Final Feasibility Report
National Waterways-21,
Region VI - Bheema River
Gundloor to Hippargi (138.9km)

SURVEY PERIOD: 07 JAN 2016 - 18 FEB 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-21 in Region VI – Bheema River from Gundloor to Hippargi.

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
GPS	Global Positioning Systems
BHM	Bheema
LBM	Local Bench Mark
MSL	Mean Sea Level
RL	Reference Level
SD	Sounding Datum
SBAS	Satellite-Based Augmentation System
TBC	Trimble Business Center
LIS	Lift Irrigation Scheme
CWC	Central Water Commission
KJBNL	Krishna Jal Bhagya Nigam Limited
ASI	Archaeological Survey of India
KPTCL	Karnataka Power Transmission Corporation Limited
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 – VI & Telangana & Karnataka</td></tr>
<tr><td>3.</td><td>Waterway stretch, NW #
(from…. to; total length)</td><td>National Waterway No – 21
Gundloor to Hippargi village (138.9km)</td></tr>
<tr><td>4.</td><td>Navigability status</td><td>At present non-navigable</td></tr>
<tr><td>a)</td><td>Tidal & non tidal portions
(from… to, length, average tidal variation)</td><td>The survey Stretch of Bheema River is non-tidal.</td></tr>
<tr><td>b)</td><td>Least Spot height status (w.r.t. MSL)
i) Survey period (07th Jan to 18th Feb 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>Bheema River is dry and the survey was conducted by topographic method.
<table>
<tr><th>LAD (m)</th><th>0-19 km</th><th>19-49 km</th><th>49-79 km</th><th>79-109 km</th><th>109-138.9 km</th><th>Total</th></tr>
<tr><td>< 1.2</td><td>19</td><td>30</td><td>30</td><td>30</td><td>29.9</td><td>138.9</td></tr>
<tr><td>1.2 - 1.4</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>1.5 - 1.7</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>1.8 - 2.0</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>> 2</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>19</td><td>30</td><td>30</td><td>30</td><td>29.9</td><td>138.9</td></tr>
</table></td></tr>
<tr><td>c)</td><td>Cross structures
i) Dams, weirs, barrages etc.
(total number; with navigation Barrages or not)
ii) Bridges, Power cables etc.
[total number; range of horizontal and vertical clearances]</td><td>Cross Structures:
i) Barrages – 6 Nos
ii) Bridges – 3 Nos.
Horizontal Clearance – 8.243 to 21.346m
Vertical Clearance – 1.157m to 2.325 w.r.t. HFL
iii) Power cables – Nil
iv) High Tension Lines – 6 Nos
Vertical Clearance – 16.36 to 28.44m w.r.t HFL</td></tr>
<tr><td>d)</td><td>Avg. discharge & no. of days</td><td>As the river is dried so Avg. Discharge cannot be calculated.</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>19.00</td><td>1 : 0.548</td></tr>
<tr><td>19.00</td><td>49.00</td><td>1 : 0.501</td></tr>
<tr><td>49.00</td><td>79.00</td><td>1 : 0.242</td></tr>
<tr><td>79.00</td><td>109.00</td><td>1 : 0.269</td></tr>
<tr><td>109.00</td><td>138.90</td><td>1 : 0.258</td></tr>
</table>
Average Slope of Bheema River 1:0.349</td></tr>
</table>

#	Particulars	Details
5.	Traffic potential	No Navigational traffic is present in the survey stretch of Bheema River.
a)	Present IWT operations, ferry services, tourism, cargo, if any	There are no IWT operations present in the River Stretch.
b)	Important industries within 50 km	ACC Cement Factory Area at Wadi is 6.10km away from Bheema River An Industry area at Jevargi is 7.72km away from Bheema River towards North JP Cement Company at Shahabad is 12.52km away from Bheema River Rice Mills at Yadgir is 4.87km away from Bheema River
c)	Distance of Rail & Road from Industry	ACC Cement Factory Area at Wadi is 1.96km away from Wadi Railway station An Industry area at Jevargi is 0.1km away from NH50 JP Cement Company is 1.59km away from Shahabad Railway Station Rice Mills at Yadgir is 0.05km away from NH150 and SH16
6.	Consultant's recommendation for going ahead with TEF / DPR preparation.	As the river stretch is dried, No scope of TEF/DPR can be provided for the Bheema River. The River stretch is not-viable for navigation.
7.	Any other information/ comment	As per the local people this year only the River found dry.

(Signature)

Date: Name of Consultant

1 Introduction

1.1 Background

The Bheema is an important River in the southwest India which is also known as Punya Damini. Bheema is considered by the people of south India in the same way as they do Ganga.

The history states that Lord Shankar came near the mountains of Bheema Shankar after he killed the demon named Tripursur. In that place, he found the king Bheemak under penance. Bheemak begged Lord Shankar for his blessings so that a sacred river would be formed from his sweat. The Lord obliged, and this is how the River Bheema is believed to have been formed. It was named after the devout king Bheemak. On the bank of this river is situated a holy place named Pandarpur and a Jyotirling named Bheema Shankar, which symbolizes Lord Shiva.

The origin of Bheema River is in Pune District in the state of Maharashtra. The Bheema River rises at 19°04′03″N 073°33′00″E near the Bhimshankar Temple in Bhimshankar Heights, which is in the Taluka called Ambegaon, west of the Western Ghats which is called Sahyadri. It flows through the Bhimshankar Wildlife Sanctuary and enters the Khed Taluka. The Chas Kaman Reservoir and dam are situated here. It leaves Khed Taluka and forms the boundary between Havali Taluka and Shirur Taluka.

This 861km long river has the Western Ghats on the west, the Balaghat Range in the north, and the Mahadeo Hills in the south. It meanders through an innumerable number of Talukas and is joined by a large number of tributaries before it merges into the Krishna River along the border between Karnataka and Telangana, 24km north of Raichur. The total length of the Bheema River is 861km. After the first sixty-five kilometers in a narrow valley through rugged terrain, the banks open up and form a fertile agricultural area which is densely populated. The river is also referred to as Chandrabhaga River, especially at Pandarpur, as it resembles the shape of the Moon.

The river has a catchment area of 70,614 sq. km. River Bheema is actually longer than the River Krishna in length.

1.2 Tributaries of Bheema River

River Bheema has a large number of tributaries which join it at different points along its journey through different talukas. Kumandala, Bhama, Indrayani, Mula-Mutha, Dhomal Vel, Kamania, Ghod, Chandani, Kamini, Moshi, Bori, Sina, Man, Bhogwati and Nira are some of its major tributaries.

Figure 1 - Tributaries of total Bheema River

The Indrayani rises near Lonavla and is joined by the Bheema River, after which it travels for 14 km and enter the Bheema at Tulapur.

The Mula-Mutha is formed by the confluence of the Mula River and the Mutha River at Pune and is joined by the Kamania on the right, after which they enter the Bheema.

The Ghod rises on the eastern slopes of the western ghats and flows through Maharashtra. It flows for about 200km before joining the Bheema. The Kukadi River is an important tributary of the Ghod which is the last western tributary of the Bheema.

The Nira flows from the Shirwal in Khandala Taluka and meets the Bheema at Nira Narsingpur near Akluj. Karha is an important tributary of the River.

The Sina is an important tributary of the river which rises near Ahmednagar, flows through Maharashtra and Karnataka joins it in the Solapur District.

1.3 State/ District through which river passes

The Bheema River is a major River in South India and the survey stretch flows through Raichur, Yadgir and Gulbarga districts of Karnataka and Mahbubnagar district of Telangana State till the confluence with Krishna River.

State	Chainage (km)		Length (km)
	From	To	
Karnataka/Telangana	0.0	8.66	8.66
Karnataka	8.66	138.9	130.24

Table 1 - State wise waterway

1.4 Maps

1.4.1 Full course of the waterway

The map displaying the state boundary with road and rail network for the course of water way is represented as below:-

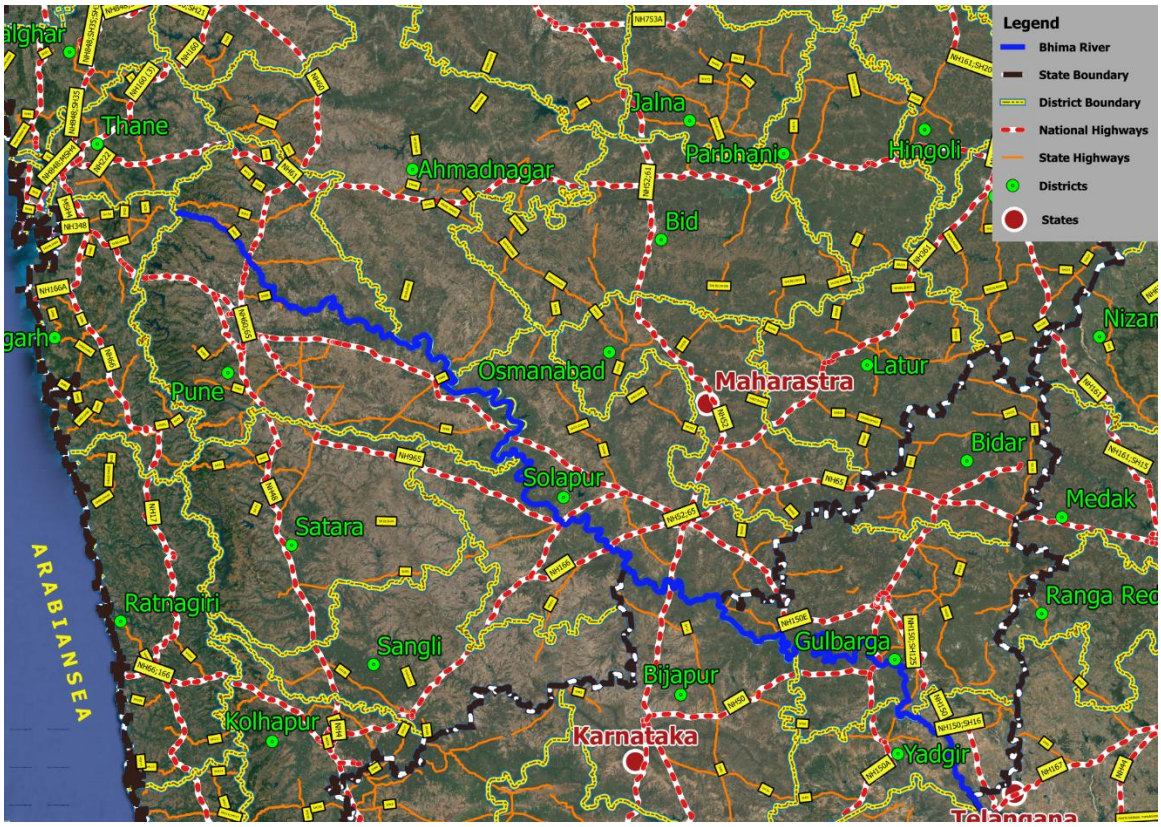


Figure 2 - Full Course of Bheema River

1.4.2 Course of the waterway under study

The survey stretch of Bheema River is about 138.90km. Out of which 8.66km portion of the river shared by Karnataka and Telangana states and the remaining 130.24km falls in Karnataka State.

The map displaying the state boundary with road and rail network for the course of water way is represented as below:-

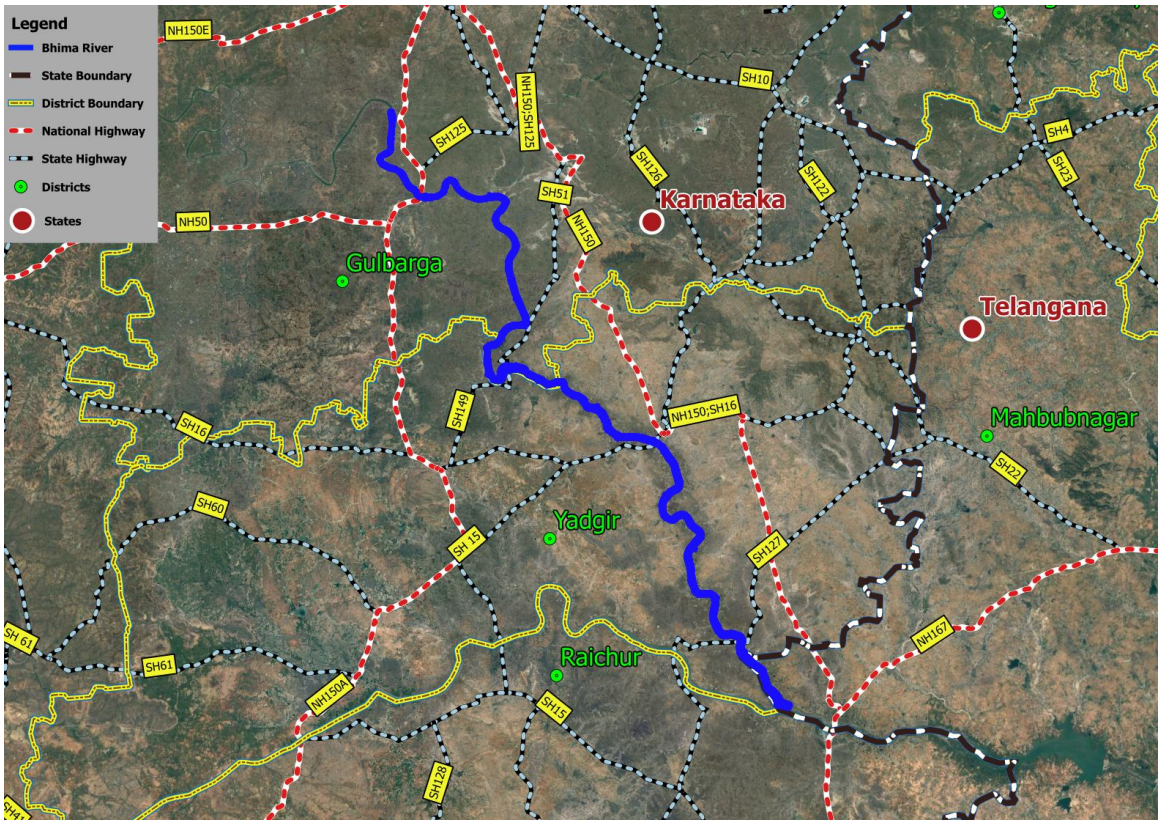


Figure 3 - Course of Bheema River

1.5 Scope of work

The major part of the work is to conduct detailed hydrographic and topographic survey of 138.9km length of the Bheema from confluence of Bheema and Krishna River at Gundloor at Lat 16°24'27.96"N, Long 77°17'12.60"E to Barrage (approx. 1 km from Hippargi village) at Lat 17°9'04.50"N, Long 76°46'34.14"E.

The scope of the work for the conduct of survey of Bheema 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 in early 12th Dec 2015 by a detach survey party. The detach survey party recovered the CWC Benchmark at Yadgir (MBM 01). The recce was started from a Saradgi village, Gulbarga Dist. in Karnataka till the Sangam of Bheema and Krishna River at a village near Yadlapur Railway Bridge. Stretch was examined at four places (Nadi Sinoor, Bheema Bridge near Jevargi and Bheema Bridge near Yadgir and Dam near Yadgir) which contain rocks and thick vegetation. Mobilization commenced in earnest on 07th Jan 2016 and was completed on 08th Jan 2016.

The following observation has been made.

- The survey area is 138.9km, from the Gundloor to Hippargi.
- River width varied between 300 mtr to 500 mtr.
- The work of topography is also very much time consuming and not feasible due to rocks and thick vegetation growth and cliffs on both the banks.

It was observed that most of the river stretch was dry and preliminary queries revealed that the river remains dry for most of the year. Hence a decision was taken to undertake topographic survey initially for the complete river stretch, the hydrographic survey would be undertaken depending on the field conditions and availability of water in limited pockets of the river stretch under consideration.

2.2 Survey Resources and Methodology

The actual survey was commenced on 07th Jan and completed on 18th Feb 2016. The survey was undertaken on a scale of 1:5000, with survey line spacing kept at 150m and plotted on UTM Projection at Zone 43N as directed in the contract.

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
DGPS Sets	Trimble R3/R4		6
Auto Level	Sokkia Auto level & Accessories	-	2
ETS	Electronic Total Station	120595 & 120768	2
Software	TBC	Version 12	1
Software	AUTOCAD	2012	1
Software	Microsoft Office	2013	1

Table 2 - Survey Equipment Used

2.2.3Topographic Survey

The survey was commenced on 07th Jan 2016 and completed on 18th Feb 2016. The weather was sunny 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 150m interval. The plotting of the chart was done on UTM Projection at Zone 43N as directed in the contract specifications. The spot levels along the river were obtained using Trimble DGPS. The data was post processed using Trimble Business Center to get the precise position and MSL height values of the rover locations. The topographic survey for the entire survey stretch was conducted to collect the following data:-

- Spot levels
- Delineation of Islands, sand patches
- 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 4 - Spot leveling by DGPS

2.2.4 Bathymetric Survey and Survey Launch

The bathymetric survey by survey launch was not conducted due to non-availability of sufficient water depth throughout the river.

2.2.5 Calibration

The equipment used for the survey was calibrated by the equipment supplier. The equipment calibration certificates are placed at Annexure-14 to this report.

2.3 Description of Bench Marks (B.M.) Reference Level

During the survey of entire stretch of Bheema River we have observed one CWC gauge present at Yadgir. The established CWC gauge of Yadgir MBM (364.698m) is available for the entire survey stretch of the Bheema River provided by KJBNL office, Yadgir, Karnataka.

Figure 5 - CWC Benchmark Yadgir (ch 49.78km)

The reference level value is used as the initial reference for vertical control and the Reference Level value of the same was transferred to station BHM-10 and BHM-09 through Auto Level (optical leveling method). The leveling data for establishing the reference level for the newly constructed benchmark pillars are placed at Annexure–10 to this report. The final accepted WGS 84 coordinates and details of station & IWAI Benchmark established during the conduct of survey are as follows:

Sl. No.	Station	Chainage (km)	Latitude	Longitude	Ht. above MSL (m)	Source/ Type
1	IWAI BM BHM01	139.22	N17°09′15.33376″	E76°46′42.78772″	387.282	Online Processed
2	IWAI BM BHM02	127.64	N17°04′28.76576″	E76°47′31.69894″	386.29	BL Processed
3	IWAI BM BHM03	117.75	N17°03′50.34069″	E76°51′18.45020″	384.109	BL Processed
4	IWAI BM BHM04	108.16	N17°02′02.99200″	E76°55′23.16038″	380.072	BL Processed
5	IWAI BM BHM05	97.47	N16°57′13.90976″	E76°55′43.51335″	378.455	BL Processed
6	IWAI BM BHM06	87.18	N16°52′59.77375″	E76°55′53.05833″	374.527	BL Processed
7	IWAI BM BHM07	77.14	N16°48′54.85950″	E76°55′17.91792″	374.068	BL Processed
8	IWAI BM BHM08	67.78	N16°48′40.16185″	E76°59′33.97986″	366.059	BL Processed
9	IWAI BM BHM09	57.18	N16°45′13.70189″	E77°03′30.57168″	364.576	BL Processed
10	IWAI BM BHM10	47.63	N16°43′14.82980″	E77°08′10.50398″	359.074	BL Processed
11	IWAI BM BHM11	37.71	N16°38′41.26768″	E77°07′58.87729″	355.808	BL Processed
12	IWAI BM BHM12	28.02	N16°36′03.76559″	E77°09′49.20080″	353.819	BL Processed
13	IWAI BM BHM13	18.49	N16°32′01.98304″	E77°12′07.88337″	348.868	BL Processed
14	IWAI BM BHM14	10.66	N16°29′15.04171″	E77°13′53.96477″	345.423	BL Processed
15	IWAI BM BHM15	0.32	N16°24′42.36005″	E77°16′52.94558″	343.569	BL Processed
16	CWC MBM 01	49.78	N16°44′24.4″	E77°07′35.6″	364.698	BL Processed

Table 3 - Accepted Station coordinates (WGS-84)

The details of horizontal and vertical control established and methodology followed for the conduct of survey is placed at Annexure-8

2.4 Tidal Influence Zone and tidal variation

The survey stretch of Bheema 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 Bheema River is of 138.9km stretch which is between Gundloor to Hippargi. There are many other various dams and barrages present in the survey stretch of the Bheema River. The water depth on an average of 0.1 to 0.2 mtr is available near the barrages. The water level is recoded as dry (dead level) in the records held by the dam authorities.

2.5.1 Sounding Datum

The established CWC Chart Datum values are available for the survey stretch of Bheema River. The Bheema River being dry, the entire stretch river is divided for per-km stretches of the river and the least MSL value obtained during the conduct of topographic survey for the stretch is considered as Chart Datum for the 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 for the river. The datum for calculation of dredge volume was accepted as the least spot height in the stretch for the entire river. The newly established sounding datum is established by assuming the least value of the spot height for every 01km of the river stretch.

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	329.81	329.81		68-69	357.12	357.12
1-2	330.198	330.198		69-70	357.325	357.325
2-3	330.257	330.257		70-71	357.375	357.375
3-4	331.131	331.131		71-72	357.554	357.554
4-5	332.358	332.358		72-73	358.164	358.164
5-6	333.675	333.675		73-74	358.296	358.296
6-7	334.214	334.214		74-75	358.378	358.378
7-8	334.079	334.079		75-75.3	358.548	358.548

Km Stretch	Least Level w.r.t MSL (m)	Established CD (m)		Km Stretch	Least Level w.r.t MSL (m)	Established CD (m)
8-9	334.244	334.244		75.3-76	358.626	358.626
9-10	334.685	334.685		76-77	358.666	358.666
10-10.7	334.685	334.685		77-78	359.044	359.044
10.7-11	336.754	336.754		78-79	359.547	359.547
11-12	336.835	336.835		79-80	360.103	360.103
12-13	337.254	337.254		80-81	360.052	360.052
13-14	337.254	337.254		81-82	360.358	360.358
14-15	337.625	337.625		82-83	360.548	360.548
15-16	337.468	337.468		83-84	360.848	360.848
16-17	338.009	338.009		84-85	361.011	361.011
17-18	338.13	338.13		85-86	361.54	361.54
18-19	338.397	338.397		86-87	361.63	361.63
19-20	339.294	339.294		87-88	361.654	361.654
20-21	339.294	339.294		88-89	361.718	361.718
21-22	340.154	340.154		89-90	361.976	361.976
22-23	340.16	340.16		90-91	362.081	362.081
23-24	340.183	340.183		91-92	362.275	362.275
24-25	340.768	340.768		92-93	362.38	362.38
25-25.2	341.113	341.113		93-94	362.475	362.475
25.2-26	341.113	341.113		94-95	362.545	362.545
26-27	342.245	342.245		95-96	362.748	362.748
27-28	342.245	342.245		96-97	362.925	362.925
28-29	342.416	342.416		97-98	363.016	363.016
29-30	342.561	342.561		98-99	363.45	363.45
30-31	342.561	342.561		99-100	363.45	363.45
31-32	342.667	342.667		100-101	363.5	363.5
32-33	342.863	342.863		101-102	364.24	364.24
33-34	342.984	342.984		102-103	365.84	365.84
34-35	342.997	342.997		103-104	366.256	366.256
35-36	343.05	343.05		104-105	366.533	366.533
36-37	343.185	343.185		105-106	367.235	367.235
37-38	343.308	343.308		106-107	367.296	367.296
38-39	343.308	343.308		107-108	367.315	367.315
39-40	343.308	343.308		108-109	367.325	367.325
40-41	346.125	346.125		109-110	367.33	367.33
41-42	345.453	345.453		110-111	367.683	367.683
42-42.8	346.857	346.857		111-112	367.965	367.965
42.8-43	348.245	348.245		112-113	368.09	368.09
43-44	348.245	348.245		113-114	368.12	368.12
44-45	348.551	348.551		114-115	368.12	368.12
45-46	349.106	349.106		115-116	368.418	368.418
46-47	349.2	349.2		116-117	369.184	369.184
47-48	350.2	350.2		117-118	369.567	369.567
48-49	350.148	350.148		118-119	369.567	369.567
49-50	350.148	350.148		119-120	370.45	370.45
50-51	350.711	350.711		120-121	370.95	370.95
51-51.8	350.845	350.845		121-122	371.67	371.67
51.8-52	351.245	351.245		122-123	371.983	371.983
52-53	351.954	351.954		123-124	372.33	372.33
53-54	352.845	352.845		124-125	372.44	372.44

Km Stretch	Least Level w.r.t MSL (m)	Established CD (m)		Km Stretch	Least Level w.r.t MSL (m)	Established CD (m)
54-55	353.015	353.015		125-126	372.52	372.52
55-56	353.685	353.685		126-127	372.55	372.55
56-57	354.258	354.258		127-128	372.818	372.818
57-58	354.284	354.284		128-129	372.99	372.99
58-59	354.453	354.453		129-130	373.005	373.005
59-60	355.845	355.845		130-131	373.223	373.223
60-61	355.996	355.996		131-132	373.245	373.245
61-62	356	356		132-133	373.312	373.312
62-63	356.104	356.104		133-134	373.42	373.42
63-64	356.2	356.2		134-135	373.604	373.604
64-65	356.273	356.273		135-136	373.71	373.71
65-66	356.546	356.546		136-137	373.811	373.811
66-67	357	357		137-138	373.902	373.902
67-68	357.02	357.02		138-138.9	374.388	374.388

Table 4 - Established CD for Stretch-wise

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

Bheema River is non tidal river body having the primary source of water receiving from dams and ends up in drying summer. There is CWC Yadgir water level data of Bheema River for the average of last 6 years.

YADGIR CWC GAUGE 2008-15

Min/Max	2008	2009	2010	2011	2012	2013	2014	2015
Jan Min.	351.373	351.403	351.303	351.263	351.903	351.433	352.013	351.113
Jan Max.	352.263	352.253	351.653	352.303	352.603	352.103	352.423	352.153
Feb Min.	351.183	351.953	351.953	351.253	352.063	351.113	351.133	351.253
Feb Max.	352.293	352.243	352.203	352.193	352.143	352.143	352.213	352.223
Mar Min.	352.193	351.993	351.453	351.583	351.333	350.303	351.223	352.033
Mar Max.	353.423	352.203	352.343	352.203	352.093	351.743	352.083	352.233
Apr Min.	352.203	351.353	351.603	351.393	351.333	350.303	351.503	351.993
Apr Max.	352.473	351.923	352.223	352.023	351.333	350.583	352.073	352.223
May Min.	351.353	351.033	351.283	350.823	350.533	350.233	350.673	351.013
May Max.	352.203	351.373	351.603	351.823	350.628	350.433	351.443	351.983
Jun Min.	350.663	350.783	351.243	350.803	350.353	350.183	350.643	
Jun Max.	351.143	350.993	351.683	350.843	350.803	350.813	350.813	
Jul Min.	350.713	350.663	351.413	350.843	350.733	350.283	350.513	
Jul Max.	351.303	350.853	353.063	352.233	351.153	351.333	351.123	
Aug Min.	351.243	350.943	351.753	351.263	350.953	351.153	350.483	
Aug Max.	353.773	354.483	356.403	354.233	351.873	353.603	354.903	
Sep Min.	352.173	352.113	353.073	351.733	351.183	351.503	351.533	
Sep Max.	356.563	354.403	355.203	357.253	352.803	357.483	355.293	
Oct Min.	351.393	351.463	352.353	351.403	351.123	351.413	350.833	
Oct Max.	353.343	359.733	354.653	351.773	352.713	353.013	352.483	
Nov Min.	351.163	351.393	351.833	351.403	351.103	351.223	352.233	
Nov Max.	352.283	354.303	352.623	351.503	351.373	352.583	352.613	
Dec Min.	352.053	351.373	351.303	351.053	351.163	351.233	352.003	
Dec Max.	352.293	352.063	352.253	352.613	352.123	352.413	352.243	

YADGIR CWC GAUGE 2008-15

Min/Max	2008	2009	2010	2011	2012	2013	2014	2015
Yearly Min.	**350.663**	**350.663**	**351.243**	**350.803**	**350.353**	**350.183**	**350.483**	**351.013**
Yearly Max.	**356.563**	**359.733**	**356.403**	**357.253**	**352.803**	**357.483**	**355.293**	**352.233**
6yr. Min.		**350.183**						
6yr. Max.		**359.733**						
6yr. Ave. Min.		**350.677**						
6yr. Ave. Max.		**356.504**						

Table 5 - Yadgir CWC gauge details from 2008-15

2.7 Transfer of Sounding Datum

The Bheema River is non tidal river and lowest MSL level of the stretch is considered as the datum value for computing sounding datum at different stretches since the river is dry.

2.8 Table indicating tidal variation at different observation points

The survey stretch of Bheema River is non tidal river and the river dries fully during the summer season.

2.9 Salient Features of Dam, Barrages, Barrage

The details of Dams, Barrages were collected during the conduct of survey and the details are as follows

2.9.1 Salient Features of Saradgi Barrage

Salient Features of Saradgi Barrage		
1	River / Basin	Bheema / Krishna
2	Latitude	17°9'4.67"N
3	Longitude	76°46'34.90"E
4	District	Gulbarga
5	Location	On Bheema River, near Hippargi village about 1.15 km downstream
6	No. of Deck	112
7	Length	270.32 m

Table 6 - Salient Features of Saradgi Barrage

2.9.2 Salient Features of Sonthi Barrage

Salient Features of Sonthi Barrage (LIS)		
1	River / Basin	Bheema / Krishna
2	Latitude	16°49'51.88"N
3	Longitude	76°55'44.53"E
4	District	Gulbarga
5	Location	Sonthi Village of Shahapur Taluk across River Bheema
6	No. of Deck	73
7	Length of Barrage	665 Mtrs.
8	Total Ayacut (Acres)	16,000 Ha.
9	Water utilization (TMC)	4.00 TMC
10	Districts benefited	Chittapur Taluk of Gulbarga Dist. & Yadgir Taluk of Yadgir District

Table 7 - Sonthi Barrage Details

2.9.3 Salient Features of Yadgir Barrage

Salient Features of Yadgir Barrage		
1	River / Basin	Bheema / Krishna
2	Latitude	16°44'30.14"N
3	Longitude	77°6'23.79"E
4	District	Yadgir
5	Location	Near Yadgir Town across River Bheema
6	No. of Deck	47
7	Length of Barrage	425 mtr.
8	Total Ayacut (Acres)	1,935 Ha
9	Water utilization (TMC)	1.01 TMC
10	Districts benefited	Shahapur & Yadgir Taluks of Yadgir District

Table 8 - Yadgir Barrage Details

2.9.4 Salient Features of Koulur Barrage

Salient Features of Koulur Barrage		
1	River / Basin	Bheema / Krishna
2	Latitude	16°40'54.37"N
3	Longitude	77°9'6.26"E
4	District	Koulur
5	Location	Nearby Koulur town about 1.49 km
6	No. of Deck	91
7	Length of Barrage	417.77 mtrs

Table 9 - Koulur Barrage Details

2.9.5 Salient Features of Anur Barrage

Salient Features of Anur Barrage		
1	River / Basin	Bheema / Krishna
2	Latitude	16°34'32.12"N
3	Longitude	77°10'4.64"E
4	District	Anur
5	Location	Near Anur Town across River Bheema
6	No. of Deck	48
7	Length of Barrage	356.41 mtr.

Table 10 - Anur Barrage Details

2.9.6 Salient Features of Joldhadgi Gudur Barrage

Salient Features of Joldhadgi Gudur Barrage		
1	River / Basin	Bheema / Krishna
2	Latitude	16°29'15.36"N
3	Longitude	77°14'3.65"E
4	District	Joldhadgi, Gudur
5	Location	11 Km Upstream of the confluence of River Bheema and Krishna.
6	No. of Deck	175
7	Length of Barrage	550 mtrs
8	Total Ayacut (Acres)	1,960 Ha. (Own lifting by farmers)
9	Water utilization (TMC)	1.29 TMC
10	Districts benefited	Shahapur & Yadgir Taluks of Yadgir District

Table 11 - Joldhadgi Gudur Barrage Details

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 value of these benchmarks w.r.t. MSL was obtained by auto leveling from the CWC Yadgir MBM (364.698m MSL) provided by Assistant Engineer KJBNL, Yadgir and refer the CD is 350.621m.

The final accepted co-ordinates and reduced level (R.L) values of these bench marks and other station established for setting up of reference DGPS base stations are as below:

S. No	Station	Chainage (km)	Location	Latitude (N) / Longitude (E)	Easting (E) / Northing (N)	Height above MSL (m)	BM Height w.r.t. CD (m)
-	**CWC MBM 01**	**49.78**	**Yadgir**	16°44'24.400"N 77°07'35.600"E	726710.831 1852017.408	**364.698**	**14.077**
1	IWAI BM BHM01	139.22	Hippargi	17°09'15.333"N 76°46'42.787"E	689184.534 1897486.329	387.282	14.219
2	IWAI BM BHM02	127.64	Firozabad	17°04'28.765"N 76°47'31.698"E	690711.226 1888689.938	386.29	16.723
3	IWAI BM BHM03	117.75	Madri	17°03'50.340"N 76°51'18.450"E	697427.131 1887571.325	384.109	16.144
4	IWAI BM BHM04	108.16	Yangunti	17°02'02.992"N 76°55'23.160"E	704695.918 1884341.083	380.072	16.622
5	IWAI BM BHM05	97.47	Malla B	16°57'13.909"N 76°55'43.513"E	705385.357 1875459.536	378.455	16.737
6	IWAI BM BHM06	87.18	Hanchinal Bhari	16°52'59.773"N 76°55'53.058"E	705744.456 1867649.275	374.527	15.861
7	IWAI BM BHM07	77.14	Sewall	16°48'54.859"N 76°55'17.917"E	704777.514 1860109.676	374.068	16.743
8	IWAI BM BHM08	67.78	Tangadgi	16°48'40.161"N 76°59'33.979"E	712364.28 1859732.754	366.059	10.063
9	IWAI BM BHM09	57.18	Nalwadgi	16°45'13.701"N 77°03'30.571"E	719436.245 1853456.777	364.576	10.123
10	IWAI BM BHM10	47.63	Birnal	16°43'14.829"N 77°08'10.503"E	727767.809 1849889.441	359.074	9.349
11	IWAI BM BHM11	37.71	Halgera	16°38'41.267"N 77°07'58.877"E	727513.283 1841474.775	355.808	10.308
12	IWAI BM BHM12	28.02	Arjungi	16°36'03.765"N 77°09'49.200"E	730835.622 1836667.278	353.819	12.577
13	IWAI BM BHM13	18.49	Bhimenhalli	16°32'01.983"N 77°12'07.883"E	735028.747 1829277.98	348.868	11.608
14	IWAI BM BHM14	10.66	Joldhadgi	16°29'15.041"N 77°13'53.964"E	738231.789 1824179.609	345.423	11.692
15	IWAI BM BHM15	0.32	Gundloor	16°24'42.360"N 77°16'52.945"E	743636.058 1815854.558	343.569	14.137

Table 12 - Accepted Benchmark coordinates

2.11 Chart Datum / Sounding Datum and Reductions Details

Due to unavailability of water in Bheema River, the spot leveling by topographic method was attempted for the entire survey stretch of Bheema River. The least MSL level for the per-kilometer stretch was obtained as the established chart datum. The details of topo level converted as depth for volume calculation is forwarded as soft copy along with the report.

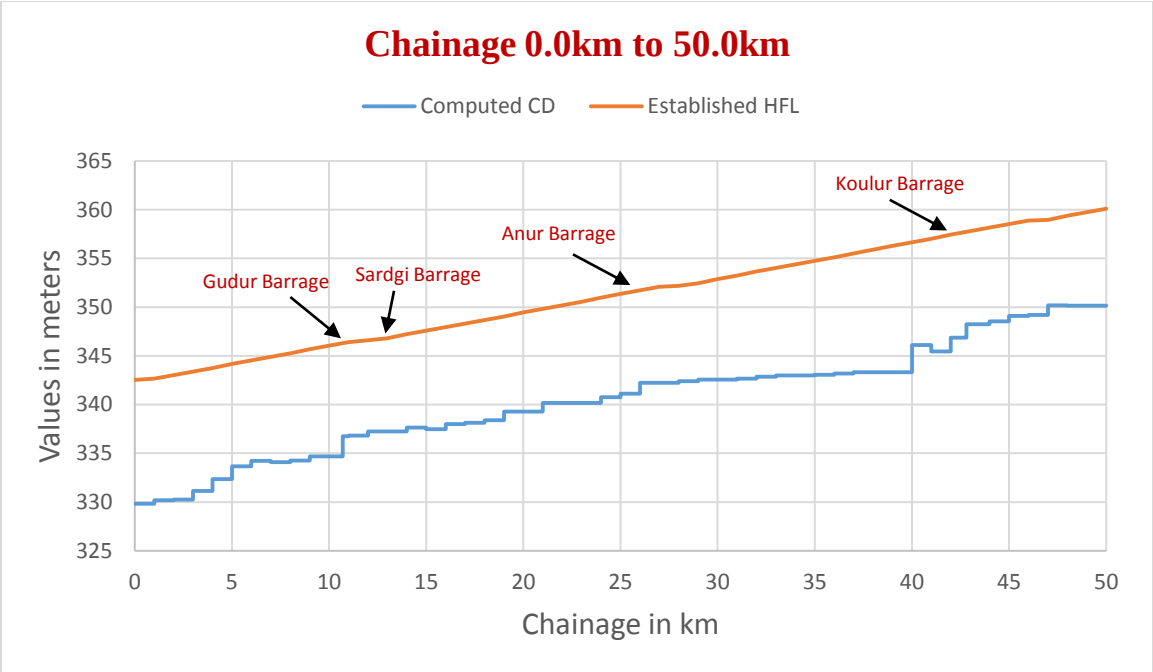
2.12 HFL values of Bridges/Cross Structures

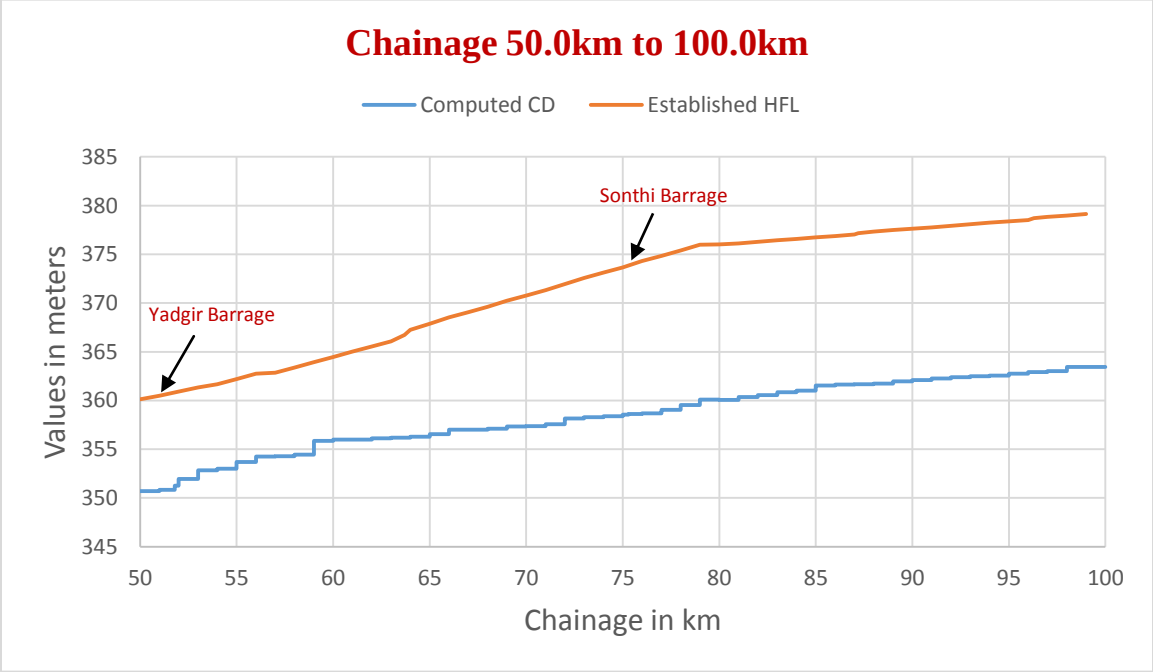
The established HFL value of 361.543m w.r.t MSL for the Yadgir Barrage was provided by Assistant Engineer, state PWD Irrigation department, Karnataka. The Estimated HFL Value of the Sonthi Barrage was also obtained from the Assistant Engineer, Gulbarga as 376.000m w.r.t MSL. The HFL value for the remaining survey stretch is computed for the Bheema River. The details of established and computed HFL values for the entire stretch is as follows:-

Sl#	Location and description of CWC gauge Barrages / Weirs / Anicut / Barrages / Aqueducts	Cross-structure details	Chainage (km)	Established HFL / FRL w.r.t. MSL (m)	Computed HFL at Cross-Structures w.r.t. MSL (m)
	A	B	C	D	E
1	Saradgi Barrage	LIS	138.52	-	385.400
2	Raddewadgi Bridge	Highway Bridge	123.42	-	383.157
3	Sonthi Barrage	LIS / small Hydel power	75.22	376.000	-
4	Sonthi Bridge	Highway Bridge	75.22	376.000	-
5	Yadgir Barrage	LIS	51.79	-	362.744
6	Yadgir Bridge	Highway Bridge	50.08	-	361.751
7	Yadgir CWC Gauge	-	49.78	361.543	-
8	Koulur Barrage	LIS	42.78	-	358.895
9	Anur Barrage	LIS	25.23	-	352.203
10	Gudur Barrage	LIS	10.76	-	346.606

Table 13 - HFL values of Bridges/Cross Structures

2.13 Graph: Sounding Datum and HFL vs Chainage





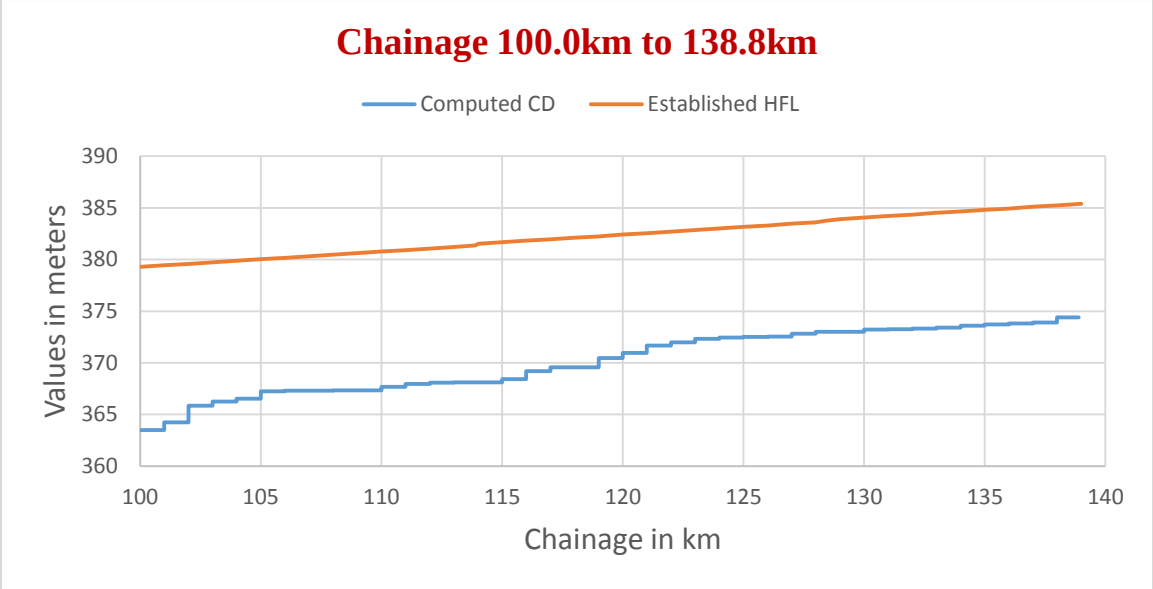


Figure 6 - Sounding Datum and HFL vs Chainage

2.14 Average Bed Slope

The average bed slope of Bheema 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 - RBL_329.997	Ch. 19 - RBL_340.377	10.38	19.00	1 : 0.548
Ch. 19 - RBL_340.377	Ch. 49 - RBL_355.4	15.023	30.00	1 : 0.501
Ch. 49 - RBL_355.4	Ch. 79 - RBL_362.649	7.249	30.00	1 : 0.242
Ch. 79 - RBL_362.649	Ch. 109 - RBL_370.716	8.067	30.00	1 : 0.269
Ch. 109 - RBL_370.716	Ch. 138.9 - RBL_378.401	7.685	29.90	1 : 0.258

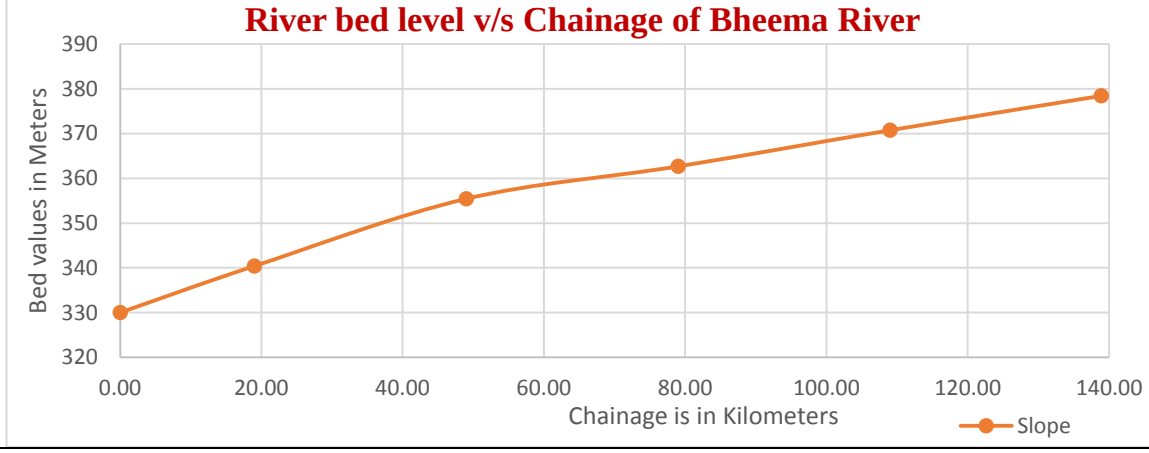


Table 14 - Average Bed Slope

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

Sl No	Structure Name	Chainage (km)	Location	Position (Lat Long) Left Bank /Right Bank	Position (UTM) Left Bank /Right Bank	Length (m)	Width (m)	Height w.r.t. MSL (m)	Present condition
1	Saradgi Barrage	138.85	Hippargi	**Left Bank:** 17° 09' 4.13"N 76°46'31.08"E **Right Bank:** 17° 09' 4.95"N 76°46'40.22"E	**Left Bank:** 688841.678 1897139.039 **Right Bank:** 689111.794 1897166.526	270.32	2.19	381.157	Operational
2	Sonthi Barrage	75.22	Sonthi	**Left Bank:** 16°49'41.82"N 76°55'46.21"E **Right Bank:** 16°50'3.41"N 76°55'43.30"E	**Left Bank:** 705601.206 1861561.557 **Right Bank:** 705508.579 1862224.716	665	2.16	381.246	Operational
3	Yadgir Barrage	51.79	Yadgir	**Left Bank:** 16°44'26.05"N 77°06'21.81"E **Right Bank:** 16°44'39.87"N 77°06'28.53"E	**Left Bank:** 724524.266 1852044.871 **Right Bank:** 724719.04 1852471.918	425	17.4	367.280	Operational
4	Koulur Barrage	42.78	Koulur	**Left Bank:** 16°40'57.42"N 77°09'1.61"E **Right Bank:** 16°40'49.79"N 77°09'13.29"E	**Left Bank:** 729327.621 1845680.904 **Right Bank:** 729676.284 1845450.043	356.41	7.38	352.376	Operational
5	Anur Barrage	25.23	Anur	**Left Bank:** 16°34'32.45"N 77°10'0.36"E **Right Bank:** 16°34'31.78"N 77°10'12.74"E	**Left Bank:** 731197.05 1833863.241 **Right Bank:** 731564.264 1833846.744	370	8.95	356.042	Operational
6	Gudur Barrage	10.76	Gudur	**Left Bank:** 16°29'16.77"N 77°13'55.04"E **Right Bank:** 16°29'13.50"N 77°14'13.44"E	**Left Bank:** 738263.121 1824233.125 **Right Bank:** 738810.218 1824138.676	550	9.09	346.029	Operational

Table 15 - Bheema River Barrages w.r.t. MSL

2.16 Details of Locks

No locks are present in the survey stretch of Bheema River.

2.17 Details of Aqueducts

No Aqueducts are present in the survey stretch of Bheema River.

2.18 Details of existing Bridges and Crossings over waterway

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	Horizontal clearance (clear distance Between piers) (m)	Vertical clearance w.r.t. HFL (m)	Remarks (complete / under - construction), in use or not, condition
					Left Bank Right Bank	Left Bank Right Bank						
1	Raddewadgi Bridge	123.42	RCC	Raddewadgi	**Left Bank:** 17°02'36.53"N 76°48'49.64"E **Right Bank:** 17°02'42.70"N 76°48'50.75"E	**Left Bank:** 693047 1885260 **Right Bank:** 693079 1885451	256.5	11.984	9	21.346	1.157	Completed and in use
2	Sonthi Bridge	75.22	RCC	Sonthi	**Left Bank:** 16°49'41.82"N 76°55'46.21"E **Right Bank:** 16°50'3.296"N 76°55'43.41"E	**Left Bank:** 705601.21 1861561.557 **Right Bank:** 705512 1862221	665	2.16	73	8.243	2.325	Completed and in use
3	Yadgir Bridge	50.08	RCC	Yadgir	**Left Bank:** 16°44'6.41"N 77°07'15.69"E **Right Bank:** 16°44'18.09"N 77°07'21.42"E	**Left Bank:** 726127.184 1851458.604 **Right Bank:** 726293.11 1851819.222	425	17.4	18	17.4	1.941	Completed and in use

Table 16 - Bridges crossing over waterway

2.19 Details of other Cross structures, pipe-lines, underwater cables

No other cross structures found in the survey stretch of Bheema River.

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

Total of 18 High Tension electrical lines were also present in the Bheema River and the height of the high tension line were also measured by ETS. There are no piers for electrical lines constructed in the river bed of Bheema River.

Sl. No.	Type of line	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	Vertical clearance w.r.t. HFL (m)	Remarks (complete / under - construction)
				Left Bank Right Bank	Left Bank Right Bank		
1	HTW	124.02	Raddewadgi	**Left Bank:** 17°02'52.38"N 76°48'34.80"E **Right Bank:** 17°02'54.82"N 76°48'38.60"E	**Left Bank:** 692604.494 1885744.083 **Right Bank:** 692716.174 1885820.135	19.607	Complete
2	HTW	123.28	Raddewadgi	**Left Bank:**	**Left Bank:**	20.247	Complete

Sl. No.	Type of line	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	Vertical clearance w.r.t. HFL (m)	Remarks (complete / under - construction)
				Left Bank Right Bank	Left Bank Right Bank		
				17°02'36.25"N 76°48'54.14"E	693181.03 1885253.518		
				Right Bank: 17°02'41.45"N 76°48'55.89"E	**Right Bank:** 693231.298 1885413.858		
3	HTW	123.16	Raddewadgi	**Left Bank:** 17°02'36.15"N 76°48'57.92"E	**Left Bank:** 693292.845 1885251.482	21.513	Complete
				Right Bank: 17°02'40.91"N 76°49'00.37"E	**Right Bank:** 693363.939 1885398.489		
4	HTPW	48.63	Birnal	**Left Bank:** 16°43'44.08"N 77°07'54.39"E	**Left Bank:** 727280.775 1850783.68	20.066	Complete
				Right Bank: 16°43'49.02"N 77°08'00.60"E	**Right Bank:** 727463.13 1850937.539		
5	HTPW	45.17	Bablad	**Left Bank:** 16°42'8.241"N 77°08'50.03"E	**Left Bank:** 728961.004 1847854.698	28.44	Complete
				Right Bank: 16°42'11.69"N 77°09'00.09"E	**Right Bank:** 729257.951 1847963.957		
6	HTPW	10.58	Gudur	**Left Bank:** 16°29'08.43"N 77°13'55.40"E	**Left Bank:** 738276.640 1823976.810	16.36	Complete
				Right Bank: 16°29'10.69"N 77°14'09.88"E	**Right Bank:** 738705.432 1824051.055		

Table 17 - High Tension Lines

2.21 Current Meter and Discharge details

No current meter observation is not done in Bheema River due to non-availability of water.

2.22 Water Samples

Water Samples were not collected in Bheema River due to non-availability of water.

3 Description of waterway

The Waterway of Bheema River within survey limits can be broadly divided in to five stretches in accordance with the gradient of the river. The details are as follows.

3.1 Sub-Stretch 01: Sangam to Shivenoor (Chainage 0.0km to 19.0km)

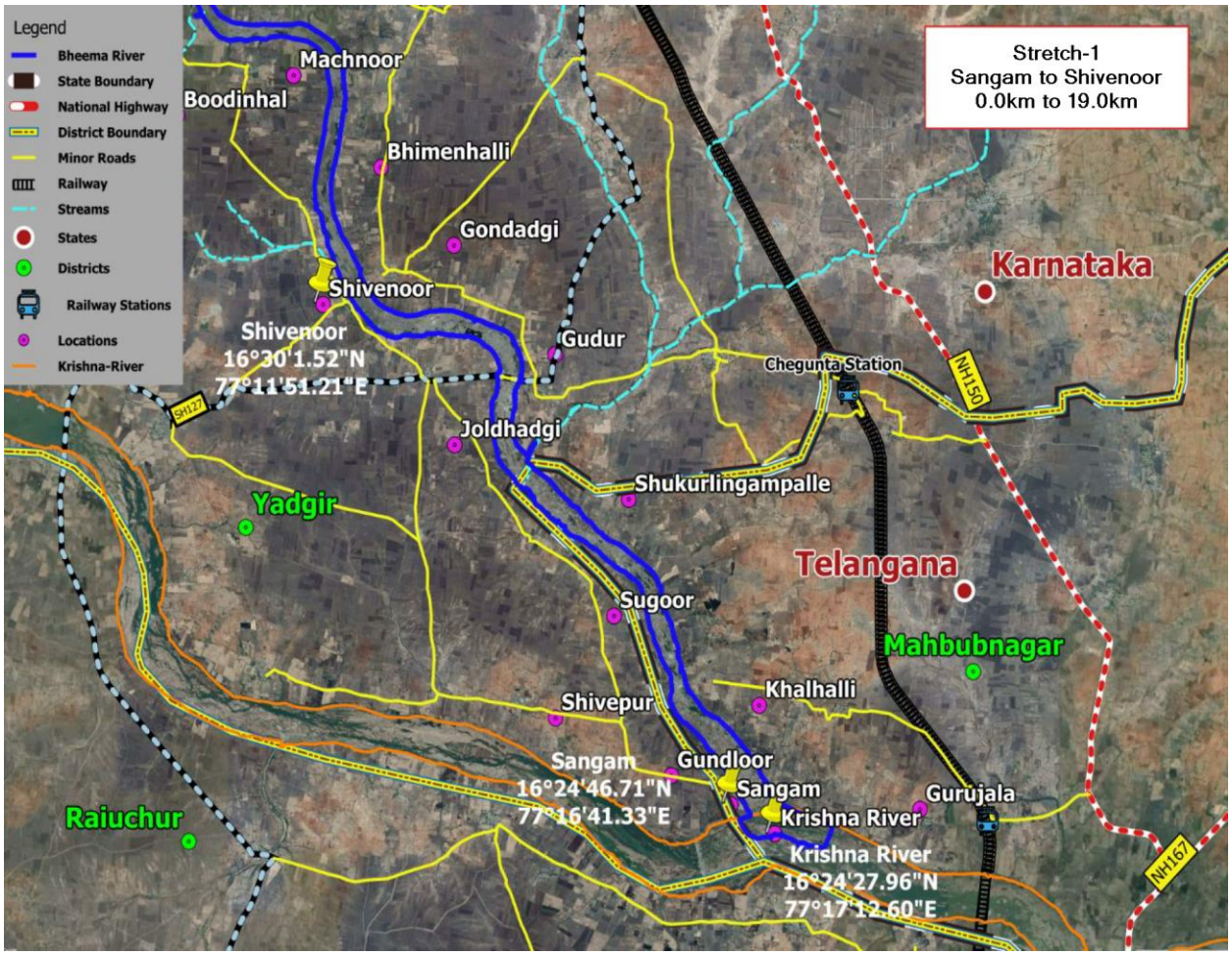


Figure 7 - Stretch-1 Sangam to Shivenoor

- **Bathymetry Survey**
  a) No bathymetric survey is conducted due to the unavailability of water
- **Topographic Survey**
  b) 19km of the length of the stretch for which the topographic survey has been carried out.

This stretch is from 0.0km to 19km chainage from Sangam to Shivenoor. There is Joldhadgi Gudur Barrage is present on this stretch. The river stretch of the Bheema

River has been accompanied with the Krishna Basin at Sangam. This stretch is covered with full of rocks and sandy with marsh. The state boundary is passing through the Joldhadgi, Sugoor, Gundloor and Sangam for the states as Karnataka of Yadgir District and Telangana of Mahbubnagar district.

The upstream of Joldhadgi Gudur Barrage is covered with rocks and land is totally dried with no water. The downstream of Joldhadgi Gudur Barrage is covered with submerged rocks and it is not navigable. This barrage is located at 11km upstream of the confluence of river Bheema and Krishna.

Figure 8 - Joldhahdgi Gudur Barrage (10.76 km chainage)

Sangam is the place where the Bheema merges into Krishna River. The Sangam of River Bheema and Krishna is near Yadlapur Railway Bridge. The water availability is again insufficient with wild vegetation and big rocks in the river. The width of the river is approximately 1000m. This stretch is covered with full of rocks and sandy with marsh. This stretch is inadequate to navigable. Bheema merges into the Krishna along with the border between Karnataka and Telangana about 24km north of Raichur.

State Highway number SH127 is crossing the river at Gudur. Railway line is passing parallel through the river.

Figure 9 - Confluence of Bheema with Krishna (0.0 km chainage)

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.
I	0	10.7	0.000	0.000	10700	457,987.89	457,987.89	-0.300	0.000	10700	588,860.56	588,860.56
I	10.7	19	0.000	0.000	8300	357,501.39	815,489.28	-0.300	0.000	8300	460,534.92	1,049,395.48
II	0	10.7	0.000	0.000	10700	696,824.37	696,824.37	-0.300	0.000	10700	865,000.89	865,000.89
II	10.7	19	0.000	0.000	8300	544,531.63	1,241,356.00	-0.300	0.000	8300	676,811.07	1,541,811.96
III	0	10.7	0.000	0.000	10700	1,051,924.28	1,051,924.28	-0.300	0.000	10700	1,260,202.56	1,260,202.56
III	10.7	19	0.000	0.000	8300	822,990.96	1,874,915.24	-0.300	0.000	8300	986,867.36	2,247,069.92
IV	0	10.7	0.000	0.000	10700	1,268,951.06	1,268,951.06	-0.300	0.000	10700	1,486,487.23	1,486,487.23
IV	10.7	19	0.000	0.000	8300	993,048.11	2,261,999.17	-0.300	0.000	8300	1,164,219.41	2,650,706.64

Table 18 - Dredging Quantity Details

3.1.1 Observed and reduced Bed Profile of the stretch

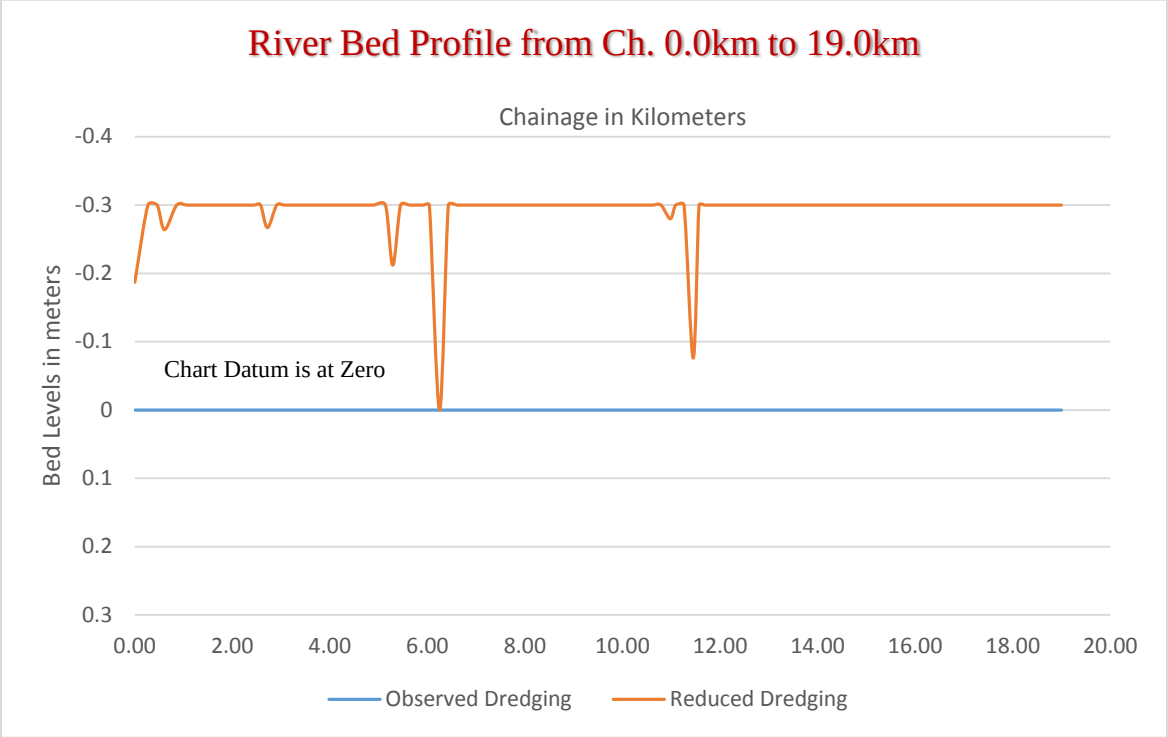


Figure 10 - River Bed Profile

3.2 Sub-Stretch 02: Shivenoor to Mustur (Chainage 19.0km to 49.0km)

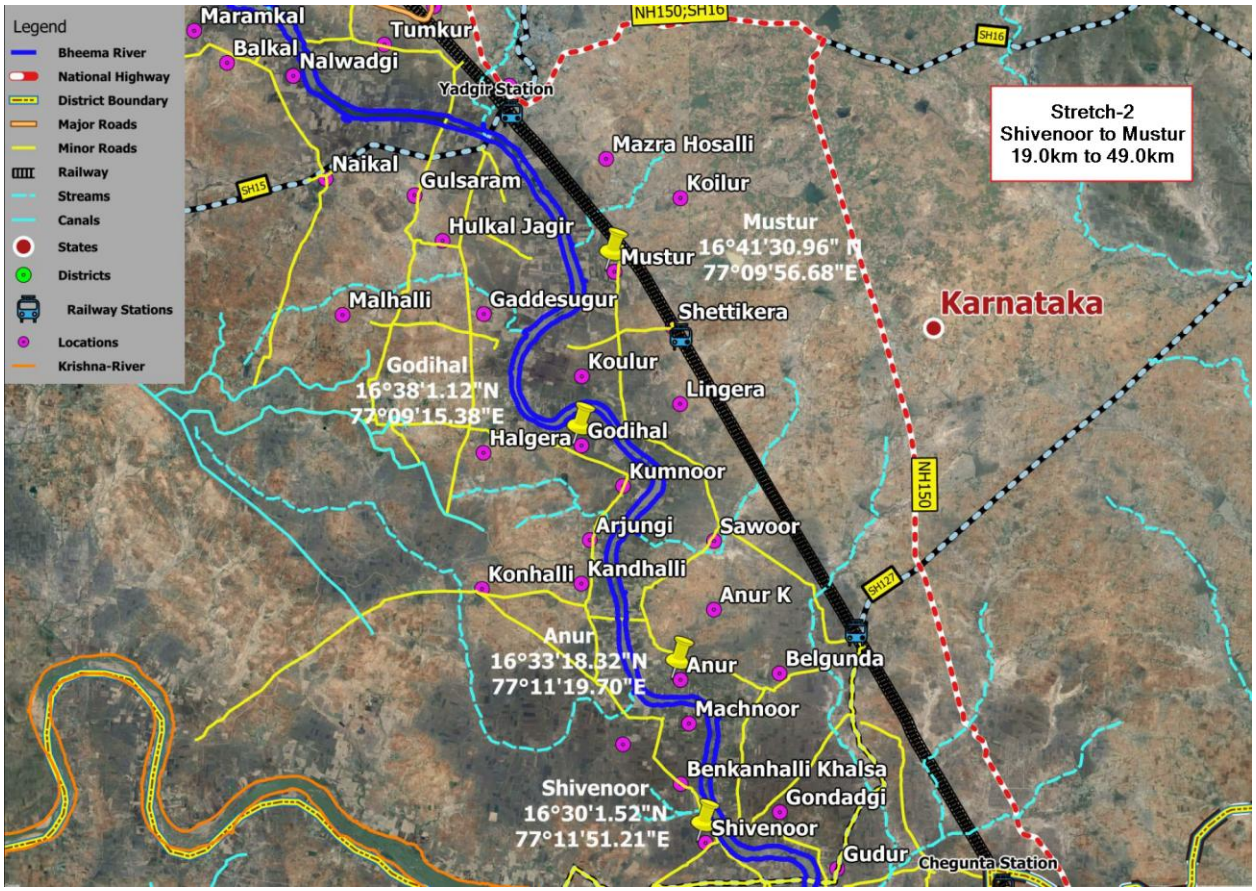


Figure 11 - Stretch-2 Shivenoor to Mustur

- **Bathymetry Survey**
  a) No bathymetric survey is conducted due to the unavailability of water
- **Topographic Survey**
  b) 30km of the length of the stretch for which the topographic survey has been carried out.

This stretch is between 19.0 to 49.0km chainage from Shivenoor to Mustur. There is Koulur Barrage and Anur Barrage is present on this stretch. Godihal village is located in Shorapur Tehsil of Yadgir district in Karnataka, India. It is situated 20km away from sub-district headquarter Shorapur and 60km away from district headquarter Yadgir. Devatkal is the gram panchayat of Godihal village.

Mustur village is located in Yadgir Tehsil of Yadgir district in Karnataka, India. It is situated 9km away from Yadgir, which is both district & sub-district headquarter of Mustur village.

Koulur is the gram panchayat of Mustur village. Koulur village is located in Yadgir Tehsil of Yadgir district in Karnataka, India. It is situated 15km away from Yadgir, which is both district & sub-district headquarter of Koulur village. Koulur village is itself a gram panchayat.

Arjungi village positioned in a rural part of Yadgir district of Karnataka, it is one among the 149 villages of Shahapur Barrage of Yadgir district. The illiteracy ratio of this village is high.

Anur is a place located in Afzalpur Mandal, Gulbarga district of Karnataka state in eastern part of India. The culture of Anur is simple, beautiful & secular.

Koulur is itself a village panchayat which is placed in tehsil of Yadgir of Gulbarga District. The culture of Koulur is simple, beautiful and secular. The upstream and downstream of Koulur Barrage is filled with Sand and slate rocks. The hydro survey could not be undertaken due to non-availability of sufficient depths.

Figure 12 - Koulur Barrage (42.78 km chainage)

The upstream and downstream of Anur Barrage is filled with rocks and no navigation is possible due to the non-availability of sufficient navigable water.

Figure 13 - Anur Barrage (25.23 km chainage)

Mustur, Godihal, Gaddesugur, Koulur are the nearby villages around Mustur to Godihal stretch. Kumnoor, Godihal, Malhar, Sawoor, Arjungi, Anur K, Anur, Anur

are the nearby villages from Godihal to Anur stretch. Manchnoor, Anur, Benkanhalli Khalsa, Bhimenhalli, Gondadgi, Shivenoor are the nearby villages around Anur to Shivenoor stretch. National Highway number NH150 is passing parallel to the River. The railway is passing parallel through the River.

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.
I	19	25.2	0.000	0.000	6200	266,838.89	1,082,328.17	-0.300	0.000	6200	342,009.32	1,391,404.80
I	25.2	42.8	0.000	0.000	17600	758,132.50	1,840,460.67	-0.300	0.000	17600	975,371.49	2,366,776.29
I	42.8	49	0.000	0.000	6200	267,269.88	2,107,730.55	-0.300	0.000	6200	337,569.37	2,704,345.66
II	19	25.2	0.000	0.000	6200	406,433.44	1,647,789.44	-0.300	0.000	6200	503,590.37	2,045,402.33
II	25.2	42.8	0.000	0.000	17600	1,154,572.17	2,802,361.61	-0.300	0.000	17600	1,433,819.22	3,479,221.55
II	42.8	49	0.000	0.000	6200	407,091.13	3,209,452.74	-0.300	0.000	6200	497,496.22	3,976,717.77
III	19	25.2	0.000	0.000	6200	614,283.79	2,489,199.03	-0.300	0.000	6200	735,412.95	2,982,482.87
III	25.2	42.8	0.000	0.000	17600	1,744,187.73	4,233,386.76	-0.300	0.000	17600	2,090,564.00	5,073,046.87
III	42.8	49	0.000	0.000	6200	615,273.79	4,848,660.55	-0.300	0.000	6200	727,670.84	5,800,717.71
IV	19	25.2	0.000	0.000	6200	741,218.41	3,003,217.58	-0.300	0.000	6200	867,886.81	3,518,593.45
IV	25.2	42.8	0.000	0.000	17600	2,104,484.26	5,107,701.84	-0.300	0.000	17600	2,466,343.08	5,984,936.53
IV	42.8	49	0.000	0.000	6200	742,412.48	5,850,114.32	-0.300	0.000	6200	859,941.39	6,844,877.92

Table 19 - Dredging Quantity Details

3.2.1 Observed and reduced Bed Profile of the stretch

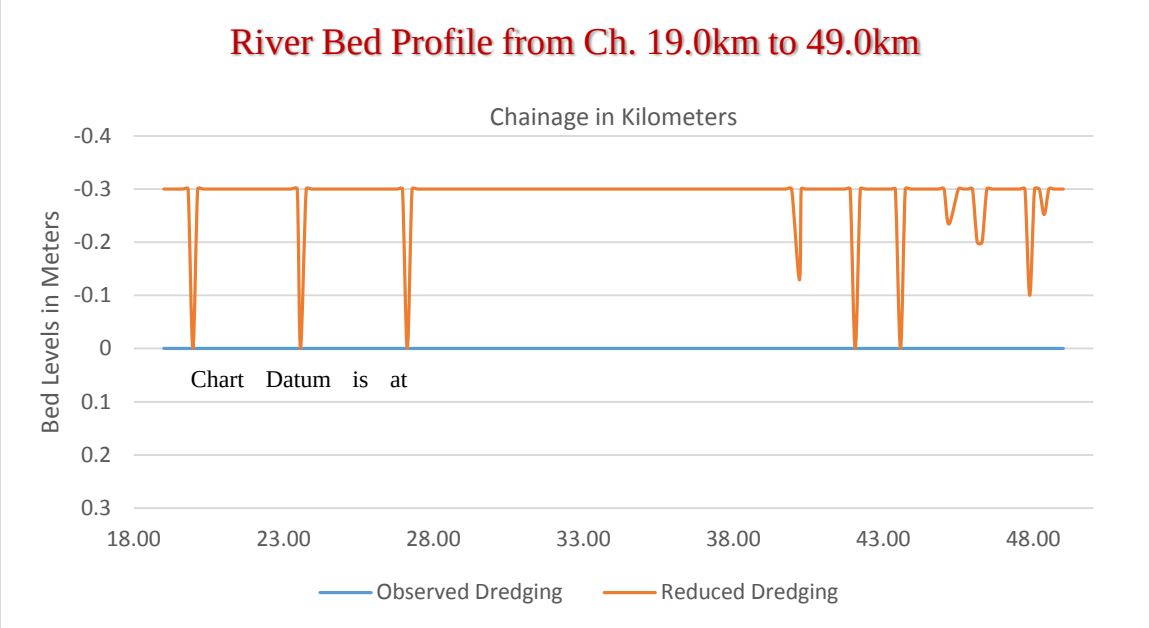


Figure 14 - River Bed Profile

3.3 Sub Stretch 03: Mustur to Sonthi (Chainage 49.0km to 79.0km)

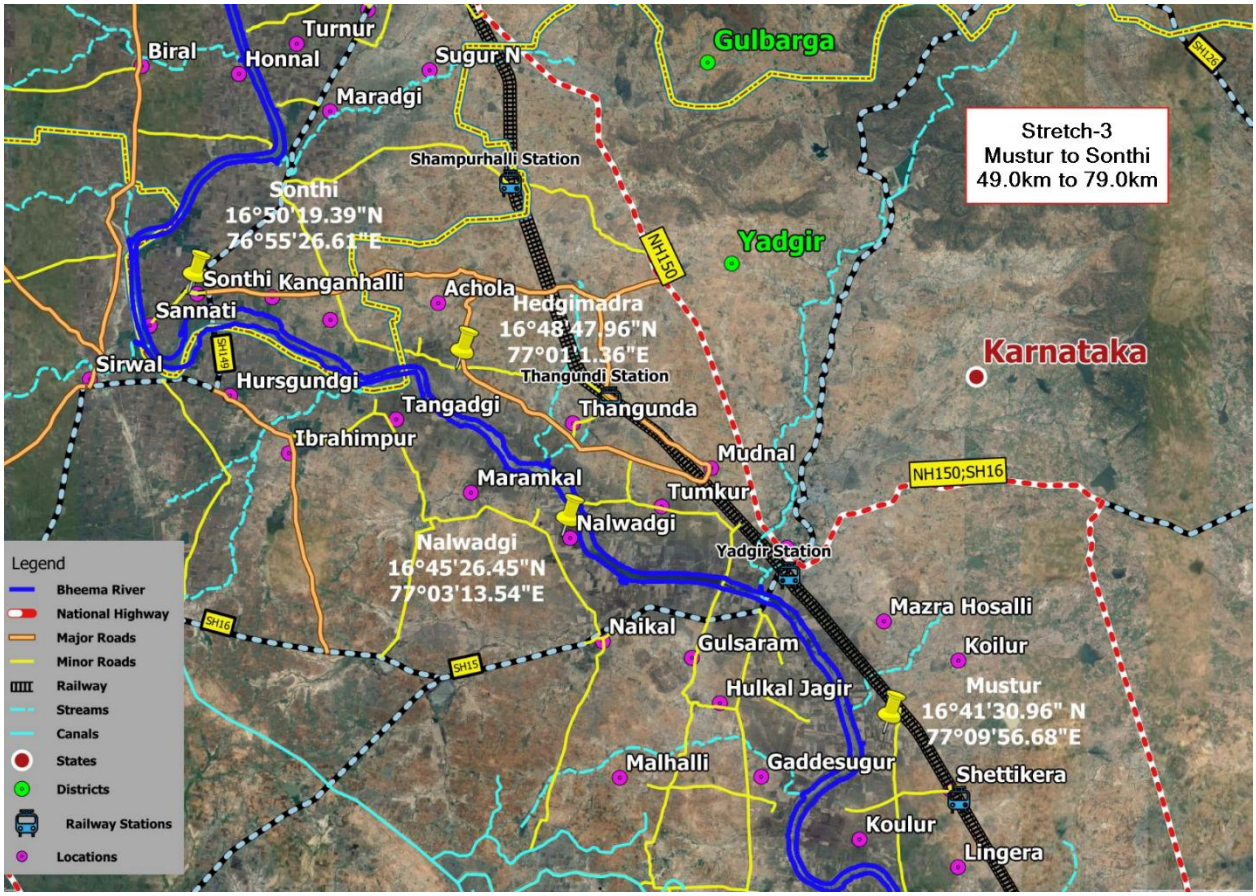


Figure 15 - Stretch-3 Mustur to Sonthi

- **Bathymetry Survey**
  a) No bathymetric survey is conducted due to the unavailability of water
- **Topographic Survey**
  b) 30km of the length of the stretch for which the topographic survey has been carried out.

This stretch is between 49.0km to 79.0km chainage from Mustur to Sonthi. There is Yadgir Barrage and overhead crossovers are present on this stretch such as a bridge.

Kanganahalli is 3km from Sannati. Govt. of Karnataka and ASI are planning to develop it as an international buddhist center because this is the place where an ancient Buddhist Mahastupa site was found.

Yadgir, popularly called as Yadavagiri by the local people, was once a capital of the Yadava Kingdom. Has a rich historical and cultural traditions. Yadgir district is the 2nd smallest district in the state, area wise is very rich in cultural traditions. The vast stretch of the fertile black soil of the district is known for bumper red

gram and jawar crops. The district is a “Daal bowl” of the state and is also known for a cluster of cement industries and a distinct stone popularly known as “Malakheda Stone”.

A Small Hydro Electric Project (SHEP) in Karnataka at the Sonthi Barrage across River Bheema near Shahapur town of Yadgiri Districts. This is a run of the river project envisaged to utilize flows available in the River Bheema for about 6 - 8 months in a year. The project has an installed capacity of 3 units of 4.5 MW each. The power generated in this project will be transmitted through a 17km long, 110kv single circuit transmission line on double circuit towers to the 110kv KPTCL substation at Khanapur.

Figure 16 - Small Hydro Electric Plant (75.00 km Chainage)

Yadgir Barrage is constructed across the Bheema River which is some 4km from the city well connected by road. Availability of water is upstream up to 6km from the barrage and approximate depth of 2 meters is confirmed by local people from December to February.

Figure 17 - Yadgir Barrage (51.79 km chainage)

Yadgir Bridge is constructed across the Bheema River which is some 4km from the city well connected by road.

Figure 18 - Yadgir Bridge (50.08 km chainage)

The Sonthi, Kanganahalli, Hulandgera, Banhatti are of Gulbarga District and Hursgundgi, Talak, Tangadgi, Habballi and Hedgimadra are of Yadgir District are the nearby villages around Sonthi to Hedgimadra. The Tangadgi, Hedgimadra, Maramkal, Balkal, Chatnalli, Nalwadgi, Thangunda, Abbe Tumkur, Tumkur are the nearby villages around Hedgimadra to Nalwadgi. Nalwadgi, Tumkur, Hulkal Jagir, Birnal, Gulsaram, Yadgir B Rural, Bablad, Mustur are the nearby villages around Nalwadgi to Mustur.

Yadgir is well connected by road and railways. National Highway number NH150 is passing parallel to the river and the distance from river to the NH150 is very nearer at Yadgir Station. State Highways SH15 and SH16 are crossing the river at Gulsaram village.

Sonthi Barrage is constructed across the Bheema River. It is located between Koulur to Kanganahalli. It is the main source for irrigation area. Irrigation area covers about 16,100 hectares.

Construction of Sonthi Bridge cum barrage across Bheema River near Sonthi Village in Chittpur Taluk of Gulbarga District in the state of Karnataka to impound 113.28m.cum (4.0 TMC) of water.

The barrage site is approachable by road from Shahapur which is about 24km. Approach to the site by air is from nearest Airport situated at Hyderabad, which is about 300km. Approach by rail is from Station Nalwar (Madras Mumbai Route and Hyderabad - Chennai via Wadi Junction) which is 20km away.

Figure 19 - Sonthi Barrage (75.22 km chainage)

Sannati has a famous temple of Chandrala Parameshwari which became a visitor's attraction and the excavation by the Archaeological Survey of India was done in 1986.

Figure 20 - Chandrala Parameshwari (75.8 km chainage)

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.
I	49	51.8	0.000	0.000	2800	120,844.04	2,228,574.59	-0.300	0.000	2800	153,948.04	2,858,293.70
I	51.8	75.3	0.000	0.000	23500	1,012,658.17	3,241,232.76	-0.300	0.000	23500	1,293,278.74	4,151,572.44
I	75.3	79	0.000	0.000	3700	158,870.60	3,400,103.36	-0.300	0.000	3700	204,879.88	4,356,452.32
II	49	51.8	0.000	0.000	2800	184,063.90	3,393,516.64	-0.300	0.000	2800	226,751.88	4,203,469.65
II	51.8	75.3	0.000	0.000	23500	1,535,855.41	4,929,372.05	-0.300	0.000	23500	1,895,812.68	6,099,282.33
II	75.3	79	0.000	0.000	3700	241,982.80	5,171,354.85	-0.300	0.000	3700	301,051.28	6,400,333.61
III	49	51.8	0.000	0.000	2800	278,193.03	5,126,853.58	-0.300	0.000	2800	331,371.99	6,132,089.70
III	51.8	75.3	0.000	0.000	23500	2,321,724.46	7,448,578.04	-0.300	0.000	23500	2,769,335.65	8,901,425.35
III	75.3	79	0.000	0.000	3700	365,732.58	7,814,310.62	-0.300	0.000	3700	438,900.42	9,340,325.77
IV	49	51.8	0.000	0.000	2800	335,677.29	6,185,791.61	-0.300	0.000	2800	391,266.93	7,236,144.85
IV	51.8	75.3	0.000	0.000	23500	2,801,601.92	8,987,393.53	-0.300	0.000	23500	3,269,504.97	10,505,649.82
IV	75.3	79	0.000	0.000	3700	441,304.52	9,428,698.05	-0.300	0.000	3700	517,725.00	11,023,374.82

Table 20 - Dredging Quantity Details

3.3.1 Observed and reduced Bed Profile of the stretch

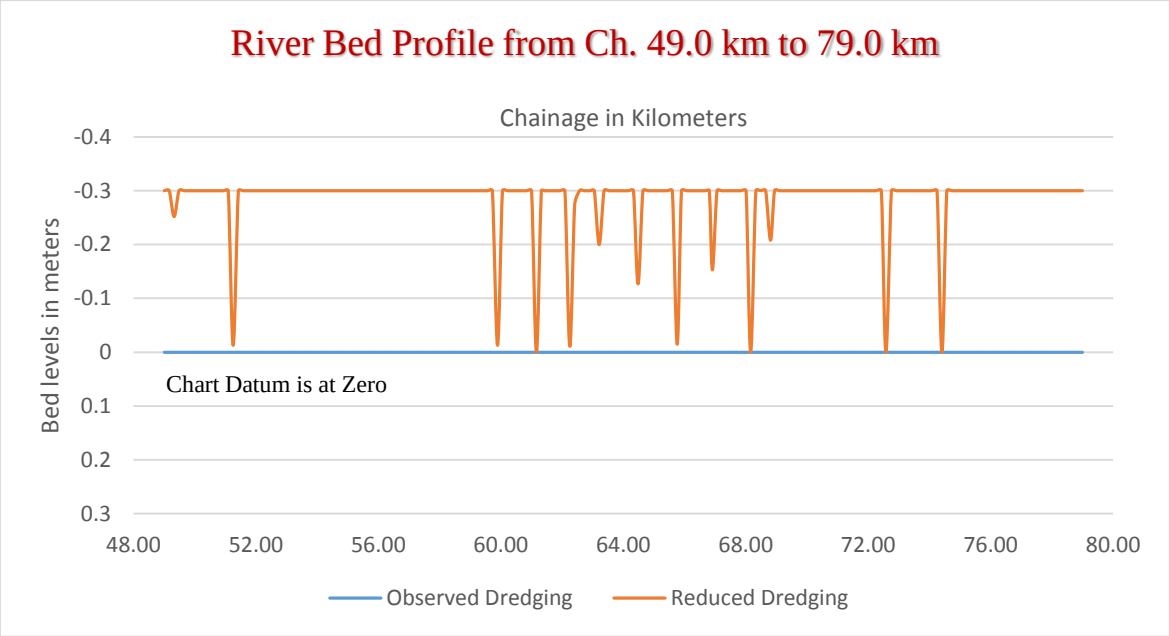


Figure 21 - River Bed Profile

3.4 Sub-Stretch 04: Sonthi to Yangunti (Chainage 79.0km to 109.0km)

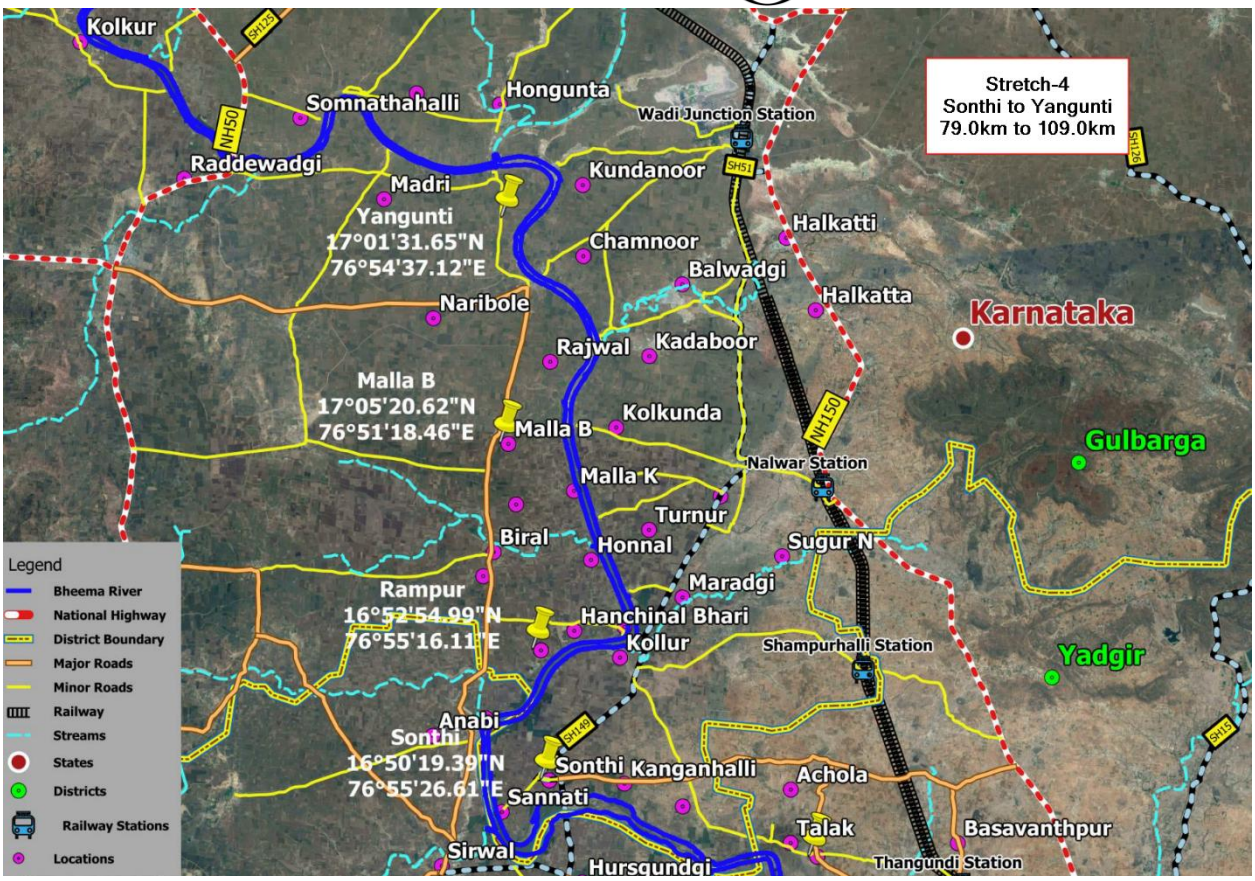


Figure 22 - Stretch-4 Sonthi to Yangunti

- **Bathymetry Survey**
  a) No bathymetric survey is conducted due to the unavailability of water
- **Topographic Survey**
  b) 30km of the length of the stretch for which the topographic survey has been carried out.

This stretch is between 79.0 to 109.0km chainage from Sonthi to Yangunti. There is Sonthi Barrage and no various overhead crossovers are present on this stretch such as bridge, high tension power lines.

Rajwal is a place located in Jevargi mandal, and Naribole village is located in Jevargi Tehsil of Gulbarga district of Karnataka state. Naribole village is itself a gram panchayat. Jevargi is the nearest town to Naribole which is approximately 16km away.

Koulur village is located in Chincholi Tehsil of Gulbarga district, 12km away from sub-district headquarter Chincholi and 96km away from district headquarter Gulbarga. Nagaidlai is the gram panchayat of Koulur village.

Anabi is a village panchayat located in the Gulbarga district of Karnataka state. Anabi‘s nearest beach is Ennore Beach located at the distance of 547.0 kilometers.

The Chamnoor, Yangunti, Naribole, Rajwal, Kadaboor, Kolkunda and Malla B are the nearby villages around this Yangunti to Malla B. The Malla B, Malla K, Honnal, Hanchinal Bhari, Rampur, Koulur, Hotinmadu, Maradgi, Turnrur, Malag N are the nearby villages around Malla B to Rampur. The Rampur, Roza Smit Sirwal, Anabi, Sannati, Sonthi are the nearby villages around Rampur to Sonthi.

There is transportation service of roads and railway line running near this stretch. National Highway number NH150 is passing parallel to the river in this stretch. State highway number SH149 crossing the river at Sonthi and Hursgundgi. The railway network passes parallel through the river. The railway track also passes through the NH150 and State Highway number SH149 meets the Nalwar Railway Station in the Gulbarga District.

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.
I	79	109	0.000	0.000	30000	1,292,809.93	4,692,913.29	-0.300	0.000	30000	1,659,299.43	6,015,751.75
II	79	109	0.000	0.000	30000	1,969,130.41	7,140,485.26	-0.300	0.000	30000	2,440,923.03	8,841,256.64
III	79	109	0.000	0.000	30000	2,976,139.37	10,790,449.99	-0.300	0.000	30000	3,561,962.27	12,902,288.04
IV	79	109	0.000	0.000	30000	3,591,112.33	13,019,810.38	-0.300	0.000	30000	4,203,190.48	15,226,565.30

Table 21 - Dredging Quantity Details

3.4.1 Observed and reduced Bed Profile of the stretch

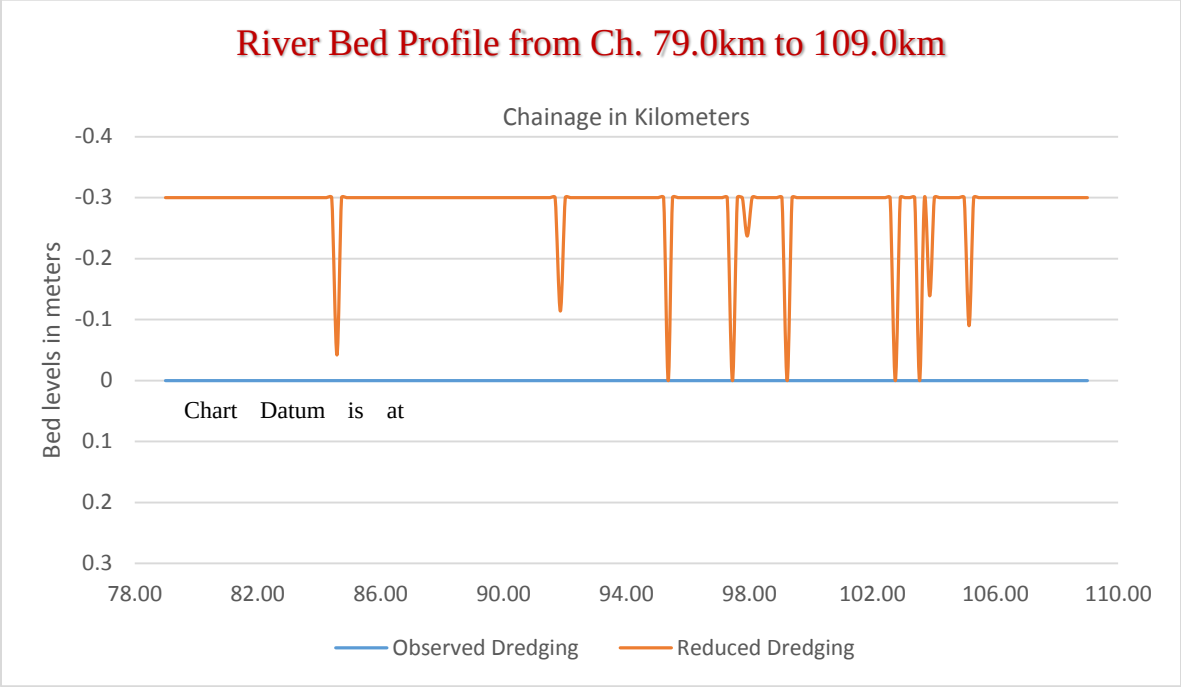


Figure 23 - River Bed Profile

3.5 Sub-Stretch-05: Yangunti to Hippargi (Chainage 109.0km to 138.9km)

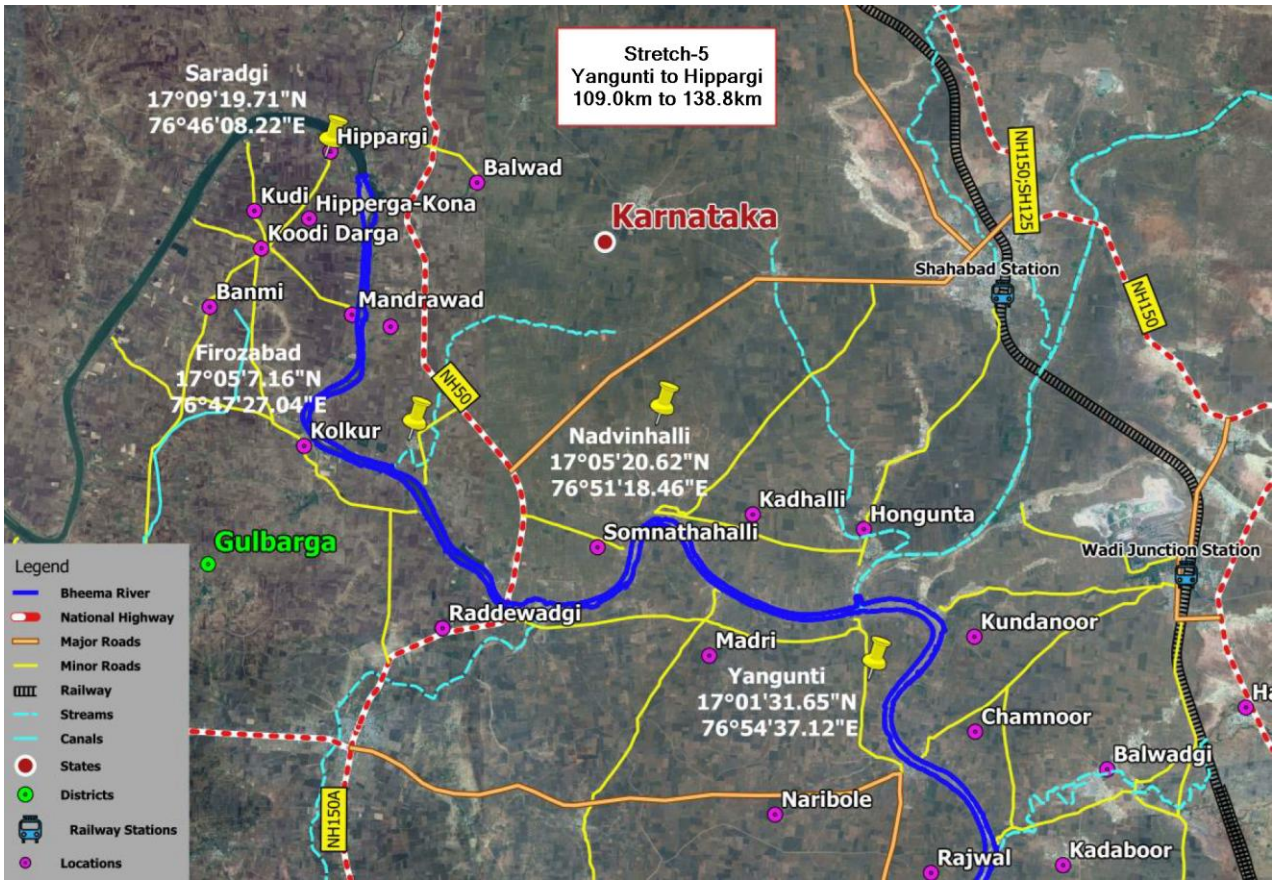


Figure 24 - Stretch-5 Yangunti to Hippargi

- **Bathymetry Survey**
  a) No bathymetric survey is conducted due to the unavailability of water
- **Topographic Survey**
  b) 28.9km of the length of the stretch for which the topographic survey has been carried out.

This stretch is between 109.0km to 138.9km chainage from Yangunti to Hippargi. This stretch forms the downstream portion of the Saradgi dam to the Yangunti. There is Saradgi Barrage and various overhead crossovers are present on this stretch such as bridge, High tension power lines. Due to protected nature of the river banks the encroachment to the waterways in not found in this stretch.

Saradgi Barrage is a small dam constructed on the Bheema River. Saradgi Barrage is approximately 1km away from Hippargi village. It is located between Hippargi and Naddisinur. It is the main source of drinking water storage and irrigation purpose to Gulbarga.

Figure 25 - Saradgi Barrage (138.85 km chainage)

Raddewadgi Bridge was constructed across the Bheema River which is connected with National Highway 218. It is located between Firozabad and Somnathahalli.

Figure 26 - Raddewadgi Bridge (123.42 km chainage)

This stretch has a sub-tributary named as Kagini River at Hongunta village. Shri Laxmi Chandralamba Devi Parameshwari temple is situated beside the Kagini River. This temple is the one of the Shakti peta. Kagini River flows through the Sedam Taluk of Gulbarga District.

Figure 27 - Shri Laxmi Chandralamba Devi Parameshwari temple (111.5 km chainage)

Gulbarga district is officially known as Kalaburagi district. Gulbarga city is well connected by road and rail from Bangalore, Hyderabad, Mumbai & other major cities.

There is transportation service of Roads and Railway line running near this stretch. National Highway number NH218 is passing in this stretch. The railway network passes through the mid of Gulbarga and Yadgir Districts of Karnataka State. The railway track crosses the NH218 near at Kalaburagi which is the main city of Gulbarga district.

The Hippargi, Kudi, Hipperga-Kona, Kodi Darga, Mandrawad, Saradgi B, Siradgi, Balwad, Firozabad, and Naddisinur are the nearby towns for Saradgi B dam. Firozabad is one of the cities in Gulbarga District. Nearby cities to Firozabad are Shahabad, Chittapur, Gulbarga Somnathahalli, Kolkur, Raddewadgi, Jevargi, and Nadvihalli. The Madri, Kadhalli, and Hongunta are the nearby towns of Yangunti.

Class	Chainage (km)		Observed					Reduced w.r.t. Sounding Datum				
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Accumulated Qty.
I	109	138.9	0.000	0.000	29900	1,284,008.84	5,976,922.13	-0.300	0.000	29900	1,619,663.05	7,635,414.80
II	109	138.9	0.000	0.000	29900	1,955,733.86	9,096,219.12	-0.300	0.000	29900	2,389,990.08	11,231,246.72
III	109	138.9	0.000	0.000	29900	2,955,881.77	13,746,331.76	-0.300	0.000	29900	3,496,010.49	16,398,298.53
IV	109	138.9	0.000	0.000	29900	3,566,671.53	16,586,481.91	-0.300	0.000	29900	4,132,743.31	19,359,308.61

Table 22 - Dredging Quantity Details

3.5.1 Observed and reduced Bed Profile of the stretch

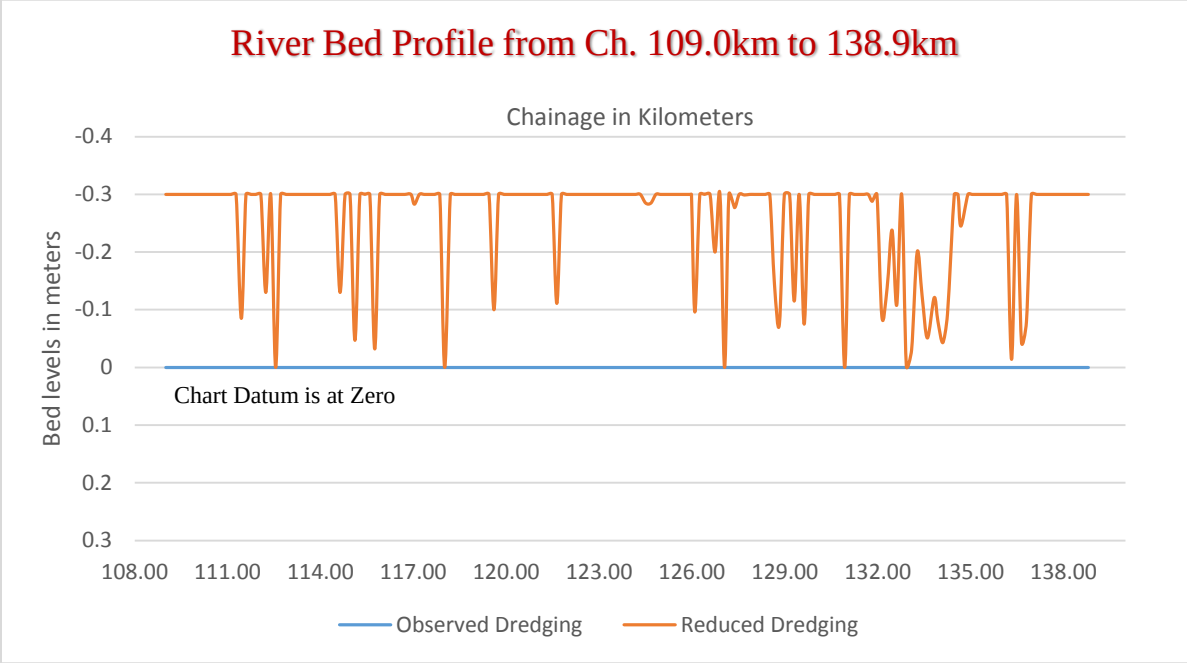


Figure 28 - River Bed Profile

3.6 Other aspects of waterway

3.6.1 Details of Irrigation Canals and Outlets

Irrigational canals at Sonthi Barrage, Yadgir and Gudur is present in the Bheema River throughout the stretches. Sonthi Branch Canal km 0.00 to 20.02, Distry. No.1 km 0.00 to 15.0 is used for irrigation purpose. They are utilized by farmers for irrigation through their own pump sets/ lift. A major source of drinking water at Gulbarga is Saradgi B Dam.

3.6.2 Irrigation/Drinking water

The Bheema River is utilized for irrigation projects for other cultivation with own lifting by farmers. There are drinking water pumping facilities found throughout the Bheema River.

3.6.3 Crops

The crops cultivated in Gulbarga district are Jowar, Bajra, Gram, Tur, Groundnut, Sunflower, and Sugarcane. The Yadgir district is a "Daal Bowl" of the state. Jowar, paddy, Red Gram, Sunflower, Groundnut are the major crops grown in the Yadgir district. Cotton and sugarcane as major commercial crops. Spices, Sorghum, Green gram and Bajra are the crops grown in the Yadgir District.

3.6.4 Industries

Yadgir District is a developing industrial area rich in uranium resources. This district has one sugar and fuel industry 'Core Green', which has an Integrated Sugar Complex with 5000 TCD sugar plant, 24 MW Co-Generation Power plant and 50 KLPD Distillery. Yadgir is known for cement, textile, leather, and chemical production in the industrial sectors.

Jevargi Agro Food Park for food processing and allied industries is available on a 106 - acre land. Sugarcane and Cotton are other major thrust areas in the district. Kalaburagi being a cement industry specialist; recognized as a cement producing zone by Karnataka

3.6.5 Important cities/towns

The major town situated near to Bheema River is Hippargi on the starting chainage and Sangam at the end chainage. Major cities are located nearby are Gulbarga, Tumkur, Yadgir. These cities are well connected by road and public transport systems.

3.6.6 Road Network

3.6.6.1 National Highway

Two national highways are passing through the Bheema River. National Highway number NH218 is passing through the villages Saradgi, Naddisinur, Firozabad, and Jevargi and towards Bijapur. National Highway number NH150 is passing through Halkatti, Wadi in Gulbarga District, Yergol, Wadenhalli, Alipur Tanda, Kanchgarhalli, Bhimnagar and Yadgir in Yadgir District. NH150 passes through the Yadgir district and intersects at NH167 near Hindupur village in Mahbubnagar district of Telangana.

3.6.6.2 State Highway

A state highway is crossing the railway track and Bheema River at Yadgir District. SH15 passes through the villages Naikal, nearby Gulsaram, and Yadgir town including the railway station of Yadgir. The SH16 merges with SH15 near Yadgir Bus station in Yadgir District.

3.6.6.3 Major District Roads

Gulbarga and Yadgir districts had a good road network. The major district roads route numbers are listed below:

S.No.	Route	Description
1	22	From West Kalaburagi to Chowdapur village
2	149	From Kalaburagi to Shahabad
3	19	From Srirangapatna to Jevargi which is connected to NH218
4	149	Passes through Nalwar, Sonthi, Sirwal

Table 23 - Major District Roads

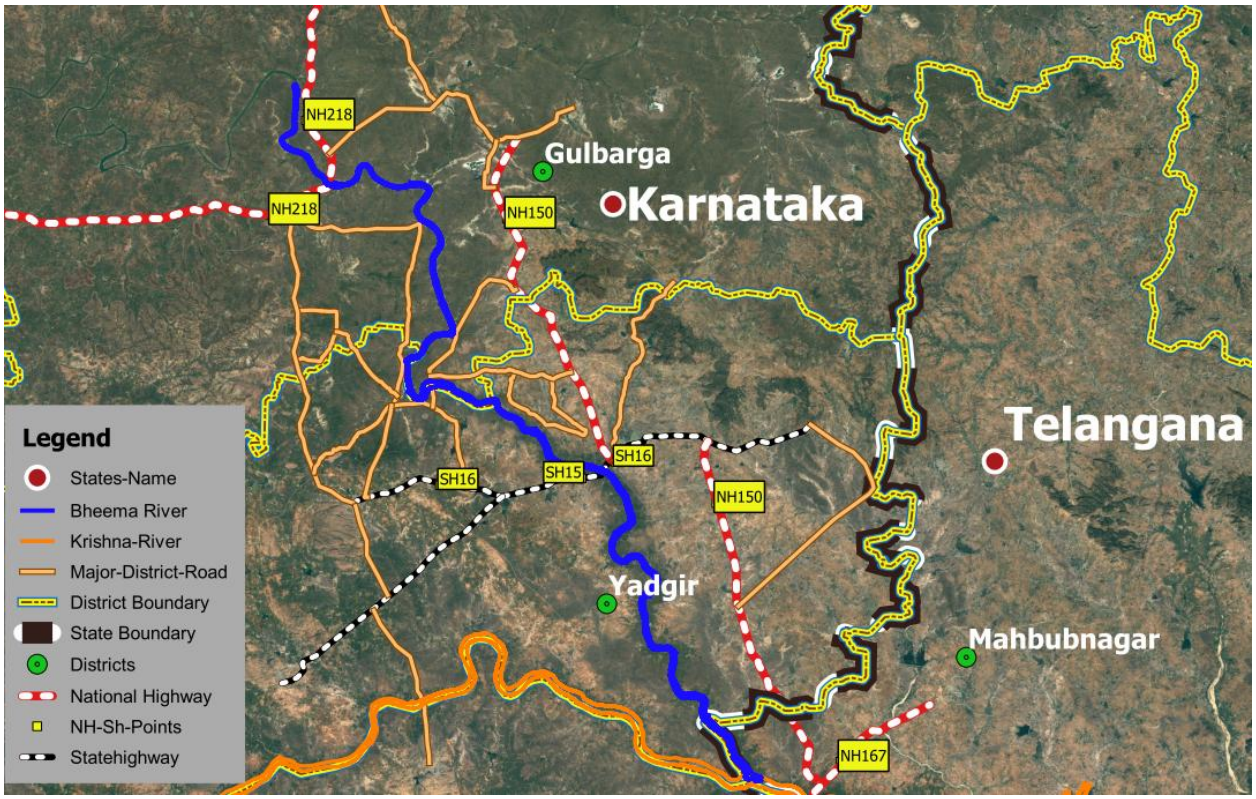


Figure 29 - Road Network

3.6.7 Railway Network

The railway network passes through the mid of Gulbarga and Yadgir Districts of Karnataka State. The railway track crosses the NH218 near at Kalaburagi which is the main city of Gulbarga district and SH15 at the city outer of Yadgir city which is the main city of Yadgir district.

The following are the list of Stations which is in the project influence area vicinity.

Location	Passage	Station Names		Location	Passage	Station Names
Kalaburagi	NH218	Gulbarga Railway Station		Basavanthpur	-	Thangundi Station
Nandoor K	-	Hirenandur Railway Station		Yadgir	SH15	Yadgir Railway Station
Martur	-	Martur Railway Station		Shettikera	-	Lingiri Station
Shahabad	Route 125	Shahabad Railway Station		Saidapur	-	Narayanpet Railway Station
Bhim Nagar	Route 51	Wadi Junction Station		Chegunta	-	Chegunta Railway Station
Nalwar	Route 149	Nalwar Railway Station		Near Gurujala	-	Krishna Station
Shampurhalli	-	Shampurhalli Railway Station				

Table 24 - Railway Stations

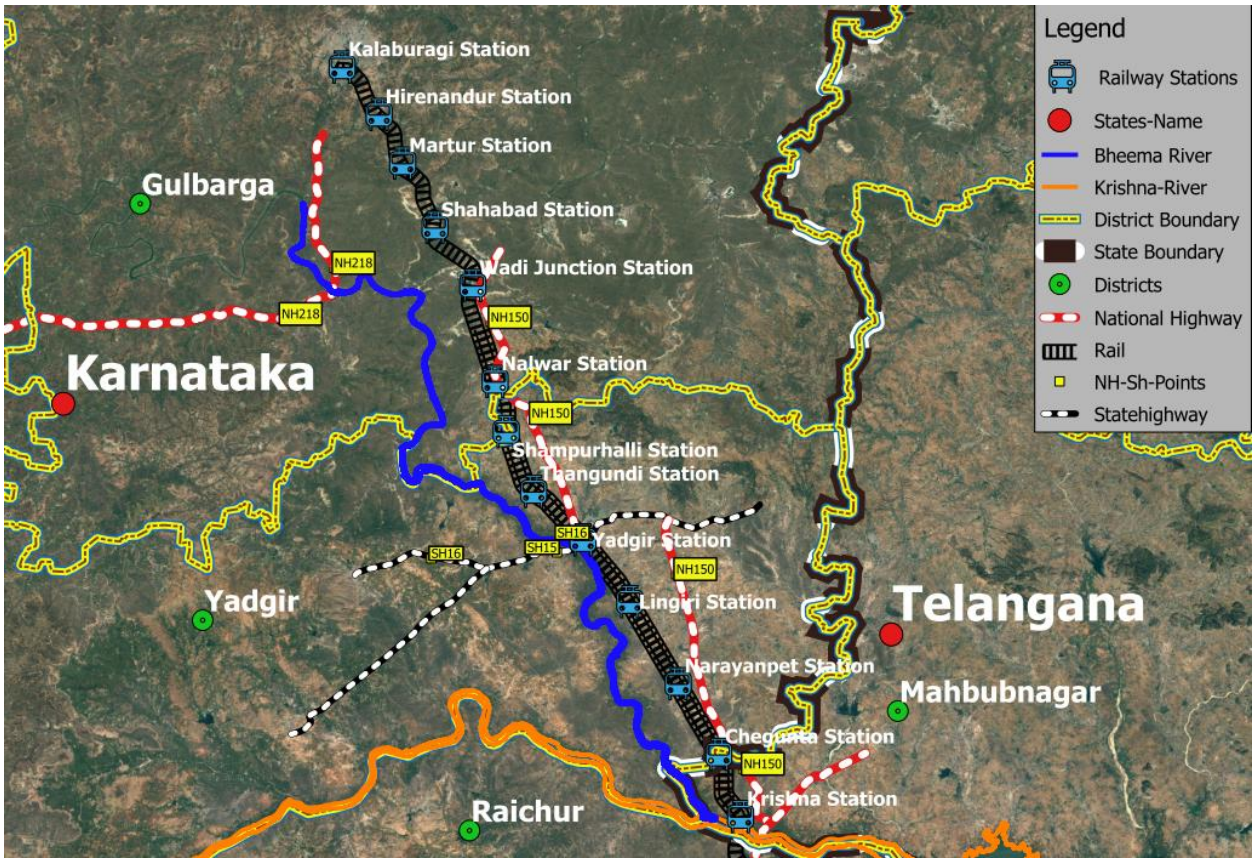


Figure 30 - Railway Network and Stations

3.6.8 Land Use

In Gulbarga District, the land use is divided into Forest area, Cultivation area and Net area Shown.

- Forest area – 690.89 km^2
- Cultivable area - 12,727.89 km^2
- Net area shown - 11,425.49 km^2

In Yadgir District the land use is as follows:

- Geographical area – 5.16 km^2
- Cultivable area – 3.105 km^2
- Forest area – 0.34 km^2
- Land under nonagricultural use – 0.30 km^2
- Permanent pastures – 0.12 km^2
- Cultivable wasteland – 0.12 km^2
- Barren and uncultivable land – 0.28 km^2

3.6.9 Construction Material

The Yadgir District is having a cluster of cement industries and limestone. The distinct stone is popularly known as "Malakheda Stone".

3.6.10 Conditions of banks

Bank is unprotected along the river.

3.6.11 Jetties and Terminals

Lack of the jetties and terminals along the river.

3.6.12 Cargo Movement

Lack of the cargo movements along the river.

3.6.13 Passenger Ferry Services

No passenger ferry services available in the river.

3.6.14 Historic importance

The Bheema River rises at 19°04′03″N 073°33′00″E near the Bhimshankar Temple in Bhimshankar Heights.

Bhimshankar is an ancient shrine situated in the Sahyadri hills in the state of Maharashtra. It is one of the well-known Jyotirling, amongst the twelve jyotirlingas situated all over India. Bhimshankar is located in the village of Bhorgiri 50km north west of Khed, near Pune. It is located 125km away from Pune in the Ghat region of the Sahyadri hills.

In recent times it has gained tremendous significance since it was declared as "wildlife sanctuary". It is also becoming one of the attractive and well known religious places in Maharashtra as well as in India. Bhimshankar is the source of the River Bheema, which is known as Chandrabhaga in Pandarpur.

Figure 31 - Bhimshankar Temple

3.6.15 Tourism

The Yadgir Fort is located in the village of Vanadurga in Shahapur taluk of Yadgir district in Karnataka. The state has many monuments and its stones breathe history and dramatic events. It is full of historical monuments and the majestic fort with three rounds of fortifications, three ancient temples, medieval mosques, tanks, and wells. There are many resources for fresh water within and outside the fort. On the hill is a temple dedicated to Bhavani, Goddess of War. There are three stepped sister wells called Akka,Tangi, and Bavi.

Along with many smaller tributaries, it flows through the Bhimshankar Wildlife Sanctuary and enters the Khed Taluka. The Chas Kaman Reservoir and dam are situated here in the upstream of the Bheema River.

4 Terminals

4.1 Details of Terminal survey carried out

In this stretch of River Bheema could not find any adequate proposed terminal, due to the unavailability of adequate water.

5 Fairway Development

5.1 Fairway Dimensions

As per the specification of the survey, dredging quantity was required to be estimated for a channel dimension of 50m x 2m with side slope of 1:5, along with the deepest route.

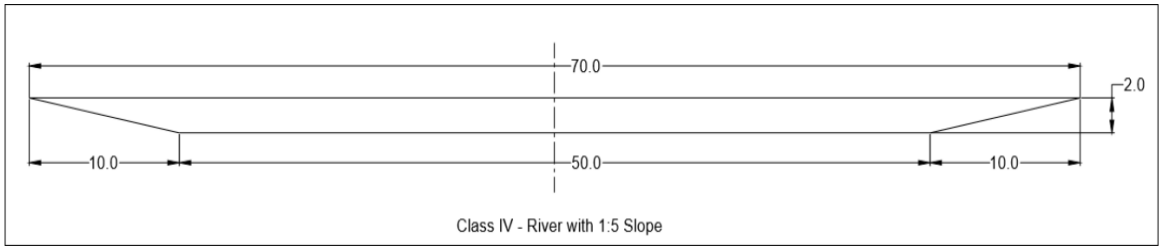
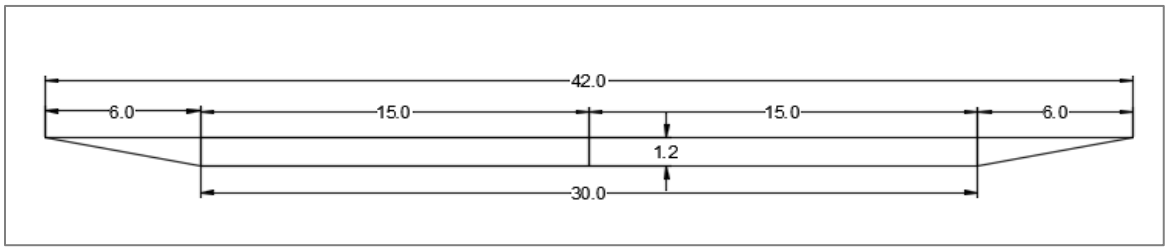


Figure 32 - Fairway Channel Dimensions 50m X 2m

5.2 Calculation of Dredging Quantity

The dredge volume calculations were accomplished using the HYPACK dredge volume computation utility. A channel profile of dimensions mentioned at para 2.3.9 in RFP. For clarity and ease of calculations, the complete channel profile was divided into segments of 1km each (enclosed at Annexure 3). The Tin v/s Channel volume algorithm was used to calculate the dredge volume in each segment. The stretch wise summary of the dredge volume is as follows:

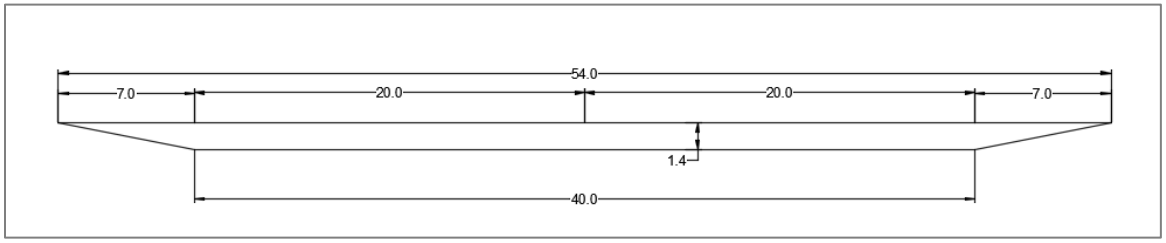
Class I



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.
Sangam	Shivenoor	0	19	0.000	0.000	19000	815,489.28	815,489.28	-0.300	0.000	19000	1,049,395.48	1,049,395.48
Shivenoor	Mustur	19	49	0.000	0.000	30000	1,292,241.27	2,107,730.55	-0.300	0.000	30000	1,654,950.18	2,704,345.66
Mustur	Sonthi	49	79	0.000	0.000	30000	1,292,372.81	3,400,103.36	-0.300	0.000	30000	1,652,106.66	4,356,452.32
Sonthi	Yangunti	79	109	0.000	0.000	30000	1,292,809.93	4,692,913.29	-0.300	0.000	30000	1,659,299.43	6,015,751.75
Yangunti	Saradgi	109	138.9	0.000	0.000	29900	1,284,008.84	5,976,922.13	-0.300	0.000	29900	1,619,663.05	7,635,414.80
Total						**138900**	**5,976,922.13**	**5,976,922.13**	**Total**		**138900**	**7,635,414.80**	**7,635,414.80**

Table 25 - Class I Stretch wise Dredge Volumes

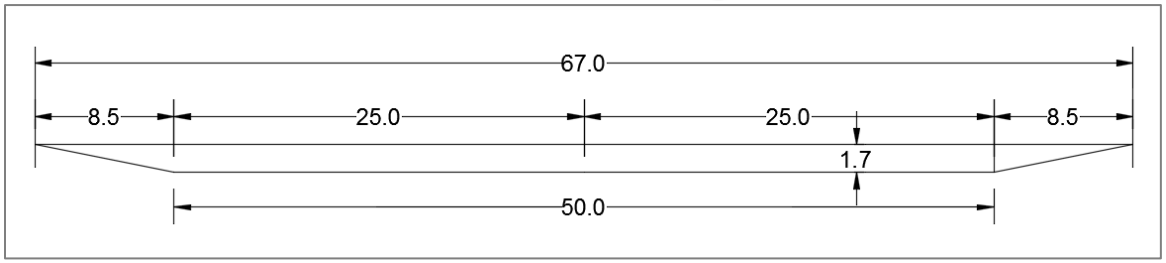
Class II



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.
Sangam	Shivenoor	0	19	0.000	0.000	19000	1,241,356.00	1,241,356.00	-0.300	0.000	19000	1,541,811.96	1,541,811.96
Shivenoor	Mustur	19	49	0.000	0.000	30000	1,968,096.74	3,209,452.74	-0.300	0.000	30000	2,434,905.81	3,976,717.77
Mustur	Sonthi	49	79	0.000	0.000	30000	1,961,902.11	7,814,310.62	-0.300	0.000	30000	2,423,615.84	9,340,325.77
Sonthi	Yangunti	79	109	0.000	0.000	30000	1,969,130.41	7,140,485.26	-0.300	0.000	30000	2,440,923.03	8,841,256.64
Yangunti	Saradgi	109	138.9	0.000	0.000	29900	1,955,733.86	9,096,219.12	-0.300	0.000	29900	2,389,990.08	11,231,246.72
Total						**138900**	**9,096,219.12**	**9,096,219.12**	**Total**		**138900**	**11,231,246.72**	**11,231,246.72**

Table 26 - Class II Stretch wise Dredge Volumes

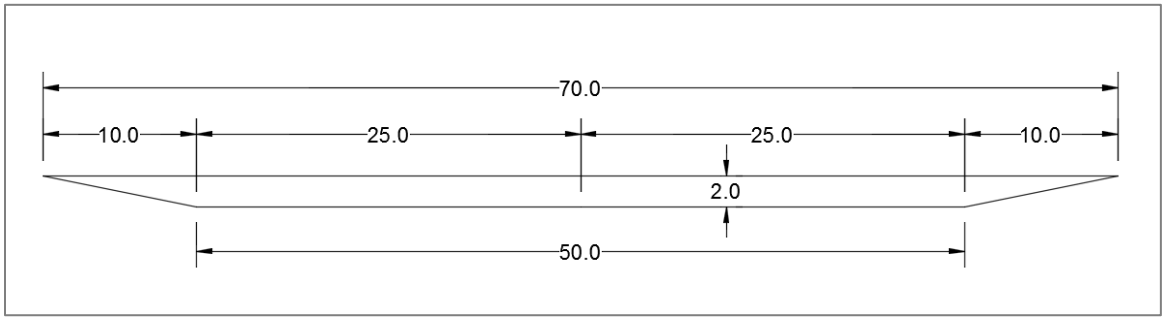
Class III



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.
Sangam	Shivenoor	0	19	0.000	0.000	19000	1,874,915.24	1,874,915.24	-0.300	0.000	19000	2,247,069.92	2,247,069.92
Shivenoor	Mustur	19	49	0.000	0.000	30000	2,973,745.31	4,848,660.55	-0.300	0.000	30000	3,553,647.79	5,800,717.71
Mustur	Sonthi	49	79	0.000	0.000	30000	2,965,650.07	7,814,310.62	-0.300	0.000	30000	3,539,608.06	9,340,325.77
Sonthi	Yangunti	79	109	0.000	0.000	30000	2,976,139.37	10,790,449.99	-0.300	0.000	30000	3,561,962.27	12,902,288.04
Yangunti	Saradgi	109	138.9	0.000	0.000	29900	2,955,881.77	13,746,331.76	-0.300	0.000	29900	3,496,010.49	16,398,298.53
Total						**138900**	**13,746,331.76**	**13,746,331.76**	**Total**		**138900**	**16,398,298.53**	**16,398,298.53**

Table 27 - Class III Stretch wise Dredge Volumes

Class IV



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.
Sangam	Shivenoor	0	19	0.000	0.000	19000	2,261,999.17	2,261,999.17	-0.300	0.000	19000	2,650,706.64	2,650,706.64
Shivenoor	Mustur	19	49	0.000	0.000	30000	3,588,115.15	5,850,114.32	-0.300	0.000	30000	4,194,171.28	6,844,877.92
Mustur	Sonthi	49	79	0.000	0.000	30000	3,578,583.73	9,428,698.05	-0.300	0.000	30000	4,178,496.90	11,023,374.82
Sonthi	Yangunti	79	109	0.000	0.000	30000	3,591,112.33	13,019,810.38	-0.300	0.000	30000	4,203,190.48	15,226,565.30
Yangunti	Saradgi	109	138.9	0.000	0.000	29900	3,566,671.53	16,586,481.91	-0.300	0.000	29900	4,132,743.31	19,359,308.61
Total						**138900**	**16,586,481.91**	**16,586,481.91**	**Total**		**138900**	**19,359,308.61**	**19,359,308.61**

Table 28 - Class IV Stretch wise Dredge Volumes

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 Bheema River is 138.9km in length and is not being explored for any navigational possibility. This survey stretch starts from the Gundloor to Hippargi village. There are no major industries present in the area. The stretch wise minimum and maximum width range, average width and average slope of the waterway are as below:-

Sl. No.	Location		Chaiange (km)		Width Range of the waterway (m)		Average Width (m)	Average Slope (in m/km)
	From	To	From	To	Min	Max		
1	Sangam	Shivenoor	0	19.0	11.05	996.92	421.34	1 : 0.548
2	Shivenoor	Mustur	19.0	49.0	14.08	554.88	334.25	1 : 0.501
3	Mustur	Sonthi	49.0	79.0	14.10	843.02	355.75	1 : 0.242
4	Sonthi	Yangunti	79.0	109.0	10.16	389.33	243.01	1 : 0.269
5	Yangunti	Hippargi	109.0	138.9	15.32	432.35	182.23	1 : 0.258

Table 29 - Stretch wise Average width and slope of waterway

6.2 Methods for making waterway feasible

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

Class	0 - 19 (km)	19 – 49 (km)	49 – 79.0 (km)	79 – 109 (km)	109 – 138.9 (km)	Total
I	1,049,395.48	1,654,950.18	1,652,106.66	1,659,299.43	1,619,663.05	**7,635,414.80**
II	1,541,811.96	2,434,905.81	2,423,615.84	2,440,923.03	2,389,990.08	**11,231,246.72**
III	2,247,069.92	3,553,647.79	3,539,608.06	3,561,962.27	3,496,010.49	**16,398,298.53**
IV	2,650,706.64	4,194,171.28	4,178,496.90	4,203,190.48	4,132,743.31	**19,359,308.61**

Table 30 - 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 Barrage is required to maintain the minimum depth required for navigation and regulate the water level in the river. Boat jetties may

be constructed at the upstream of Yadgir Barrage. No cargo movement or passenger movement is envisaged through this River. The class-wise details of reduced depth at different stretches of the waterways are as tabulated below:-

Sl. No.	Chaiange (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	19	19	100%	0	0 %	0	0 %	0	0 %	0	0 %
2	19	49	20	100%	0	0 %	0	0 %	0	0 %	0	0 %
3	49	79	30	100%	0	0 %	0	0 %	0	0 %	0	0 %
4	79	109	30	100%	0	0 %	0	0 %	0	0 %	0	0 %
5	109	138.9	29.9	100%	0	0 %	0	0 %	0	0 %	0	0 %
Total			**138.9**	**100%**	**0**	**0 %**	**0**	**0 %**	**0**	**0 %**	**0**	**0 %**

Table 31 - 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 not prominent and no signs of erosion of river banks are found in the entire stretch of Bheema River. The limitation for improvement of navigational aspects includes the gradient of the river, non-availability of the water throughout the period and presence of various Barrages. 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	3	3	0	VC of 01 HT line is less than class
II	3	3		
III	3	3		
IV	3	3		

Table 32 - Bridges and HTL Clearances less than Class no.

6.4 Recommendation

There is no major scope for navigational aspect for waterway due to non-availability of water throughout the year. The River banks are well connected with the road network and major distribution of settlements are there near to Yadgir

District. Yadgir which is known the cement, textile leather and chemical production in the industrial sector. The road is a near parallel on both sides throughout the River stretch. On discussion with the Assistant engineers of KJNL, Karnataka, no scope for the future development of the river was recommended for navigational purpose and the survey Stretch is not-viable for development as navigable channel.

The purpose of the survey was for assessing the river stretch from Gundloor to Hippargi Village for the development of water transport facilities in the new National Waterway (NW-21). 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

Volume - II