.62"E	**Left Bank:** 330156.207 2326914.574 **Right Bank:** 330146.305 2326962.653	49.5	8.0	4	9.998	0.953	Completed
18	Bridge_18	5.33	RCC	Chapegadi	**Left Bank:** 21°04'53.78"N 79°25'42.59"E	**Left Bank**: 336749.243 2331984.627	89.1	8.0	5	14.997	1.017	Completed

Sl. No.	Structure Name and for road / rail	Chainage (km)	Type of Structure (RCC / Iron / Wooden)	Location	Position (Lat Long)	Position (UTM)	Length (m)	Width (m)	No of Piers	HC (clear distance Between piers) (m)	VC w.r.t. HFL / MHWS (m)	Remarks (complete / under - construction), in use or not, condition
					Left Bank Right Bank	Left Bank Right Bank						
					Right Bank: 21°04'56.41"N 79°25'41.53"E	**Right Bank:** 336719.448 2332065.805						

Table 10 - Details of Existing Bridges

2.19 Details of other Cross structures, pipelines, under water cables

There are no other cross-structures, pipeline, and underwater cables, observed in the survey stretch of Nag River.

2.20 Details of High Tension Lines / Electric lines / Tele-communication lines

Total of 03 High Tension electrical lines and 07 Electrical lines were present in the Nag River and the height of the crossing wires was also measured by using ETS. There are no piers for electrical lines constructed in the river bed of Nag River.

Sl. No.	Type of line	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	Vertical clearance w.r.t. HFL / MHWS (m)	Remarks (complete / under - construction)
				Left Bank Right Bank	Left Bank Right Bank				
1	HTL	22.79	Warambha Village	**Left Bank:** 21°02'26.3200"N 79°20'28.1400"E **Right Bank:** 21°02'31.8900"N 79°20'27.1500"E	**Left Bank:** 327626.407 2327541.948 **Right Bank:** 327599.607 2327713.535	-	-	28.53	Complete
2	HTL	28.44	Bhamewada	**Left Bank:** 21°03'45.9800"N 79°18'16.5200"E **Right Bank:** 21°03'52.9000"N 79°18'16.0600"E	**Left Bank:** 323852.514 2330031.652 **Right Bank:** 323841.5 2330244.602	-	-	24.35	Complete
3	HTL	44.86	Khedi	**Left Bank:** 21°05'55.6100"N 79°11'52.9300"E **Right Bank:** 21°05'57.4800"N 79°11'52.4200"E	**Left Bank:** 312824.508 2334139.799 **Right Bank:** 312810.44 2334197.476	-	-	27.86	Complete
4	EL	5.27	Chepangadi	**Left Bank:** 21°04'58.2700"N 79°25'43.6100"E	**Left Bank:** 336806.817 2331998.206	-	-	25.35	Complete

Sl. No.	Type of line	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	No of Piers	Horizontal clearance (clear distance Between piers) (m)	Vertical clearance w.r.t. HFL / MHWS (m)	Remarks (complete / under - construction)
				Left Bank Right Bank	Left Bank Right Bank				
				Right Bank: 21°04'54.2400"N 79°25'44.5800"E	**Right Bank:** 336780.044 2332122.41				
5	EL	5.32	Chepangadi	**Left Bank:** 21°04'57.3900"N 79°25'42.1500"E **Right Bank:** 21°04'53.6300"N 79°25'43.1900"E	**Left Bank:** 336766.515 2331979.844 **Right Bank:** 336737.64 2332095.765	-	-	19.5	Complete
6	EL	9.81	Umarpeth	**Left Bank:** 21°04'6.0300"N 79°24'10.3900"E **Right Bank:** 21°04'3.8300"N 79°24'12.7200"E	**Left Bank:** 334140.055 2330474.384 **Right Bank:** 334073.479 2330542.711	-	-	18.23	Complete
7	EL	40.61	Temsana	**Left Bank:** 21°04'57.8300"N 79°13'11.5500"E **Right Bank:** 21°04'58.4300"N 79°13'12.7600"E	**Left Bank:** 315073.655 2332337.301 **Right Bank:** 315108.786 2332355.363	-	-	20.13	Complete
8	EL	45.23	Khedi	**Left Bank:** 21°06'2.7800"N 79°11'41.6300"E **Right Bank:** 21°06'0.5800"N 79°11'40.6400"E	**Left Bank:** 312471.543 2334296.668 **Right Bank:** 312500.883 2334364.003	-	-	19.56	Complete
9	EL	46.96	Outer Ring Road	**Left Bank:** 21°05'50.7482"N 79°10'49.5561"E **Right Bank:** 21°05'53.6500"N 79°10'49.9900"E	**Left Bank:** 310993.775 2334011.092 **Right Bank:** 311007.318 2334100.192	-	-	16.23	Complete
10	EL	48.56	Bahaduara	**Left Bank:** 21°05'32.0300"N 79°10'12.7100"E **Right Bank:** 21°05'30.7900"N 79°10'10.8600"E	**Left Bank:** 309923.731 2333447.619 **Right Bank:** 309869.897 2333410.097	-	-	22.53	Complete

Table 11 - High Tension Lines Details

2.21 Current Meter and Discharge Details

Current meter observation was not done in Nag River due to non-availability of sufficient water.

2.22 Water Sample Locations

Water samples were not collected from Nag River due to non-availability of sufficient water level.

3 Description of Waterway

The Waterway of Nag River for 58.7 km river chainage is divided into 03 different sections for the easy interpretation. The topographic feature, width, and nature of river, stream were considered in dividing the survey stretch to these 03 subdivisions. The details of the stretches are as follows:-

3.1 Sub-Stretch-01: Sawangi Village to Kuhi-Wadoda Bridge (0 km to 16.4km)

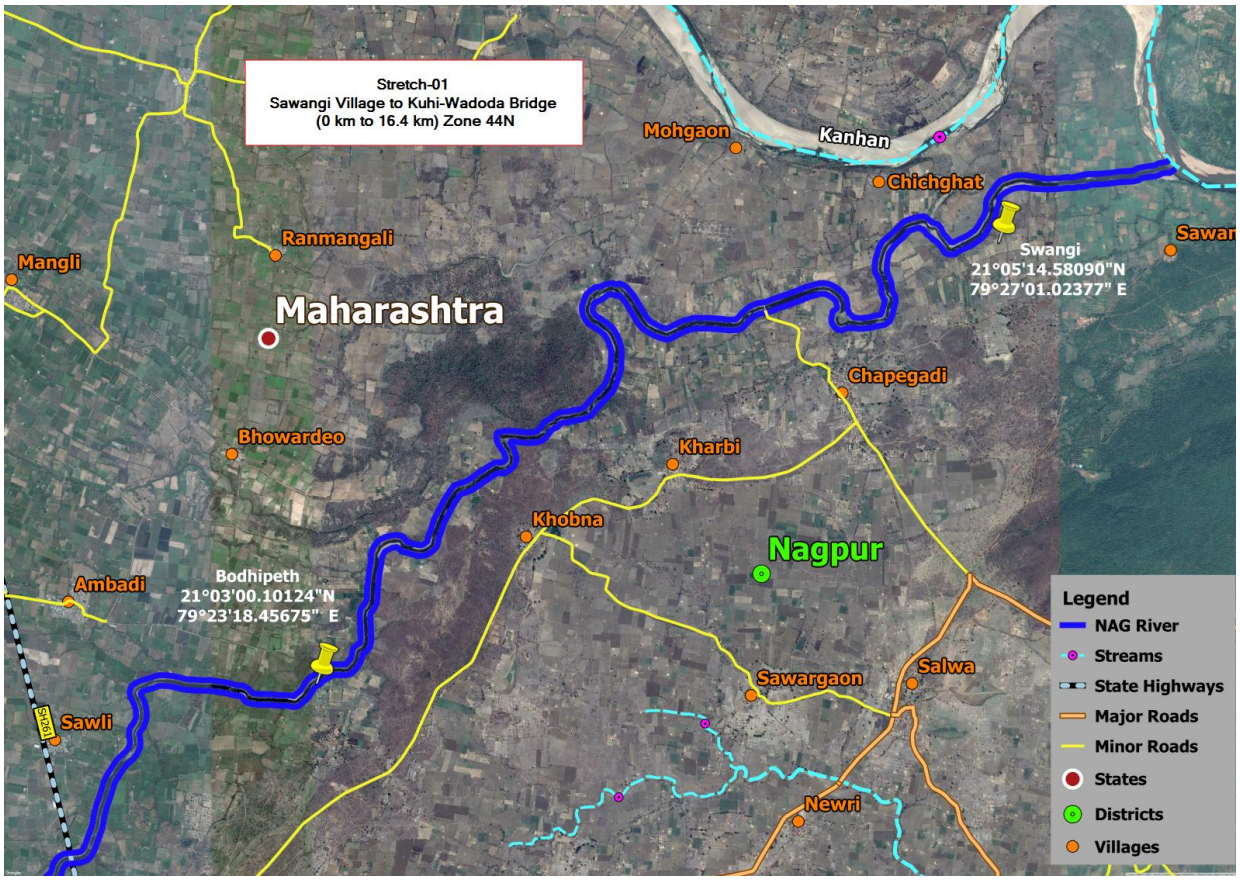


Figure 6 - Stretch-01 Sawangi Village to Kuhi-Wadoda Bridge

- **Bathymetry Survey**
  a) No bathymetric survey is conducted due to the unavailability of water
- **Topographic Survey**
  b) 16.4 km of the length of the stretch for which the Topographic survey has been carried out.

This stretch is from 0 to 16.4 km of Nag River and is the confluence of Kanhan River near a Sawangi village to Kuhi-Wadoda Bridge. The river bed is flat and sandy in nature, the sand mining is not observed in the entire survey stretch of the Nag River. There are no ferry transport system or any boats operating in the stretch. The river banks in this stretch are not populated and the both sides of the river streams are used for agricultural purpose only. The water from the Nag River in this area is widely used for irrigation purpose of pumping system by the local owners of the nearby land.

Figure 7 - Sandy River bed on Sub-Stretch-01

The river banks are un-protected in nature, but are a high rise in nature and lined very prominently with cultivatable land on both sides. The Mathani – Chapengadi road runs through this stretch. The Road from Kuhi to Agargaon, which runs parallel to this stretch is under construction. The Kuhi Railway station the nearest railway station available on this stretch of Nag River. The interconnectivity of roads towards the river bank is very less due to non-availability of the proper road network. The construction materials are available in the town area, but the facilities for the transportation of the same, towards the river bank area are not available. The Kuhi town is the nearest town situated on this stretch of river.

Figure 8 - Dense Shrubs and Trees on the River banks of Sub-stretch-1

The land on both sides of the river is cultivatable lands (Soyabean, Cotton, and paddy) with some portions as forest area with full grown trees and shrubs. The nearby villages

within this stretch are Sawangi, Chapegadi, Kharbi on Right Bank side and Chichghat of Left bank side of River. A stream originating from Kanhan River confluence with the Nag River at Lat 21° 5'20.92"N Long 79°26'36.04"E is present in this stretch act as the overflow discharge from Kanhan River.

The water from this stretch is not used for drinking purpose due to deteriorating water quality, but are used for small scale irrigation purpose for nearby cultivatable land. There is no polluted water discharge to this stretch of Nag River. Due to the polluted water discharge on the upstream of Nag River, the water on downstream of Nag River and confluence of Kanhan River is also polluted in nature.

Classes	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.)	Accumulated Qty.	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.
I	0	16.4	0.000	0.000	16400	682,224.04	682,224.04	-0.300	0.000	16400	843,677.68	843,677.68
II	0	16.4	0.000	0.000	16400	1,041,004.55	1,041,004.55	-0.300	0.000	16400	1,252,625.42	1,252,625.42
III	0	16.4	0.000	0.000	16400	1,558,541.76	1,558,541.76	-0.300	0.000	16400	1,812,553.41	1,812,553.41
IV	0	16.4	0.000	0.000	16400	1,896,589.23	1,896,589.23	-0.300	0.000	16400	2,176,172.54	2,176,172.54

Table 12 - Stretch 1 Dredging Quantity

3.1.1 Observed and Reduced Bed Profile of the Stretch

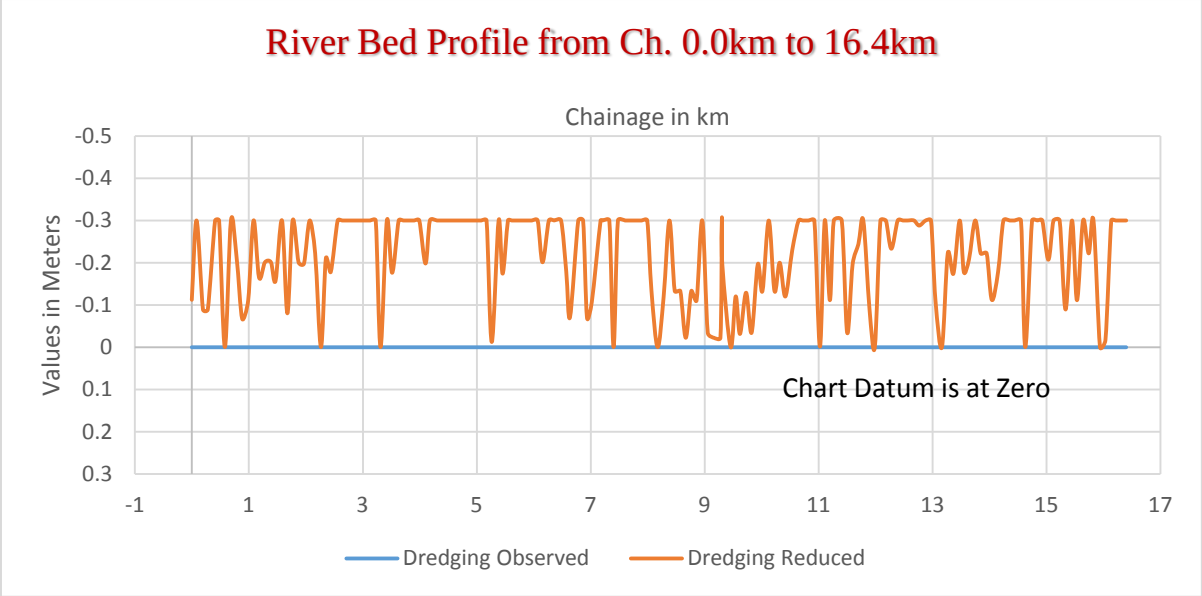


Figure 9 - Stretch 1 River-bed Profile

3.2 Sub-Stretch-2: Kuhi Wadoda Bridge to Kedi Bridge (16.4 km to 44.6km)

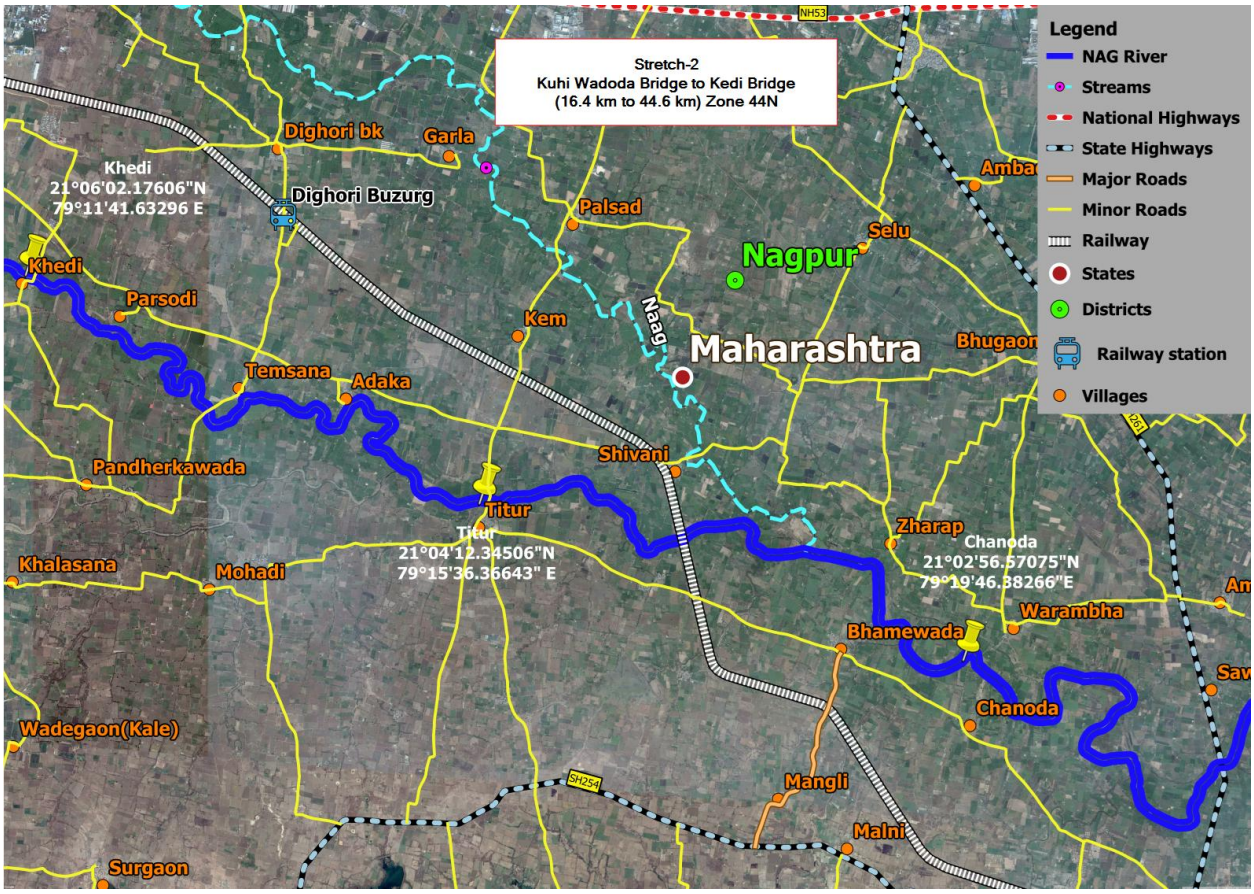


Figure 10 - Stretch-02 Kuhi-Wadoda Bridge to Kedi Bridge

- **Bathymetry Survey**
  a) No bathymetric survey is conducted due to the unavailability of water
- **Topographic Survey**
  b) 28.2 km of the length of the stretch for which the Topographic survey has been carried out.

This stretch is between 16.4km to 44.6km of Nag River and is from the Kuhi Wadoda Bridge to Kedi Bridge. The river bed is flat and the bed is firm in nature, the sand mining is not observed in the entire survey stretch of the Nag River. There are no ferry transport system or any boats operating in the stretch. The river banks in this stretch are sparsely populated with cluster type settlements spread near to the river banks. The both sides of the river, stream area are used for various agricultural purposes. The water from the Nag River in this area is widely used for irrigation purpose of pumping system by the local owners of the nearby land.

Figure 11 - Titur Railway Bridge (30.534 km chainage)

The river banks are un-protected in nature, but are a high rise in nature and lined very prominently with cultivatable land and some settlements on both sides. The state highway SH-254 and NH-06 run near to this stretch of Nag River. The Titur and Kuhi railway stations the nearest railway station available. These stations are used by the passengers for reaching Itwari and Nagpur City. The inter-connectivity between these state highways towards the river bank are linked through various cross-structures. The construction materials are available in the town area, but the facilities for the transportation of the same, towards the river bank area are available in limited condition.

The nearby villages within this stretch are Chanoda, Bhamewada, Titur and Kedi on Right bank side and the villages like Warambha, Zharap, Shivani, Adaka,Temsana, and Parsodi is situated on the Left Bank side of Nag River. The land on both sides of the river are cultivatable lands (Soyabean, Cotton, and paddy)

Figure 12 - Damaged Check Dam (33.328 km chainage)

The water from this stretch is not used for drinking purpose due to deteriorating water quality, but are used for small scale irrigation purpose for nearby cultivatable land. There

is no polluted water discharge to this stretch of Nag River. Due to the polluted water discharge on the upstream of Nag River, the downstream water is also polluted in nature.

Classes	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.)	Accumulated Qty.	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.
I	16.4	33.3	0.000	0.000	16900	707,754.43	1,389,978.47	-0.300	0.000	16900	886,942.09	1,730,619.77
I	33.3	39.1	0.000	0.000	5800	233,762.10	1,623,740.57	-0.300	0.000	5800	298,899.81	2,029,519.58
I	39.1	41.1	0.000	0.000	2000	80,577.54	1,704,318.11	-0.300	0.000	2000	103,070.99	2,132,590.57
I	41.1	42.5	0.000	0.000	1400	52,164.01	1,756,482.12	-0.300	0.000	1400	67,226.64	2,199,817.21
I	42.5	44.6	0.000	0.000	2100	86,733.93	1,843,216.05	-0.300	0.000	2100	108,223.48	2,308,040.69
II	16.4	33.3	0.000	0.000	16900	1,077,872.85	2,118,877.40	-0.300	0.000	16900	1,312,054.96	2,564,680.38
II	33.3	39.1	0.000	0.000	5800	355,256.80	2,474,134.20	-0.300	0.000	5800	439,142.48	3,003,822.86
II	39.1	41.1	0.000	0.000	2000	122,719.51	2,596,853.71	-0.300	0.000	2000	151,850.41	3,155,673.27
II	41.1	42.5	0.000	0.000	1400	79,363.20	2,676,216.91	-0.300	0.000	1400	98,711.62	3,254,384.89
II	42.5	44.6	0.000	0.000	2100	131,936.15	2,808,153.06	-0.300	0.000	2100	160,170.11	3,414,555.00
III	16.4	33.3	0.000	0.000	16900	1,614,597.09	3,173,138.85	-0.300	0.000	16900	1,895,839.76	3,708,393.17
III	33.3	39.1	0.000	0.000	5800	530,304.25	3,703,443.10	-0.300	0.000	5800	629,848.19	4,338,241.36
III	39.1	41.1	0.000	0.000	2000	181,649.16	3,885,092.26	-0.300	0.000	2000	216,128.50	4,554,369.86
III	41.1	42.5	0.000	0.000	1400	118,921.39	4,004,013.65	-0.300	0.000	1400	141,936.62	4,696,306.48
III	42.5	44.6	0.000	0.000	2100	197,245.23	4,201,258.88	-0.300	0.000	2100	231,256.93	4,927,563.41
IV	16.4	33.3	0.000	0.000	16900	1,964,735.46	3,861,324.69	-0.300	0.000	16900	2,273,468.47	4,449,641.01
IV	33.3	39.1	0.000	0.000	5800	644,871.87	4,506,196.56	-0.300	0.000	5800	753,370.48	5,203,011.49
IV	39.1	41.1	0.000	0.000	2000	221,131.96	4,727,328.52	-0.300	0.000	2000	258,733.90	5,461,745.39
IV	41.1	42.5	0.000	0.000	1400	144,211.46	4,871,539.98	-0.300	0.000	1400	169,123.43	5,630,868.82
IV	42.5	44.6	0.000	0.000	2100	239,335.77	5,110,875.75	-0.300	0.000	2100	276,514.14	5,907,382.96

Table 13 - Stretch 2 Dredging Quantity

3.2.1 Observed and Reduced Bed Profile of the Stretch

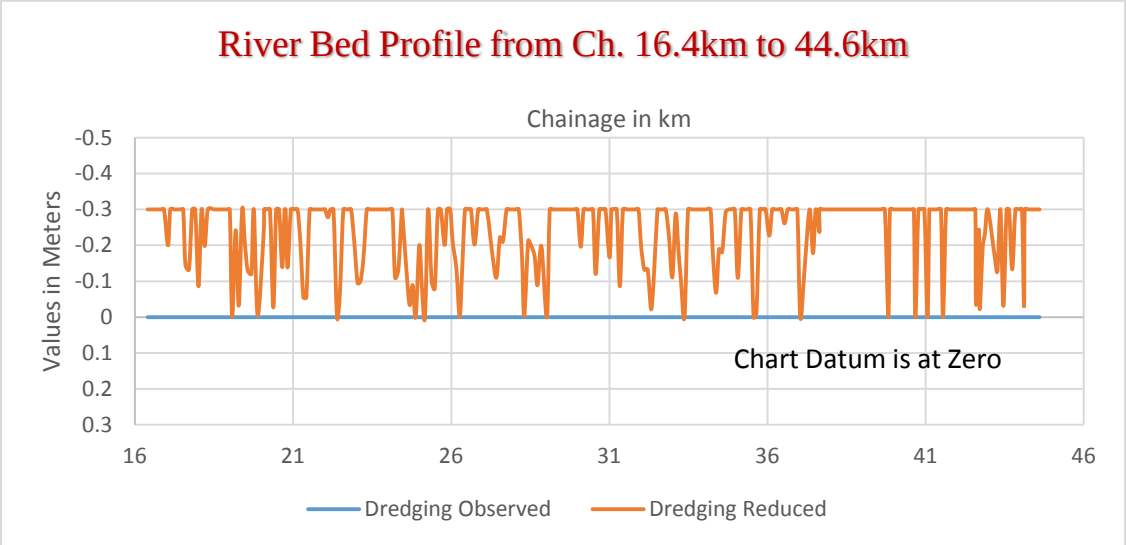


Figure 13 - Stretch 2 River-bed Profile

3.3 Sub-Stretch-3: Kedi Bridge to NIT colony, Nagpur (44.6 to 58.7km)

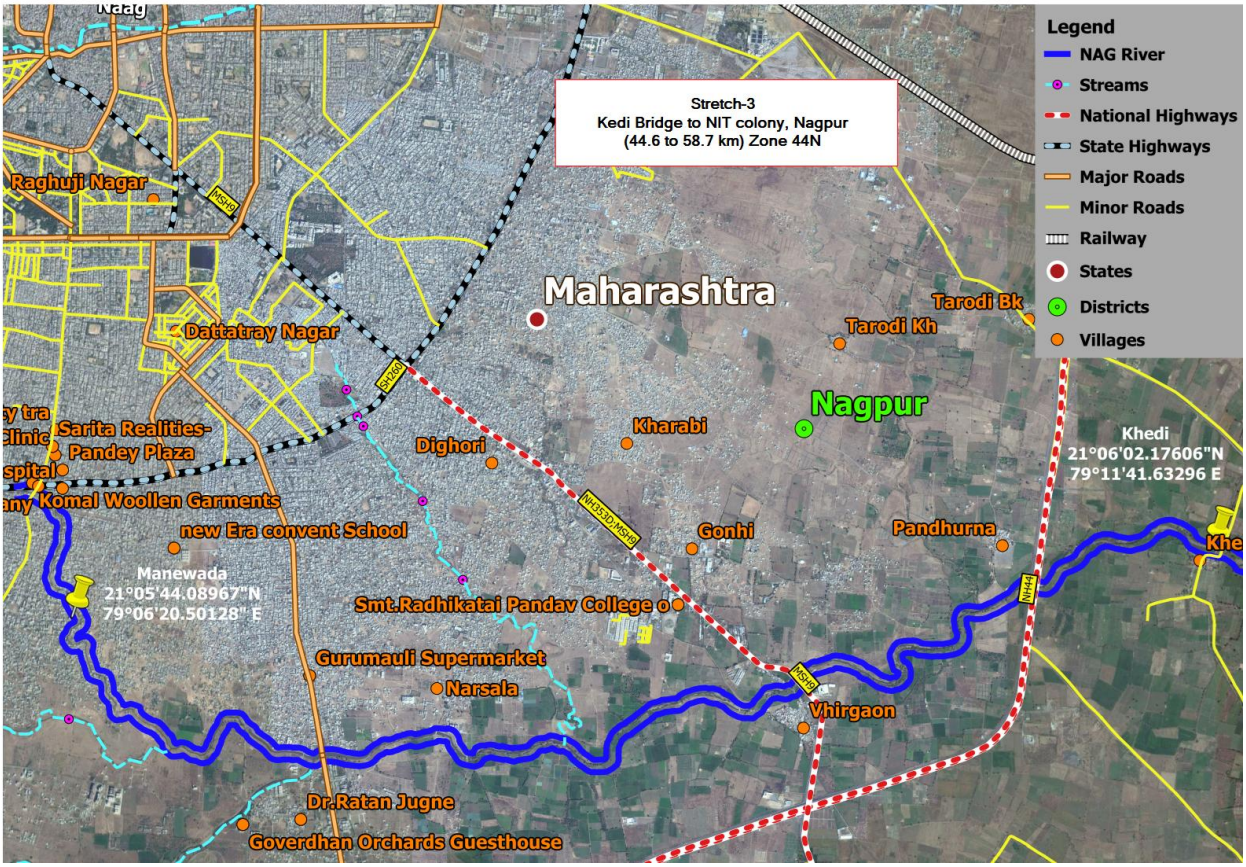


Figure 14 - Stretch-03 Kedi Bridge to NIT colony, Nagpur

- **Bathymetry Survey**
  a) No bathymetric survey is conducted due to the unavailability of water
- **Topographic Survey**
  b) 14.1 km of the length of the stretch for which the Topographic survey has been carried out.

This stretch is from 44.6 to 58.7km of Nag River and is from the Kedi Bridge to NIT Colony, Nagpur city. The river bed is flat and the bed is firm in nature and no activities in the riverbed is observed due to its highly polluted in nature. There are no cargo movement, ferry transport system or any boats operating in the stretch. The river banks in this stretch are densely populated in nature along the entire river bank. The water from this stretch is not used for drinking purpose due to deteriorating water quality. The water from the Nag River in this area is not used for irrigation purpose or any another pumping arrangement is found in this stretch.

Figure 15 - View of Outer Ring Road Bridge (46.983 km chainage)

The river banks are un-protected in nature, but various boundary walls are observed to be constructed very near to the river streams. The river bed is lined with many residential constructions and some construction is found to encroach towards the river bed itself.

Figure 16 - Constructions on the waterway area (21° 5'44.81"N, 79° 6'20.41"E) (57.5 km chainage)

This stretch falls within the Nagpur City limited and the road network is very well connected with various roads crossing the river. The Nagpur Junction railway station the nearest railway station available for this stretch. The inter-connectivity between these state highways towards the river bank are linked through various cross-structures. The construction materials are available in the town area, but the facilities for the transportation of the same, towards the river bank area are available in limited condition.

There are various polluted city waste and sewage discharges found to be flowing to the Nag River and the river is much polluted in nature with only this polluted water discharge available in the entire stretch of Nag River.

Figure 17 - View of Nag River in City area (58.129 km chainage)

Classes	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.)	Accumulated Qty.	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.
I	44.6	58.7	0.000	0.000	14100	565,825.20	2,409,041.25	-0.300	0.000	14100	719,117.09	3,027,157.78
II	44.6	58.7	0.000	0.000	14100	860,239.17	3,668,392.23	-0.300	0.000	14100	1,058,694.97	4,473,249.97
III	44.6	58.7	0.000	0.000	14100	1,282,163.33	5,483,422.21	-0.300	0.000	14100	1,517,960.43	6,445,523.84
IV	44.6	58.7	0.000	0.000	14100	1,558,321.86	6,669,197.61	-0.300	0.000	14100	1,815,963.93	7,723,346.89

Table 14 - Stretch 3 Dredging Quantity

3.3.1 Observed and Reduced Bed Profile of the Stretch

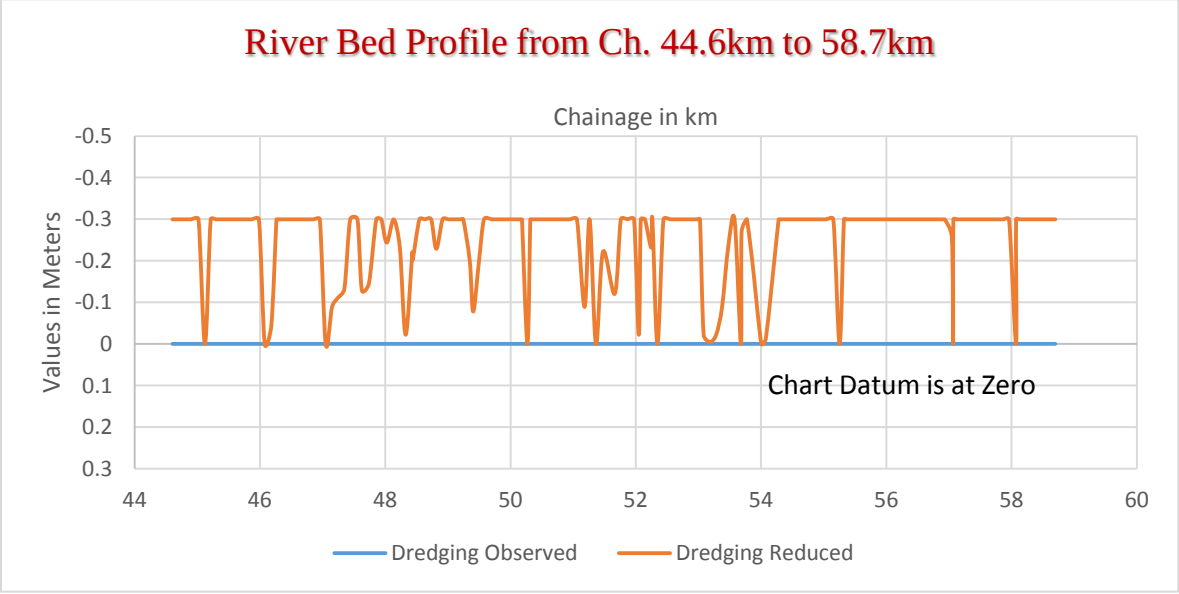


Figure 18 - Stretch 3 River-bed Profile

3.4 Other Aspects of Waterway

3.4.1 Fishing

No fishing activities exist on the entire survey stretch of the Nag River. No scope of fishing does exist in the Nag River due to deteriorating water quality and non-availability of water during the summer season. The fishing boats/any other type country boats are also not available in the Nag River due to low depths. The inland fishery breeding is practiced and varieties of fish like Maral, Katla, Katwa, Prawns etc. are produced near the survey area.

3.4.2 Industries

Various major individual industrial units located in the catchment of Nag River & Pili River within the city and outside the city limits. There are about 5 industrial units, namely Govt. Milk Scheme, Civil Lines, Nagpur, Dinshaw's Dairy, Gittikhadan, Shree Baidyanath Ayurved Bhavan, Great Nag Road, Haldiram Food International, Bhandara Road, Murli Industries Ltd., Wadoda in the catchment of the Nag River & Pili River basin.

3.4.3 Crops

The major crops being Soybean, Cotton, Paddy and Tur in Kharif (July –October during the south-west monsoon) and Wheat & Gram in Rabi (October-March - winter) season. The fruits like orange and vegetable crops like Brinjal, Tomato, Bhendi, Cauliflower, and Cabbage, etc. are also cultivated in the region. Apart from these, spice crops like Chilly (Red), Turmeric, etc. and flower crops like marigold, rose, etc. are also grown in the area.

Figure 19 - Agricultural Land near River Bank

3.4.4 Settlements

The overall River banks are moderately populated for the entire survey stretch. The Nagpur city is located on the stretch-03 of the Nag River. The area near the stretch-02 of Nag River is sparsely populated with small clusters of settlements located near river banks. The stretch-01 area of Nag River is sparsely populated and consists mainly of cultivatable lands. The stretch-02 and stretch-03 of Nag River connect with the roads. The facility of the state run public transport system is there from Nagpur city to Kuhi, however, the frequency of operation is not sufficient, as a result, many local jeeps are found to be operating between Nagpur to Kuhi on sharing basis.

Figure 20 - Settlements near to River bank (57.75 km chainage)

3.4.5 Drinking Water

The domestic and industrial waste water is discharged directly into the Nag River, because of this, its water has been severely polluted. The water from the Nag River is not used for drinking purpose in the entire survey stretch. As per the various studies conducted by different agencies, the flows also contaminate ground water, which is the primary sources of domestic water supply in the nearby area. The river further carries the polluted water to Gosikhurd Dam, which supplies water for irrigation, domestic consumption, and industrial uses.

3.4.6 Important Cities/Towns

The Nagpur city is towns situated near to the survey stretch of Nag River. Kuhi Town is the prominent town situated near to the survey stretch of the Nag River. Kuhi Town is connected with state transport bus runs from Nagpur City and Local Taxis and Autos are also available along the entire River stretch.

3.4.7 Transportation

Nagpur City is at the center of India. It is connected with Delhi, Chennai, Mumbai, Kolkata and other main cities by rail & road. Kolkata-Mumbai National Highway No.6 and Delhi-Hyderabad NH- 7 passes through Nagpur district connecting it to all parts of the country.

3.4.7.1 Road Network

The both sides of Nag River are well connected with the road network, SH-254 and & SH-253 runs parallel on the Right and Left bank side respectively to the Nag River. The connecting roads from these state highways to the River banks are not well developed on the downstream of Nag River particularly between Kuhi to the confluence with Kanhan River.

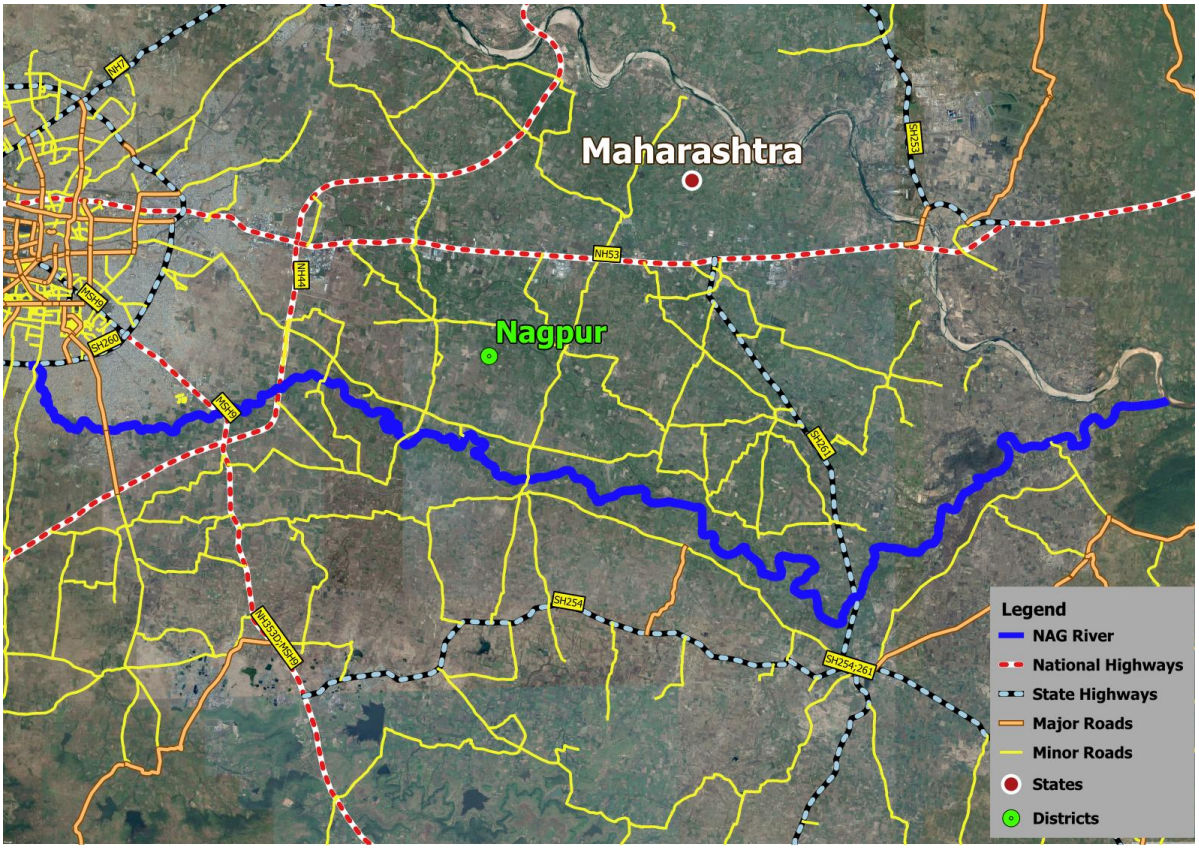


Figure 21 - Road Network

3.4.7.2 Rail Network

The major stations within the project influence area of Nag River are Nagpur Junction, Itwari, Kuhi, Mahuli, Titur, Kem and Dighori railway stations. The passenger train from

between these stations is utilized widely for the transition between villages to Nagpur City.

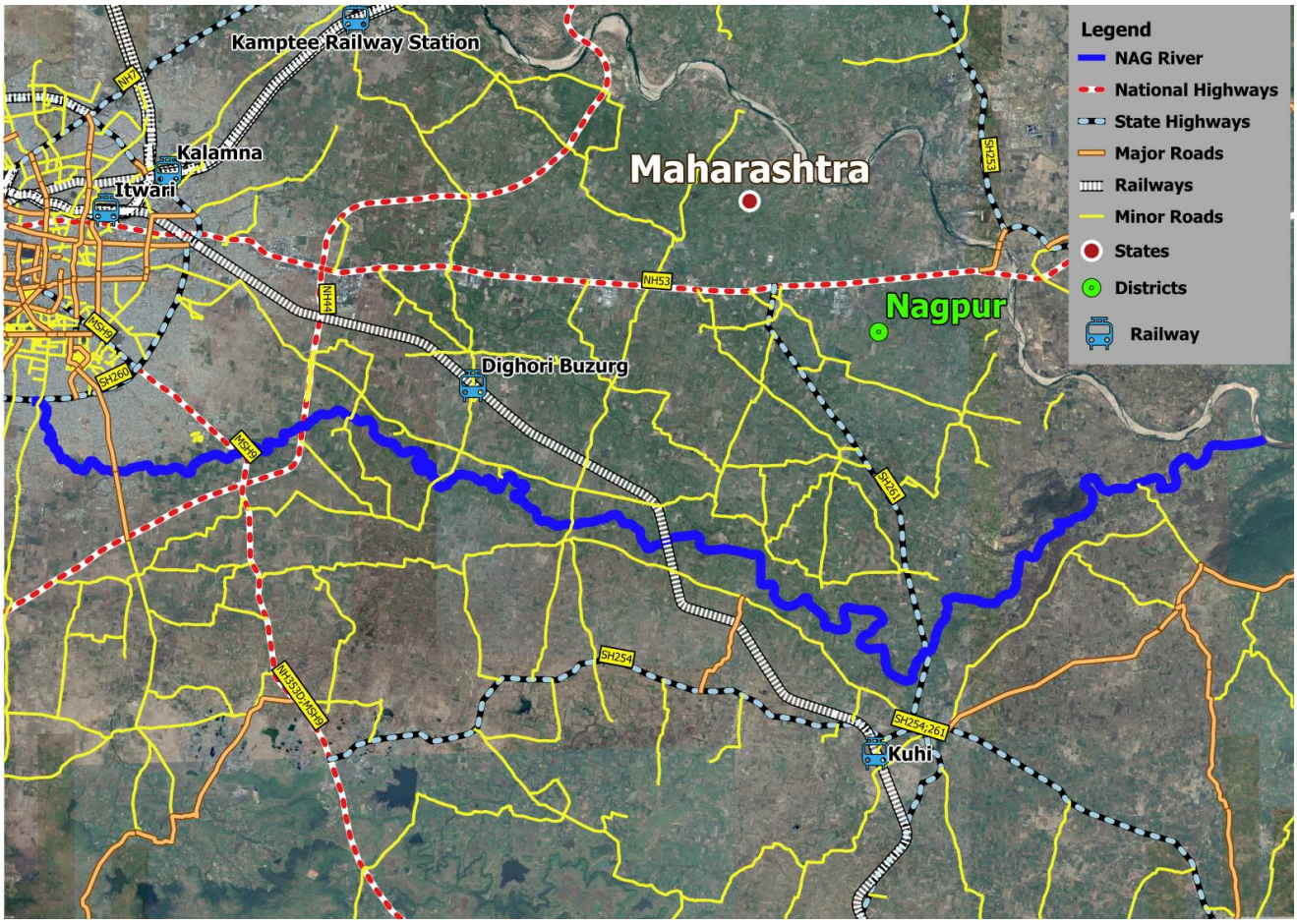


Figure 22 - Rail Network

3.4.8 Land Use

The Nagpur City is situated near to the river banks of Nag River. The land near the city area is extensively used for the commercial and residential purpose. Dense Forest is distributed near to Umarpeth and Teak is economically significant species in these forests. Barren Lands are significantly seen in Khobna, Kuhi, and Bhivapur and are mostly the rocky surfaces. The Mines - Manganese and Coal mines are located in the hilly parts of Ramtek and Umrer tehsils, respectively. The cultivated Lands are spread over the gently sloping plateaus and plains along the river streams of Nag River.

3.4.9 Construction Material

The area being near to Nagpur city, all types of modern construction materials like cement, Iron etc., is available in bulk quantity. The downstream of Nag River is sandy in nature, but sand mining activities are not observed in these stretches due to non-

availability for road network to these stretches. The mining of rocks and boulders are also in progress in the area near to Kuhi town.

3.4.10 Cargo Movement

The cargo movement through Nag River is not envisaged as there are any Major industries present near Nag River. The Road connectivity towards the river banks stretches also very limited in the lower stretched of Nag River.

3.4.11 Passenger Ferry Services

No passenger ferry service is available in the survey stretch of the Nag River. Due to the low water level in the Nag River, no boats are found to be operating in the entire survey stretch of the river.

3.4.12 Historic Importance

Zero Mile Stone: - The Zero Mile Stone was erected by the British who used this point to measure all the distances. The Zero Mile Stone consists of four horses and a pillar made up of sandstone. The British rulers considered Nagpur to be the center of India and hence identified this point and constructed the Zero Mile Stone. Zero Mile Stone is a monument locating the geographical center of Colonial India in the city of Nagpur.

Kalidas Festival: - Kalidas Festival has celebrated annually at Ramtek and Nagpur for two days in the month of November. Organized by MTDC in association with the District Collectorate Office of Nagpur, this festival of Music, Dance and Drama is held to honor the great Sanskrit poet Kalidasa. During Kalidas festival, celebrities of music, dance, and drama gathered here to perform their talent.

Sitabuldi Fort: - This is the site of the Battle of Sitabuldi in 1817, is located atop a hillock in Nagpur and the fort was built by Mudhoji II Bhonsle of the Kingdom of Nagpur. The area surrounding the hillock, now known as Sitabuldi, is an important commercial hub for Nagpur. The fort is now home to the Indian Army's 118th infantry battalion. The fort opens to the general public only on two national holidays- 26th January and 15th August.

Deekshabhoomi: - Deekshabhoomi is a location regarded as a pilgrimage center of Buddhism in India. Millions of pilgrims visit Deekshabhoomi every year, especially on Dhamma Chakra Pravartan Din 14 October, the Memorial Day when Dr. Ambedkar converted to Buddhism here. The biggest stupa in Asia is erected in his memory at the place.

3.4.13 Tourism

Maharajbagh Zoo: - The Maharajbagh is the central Zoo of Nagpur, India. The zoo is located in the heart of the city and has been built in the garden of the Bhonsle and Maratha rulers of the city. The zoo comes under the Central Zoo Authority (CZA) of India and is maintained by the Panjabrao Deshmukh Krishi Vidyapeeth (PKV) of Nagpur.

The Central Museum: - The Nagpur Central Museum, known as Ajab Bangla, is located in Nagpur, Maharashtra, India. It holds coins, ancient inscriptions, sculptures, inscriptions and pre-historic artifacts. The Central Museum, Nagpur is one of the oldest museum in India, established in 1863. Sir Richard Temple, the then Chief Commissioner of the Nagpur took a leading role in establishing the Central Museum, Nagpur.

3.4.14 Irrigation Canals and Inlets/Outlet streams

There are various discharge inlets found between 55.6km to 58.7km chainage of Nag River. This chainages being near Nagpur city area, the water discharge to the river is polluted with domestic and city drainage system. The details of other major inlet streams joining the Nag River are as follows:-

Sl. No.	Canals/ Stream	Chainage (km)	Type	Description
01	21°05'20.80"N 79°26'35.32"E	2.72	Inlet	The stream originating from Kanhan River, which functions as discharging water from Kanhan to Nag River and the confluence with Nag River. The stream is on the left bank side of Nag River and is dry during the conduct of the survey.
02	21° 2'3.29"N 79°21'10.59"E	18.78	Inlet	The stream originating from Tembhari Lake and the confluence with the Nag River on the right bank side.
03	21° 3'6.82"N 79°19'11.53"E	25.75	Inlet	The stream originating from the water body situated near Manjli and confluence with Nag River on the right bank side.
04	21° 3'51.13"N 79°18'20.54"E	28.32	Inlet	The Pili River originating from Gorewada Lake and the confluence with the Nag river on the left bank side.
05	21° 4'30.12"N 79°14'52.89"E	35.59	Inlet	The stream originating from Wadadh and Matkazari and the confluence with the Nag River on the right bank side.

Table 15 - Details of Major Inlet Streams

4 Terminals

The Nag River is 58.7 km in length with various damaged check dams and obstructions in the survey stretches. The water availability being very low on the river, there are no boats operating in the entire survey stretch of the Nag River. The water level in the survey stretch of Nag River is very less and the most of the downstream survey stretches river bank are not easily approachable. The scope of navigation is very less and no signs of development of tourism activities are observed in the Nag River. Appropriate location

satisfying the requirements for construction of the proposed terminals could not be identified on the entire survey stretch of Nag River.

5 Fairway Development

The Nag River flows south Easterly course till Kuhi town and then flows in a northeasterly direction and confluence with Kanhan River. The river flows with many sharp turns at various places throughout the survey stretch.

5.1 Design Channel of the Waterway

The waterway is not used for any major irrigation purpose/ drinking water supply due to pollution in the river water. The Nag River is also not explored for any navigational aspects and the water level in the river is very less. There exist many cross structures in the waterway, which are presently in use. The dredging on the Waterway of Nag River will improve the depth of the channel for any navigational requirement.

5.2 Fairway Dimensions

As per the specification of the survey, dredging quantity is required to be estimated for different channel classifications along the deepest route. Class-I channel with dimension 30m width, 1.2m depth and side slop of 1:5 is shown below.

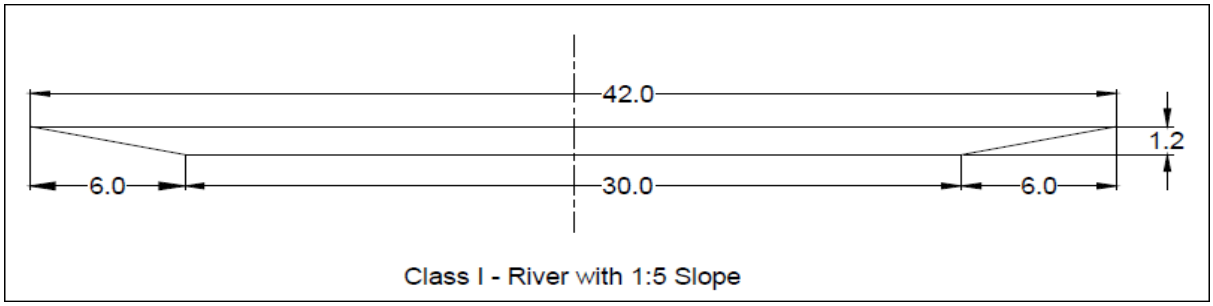
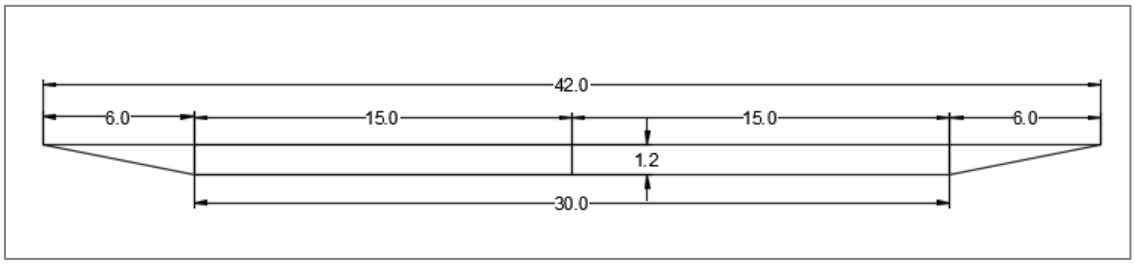


Figure 23 - Fairway Channel Dimensions

5.3 Calculation of Dredging Quantity

The dredge volume calculations were accomplished using the HYPACK dredge volume computation utility. The channel template was created as per the different classification and kilo meter wise dredging calculation was carried out. (Enclosed at Annexure-3) The Hypack Standard volume algorithm was used to calculate the dredge volume in each segment. The stretch wise dredge volume for different class of fairway is as follows:-

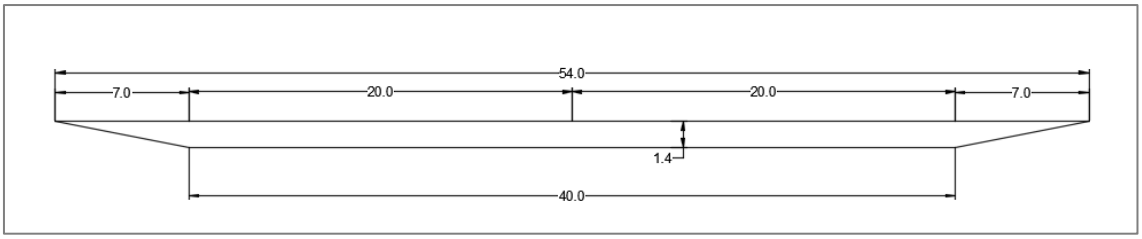
Class I



Location		Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
From	To	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.
Sawangi Village	Kuhi-Wadoda Bridge	0	16.4	0.000	0.000	16400	682,224.04	682,224.04	-0.300	0.000	16400	843,677.68	843,677.68
Kuhi-Wadoda Bridge	Titur Check Dam	16.4	33.3	0.000	0.000	16900	707,754.43	1,389,978.47	-0.300	0.000	16900	886,942.09	1,730,619.77
Titur Check dam	Adaka Check Dam	33.3	39.1	0.000	0.000	5800	233,762.10	1,623,740.57	-0.300	0.000	5800	298,899.81	2,029,519.58
Adaka Check Dam	Temsana Check Dam	39.1	41.1	0.000	0.000	2000	80,577.54	1,704,318.11	-0.300	0.000	2000	103,070.99	2,132,590.57
Temsana Check dam	Parsodi Check Dam	41.1	42.5	0.000	0.000	1400	52,164.01	1,756,482.12	-0.300	0.000	1400	67,226.64	2,199,817.21
Parsodi Check Dam	Kedi Bridge	42.5	44.6	0.000	0.000	2100	86,733.93	1,843,216.05	-0.300	0.000	2100	108,223.48	2,308,040.69
Kedi Bridge	NIT Colony, Nagpur	44.6	58.7	0.000	0.000	14100	565,825.20	2,409,041.25	-0.300	0.000	14100	719,117.09	3,027,157.78
					Total	**58700**	**2,409,041.25**	**2,409,041.25**		**Total**	**58700**	**3,027,157.78**	**3,027,157.78**

Table 16 - Dredge Volumes Class-I

Class II

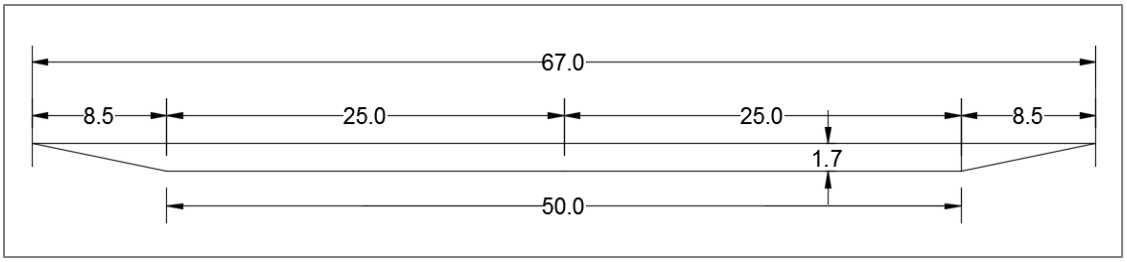


Location		Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
From	To	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.
Sawangi Village	Kuhi-Wadoda Bridge	0	16.4	0.000	0.000	16400	1,041,004.55	1,041,004.55	-0.300	0.000	16400	1,252,625.42	1,252,625.42
Kuhi-Wadoda Bridge	Titur Check Dam	16.4	33.3	0.000	0.000	16900	1,077,872.85	2,118,877.40	-0.300	0.000	16900	1,312,054.96	2,564,680.38
Titur Check dam	Adaka Check Dam	33.3	39.1	0.000	0.000	5800	355,256.80	2,474,134.20	-0.300	0.000	5800	439,142.48	3,003,822.86
Adaka Check Dam	Temsana Check Dam	39.1	41.1	0.000	0.000	2000	122,719.51	2,596,853.71	-0.300	0.000	2000	151,850.41	3,155,673.27
Temsana	Parsodi Check	41.1	42.5	0.000	0.000	1400	79,363.20	2,676,216.91	-0.300	0.000	1400	98,711.62	3,254,384.89

Location		Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
From	To	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.
Check dam	Dam												
Parsodi Check Dam	Kedi Bridge	42.5	44.6	0.000	0.000	2100	131,936.15	2,808,153.06	-0.300	0.000	2100	160,170.11	3,414,555.00
Kedi Bridge	NIT Colony, Nagpur	44.6	58.7	0.000	0.000	14100	860,239.17	3,668,392.23	-0.300	0.000	14100	1,058,694.97	4,473,249.97
					Total	**58700**	**3,668,392.23**	**3,668,392.23**		**Total**	**58700**	**4,473,249.97**	**4,473,249.97**

Table 17 - Dredge Volumes Class-II

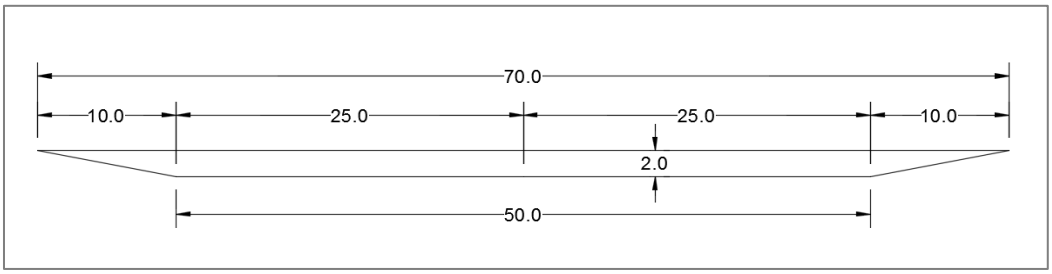
Class III



Location		Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
From	To	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.
Sawangi Village	Kuhi-Wadoda Bridge	0	16.4	0.000	0.000	16400	1,558,541.76	1,558,541.76	-0.300	0.000	16400	1,812,553.41	1,812,553.41
Kuhi-Wadoda Bridge	Titur Check Dam	16.4	33.3	0.000	0.000	16900	1,614,597.09	3,173,138.85	-0.300	0.000	16900	1,895,839.76	3,708,393.17
Titur Check dam	Adaka Check Dam	33.3	39.1	0.000	0.000	5800	530,304.25	3,703,443.10	-0.300	0.000	5800	629,848.19	4,338,241.36
Adaka Check Dam	Temsana Check Dam	39.1	41.1	0.000	0.000	2000	181,649.16	3,885,092.26	-0.300	0.000	2000	216,128.50	4,554,369.86
Temsana Check dam	Parsodi Check Dam	41.1	42.5	0.000	0.000	1400	118,921.39	4,004,013.65	-0.300	0.000	1400	141,936.62	4,696,306.48
Parsodi Check Dam	Kedi Bridge	42.5	44.6	0.000	0.000	2100	197,245.23	4,201,258.88	-0.300	0.000	2100	231,256.93	4,927,563.41
Kedi Bridge	NIT Colony, Nagpur	44.6	58.7	0.000	0.000	14100	1,282,163.33	5,483,422.21	-0.300	0.000	14100	1,517,960.43	6,445,523.84
					Total	**58700**	**5,483,422.21**	**5,483,422.21**		**Total**	**58700**	**6,445,523.84**	**6,445,523.84**

Table 18 - Dredge Volumes Class-III

Class IV



Location		Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
From	To	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.
Sawangi Village	Kuhi-Wadoda Bridge	0	16.4	0.000	0.000	16400	1,896,589.23	1,896,589.23	-0.300	0.000	16400	2,176,172.54	2,176,172.54
Kuhi-Wadoda Bridge	Titur Check Dam	16.4	33.3	0.000	0.000	16900	1,964,735.46	3,861,324.69	-0.300	0.000	16900	2,273,468.47	4,449,641.01
Titur Check dam	Adaka Check Dam	33.3	39.1	0.000	0.000	5800	644,871.87	4,506,196.56	-0.300	0.000	5800	753,370.48	5,203,011.49
Adaka Check Dam	Temsana Check Dam	39.1	41.1	0.000	0.000	2000	221,131.96	4,727,328.52	-0.300	0.000	2000	258,733.90	5,461,745.39
Temsana Check dam	Parsodi Check Dam	41.1	42.5	0.000	0.000	1400	144,211.46	4,871,539.98	-0.300	0.000	1400	169,123.43	5,630,868.82
Parsodi Check Dam	Kedi Bridge	42.5	44.6	0.000	0.000	2100	239,335.77	5,110,875.75	-0.300	0.000	2100	276,514.14	5,907,382.96
Kedi Bridge	NIT Colony, Nagpur	44.6	58.7	0.000	0.000	14100	1,558,321.86	6,669,197.61	-0.300	0.000	14100	1,815,963.93	7,723,346.89
					Total	**58700**	**6,669,197.61**	**6,669,197.61**		**Total**	**58700**	**7,723,346.89**	**7,723,346.89**

Table 19 - Dredge Volumes Class-IV

6 Conclusion

The aim is to undertake bathymetric survey, topographic survey, collection of data on cargo movement, industry survey, tourism facilities etc. in the project area; prepare detailed hydrographic survey charts, topographic survey charts, and feasibility report.

6.1 Description of Waterways

The surveyed stretch of Nag River is 58.7 km in length and is not being explored for any navigational possibility. This survey stretch starts from Bridge near NIT Colony, Nagpur to the confluence with river Kanhan near Sawangi village. There is no major scope for navigational aspect for waterway due to non-availability of water throughout the season.

The major settlements are distributed near to Nagpur City and the downstream is very sparsely populated in nature. The Project Influence area connects to the road network, however, the area near to the river banks are not connected adequately by road network. The stretch wise minimum and maximum width range, average width and average slope of the waterway are as below:-

Sl. No.	Location		Chainage (km)		Width Range of the waterway (m)		Average Width (m)	Average Slope (in m/km)
	From	To	From	To	Min	Max		
1	Sawangi Village	Kuhi-Wadoda Bridge	0	16.4	60.301	203.64	131.970	1 : 0.622
2	Kuhi-Wadoda Bridge	Kedi Bridge	16.4	44.6	3.785	154.52	79.152	1 : 0.635
3	Kedi Bridge	NIT colony, Nagpur	44.6	58.7	3.885	217.29	110.587	1 : 1.649

Table 20 - Stretch wise Average width and slope of waterway

6.2 Methods for making Waterway Feasible

The waterway may be developed as a Class II navigational canal by carrying out capital dredging to achieve the navigability. The class-wise details of reduced dredging quantities of the waterways are as tabulated below:-

Reduced w.r.t. CD Dredging Values				
Class	**0 – 16.4 (km)**	**16.4 – 44.6 (km)**	**44.6 – 58.7 (km)**	**Total**
I	843,677.68	1,464,363.01	719,117.09	**3,027,157.78**
II	1,252,625.42	2,161,929.58	1,058,694.97	**4,473,249.97**
III	1,812,553.41	3,115,010.00	1,517,960.43	**6,445,523.84**
IV	2,176,172.54	3,731,210.42	1,815,963.93	**7,723,346.89**

Table 21 - Class-wise Reduced Dredging quantity

Due to the continuous gradient of the river and the water level will not be available during the summer season the navigation aspect will not be fulfilled throughout the year. The navigational lock is required to maintain the minimum depth required for navigation and regulate the water level in the river. The class-wise details of reduced depth at different stretches of the waterways are as tabulated below:-

Sl. No.	chainage (km)		< 1.2		1.2 - 1.4		1.5 - 1.7		1.8 - 2.0		> 2.0	
	From	To	Availability of Depth (km)	% of availability	Availability of Depth (km)	% of availability	Availability of Depth (km)	% of availability	Availability of Depth (km)	% of availability	Availability of Depth (km)	% of availability
1	0	16.4	16.4	100%	0	0 %	0	0 %	0	0 %	0	0 %
2	16.4	44.6	28.2	100%	0	0 %	0	0 %	0	0 %	0	0 %
3	44.6	58.7	14.1	100%	0	0 %	0	0 %	0	0 %	0	0 %
Total			**58.7**	**100%**	**0**	**0 %**	**0**	**0 %**	**0**	**0 %**	**0**	**0 %**

Table 22 - Class-wise availability of reduced depth of the waterway

6.3 Modifications/ Improvement Measures

Improvement measures for design and depth improvement are required on the first phase of the development. River banks being very prominently structured and no signs of erosion of the river banks are found in the entire stretch of Nag River. The limitation for improvement of navigational aspects includes the gradient of the river, non-availability of the water throughout the period and the presence of various check dams. The class-wise modification details of cross structure and high tension line clearance are as tabulated below:-

Bridges Clearances less than Class			High Tension lines Clearances less than Class	
Class	**Horizontal**	**Vertical**	**Horizontal**	**Vertical**
I	17	18	0	0
II	18	18		
III	18	18		
IV	18	18		

Table 23 - Bridges and HTL Clearances less than Class no.

6.4 Recommendations

There is no major scope for navigational aspect of the waterway due to its geographic condition and non-availability of water throughout the region. The River banks are connected with the road network and to major distribution of settlements. No cargo movement or passenger movement is envisaged through this river and the survey Stretch is not-viable for navigable channel.

The purpose of the survey was for assessing the River stretch from the Sawangi Village to NIT colony, Nagpur for the development of water transport facilities in the new National Waterway (NW-72). All conspicuous objects within and in the vicinity of the survey area have been fixed. The deliverable sheets contain mean sea level values of elevation information, important landmarks with the state of the River banks. The survey is considered complete in all respects.

7 Details of Annexures

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