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VOLUME-I



## INLAND WATERWAYS AUTHORITY OF INDIA (IWAI)

### CONSULTANCY SERVICES FOR PREPARATION OF DETAILED PROJECT REPORT INCLUDING TECHNICAL AND FINANCIAL STUDY IN RIVER JHELUM (NW 49)



## VOLUME-I (MAIN REPORT)

## FINAL DETAILED PROJECT REPORT



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(A Government of India Undertaking - Ministry of Water Resources, River Development & Ganga Rejuvenation)



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# FINAL DETAILED PROJECT REPORT- RIVER JHELUM

## **VOLUME-I: MAIN REPORT**

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**Table 20.1 Phase-wise details of terminals**

**Table 20.2 Phase-wise details of length, dredging quantity, proposed class and bridges**

## Abbreviation

IWT	Inland Water Transport
SWOT	Strength, Weaknesses, Opportunities and threats
BM	Bench Mark
CD	Chart Datum
DGPS	Differential Geo Positioning System
GTS	Great Trigonometric Survey
LAD	Least Available Depth
PPK	Post Processing Kinematics
SD	Sounding Datum
RTK	Real Time Kinematics
TBM	Temporary Bench Mark
TS	Total Station
HC	Horizontal Control
Km	Kilometer
Cum	Cubic Meter
RL	Reference Level
HFL	Highest Flood Level
MSL	Mean Sea Level
DGPS	Differential Global positioning system
DWT	Deadweight tonnage
CH	Chainage
NH	National Highway
IF&C	Irrigation & Flood Control Department
SMC	Srinagar Municipal Corporation
LWDA	Lake water Development Authority
CWC	Central Water Commission
INTACH	Indian National Trust for Art and Cultural Heritage
CWPRS	Central Water And Power Research Station
G	Gauge
GD	Gauge and Discharge
GQ	Gauge and Water Quality
GDQ	Gauge, Discharge and Water Quality
GDSQ	Gauge, Discharge, Sediment, and Water Quality
DWT	Dead Weight Tonnage

## SALIENT FEATURES

Sr. No.	Particulars	Details								
<b>A.</b>	<b>GENERAL</b>									
<b>1.</b>	<b>Location</b>	<b>River Jhelum</b>								
b)	State(s)	Jammu & Kashmir								
c)	Co-ordinates & Name of Place	<b>Start</b>				<b>End</b>				
	Place	Lower Jhelum Power Project				Sangam				
	Latitude	34°09'02.17"N				33°49'25.20"N				
	Longitude	74° 11'34.15"E				75° 03'49.87"E				
<b>B.</b>	<b>TECHNICAL</b>									
<b>1.</b>	<b>Waterway</b>									
a)	National Waterway Number	49								
b)	Class	I & Special Class (Refer chapter 3)								
c)	Type (Tidal/Non-Tidal)	Non-Tidal								
	Length (Km.)	<b>Total</b>		<b>Tidal</b>		<b>Non-Tidal</b>				
		181.205		-		181.205				
d)	Average Tidal Variation, if applicable	-								
e)	Chart Datum	Chart Datum/ Sounding Datum, Minimum 10 years of data needed from CWC gauge / IFCK/ Weir in between waterway area. The chart datum was fixed based on last 6 years gauge data provided by IFCK.								
	Description/Basis	<b>Tidal Stretch - Nil</b> <b>Non-Tidal Stretch</b> The non-tidal stretch of River Jhelum is from Ch 0 km to Ch181.205 km.								
f)	LAD Status (w.r.t. CD)									
<b>Survey Period – 12<sup>th</sup> April 2018 to 28<sup>th</sup> August 2018</b>										
	Stretch (From.....To.....) in km	<b>0-9.685</b>	<b>9.685-39.685</b>	<b>39.685-70.935</b>	<b>70.935-100</b>	<b>100.0-130.0</b>	<b>130.0-160</b>	<b>160.0-181.205</b>	<b>Total km</b>	
	Length with LAD < 1.2 m	9.685	4.0	14.0	00	00	0	2.6	30.285	
	With LAD from 1.2-1.4 m	0	0	0	0	0	0	0	0	
	Length with LAD 1.5 – 1.7m	0	0	0	2.2	0	0	0	2.2	
	With LAD from 1.8-2.0 m	0	0	0	0	0	0	0		
	With LAD > 2.0 m	0	26.0	17.25	26.865	30.0	30.	18.605	148.72	
		<b>Grand Total</b>						<b>181.205</b>		
g)	Target Depth of Proposed Fairway (m)	1.2m for Class-1 & 0.6m for Proposed Special Class								
h)	Conservancy Works Required									

Sr. No.	Particulars	Details				
	<b>Type of Work</b>					
	Dredging Required (M. Cum.)	<b>Phase-1</b> Chhatabal to Pantha Chowk – <b>46060 cum</b> <b>Phase-2</b> Gund Parang to Sumbal - <b>19826 cum</b> Sumbal to Chhatabal - <b>218248 cum</b> Shah-E-Hambam to Sangam Bridge- <b>738618 cum</b> <b>Phase-3</b> Sopore to Chhatabal- <b>828210 cum</b>				
	Bandalling	No				
	Barrages & Locks	NIL				
	River Training/Bank Protection (Km.)	At all terminal sites				
i)	Existing Cross Structures					
	<b>Name of Structure</b>	<b>Type</b>	<b>Nos.</b>	<b>Range of Horizontal Clearance</b>	<b>Range of Vertical Clearance w.r.t. HFL/MHWS</b>	
	Dams/Barrages/Weirs/Aqueducts etc.	Gantamulla Barrage	1	NA	NA	
		Weirs- (Chhatabal weir)	1			
		Navigational Lock Chhatabal	1			
	Bridges	-	57	13.0m – 100.0 m	-0.3 m to 6.14 m	
	HT/Tele-communication lines	HT & LT	156	65 m – 330.0 m	6.0 m to 20.0 m	
<b>2.</b>	<b>Traffic</b>					
a)	Present IWT Operations (type of services)	Few small boats are seen plying on bank of the river for tourism purpose. At many locations, sand mining activities are found in river Jhelum. Apart from this, no transportation of passengers or cargo happens in the river at present.				
b)	Major industries in the hinterland (i.e. within 25 km. on either side)	No major or medium scale industries exist in the hinterland.				
c)	Connectivity of major industries with Rail/Road network (Distances/Nearest Railway Stations etc.)	-				
d)	Commodities	<b>In-bound</b>		<b>Out-bound</b>		
		Inter-District Movement – Tourists, Passenger & Cargo (later) Intra-District Movement – Tourists and Passenger				
e)	Future Potential					
	<b>Name of Commodity</b>	<b>FY'22</b>	<b>FY'27</b>	<b>FY'37</b>	<b>FY'47</b>	
	Passenger and Tourists (No.)	311,386	407,691	652,267	1,164,174	
	Cargo-Horticulture Products (Tons)	10,320	12,840	15,960	21,720	
<b>3.</b>	<b>Terminals/Jetties</b>					
a)	Terminal/Jetty - 1	Near Pantha Chowk				
	Location (Bank/city/district)	Right Bank, Near Pantha Chowk				
	Type/Services	Passenger & Tourists				
	Facilities	At present, no facilities available for IWT				

Sr. No.	Particulars	Details
	Approach	NH-44
	Land Ownership	Private
b)	Terminal/Jetty - 2	Near Zero Bridge
	Location (Bank/city/district)	Left Bank, Rajbagh, Srinagar
	Type/Services	Passenger & Tourists
	Facilities	At present, no facilities available for IWT
	Approach	Rajbagh-Modern Hospital Bund Rd – 200m
	Land Ownership	Government
c)	Terminal/Jetty - 3	Near Amira Kadal
	Location (Bank/city/district)	Right Bank, Lal Chowk, Srinagar
	Type/Services	Passenger & Tourists
	Facilities	At present, no facilities available for IWT
	Approach	Maulana Azad Rd – 150m
	Land Ownership	Private
d)	Terminal/Jetty - 4	Near Shah-e-Hamdan
	Location (Bank/city/district)	Right Bank, Shamswari, Srinagar
	Type/Services	Passenger & Tourists
	Facilities	At present, no facilities available for IWT
	Approach	Khan Kah-Babdem Rd - km
	Land Ownership	Government (Trust)
e)	Terminal/Jetty - 5	Near Safa Kadal / Chattabal Shrine
	Location (Bank/city/district)	Left Bank, Malik Sahib Mohalla, Srinagar
	Type/Services	Passenger & Tourists
	Facilities	At present, no facilities available for IWT
	Approach	Malik Sahib-Cement Kadal Rd. – 50m
	Land Ownership	Private
f)	Terminal/Jetty - 6	Near Sumbal Bridge
	Location (Bank/city/district)	Left Bank, Sumbal, Ganderbal
	Type/Services	Passenger & Tourists
	Facilities	At present, no facilities available for IWT
	Approach	Bandipora Sumbal Rd – 500m
	Land Ownership	Private
g)	Terminal/Jetty - 7	Gund Prang
	Location (Bank/city/district)	Right Bank, Gund Prang, Bandipora
	Type/Services	Cargo, Passenger & Tourists
	Facilities	At present, no facilities available for IWT
	Approach	Local Road – 200m
	Land Ownership	Private
h)	Terminal/Jetty - 8	Near Sangam Bridge
	Location (Bank/city/district)	Left Bank, Sangam, Anantnag
	Type/Services	Cargo, Passenger & Tourists

Sr. No.	Particulars	Details
	Facilities	At present, no facilities available for IWT
	Approach	DogriPora Rd. - 1 km
	Land Ownership	Private
i)	Terminal/Jetty - 9	Near Sopore Chowk
	Location (Bank/city/district)	Left Bank, Hatishah, Baramulla
	Type/Services	Tourists
	Facilities	At present, no facilities available for IWT
	Approach	Tarzoos – Sopore Road
	Land Ownership	Private
<b>4.</b>	<b>Design Vessel</b>	
a)	Type	Self-propelled vessel
b)	No. & Size (Length X Beam)	Intra District Movement – 11m X 3.84m (3-Vessel) Inter District – 13.2m X 5.6m (2+5+6 vessel)
c)	Loaded Draft	Intra District Movement – 0.6m Inter District – 0.8m
d)	Capacity	Intra District Movement – 20 Passengers Inter District – 50 Passengers
<b>5.</b>	<b>Navigation Aids</b>	
a)	Type	-
b)	Nos.	Marine Lantern/Buoys (11 nos.)
b)	Communication Facilities	DGPS, Marine Lantern/Buoys, , RIS Station
3.0	Cost Estimate	
	Phase-1	Rs. 52.94 Crores (Recommended)
	Phase-2	Rs.66.00 Crores
	Phase-3	Rs. 26.50 Crores

## EXECUTIVE SUMMARY

- 0.1 Inland Water Transport (IWT) has the potential to form the most economic, reliable, safe and environment friendly mode of transport. When developed for use by modern inland waterway vessels, it can reduce investment needs in rail and road infrastructure, promote greater complementarities in the riparian states, enhance intra-regional trade and, through increased economies of scale, significantly reduce transport costs for the benefit of the entire economy and India's global trade competitiveness.
- 0.2 The Govt. of India desires to explore the commercial navigation potential on year round basis in inland waterways. Ministry of Shipping (MoS), Govt. of India had directed Inland Waterways Authority of India (IWAI) to identify the viable waterways in India for their phased development.
- 0.3 Inland Waterway Authority of India (IWAI) intends to explore transportation potential of National Waterway (NW) - 49. The proposed route National Waterway 49 (River Jhelum) from Starting point of Downstream of Lower Jhelum Power Project at 34°09'02.17"N, 74°11'34.15"E and End Point is Sangam Bridge at 33°49'49.81"N, 75°04'14.31"E. This stretch is 181.2 km long, and passes through Baramula, Srinagar, Ganderbal and Budgam etc.
- 0.4 With a view to serve the purpose of the project IWAI has commissioned WAPCOS Ltd. for Detailed Project Report (DPR) for **"Consultancy Services for Preparation of Detailed Project Report Including Technical and Financial Study in River Jhelum (NW-49)"**
- 0.5 Waterway using River Jhelum was used as traditional means of transportation in the Kashmir Valley. This was predominantly the reason why several cities, commercial establishment, educational institution, etc. developed around River Jhelum. The whole city developed around Waterway. However, with passage of time the roads have now become congested and the advantage of faster commuting, along with convenience has reduced. This has led to evaluation for reviving water transportation using river for intercity as well as intracity movement of passenger and cargo.
- 0.6 The objective of this report is to consolidate Phase wise development of various infrastructures for 24 hour navigation in River Jhelum. Before consolidation of the proposal, Data analysis based available data as well as data collected from various sources during site visit carried out by WAPCOS on 22<sup>nd</sup> July 2018. During preparation of this report, Model studies carried out by CWPRS Pune & Ongoing studies on flood routing studies in River Jhelum by WAPCOS have been analysed from the point of view of navigation. Also, infrastructure analysis for navigation has been framed based on fresh "Market Assessment Report" Prepared by WAPCOS in the month of April 2018 which was based on site visit by WAPCOS officials on 11<sup>th</sup> March 2018. Apart from above, detailed morphological studies based on available Landsat images (USGS site), Google earth images 0.7 has been

carried out for planning, designing and maintaining river engineering structures. Total 9 terminals have been proposed in River Jhelum;

Terminal No.	Tentative Location	Districts	Size	Chainage (km)
1	Pantha Chowk	Srinagar	50m x 5 m	133.20
2	Zero Bridge	Srinagar	50m x 5 m	122.36
3	Amira Kadal	Srinagar	50m x 5 m	121.07
4	Shah-e-Hambam bridge	Srinagar	50m x 5 m	117.91
5	Safa Kadal / Chattabal Shrine	Srinagar	50m x 5m	115.76
6	Sumbal Bridge	Ganderbal	50m x 5 m	91.90
7	Gund Parang	Bandipora	60m x 10m	74.42
8	Sangam Bridge	Anantnag	60m x 10m	179.60
9	Sopore	Baramulla	50m x 5 m	39.55

Traffic Potential:

Future Potential				
Name of Commodity	FY'22	FY'27	FY'37	FY'47
Passenger and Tourists (No.)	311,386	407,691	652,267	1,164,174
Cargo-Horticulture Products (Tons)	10,320	12,840	15,960	21,720

Development of terminals have been proposed in three phases, **In Phase 1-** Chhatabal to Pantha Chowk, **Phase-2-** Gund Parang to Sumbal, Sumbal to Chhatabal & Shah-E-Hambam to Sangam Bridge, **In Phase-3-** Sopore to Chhatabal.

Dredging quantity has been calculated based on Survey Report provided by IWAI. In **Phase-1-0.05 M.cum**, In **Phase-2-0.74 M.cum** & In **Phase-3-0.8** dredging quantity have been computed.

Bank Protection at terminal sites has been recommended.

0.7 Following are the main conclusion drawn from Model Studies:

- **At Sangam-**Maximum average water level is at EL 1588.91 m and Minimum average water level is at EL 1585.66 m which occurred in the months of September and December respectively. The water level increases linearly from January to may then recedes till the month of December with some maximum discharges in the period of September due to flood.
- **At Ram Munshi Bagh-** Maximum average water level is at EL 1588.55 m and Minimum average water level is at EL 1585.53 m Which occurred in the months of September and December respectively. The water level increases from January to may then recedes till the month of December with some maximum discharges in the period of September due to flood.
- **At Asham -**Maximum average water level is at EL 1579.37 m and Minimum average water level is at EL 1576.73 m which occurred in the months of May and December respectively. The water level increases from January

to may then recedes till the month of December with some maximum discharges in the period of September due to flood

- **At Sopore-** Maximum average water level is at EL 1576.44 m and Minimum average water level is at EL 1573.32 m Which occurred in the months of May and December respectively. The water level increases from January to may then recedes till the month of December with some maximum discharges in the period of September due to flood.
- **At Sangam** - From Gauge-Discharge curve it has been observed that level of EL 1588m w.r.t MSL is obtained at 500 cum/s discharge and goes upto level of EL 1596 m w.r.t MSL at 3500 Cum/s discharge later on there is no significant change in water level have been noticed.
- **At Ram Munshi Bagh-** From Gauge-Discharge curve it has been observed that level of of EL 1587 m w.r.t MSL is obtained at 500 cum/s discharge and goes upto level of EL 1594 m w.r.t MSL at 2000 Cum/s discharge later on there is no significant change in water level have been noticed due to wide area.
- **At Asham-** From Gauge-Discharge curve it has been observed that level of EL 1579.5 m w.r.t MSL is obtained at 500 cu.m/s discharge and goes upto level of EL 1582 m w.r.t MSL at 1400 Cum/s discharge later on there is no significant change in water level have been noticed.
- **At Sopore-** From Gauge-Discharge curve it has been observed that level of EL 1577 m w.r.t MSL is obtained at 500 cum/s discharge and goes upto level of EL 1579 m w.r.t MSL at 900 Cum/s discharge later on there is no significant change in water level have been noticed.
- Total 9 terminals are proposed on River Jhelum (NW-49) for passenger, tourist and cargo handling. Out of which, 3 terminals have been identified as multi-purpose terminals for handling both cargo and passenger/tourist traffic.
- From Sangam to Padshaibag reach of about 56 km will be suitable for class – I and II type waterways even for discharge 30 to 50 m<sup>3</sup>/s with marginal dredging at few isolated places. Depths 2 to 4 m will be available in most of reach.
- In reach of about 50 km from Padshahibagh to Baniyari( near outfall of Jhelum in Wullar lake) depths in range 0.5 m to 1.8 m will prevail for discharge of 50 m<sup>3</sup>/s as indicated in Table --. The total length of the reach with depths less than 2 m will be about 12 km. With dredging of the order of 0.5 m to 1.5 m in these reaches entire reach from Sangam to Baniyari will be suitable for class I & II.
- The Jhelum river reach of about 28 km from Wullar outfall near Ningli to LJHEP reservoir has some stretches with steep slopes and rapids. Even with discharge of 100 m<sup>3</sup>/s, depths of the order of 0.20 m to 1.80 m will prevail in this reach. Dredging in rocky bed may not be appropriate solution. Provision of couple of barrages with some localised dredging may give optimum solution. This aspect will be studied further on mathematical model.
- The reach from Baniyari to Ningli is about 30 km and it is Wullar lake itself. As per bathymetry survey report by TOJO- Vikas, in reach of about 14 km

(out of 30 km) depths are less than 1.2 m. In remaining reach depths are more than 2 m. Dredging or raising of lake level during lean season (by provision of gates at Wullar outfall at Ningli) may be possible solutions. During monsoon gates will be opened to pass flood and to lower water level in lake. This aspect will be studied further on mathematical model.

- The longitudinal slope of the river from Sangam to Wullar lake is comparatively uniform and thereby navigability can be achieved with ease. However, the bed elevations for the reach from Wullar exit to lower Jhelum HE project is comparatively varying and steeper. Hence, achieving navigability is difficult.
- The water depths along the Jhelum main channels from Sangam to Chattabal weir are already controlled by the channel slope itself and the chattabal weir. However, the reach from Chattabal weir to entry of Jhelum near baniyari are affected by the water levels existing in the Wullar Lake. The wullar lake water levels are controlled by the flow conditions over the crude weir at sopore. The available depths in the upstream channels during lean season flows can be boosted by either providing a barrage at the exit of wullar lake (Ninglee) or at the entry of the lake near Baniyari.
- The provision of Barrage or some structure near Baniyari that can raise water depth upstream up to chattabal weir is an easy option when compared with the barrage at the exit of wullar lake. The site location needs to investigate from other angles before proceeding. However, the investigated Tulbul barrage site location exists at the Wullar Lake exit.
- The safe grade elevations for the proposed jetties may be decided based on the HFL's given in the Table 1 of Chapter-8 (Model Studies)
- The final design of bank protection necessary near the proposed structures will be fine-tuned after the finalization of the structures and assessing the site conditions. For DPR the tentative designs could be based on velocities near terminal sites as mentioned in Table –I.
- Impact of Dredging: The flood is arriving at faster rate from the Sangam to RMB. This may have been caused by the channel improvement in the form of de-silting/dredging/sand mining undertaken earlier or being undertaken, at present, in this reach. This rate of flood wave propagation may also be possible because of construction of embankments. The effect of embankment construction will be more prominent if the embankments disconnect the low lying areas or avoid the flood water to spread into the flood plain disconnect the low lying areas or avoid the flood water to spread into the flood plain.
- Hence, unplanned dredging and de-silting or sand mining of channels should be avoided. The channels attain the regime on their own and human intervention should be minimized and; if at all necessary, should be based on sound reasoning not only including local effects, but also effects on upstream and downstream. it is strongly advised that the dredging of Jhelum main channel from Sangam to Asham must be avoided in future.
- Impact of channelization & Bank protection work: The present proposal of Irrigation & Flood control department for “Priority Works- Comprehensive

Plan for Flood Management Works on Jhelum- Phase-I” had been framed & executed at many places. This includes channelization & Bank protection work. Hence, As of now there is no need to channelize the flow again in order to avoid duplication.

0.8 Computed project costing in phase wise manner is shown below:

For **Phase-I** total capital cost of the project will be **Rs. 52.94 Crores.**

It includes the cost of terminal, land & its construction, Bank protection near terminals, Infrastructure requirement, Navigation & Communication Cost, Mechanical Handling Equipment and Dredging.

For **Phase-II** total capital cost of the project will be **Rs. 66.00 Crores.**

It includes the cost of terminal, land & its construction, Bank protection near terminals, Infrastructure requirement, Navigation & Communication Cost, Mechanical Handling Equipment and Dredging.

For **Phase-III** total capital cost of the project will be **Rs. 26.55 Crores.**

It includes the cost of terminal, land & its construction, Bank protection near terminals, Infrastructure requirement, Navigation & Communication Cost, Mechanical Handling Equipment and Dredging.

0.9 **Based on technical & financial feasibility only Phase-1 has been recommended for development in NW-49.**

## CHAPTER – 1 INTRODUCTION

### 1.0 Introduction

### 1.1 Project Background

The Govt. of India desires to explore the commercial navigation potential on year round basis in inland waterways. Ministry of Shipping (MoS), Govt. of India had directed Inland Waterways Authority of India (IWAI) to identify the viable waterways in India for their phased development.

Accordingly, to make provisions for existing national waterways and to provide for the declaration of certain inland waterways to be national waterways and also to provide for the regulation and development of the said waterways for the purposes of shipping and navigation, National waterway act, 2016 has received the assent of the President on the 25th March, 2016 declaring a total of 111 National Waterways.

Inland Water Transport (IWT) has the potential to form the most economic, reliable, safe and environment friendly mode of transport. When developed for use by modern inland waterway vessels, it can reduce investment needs in rail and road infrastructure, promote greater complementarities in the riparian states, enhance intra-regional trade and, through increased economies of scale, significantly reduce transport costs for the benefit of the entire economy and India's global trade competitiveness.

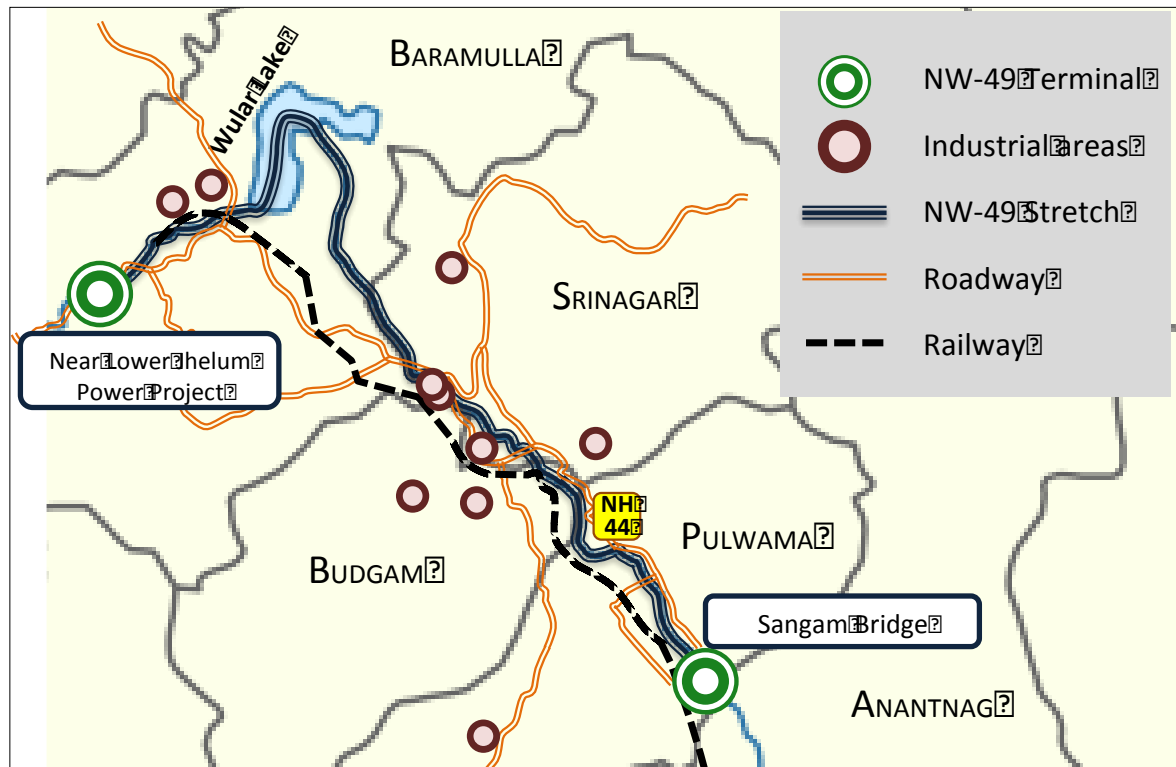
Inland Waterway Authority of India (IWAI) intends to explore transportation potential of National Waterway (NW) - 49. The proposed route **National Waterway 49 (River Jhelum) from Starting point of Downstream of Lower Jhelum Power Project at 34°09'02.17"N,74°11'34.15"E and End Point is Sangam Bridge at 33°49'25.20"N,75°03'49.87"E**. This stretch is 181.205 km long, and passes through Baramula, Srinagar, Ganderbal and Budgam etc.

### 1.2 Project Location / Details of Study Area

Jhelum River is a major river of India and Pakistan. It flows in the Indian and Pakistani controlled portions of Kashmir, and Punjab in Pakistan. It is a tributary of the Chenab River and has a total length of about 725 kilometers. The waters of the Jhelum are allocated to Pakistan under the terms of the Indus Waters Treaty. The length under consideration for present studies is detailed below:

<b>181.205 km length of the river from downstream of Lower Jhelum Power Project to Sangam Bridge (National Waterway 49)</b>	<b>From: 34°09'02.17"N, 74°11'34.15"E</b>	<b>Up to: 33°49'25.20"N 75°03'49.87"E</b>
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The following map charts the NW-49 stretch along with the prominent locations:



**Figure 1.1 Google Map showing NW-49 along with the prominent locations**

**1.3 The work Consultancy Services for Preparation of Detailed Project Report Including Technical and Financial Study in River Jhelum (NW-49) has been awarded to WAPCOS Limited vide Work order No. IWAI/HY/NW/JHELUM/DPR/2017-18 dated 16/02/2018 by IWAI. The scope of work of the study is as given below:**

- Collection and Review the Available Data and Reports.
- Undertake physical condition surveys of existing locks / barrages and associated works to establish backlog maintenance or other needs.
- Hydrographic and Topographic Survey.
- Market Survey and Analysis.
- Market Development.
- Market Trends.
- Waterway & Infrastructure Analysis
- Model study
- Financial Analysis
- Economic Analysis
- Socio Economic Environment Assessment
- Capacity Building and Financing
- Conducting stakeholder meeting along with IWAI and shall arrange for public hearing / Consultations in coordination with IWAI.

## CHAPTER – 2 WATERWAY/DETAILED HYDROGRAPHIC SURVEY

### 2.1 Hydrographic Survey

*This chapter is exclusively based on the survey report provided by IWAI. The survey was conducted in stretch of about 181.205KM from Lower Jhelum Power Project RD-178 to Sangam Dangpura Village (NW-49). The survey was carried out from 14th April 2018 to 28th August 2018 by M/s Tojo Vikas International Pvt. Ltd. All the data, figures, tables etc. are based on the Draft Report submitted by M/s Tojo Vikas to M/s IWAI.*

The purpose of detailed hydrographic survey was to determine the hydraulic features and existing conditions of the Jhelum River from Lower Jhelum Power project to Sangam 181.205 km length.

#### 2.1.1 Waterway in General and Hydro-morphological Characteristics

Jhelum River is a major river of India and Pakistan. It flows in the Indian and Pakistani controlled portions of Kashmir, and Punjab in Pakistan. It is a tributary of the Chenab River and has a total length of about 725 kilometres. The waters of the Jhelum are allocated to Pakistan under the terms of the Indus Waters Treaty. The length under consideration for present studies is detailed below:

<b>181.205 km length of the River from Lower Jhelum Power Project to Sangam (National Waterway - 49)</b>	<b>From: 34°09'02.17"N, 74° 11'34.15"E</b>	<b>Up to: 33°49'25.20"N, 75° 3'49.87"E</b>
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#### 2.1.2 Existing Hydrological / Topographical Reference levels

The reference Bench Mark for Bathymetric survey, Topographic survey and Pillars establishment is based on the information provided by officials of Irrigation & Flood Control Kashmir (IFCK), Srinagar. The reference bench mark was installed at Suleiman complex right bank of Jhelum River by Irrigation & Flood Control Kashmir (IFCK) with Lat 34°04'33.05"N Long 74°49'52.45"E and level erected (1598.663m from MSL) on Bench Mark provided. Tide pole was set up at every 10 km interval, for the duration of survey. The tide poles remained vertical during the course of survey and no shift was observed in the poles for the duration of survey. Bench Mark Pillars (Naming as JLM 1 to JLM 19) were constructed and erected along the River stretches from LJHP to Sangam Dangpura Village.

MSL was the vertical datum used for deducing the heights for spot levels obtained as part of the topographic survey.



**Figure 2.1- IFCK Reference Bench Mark**

**Table 2.1 : Accepted Station coordinates (WGS-84)**

Sl. No.	Station	Chainage	Latitude (N)	Longitude (E)	BM Height above MSL (m)	Source/ Type
		(km)				
1	BM (IFCK)	51.3	34°4' 33.00"N	74°49' 52.48"E	1598.664	48 Hrs Obs/Baseline Processed
2	JLM-19	0.665	34°9' 1.97"N	74°11' 59.10"E	1506.350	6 Hrs Obs/Baseline Processed
3	JLM-18	11.921	34°10'51.34"N	74°17'39.06"E	1567.680	6 Hrs Obs/Baseline Processed
4	JLM-17	24.726	34°13'21.48"N	74°22'51.90"E	1578.140	6 Hrs Obs/Baseline Processed
5	JLM-16	33.991	34°15'46.70"N	74°25'6.34"E	1579.530	6 Hrs Obs/Baseline Processed
6	JLM-15	44.262	34°17'15.06"N	74°30'35.25"E	1579.530	6 Hrs Obs/Baseline Processed
7	JLM-14	52.699	34°21' 26.43"N	74°31' 37.83"E	1577.930	6 Hrs Obs/Baseline Processed
8	JLM-13	64.238	34°24' 0.73"N	74°37' 57.08"E	1580.040	6 Hrs Obs/Baseline Processed
9	JLM12	74.634	34°20' 12.27"N	74°38' 7.14"E	1580.182	6 Hrs Obs/Baseline Processed
10	JLM11	81.454	34°17' 6.32"N	74°37' 30.62"E	1580.181	6 Hrs Obs/Baseline Processed
11	JLM10	92.161	34°13' 27.49"N	74°39' 12.55"E	1581.916	6 Hrs Obs/Baseline Processed
12	JLM09	103.271	34°8' 54.99"N	74°42' 43.26"E	1581.563	6 Hrs Obs/Baseline Processed
13	JLM08	111.09	34°6' 40.88"N	74°45' 9.63"E	1583.937	6 Hrs Obs/Baseline

Sl. No.	Station	Chainage	Latitude (N)	Longitude (E)	BM Height above MSL (m)	Source/ Type
		(km)				
						Processed
14	JLM07	122.016	34°4' 16.76"N	74°49' 22.47"E	1588.420	6 Hrs Obs/Baseline Processed
15	JLM06	132.832	34°2' 38.89"N	74°52' 22.82"E	1586.653	6 Hrs Obs/Baseline Processed
16	JLM05	140.838	34°1' 16.74"N	74°55' 2.60"E	1589.445	6 Hrs Obs/Baseline Processed
17	JLM04	149.88	33°57' 54.09"N	74°55' 21.63"E	1590.056	6 Hrs Obs/Baseline Processed
18	JLM03	154.147	33°57' 53.41"N	74°57' 0.36"E	1592.585	6 Hrs Obs/Baseline Processed
19	JLM02	165.628	33°54' 34.15"N	75°0' 48.87"E	1591.166	6 Hrs Obs/Baseline Processed
20	JLM01	179.087	33°50' 0.02"N	75°4' 6.71"E	1595.030	6 Hrs Obs/Baseline Processed

### 2.1.3 Chart Datum / Sounding Datum

As per the discussion with IWAI officials for fixing of Chart Datum/ Sounding Datum, minimum 10 years of data needed from CWC gauge / IFCK/ Weir in between waterway area. The datum for calculation of dredge volume needs to be adopted as per the gradient of the River and the average water level observed for the River in total stretch.

#### Transfer of Sounding Datum for Tidal stretch

River is Non Tidal so there is no need to transfer of sounding datum for tidal river.

#### Erected IWAI Benchmark Pillars

The final accepted coordinates and a Reference Level value of IWAI BM Pillars are as below

**Table 2.2: Accepted BM coordinates w.r.t. established CD**

Tide Gauge no.	Location	Chainage (km)	Latitude	Longitude	Easting	Northing	Period of Observation	Zero of Tide Gauge w.r.t. MSL (m)
Tide Pole 1	Peernia Baramulla	5.65	34°10' 16.901"N	74°14' 33.404"E	430196.908	3781415.620	22-Mar-18	1558.053
Tide Pole 2	Zamzam Pora	11.96	34°10' 52.667"N	74°17' 38.865"E	434952.564	3782483.200	24-Aug-18	1565.258
IFCK gauge	Baramulla	20.889	34°12'30.01"N	74°20'44.64"E				1572.15
Tide Pole 3	Khawaja Bagh	24.889	34°13' 21.588"N	74°22' 50.433"E	442956.022	3787018.304	24-Aug-18	1572.150
Tide Pole 4	Gore Seer	33.94	34°15' 52.776"N	74°25' 4.293"E	446407.538	3791654.897	20-Aug-18	1572.981
IFCK gauge	Ningli gauge is RJ 29	44.122	34°17'15.68"N	74°30'31.28"E				1572.15
Tide Pole 5	Ninglikul	44.31	34°17' 15.812"N	74°30' 38.310"E	454961.576	3794167.535	19-Mar-18	1574.525
Tide Pole 6	Watlab	52.96	34°21'	74°31' 59.354"E	457069.828	3802061.936	30-Mar-17	1575.123

Tide Gauge no.	Location	Chainage (km)	Latitude	Longitude	Easting	Northing	Period of Observation	Zero of Tide Gauge w.r.t. MSL (m)
			32.428"N					
Tide Pole 7	NUSHU	63.91	34°23' 52.342"N	74°36' 58.590"E	464729.823	3806339.482	27-Mar-18	1575.865
Tide Pole-8	Gund Prang	74.625	34°20' 12.484"N	74°38' 6.758"E	466445.943	3799561.09	26-Jul-18	1577.782
Tide Pole-9	Kosum Bagh	81.479	34°17' 5.689"N	74°37' 29.711"E	465478.148	3793811.03	22-Jul-18	1576.761
IFCK gauge	Asham	88.051	34°14'47.88"N	74°37'23.93"E	465314.62	3789566.91	-	1577.33
Tide Pole-10	Sumbal	92.159	34°13' 27.384"N	74°39' 11.366"E	468054.172	3787077.8	21-Jul-18	1575.666
Tide Pole-11	Abdullah Pora	103.212	34°8' 50.184"N	74°42' 39.378"E	473351.895	3778523.3	16-Aug-18	1576.761
IFCK gauge	Chattabal D/s	115.269	34° 5'23.19"N	74°46'59.01"E	479986.99	3772131.36	-	1578.7
Tide Pole-13	Nowshera	121.986	34°4' 16.663"N	74°49' 21.070"E	483623.762	3770075.31	Tide Pole - 13	1582.85
Tide Pole-14	Lasjan	132.843	34°2' 36.932"N	74°52' 18.251"E	488161.184	3766996.84	12-Aug-18	1581.833
Tide Pole-15	Zooni Pora	140.833	34°1' 17.007"N	74°55' 1.709"E	492350.123	3764530.85	11-Aug-18	1583.425
Tide Pole-16	Samboora	149.975	33°57' 50.488"N	74°55' 20.799"E	492834.88	3758169.82	11-Aug-18	1583.446
Tide Pole-17	Alchi Bagh	154.09	33°57' 51.910"N	74°56' 58.512"E	495342.505	3758212.05	10-Aug-18	1584.405
Tide Pole-18	Gaad Hanjipora	165.451	33°54' 37.287"N	75°0' 32.139"E	500825.31	3752216.72	10-Aug-18	1586.626
CWC gauge	Sangam	177.456	33°50'40.21"N	75° 3'22.82"E	505212.24	3744916.4	-	1585.32
Tide Pole-19	Sangam	179.27	33°49' 52.677"N	75°4' 4.920"E	506295.14	3743453.11	27-Jul-18	1588.452

### Description of erected Tide Gauges

**Table 2.3: Description of erected tide pole**

Tide Gauge no.	Location	Chainage (km)	Latitude	Longitude	Easting	Northing	Period of Observation	Zero of Tide Gauge w.r.t. MSL (m)
Tide Pole 1	Peernia Baramulla	5.65	34°10' 16.901"N	74°14' 33.404"E	430196.908	3781415.620	22-Mar-18	1558.053
Tide Pole 2	Zamzam Pora	11.96	34°10' 52.667"N	74°17' 38.865"E	434952.564	3782483.200	24-Aug-18	1565.258
IFCK gauge	Baramulla	20.889	34°12'30.01"N	74°20'44.64"E				1572.15
Tide Pole 3	Khawaja Bagh	24.889	34°13' 21.588"N	74°22' 50.433"E	442956.022	3787018.304	24-Aug-18	1572.150
Tide Pole 4	Gore Seer	33.94	34°15' 52.776"N	74°25' 4.293"E	446407.538	3791654.897	20-Aug-18	1572.981
IFCK gauge	Ningli gauge is RJ 29	44.122	34°17'15.68"N	74°30'31.28"E				1572.15
Tide Pole 5	Ninglikul	44.31	34°17' 15.812"N	74°30' 38.310"E	454961.576	3794167.535	19-Mar-18	1574.525
Tide Pole 6	Watlab	52.96	34°21' 32.428"N	74°31' 59.354"E	457069.828	3802061.936	30-Mar-17	1575.123
Tide Pole 7	NUSHU	63.91	34°23' 52.342"N	74°36' 58.590"E	464729.823	3806339.482	27-Mar-18	1575.865

Tide Gauge no.	Location	Chainage (km)	Latitude	Longitude	Easting	Northing	Period of Observation	Zero of Tide Gauge w.r.t. MSL (m)
Tide Pole-8	Gund Prang	74.625	34°20' 12.484"N	74°38' 6.758"E	466445.943	3799561.09	26-Jul-18	1577.782
Tide Pole-9	Kosum Bagh	81.479	34°17' 5.689"N	74°37' 29.711"E	465478.148	3793811.03	22-Jul-18	1576.761
IFCK gauge	Asham	88.051	34°14'47.88"N	74°37'23.93"E	465314.62	3789566.91	-	1577.33
Tide Pole-10	Sumbal	92.159	34°13' 27.384"N	74°39' 11.366"E	468054.172	3787077.8	21-Jul-18	1575.666
Tide Pole-11	Abdullah Pora	103.212	34°8' 50.184"N	74°42' 39.378"E	473351.895	3778523.3	16-Aug-18	1576.761
IFCK gauge	Chattabal D/s	115.269	34° 5'23.19"N	74°46'59.01"E	479986.99	3772131.36	-	1578.7
Tide Pole-13	Nowshera	121.986	34°4' 16.663"N	74°49' 21.070"E	483623.762	3770075.31	Tide Pole -13	1582.85
Tide Pole-14	Lasjan	132.843	34°2' 36.932"N	74°52' 18.251"E	488161.184	3766996.84	12-Aug-18	1581.833
Tide Pole-15	Zooni Pora	140.833	34°1' 17.007"N	74°55' 1.709"E	492350.123	3764530.85	11-Aug-18	1583.425
Tide Pole-16	Samboora	149.975	33°57' 50.488"N	74°55' 20.799"E	492834.88	3758169.82	11-Aug-18	1583.446
Tide Pole-17	Alchi Bagh	154.09	33°57' 51.910"N	74°56' 58.512"E	495342.505	3758212.05	10-Aug-18	1584.405
Tide Pole-18	Gaad Hanjipora	165.451	33°54' 37.287"N	75°0' 32.139"E	500825.31	3752216.72	10-Aug-18	1586.626
CWC gauge	Sangam	177.456	33°50'40.21"N	75° 3'22.82"E	505212.24	3744916.4	-	1585.32
Tide Pole-19	Sangam	179.27	33°49' 52.677"N	75°4' 4.920"E	506295.14	3743453.11	27-Jul-18	1588.452

### Chart Datum / Sounding Datum and Reduction Details

As per discussion with IWAI officials, the Established gauge and newly erected tide pole were used for calculation of chart datum. The total of three established CD were available, with the help of these established chart datum the values of the erected tide pole was calculated. The same was cross verified with the available data of water level at different places.

**Table 2.4: Chart Datum/Sounding Datum**

S. No.	CWC gauge / Dam / Barrage / Weir / Anicut / Bench Mark / tide gauges	Chainage (km)	Stretch for corrected soundings and topo levels (km) C		Established Sounding Datum w.r.t. MSL (m)	Sounding Datum (m) from MSL	Correction in WL data for Bathymetric survey (m)	Topo level data to be converted as depth for volume calculation wrt SD (m)
			(50% stretch is to be selected on both side of tide gauge)					
			From	To				
1		1	0	1		1489.962	Details at Annexure-III. (Data)	A separate xyz file is to create
2		2	1	2		1496.611		

3		3	2	3		1504.188	Provide in Digital Format)
4		4	3	4		1517.633	
5		5	4	5		1534.811	
6	Tide Pole 1	6	5	6		1552.517	
7		7	6	7		1558.847	
8		8	7	8		1558.998	
9		9	8	9.685		1560.68	
10	Tide Pole 2	11.96	9.685	17.0		1562.804	
11	Baramulla IFCK	20.889			1571.55	1571.55	
12	Tide Pole 3	24.889	17.0	26.0		1571.922	
13	Tide Pole 4	33.94	26.0	39.0		1572.826	
14	Ningli IFCK	44.122			1573.82	1573.82	
15	Tide Pole 5	44.31	39.0	47.0		1573.835	
16	Tide Pole 6	52.96	47.0	58.0		1574.503	
17	Tide Pole 7	63.91	58.0	70.935		1575.355	
18	Tide Pole 8	74.625	70.935	76.135		1576.21	
19	Tide Pole-9	81.479	76.135	86.735		1576.70	
20	IFCK gauge	88.051			1577.33	1577.33	
21	Tide Pole-10	92.159	86.735	97.735		1577.54	
22	Tide Pole-11	103.212	97.735	107.135		1578.10	
23	Tide Pole-12	111.025				1578.49	
24	CHATTABAL IFCK gauge	115.269	107.135	116.435	1578.7	1578.70	
25	Tide Pole-13	121.986	116.435	127.335		1580.53	
26	RAM MUNSHIBAGH	122.728			1580.77	1580.77	
27	Tide Pole-14	132.843	127.335	136.735		1581.61	
28	Tide Pole-15	140.833	136.735	145.335		1582.27	
29	Tide Pole-16	149.975	145.335	152.035		1583.03	
30	Tide Pole-17	154.09	152.035	159.875		1583.38	
31	Tide Pole-18	165.451	159.875	172.395		1584.34	
32	SANGAM IFCK	177.456			1585.32	1585.32	
33	Tide Pole-19	179.27	172.395	181.205		1585.46	

### High Flood Level (H.F.L.) and Maximum WL/Full Reservoir Level (MWL/FRL)

Data collected (Maximum Flood Level (MFL) and Minimum Water Levels (MWL) at Cross Structures in Jhelum River is purely based on field observations.

**Table 2.5: Maximum Flood Level (MFL) and Minimum Water Levels (MWL) at Cross Structures in Jhelum River**

S. No.	Location and description of CWC gauge / Dam / Barrages / Weirs / Anicut / Locks / Aqueducts / BM	Cross-Structure details	Chainage (km)	Established HFL / MHWS / FSL / MWL / FRL w.r.t. MSL (m)	Computed HFL at Cross-Structures w.r.t. MSL (m)
1	BIMYAR	BIMYAR	0.687		1497.506
2	Peernia Baramulla	Near Peernia Baramulla	5.497		1541.223
3	Peernia Baramulla	Peernia Foot Bridge	5.84		1544.390
4	Zehem Pora	gantamula bridge	9.685	1564.995	1564.996
5	KHADANYAR	Suspension Bridge	15.286		1572.005
6	KHANPORA	new bridge between khanpora	19.93		1577.816
7	Khanpura	baramulla old bridge	20.327		1578.313
8	Khanpura	Cement Bridge	20.541		1578.581
9	Khanpura(Pipe Line)	Khanpura(Pipe Line)	20.541		1578.581
10	Azad Gunj	Azad Gunj	20.796	1578.9	1578.9
11	Dewan Bagh	Dewan Bagh Suspension Bridge	21.293		1578.937
12	LADOORA	LADOORA	28.5		1579.476
13	Badami Bagh	Sopore Bypass Bridge	38.434		1580.218
14	Sopore	Sopore New Bridge	39.376		1580.288
15	SOPOR(Pipe LINE)	SOPOR old wood gridge (Pipe LINE)	39.376		1580.288
16	Sopore	Sopore old wood bridge	39.403		1580.29
17	Sopore	JAMIA QADEEM BRIDGE	40.38		1580.363
18	Ninglikul	Ninglikul	44.312	1580.657	1580.657
19	Rakh Hajin	Hajin Bridge	80.12	1581.18	
20	Push Wari	Push Wari Bridge	88.07		1582.14
21	Sumbal	Sumbal Bridge	91.69	1582.48	
22	Bat Pora Dab	Shadipora Road Bridge	97.28	1582.84	
23	Takan Wari Pora	Takan Wari Pora Bridge	106.39		1583.00
24	Shalateng	Under Construction Bridge	111.03		-
25	Shalateng	Shalteng Palpora Pipe Line Crossing	111.07	1584.46	
26	Guri Pora	Parim Pora	112.04		1584.46
27	Shongli Pora	Cement kadal Bridge	114.85	1584.58	
28	Palayarbal	Weir Chattabal	115.42	1584.91	
29	Nalbandpora	Safa Kadal Bridge	116.13	1584.98	
30	Lokhriyaar	Nawa Kadal Bridge	116.86	1585.22	
31	Sokalipora	Ali Kadal Bridge	117.23	1585.47	

S. 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)
32	Maharajganj	Old Zaina Kadal Bridge	117.64		1585.58
33	Shamswari	New Zaina Kadil Bridge	117.76	1585.58	
34	Zaldagar	Old Fateh Kadal Bridge	118.18		1585.77
35	Chinkral Mohalla	Fathe Kadal-Bad Dem Bridge	118.32	1585.96	
36	kani Kadal	Old Habba Kadal Bridge	118.97		1585.96
37	Habba Kadal	Habba Kadal Bridge	119.02	1586.19	
38	Basant Bagh	MA Road Bridge	120.11		1586.19
39	Hari Singh High Street	Amira Kadal Bridge	120.33	1586.56	
40	Lal Mandi	Foot Over Bridge	120.97	1586.63	
41	Munshi Bagh	Abdullah Bridge	122.50	1586.84	
42	Munshi Bagh	Zero Bridge	122.70	1587.36	
43	Aramwari	Sonwar Bagh Foot Bridge	123.54		1587.36
44	Soitang	Bridge under construction Bagandhar	130.76		
45	Athwagan	New Lasjan Bridge	133.39		1587.00
46	Athwagan	Lasjan Bridge	133.41		1587.00
47	Ali Abad	Ali Abad Bridge under construction	135.58		-
48	Pampore	Zooni Pora Bridge	141.21		1588.66
49	Pampore	Kadlabal Bridge	142.43	1588.66	
50	Kandizal	Bridge under construction Near Kandizal	151.52		1589.75
51	Kakapora	Kakapora Bridge	155.48	1589.75	
52	Bander Pora Cherat	Bridge connecting haji bal and lethapora	158.27		1589.75
53	Manwaji	Iron Bridge	159.32		
54	Kanil Bagh	Bridge Bridge under construction			
55	Kanil Bagh	Bridge under construction Near Kanil Bagh	159.35		
56	Near Padgampora	Padgampora bridge	165.61	1591.86	
57	Chersoo Awantipora	Chersoo awantipora Bridge	170.94	1593.28	
58	Sangam Village	Sangam Bridge	179.54	1594.99	
59	Sangam Village	Sangam Bridge	179.57	1595.00	
60	Niyana	Niyana Bridge	180.73		1595.00

## Average Bed Slope

Table 2.6: Average Bed Slope

Reach (km)		River / Canal Bed Level Change (m) A	Distance (m) B	Slope A/B
From	To			
0.00	9.685	67.537	9685	0.006973
9.685	39.685	13.010	30000	0.000434
39.685	70.935	2.030	31250	0.000065
70.935	100.00	1.543	29065	0.000053
100.00	130.00	3.817	30000	0.000127
130.00	160.00	2.166	30000	0.000072
160.00	181.205	4.184	21205	0.000197

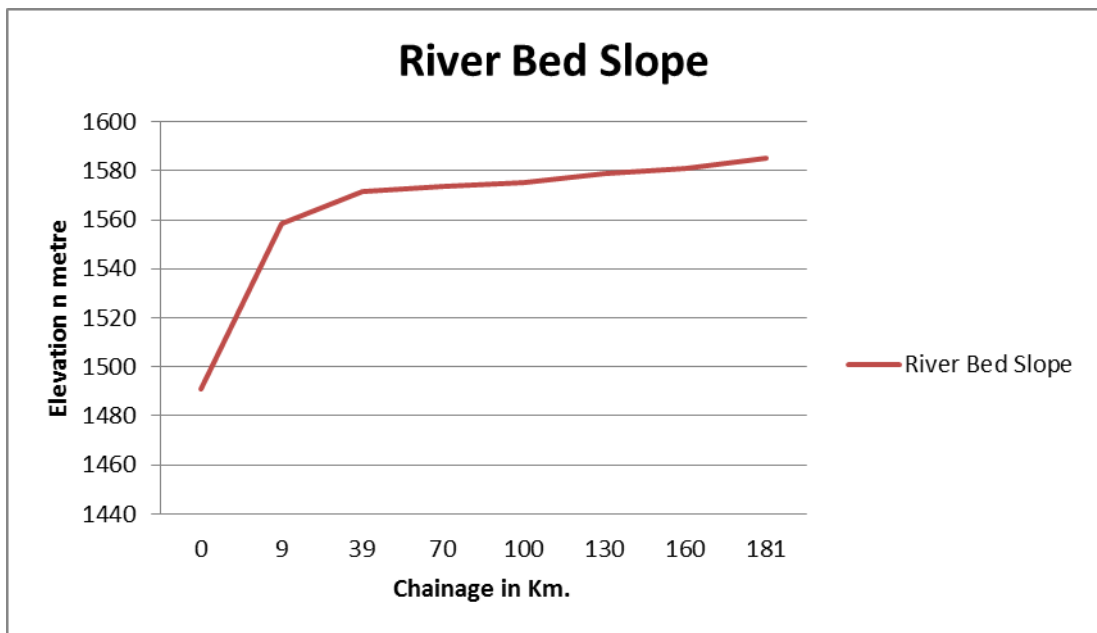


Figure 2.2 – Average Bed Slope of Extended Jhelum River Stretch

## 2.2 Existing Cross Structures

### 2.2.1 Salient features of Dam, Barrages, Weirs, Anicut, Locks, Aqueducts

No Dam, Anicut, Aqueducts are present on site. Only Chattabal Weir with Navigational lock is present on site.

One Gantamula Barrage on upstream side of Lower Jhelum Power project is present.

## 2.2.2 Details of Cross-structures in Jhelum River

**Table 2.7: Bridges and Cross Structure in Jhelum River**

SI 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	BIMYAR	0.69	RCC	BIMYAR	34°9'1.599"N	34°8'58.669"N	426258.13	426276.932	100	6.5	3	60	2.5	complete
					74°12'0.265"E	74°12'1.027"E	3779126.1	3779035.72						
2	Near Peernia Baramulla	5.50	RCC	Peernia Baramulla	34°10'15.405"N	34°10'12.289"N	430038.67	430080.643	0	0	0	0	2	uncomplete
					74°14'27.237"E	74°14'28.904"E	3781370.7	3781274.41						
3	Peernia Foot Bridge	5.84	RCC	Peernia Baramulla	34°10'21.380"N	34°10'19.872"N	430300.56	430363.494	70	2	2	70	0.5	complete
					74°14'37.413"E	74°14'39.885"E	3781552.8	3781505.89						
4	Gantamula bridge	9.69	RCC	Zehem Pora	34°11'0.227"N	34°10'56.2048"N	432940.82	432919.827	115	7	0	0	-	complete
					74°16'20.2115"E	74°16'19.425"E	3782730.2	3782606.43						
5	Suspension Bridge	15.29	RCC	KHADANYAR	34°11'40.424"N	34°11'42.695"N	435283.1	435335.467	90	2.5	2	90	0.5	complete
					74°17'51.381"E	74°17'53.409"E	3783951.9	3784021.53						
6	new bridge between khanpora	19.93	RCC	KHANPORA	34°12'32.118"N	34°12'28.658"N	438870.28	438856.968	100	10	4	50	2.5	complete
					74°20'11.132"E	74°20'10.639"E	3785520.2	3785413.74						
7	baramulla old bridge	20.33	RCC	Khanpura	34°12'35.962"N	34°12'32.05"N	439221.17	439241.812	0	0	0	0	-	under construction
					74°20'24.814"E	74°20'25.651"E	3785636.3	3785515.7						
8	Cement Bridge	20.54	RCC	Khanpura	34°12'38.677"N	34°12'31.886"N	439444.25	439441.678	##	10	4	35	2.5	complete
					74°20'33.511"E	74°20'33.463"E	3785718.5	3785509.38						
9	Khanpura(Pipe Line)	20.54		Khanpura (Pipe Line)	34°12'38.677"N	34°12'31.886"N	439444.25	439441.678	135	10	6	0	2.5	complete
					74°20'33.5115"E	74°20'33.463"E	3785718.5	3785509.38						

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						
10	Azad Gunj	20.80	RCC	Azad Gunj	34°12'35.621"N	34°12'31.5693"N	439714.08	439659.493	135	10	6	50	2.5	complete
					74°20'44.0798"E	74°20'41.977"E	3785622.7	3785498.2						
11	Dewan Bagh Suspension Bridge	21.29	RCC	Dewan Bagh	34°12'29.363"N	34°12'26.058"N	440157.81	440130.38	100	6	2	100	0.3	complete
					74°21'1.4679"E	74°21'0.421"E	3785427.1	3785325.44						
12	LADOORA	28.50	RCC	LADOORA	34°15'11.264"N	34°15'5.201"N	443939.52	443964.023	178	10	5	44	2	complete
					74°23'28.083"E	74°23'29.085"E	3790390.6	3790203.75						
13	Sopore Bypass Bridge	38.43	RCC	Badami Bagh	34°16'37.354"N	34°16'30.364"N	449808.03	449765.711	218	10	6	44	2	complete
					74°27'16.979"E	74°27'15.369"E	3793009.2	3792794.08						
14	Sopore New Bridge	39.38	RCC	Sopore	34°16'36.114"N	34°16'30.448"N	450611.52	450699.426	182	10	6	36	3	complete
					74°27'48.411"E	74°27'51.885"E	3792966.7	3792791.69						
15	SOPOR old wood gridge (Pipe LINE)	39.38	RCC	SOPOR(Pipe LINE)	34°16'36.114"N	34°16'30.448"N	450611.52	450699.426	170	8	11	16	3	complete
					74°27'48.411"E	74°27'51.885"E	3792966.7	3792791.69						
16	SOPOR Old wood gridge	39.40	RCC	Sopore	34°16'35.809"N	34°16'31.090"N	450646.17	450715.382	170	8	11	16	3	complete
					74°27'49.768"E	74°27'52.505"E	3792957.1	3792811.39						
17	JAMIA QADEEM BRIDGE	40.38	RCC	Sopore	34°16'58.134"N	34°16'54.319"N	451295.065	451384.325	140	8	4	70	1.5	complete
					74°28'15.006"E	74°28'18.521"E	3793641.371	3793523.384						
18	Ninglikul	44.31	RCC	Ninglikul	34°17' 17.663"N	34°17' 15.4428"N	454956.462	454967.344	50	4	4	13	0.5	complete
					74°30' 38.100"E	74°30' 38.538"E	#####	3794156.115						
19	Hajin Bridge	80.12	RCC	Rakh Hajin	34°17' 45.60"N	34°17' 41.42"N	465442.73	465460.164	140	7	4	35	1.9 1	complete
					74°37' 28.14"E	74°37' 28.84"E	3795040.7	3794911.82						
20	Push Wari Bridge	88.07	RCC	Push Wari	34°14' 48.04"N	34°14' 54.88"N	465346.14	465393.492	220	4	4	60	0.9	complete

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						
					74°37' 25.16"E	74°37' 26.98"E	3789572	3789782.26						
21	Sumbal Bridge	91.70	RCC	Sumbal	34°13' 41.96"N	34°13' 43.91"N	467868.05	468042.384	200	9	5	40	2.1	complete
					74°39' 4.03"E	74°39' 10.83"E	3787527.7	3787586.91						
22	Shadipora Road Bridge	97.28	RCC	Bat Pora Dab	34°11' 9.29"N	34°11' 11.73"N	469895.11	470090.073	220	8	6	35	2.1	complete
					74°40' 23.82"E	74°40' 31.72"E	3782819	3782889.53						
23	Takan Wari Pora Bridge	106.39	RCC	Takan Wari Pora	34°7' 42.01"N	34°7' 46.48"N	474194.17	474199.702	180	11	5	40	2	complete
					74°43' 12.49"E	74°43' 12.69"E	3776421.2	3776559.03						
24	Under Construction Bridge	111.04	RCC	Shalateng	34°6' 38.42"N	34°6' 42.00"N	477026.79	477143.516	-	-	-	-	-	under - construction
					74°45' 3.65"E	74°45' 7.81"E	3774483.6	3774565.25						
25	Shalteng Palpora Pipe Line Crossing	111.07	RCC	Shalateng	34°6' 38.56"N	34°6' 51.60"N	477057.77	477160.15	150	3	5	30	0.8	complete
					74°45' 4.47"E	74°45' 8.30"E	3774459.5	3774530.81						
26	Parim Pora	112.04	RCC	Guri Pora	34°6' 22.94"N	34°6' 26.51"N	477894.11	477874.253	110	4	4	30	1.1	complete
					74°45' 37.16"E	74°45' 36.38"E	3773976.5	3774086.56						
27	Cement kadal Bridge	114.85	RCC	Shongli Pora	34°5' 31.88"N	34°5' 34.38"N	479637.59	479714.102	135	6	4	30	2.4	complete
					74°46' 45.35"E	74°46' 48.33"E	3772399.8	3772476.75						
28	Weir Chattabal	115.42	RCC	Palayarbal	34°5' 22.66"N	34°5' 27.56"N	80171.458	480173.884	140	5	-	-	0	complete
					74°47' 6.21"E	74°47' 6.29"E	3772114.7	3772265.8						
29	Safa Kadal Bridge	116.14	RCC	Nalbandpora	34°5' 26.78"N	34°5' 29.24"N	480878.86	480836.594	100	18	3	30	1.3	complete
					74°47' 33.80"E	74°47' 32.15"E	3772240.3	3772316.03						
30	Nawa Kadal Bridge	116.87	RCC	Lokhriyaar	34°5' 40.99"N	34°5' 43.21"N	481457.06	481427.341	80	10	4	20	1.4	complete
					74°47' 56.33"E	74°47' 55.17"E	3772676.6	3772745.09						

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						
31	Ali Kadal Bridge	117.23	RCC	Sokalipora	34°5' 42.98"N	34°5' 45.28"N	481785.86	481813.777	82	10	3	30	1.75	complete
					74°48' 9.16"E	74°48' 10.24"E	3772737.3	3772808.14						
32	Old Zaina Kadal Bridge	117.64	RCC	Maharajganj	34°5' 36.94"N	34°5' 38.49"N	482115.65	482179.646	100	9	3	30	1.64	complete
					74°48' 22.04"E	74°48' 24.54"E	3772550.6	3772598.26						
33	New Zaina Kadil Bridge	117.77	RCC	Shamswari	34°5' 33.73"N	34°5' 34.46"N	482171.98	482228.41	100	17	4	27	1.33	complete
					74°48' 24.25"E	74°48' 26.45"E	3772451.6	3772474.15						
34	Old Fateh Kadal Bridge	118.18	RCC	Zaldagar	34°5' 20.59"N	34°5' 20.34"N	482144.87	482208.634	70	3.6	3	20	4.17	complete
					74°48' 23.22"E	74°48' 25.71"E	3772047.1	3772039.16						
35	Fathe Kadal-Bad Dem Bridge	118.32	RCC	Chinkral Mohalla	34°5' 16.14"N	34°5' 15.85"N	482126.76	482175.474	80	12	4	20	3.98	complete
					74°48' 22.52"E	74°48' 24.43"E	3771910.2	3771901.07						
36	Old Habba Kadal Bridge	118.97	RCC	kani Kadal	34°4' 55.18"N	34°4' 55.20"N	482080.99	482141.016	80	9	4	20	2.05	complete
					74°48' 20.79"E	74°48' 23.13"E	3771264.4	3771265.04						
37	Habba Kadal Bridge	119.03	RCC	Habba Kadal	34°4' 53.18"N	34°4' 53.31"N	482077.36	482124.015	140	12	3	44	1.82	complete
					74°48' 20.65"E	74°48' 22.47"E	3771202.9	3771207.01						
38	MA Road Bridge	120.13	RCC	Basant Bagh	34°4' 17.82"N	34°4' 17.88"N	482119.03	482202.431	94	26	2	43	1.46	complete
					74°48' 22.35"E	74°48' 25.61"E	3770114	3770115.52						
39	Amira Kadal Bridge	120.34	RCC	Hari Singh High Street	34°4' 10.84"N	34°4' 11.11"N	482135.01	482246.494	110	14	4	20	3.86	damaged
					74°48' 22.99"E	74°48' 27.3"E	3769898.8	3769907.05						
40	Foot Over Bridge	120.97	RCC	Lal Mandi	34°4' 4.16"N	34°4' 7.34"N	482719.36	482670.777	120	4	3	35	0.75	complete
					74°48' 45.81"E	74°48' 43.90"E	3769692	3769789.89						
41	Abdullah Bridge	122.51	RCC	Munshi Bagh	34°4' 9.63"N	34°4' 15.03"N	484106.41	484141.371	180	10	6	50	3.3	complete

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						
					74°49' 39.91"E	74°49' 41.26"E	3769858	3770024.36						
42	Zero Bridge	122.71	RCC	Munshi Bagh	34°4' 10.18"N	34°4' 13.72"N	484314.7	484321.854	160	12	4	40	1.35	complete
					74°49' 48.04"E	74°49' 48.31"E	3769874.7	3769983.65						
43	Sonwar Bagh Foot Bridge	123.53	Iron	Aramwari	34°4' 9.73"N	34°4' 12.67"N	485129.88	485162.386	120	1.6	4	26	1.14	complete
					74°50' 19.84"E	74°50' 21.10"E	3769859.4	3769949.83						
44	Bridge under construction Bagandhar	130.76	RCC	Soitang	34°3' 15.41"N	34°3' 15.92"N	486975.37	487101.634	-	-	-	-	-	under - construction
					74°51' 31.93"E	74°51' 36.86"E	3768183.6	3768199.26						
45	New Lasjan Bridge	133.39	RCC	Athwagan	34°2' 18.29"N	34°2' 19.80"N	488107.32	488274.943	200	8	6	40	2.5	complete
					74°52' 16.17"E	74°52' 22.71"E	3766423	3766469.24						
46	Lasjan Bridge	133.42	RCC	Athwagan	34°2' 17.42"N	34°2' 18.92"N	488117.71	488276.473	200	8	6	40	2	complete
					74°52' 16.58"E	74°52' 22.77"E	3766396.2	3766442.08						
47	Ali Abad Bridge under construction	135.58	RCC	Ali Abad	34°2' 7.07"N	34°2' 11.92"N	489950.69	489998.75	-	-	-	-	-	under - construction
					74°53' 28.08"E	74°53' 29.95"E	3766075.3	3766224.36						
48	Zooni Pora Bridge	141.20	RCC	Pampore	34°1' 12.55"N	34°1' 8.94"N	491981.71	492022.659	126	3.9	4	25	0.84	complete
					74°54' 47.34"E	74°54' 48.94"E	3764394	3764282.71						
49	Kadlabal Bridge	142.43	Iron	Pampore	34°0' 40.52"N	34°0' 43.23"N	491588.02	491700.43	148	7.6	2	70	4.34	complete
					74°54' 32.03"E	74°54' 36.41"E	3763408	3763491.19						
50	Bridge under construction Near Kandizal	144.78	RCC	Kandizal	33°59' 34.87"N	33°59' 37.13"N	492550.38	492707.767	200	9	3	60	-	under - construction
					74°55' 9.61"E	74°55' 15.74"E	3761385.1	3761454.51						
51	Kakapora Bridge	151.53	RCC	Kakapora	33°57' 6.33"N	33°57' 12.03"N	493265.9	493290.408	200	7.5	5	40	2.25	complete
					74°55' 37.63"E	74°55' 38.58"E	3756809.5	3756985.13						

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						
52	Bridge connecting haj i bal and lethapora	155.47	Iron	Bander Pora Cherat	33°57' 40.52"N	33°57' 41.41"N	496475.86	496594.013	150	2.6	3	50	1.75	complete
					74°57' 42.68"E	74°57' 47.28"E	3757860.8	3757888.2						
53	Iron Bridge	158.27	Iron	Manwaji	33°56' 56.50"N	33°56' 55.78"N	498227.65	498319.756	130	2.5	3	45	1.25	complete
					74°58' 50.94"E	74°58' 54.53"E	3756504.6	3756482.36						
54	Bridge Bridge under construction	159.33	RCC	Kanil Bagh	33°56' 28.86"N	33°56' 34.14"N	498754.51	498822.603	-	-	-	-	-	under - construction
					74°59' 11.48"E	74°59' 14.13"E	3755653.3	3755815.76						
55	Bridge under construction Near Kanil Bagh	159.36	RCC	Kanil Bagh	33°56' 28.89"N	33°56' 33.34"N	498776.3	498833.082	200	14	4	50	-	under - construction
					74°59' 12.32"E	74°59' 14.54"E	3755654.1	3755791.32						
56	Padgampora bridge	165.61	RCC	Near Padgampora	33°54' 31.07"N	33°54' 32.24"N	500823.32	500937.272	200	7.5	4	50	6.14	complete
					75°0' 32.06"E	75°0' 36.49"E	3752025.5	3752061.49						
57	Chersoo awantipora Bridge	170.94	RCC	Chersoo Awantipora	33°52' 58.82"N	33°53' 3.74"N	502320.31	502329.945	165	4	5	30	3.61	complete
					75°1' 30.32"E	75°1' 30.70"E	3749184.5	3749335.81						
58	Sangam Bridge	179.54	RCC	Sangam Village	33°49' 48.54"N	33°49' 51.832"N	506542.29	506540.191	145	9	5	30	0.5	complete
					75°4' 14.53"E	75°4' 14.454"E	3743326.1	3743427.24						
59	Sangam Bridge	179.57	RCC	Sangam Village	33°49' 47.49"N	33°49' 51.86"N	506571.07	506568.08	135	8	5	30	2.2	complete
					75°4' 15.65"E	75°4' 15.5"E	3743293.7	3743428.22						

### 2.2.3 Details of High Tension Lines / Electric lines / Tele-communication lines

HFL data collected at cross structures based on field observation is interpolated at each chainage of electric line crossings for the vertical clearance.

**Table 2.8 - Electric Lines in Jhelum River**

S.N	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	HT Line	0.375	BIMYAAR	34°9' 5.060"N	34°8' 57.501"N	425596.829	426090.660	2	547	16	Complete
				74°11' 34.408"E	74°11' 53.764"E	3779237.942	3779001.201				
2	HT Line	0.88	BIMYAAR	34°9' 9.988"N	34°9'0.063"N	426406.042	426466.7489	2	312	15	complete
				74°12' 5.962"E	74°12' 8.426"E	3779383.387	3779077.179				
3	HT Line	1.8	BIMYAAR	34°9' 18.702"N	34°9' 13.759"N	427107.139	427135.2712	2	155	14	complete
				74°12' 33.260"E	74°12'34.404"E	3779646.34	3779493.873				
4	HT Line	5.879	POSHWAN COLONY	34°10' 22.162"N	34°10' 19.313"N	430313.643	430498.5924	2	206	16	complete
				74°14' 37.917"E	74°14' 45.167"E	3781576.786	3781487.68				
5	Electric Line	6	POSHWAN COLONY	34°10' 24.84"N	34°10' 22.308"N	430394.382	430584.6453	2	208	13	complete
				74°14' 41.047"E	74°14' 48.502"E	3781658.794	3781579.295				
6	Electric Line	7.423	Near POSHWAN COLONY	34°10' 49.894"N	34°10' 42.707"N	431062.092	431053.4752	2	221	12	complete
				74°15' 6.908"E	74°15' 6.635"E	3782425.506	3782204.199				
7	HT Line	10.439	PEERNIA BARAMULL	34°10' 52.366"N	34°10' 46.703"N	433524.053	433658.327	2	220	14	complete

S.N	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				
			A	74°16' 43.062"E	74°16' 48.356"E	3782483.923	3782308.518				
8	HT Line	11.799	GANTAMU LA BRIDGE	34°19' 29.334"N	34°10' 48.223"N	466751.973	434859.928	2	108	16	complete
				74°38' 18.920"E	74°17' 35.283"E	3798230.909	3782346.937				
9	Electric Line	12.757	GANTAMU LA BRIDGE	34°10' 58.765"N	34°10' 55.160"N	435639.9847	435661.195	2	113	12	complete
				74°18' 5.669"E	74°18' 6.527"E	3782666.299	3782555.11				
10	HT Line	12.982	NEAR GANTAMU LA BRIDGE	34°11' 1.020"N	34°10' 57.014"N	435903.604	435831.79	2	142	15	complete
				74°18' 15.949"E	74°18' 13.176"E	3782733.938	3782611.039				
11	Electric Line	13.059	NEAR GANTAMU LA BRIDGE	34°11' 1.096"N	34°10' 58.640"N	435918.111	435964.192	2	88	11	complete
				74°18' 16.515"E	74°18' 18.335"E	3782736.199	3782660.209				
12	Electric Line	13.34	SHALTAING	34°11' 5.877"N	34°11' 0.766"N	436151.36	436244.1389	2	183	10	complete
				74°18' 25.588"E	74°18' 29.254"E	3782881.864	3782723.819				
13	Electric Line	13.346	SHALTAING	34°11' 5.840"N	34°11' 0.886"N	436154.635	436258.9522	2	185	10	complete
				74°18' 25.716"E	74°18' 29.832"E	3782880.716	3782727.41				
14	Electric Line	13.765	NEAR SHALTAING	34°11' 12.129"N	34°11' 14.620"N	436235.995	436299.577	2	99	10	complete
				74°18' 28.843"E	74°18' 31.307"E	3783073.884	3783150.178				
15	Elect	13.79	SHEERI	34°11' 12.304"N	34°11' 15.294"N	436228.2	436276.254	2	99	10	complete

S.N	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				
	Electric Line			74°18' 28.537"E	74°18' 30.390"E	3783079.316	3783171.101				
16	HT Line	13.857	SHEERI	34°11' 12.304"N	34°11' 15.294"N	436228.2	436276.254	2	103	15	complete
				74°18' 28.537"E	74°18' 30.390"E	3783079.316	3783171.101				
17	Electric Line	14.999	NEAR SHEERI	34°11' 13.597"N	34°11' 16.520"N	436157.51	436229.088	2	114	15	complete
				74°18' 25.765"E	74°18' 28.538"E	3783119.626	3783209.167				
18	Electric Line	17.315	POLICE TRAINING COLLEGE	34°11' 29.133"N	34°11' 31.953"N	435217.8995	435406.795	2	207	13	complete
				74°17' 48.928"E	74°17' 56.284"E	3783604.597	3783690.17				
19	Electric Line	19.272	JALSHERI	34°12' 16.069"N	34°12' 14.707"N	436505.695	436602.989	2	106	12	complete
				74°18' 38.860"E	74°18' 42.673"E	3785041.567	3784998.962				
20	Electric Line	20.743	KHANPORA	34°12' 39.323"N	34°12' 36.599"N	438255.1988	438238.834	2	85	11	complete
				74°19' 47.039"E	74°19' 46.421"E	3785746.186	3785662.371				
21	Electric Line	22.008	CEMENT BRIDGE	34°12' 35.820"N	34°12' 32.112"N	439663.557	439587.3351	2	136	10	complete
				74°20' 42.103"E	74°20' 39.153"E	3785629.113	3785515.389				
22	Electric Line	32.474	AZAD GUNJ	34°12' 35.241"N	34°12' 30.679"N	440803.232	440869.1215	2	155	13	complete
				74°21' 26.645"E	74°21' 29.254"E	3785604.026	3785463.089				
23	Electric Line	33.482	NAWGAM	34°15' 28.756"N	34°15' 27.939"N	445241.699	445393.145	2	153	10	complete
				74°24' 18.874"E	74°24' 24.801"E	3790921.754	3790895.7				
24	Electric Line	34.081	DARPORA	34°15' 55.093"N	34°15' 50.95"N	445934.834	445969.262	2	132	9	complete
				74°24' 45.793"E	74°24' 47.168"E	3791728.957	3791601.173				

S.N	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				
25	Electric Line	35.246	DOABGAH	34°16' 0.033"N	34°15' 51.224"N	446418.758	446605.4412	2	330	10	complete
				74°25' 4.682"E	74°25' 12.043"E	3791878.363	3791605.939				
26	Electric Line	36.236	GORE SEER	34°15' 45.663"N	34°15' 41.950"N	447682.66	447654.7951	2	117	11	complete
				74°25' 54.204"E	74°25' 53.139"E	3791428.589	3791314.372				
27	Electric Line	36.433	MANZ SEER	34°16' 0.912"N	34°16' 0.088"N	448124.04	448254.384	2	132	10	complete
				74°26' 11.361"E	74°26' 16.464"E	3791895.835	3791869.743				
28	HT Line	37.873	NEAR MANZ SEER	34°16' 6.29"N	34°16' 7.244"N	448111.032	448246.616	2	138	14	complete
				74°26' 10.817"E	74°26' 16.113"E	3792061.542	3792090.201				
29	Electric Line	38.456	GARBAGE DUMP	34°16' 33.977"N	34°16' 30.624"N	449177.6257	449208.653	2	108	6	complete
				74°26' 52.346"E	74°26' 53.581"E	3792908.543	3792805.08				
30	Electric Line	38.736	TULIBAL	34°16' 35.274"N	34°16' 30.119"N	449810.1722	449783.056	2	160	15	complete
				74°27' 17.076"E	74°27' 16.049"E	3792945.058	3792786.434				
31	Electric Line	38.758	BADAMI BAGH	34°16' 32.417"N	34°16' 27.243"N	450086.84	450019.989	2	172	15	complete
				74°27' 27.915"E	74°27' 25.333"E	3792855.579	3792696.57				
32	Electric Line	39.393	NEAR BADAMI BAGH	34°16' 32.858"N	34°16' 27.115"N	450130.404	450031.622	2	202	12	complete
				74°27' 29.616"E	74°27' 25.789"E	3792868.932	3792692.584				
33	Electric Line	42.053	MASJID SAHARIF	34°16' 34.941"N	34°16' 30.858"N	450643.384	450702.5544	2	139	12	complete
				74°27' 49.665"E	74°27' 52.005"E	3792930.377	3792804.292				
34	Elect	42.084	JAMIA	34°17' 25.474"N	34°17' 15.828"N	452820.769	452771.824	2	301	11	complete

S.N	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				
	Electric Line		MASJID SOPORE	74°29' 14.514"E	74°29' 12.658"E	3794475.69	3794178.803				
35	Electric Line	71.031	IQRA ISLAMIA HIGH SHCHOOL	34°17' 23.948"N	34°17' 16.387"N	452820.627	452835.176	2	233	13	complete
				74°29' 14.518"E	74°29' 15.133"E	3794428.688	3794195.722				
36	Electric Line	72.135	WULAR LAKE	34°21' 37.174"N	34°21' 34.524"N	464243.1889	464225.7536	2	83	16	complete
				74°36' 40.156"E	74°36' 39.485"E	3802177.899	3802096.332				
37	Electric Line	72.597	NEAR WULAR LAKE	34°21' 13.313"N	34°21' 12.650"N	464952.8258	464842.7746	2	111	16	complete
				74°37' 8.045"E	74°37' 3.740"E	3801440.234	3801420.233				
38	HT Line	73.197	WULAR LAKE ISLAND	34°21' 1.898"N	34°20' 58.683"N	465158.209	465087.4595	2	121	15	complete
				74°37' 16.136"E	74°37' 13.381"E	3801087.852	3800989.083				
39	Electric Line	74.13	WULAR LAKE ISLAND	34°20' 49.933"N	34°20' 46.874"N	465629.706	465559.0539	2	117	12	complete
				74°37' 34.646"E	74°37' 31.894"E	3800717.575	3800623.592				
40	Electric Line	74.133	KHAN TRADERS NADIHAL	34°20' 27.957"N	34°20' 26.558"N	466316.666	466156.0913	2	166	12	complete
				74°38' 1.631"E	74°37' 55.352"E	3800038.16	3799995.661				
41	HT Line	74.144	KHAN TRADERS NADIHAL	34°20' 27.871"N	34°20' 26.473"N	466317.499	466156.9243	2	166	15	complete
				74°38' 1.664"E	74°37' 55.385"E	3800035.527	3799993.028				
42	Electric Line	74.247	NEAR KHAN TRADERS NADIHAL	34°20' 27.508"N	34°20' 26.103"N	466316.8427	466155.7133	2	166	10	complete
				74°38' 1.640"E	74°37' 55.339"E	3800024.332	3799981.648				

S.N	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				
43	Electric Line	74.519	NEAR KHAN TRADERS NADIHAL	34°20' 24.650"N	34°20' 23.011"N	466368.322	466209.7362	2	166	12	complete
				74°38' 3.667"E	74°37' 57.467"E	3799936.119	3799886.199				
44	Electric Line	75.323	NEAR KHAN TRADERS NADIHAL	34°20' 16.182"N	34°20' 14.237"N	466452.7201	466246.6088	2	214	16	complete
				74°38' 7.007"E	74°37' 58.949"E	3799674.975	3799615.802				
45	Electric Line	76.021	GUND PRANG	34°19' 49.758"N	34°19' 49.058"N	466508.238	466370.2615	2	139	12	complete
				74°38' 9.294"E	74°38' 3.897"E	3798860.877	3798839.806				
46	Electric Line	76.22	GUND PRANG	34°19' 29.334"N	34°19' 27.940"N	466751.973	466634.676	2	124	13	complete
				74°38' 18.920"E	74°38' 14.336"E	3798230.909	3798188.383				
47	HT Line	76.423	NEAR GUND PRANG	34°19' 22.474"N	34°19' 22.193"N	466797.0899	466676.962	2	120	15	complete
				74°38' 20.715"E	74°38' 16.015"E	3798019.446	3798011.215				
48	Electric Line	77.736	MADWAN	34°19' 17.520"N	34°19' 15.303"N	466849.611	466759.9793	2	112	12	complete
				74°38' 22.791"E	74°38' 19.294"E	3797866.678	3797798.694				
49	Electric Line	78.283	MADWAN	34°18' 37.369"N	34°18' 40.531"N	466912.6119	466789.3264	2	157	13	complete
				74°38' 25.428"E	74°38' 20.591"E	3796629.724	3796727.579				
50	Electric Line	79.83	NEAR MADWAN	34°18' 25.127"N	34°18' 28.781"N	466516.979	466382.5619	2	175	20	complete
				74°38' 10.001"E	74°38' 4.727"E	3796254.074	3796367.101				
51	Electric	80.372	NEAR MADWAN	34°17' 42.891"N	34°17' 47.232"N	465759.6008	465718.891	2	139	16	complete
				74°37' 40.556"E	74°37' 38.944"E	3794955.86	3795089.741				

S.N	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				
52	Electric Line	80.658	RAKH HAJIN	34°17' 39.029"N	34°17' 42.241"N	465262.413	465181.1549	2	128	13	complete
				74°37' 21.124"E	74°37' 17.931"E	3794838.752	3794938.003				
53	Electric Line	81.217	RAKH HAJIN	34°17' 33.488"N	34°17' 31.04"N	465281.013	465118.8357	2	178	12	complete
				74°37' 21.876"E	74°37' 15.543"E	3794668.013	3794593.197				
54	Electric Line	81.579	BISMILLAH SAW MILLS	34°17' 15.324"N	34°17' 15.541"N	465497.793	465227.735	2	270	13	complete
				74°37' 30.437"E	74°37' 19.873"E	3794107.737	3794115.404				
55	Electric Line	82	ITI (HAJIN)	34°17' 2.196"N	34°17' 5.631"N	465454.765	465151.202	2	321	10	complete
				74°37' 28.812"E	74°37' 16.923"E	3793703.518	3793810.45				
56	Electric Line	82.39	JHELUM RIVER (HAJIN)	34°16' 49.214"N	34°16' 53.063"N	465175.796	465044.741	2	177	10	complete
				74°37' 17.959"E	74°37' 12.816"E	3793304.687	3793423.727				
57	Electric Line	84.267	JHELUM RIVER (HAJIN)	34°16' 40.756"N	34°16' 41.676"N	464929.673	464844.724	2	89	9	complete
				74°37' 8.371"E	74°37' 5.044"E	3793045.098	3793073.756				
58	HT Line	85.627	KATHPORA	34°15' 54.337"N	34°15' 59.346"N	465730.9801	465573.7176	2	220	10	complete
				74°37' 39.915"E	74°37' 33.743"E	3791612.363	3791767.225				
59	Electric Line	85.764	MASJID SAHARIF	34°15' 44.315"N	34°15' 48.818"N	464395.093	464307.035	2	164	13	complete
				74°36' 47.721"E	74°36' 44.257"E	3791308.656	3791447.684				
60	Electric Line	86.06	MASJID SAHARIF	34°15' 41.678"N	34°15' 45.535"N	464312.4808	464183.3815	2	175	16	complete
				74°36' 44.503"E	74°36' 39.437"E	3791227.746	3791347.039				

S.N	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				
61	Electric Line	86.364	MASJID SAHARIF	34°15' 35.126"N	34°15' 35.565"N	464209.1189	464014.3053	2	195	8	complete
				74°36' 40.492"E	74°36' 32.872"E	3791026.327	3791040.593				
62	HT Line	86.697	MASJID SAHARIF	34°15' 27.075"N	34°15' 24.601"N	464261.8484	464040.5144	2	233	15	complete
				74°36' 42.590"E	74°36' 33.947"E	3790778.12	3790702.782				
63	Electric Line	86.853	NEAR MASJID SAHARIF	34°15' 17.351"N	34°15' 14.287"N	464354.876	464181.457	2	197	12	complete
				74°36' 46.272"E	74°36' 39.506"E	3790478.254	3790384.554				
64	Electric Line	86.976	NEAR MASJID SAHARIF	34°15' 12.764"N	34°15' 9.820"N	464419.5977	464256.8484	2	185	13	complete
				74°36' 48.824"E	74°36' 42.474"E	3790336.73	3790246.688				
65	Electric Line	87.155	NEAR MASJID SAHARIF	34°15' 11.561"N	34°15' 5.518"N	464507.8756	464334.671	2	253	10	complete
				74°36' 52.281"E	74°36' 45.537"E	3790299.344	3790113.863				
66	HT Line	87.965	NEAR MASJID SAHARIF	34°15' 7.360"N	34°15' 1.836"N	464616.504	464486.4185	2	213	13	complete
				74°36' 56.547"E	74°36' 51.486"E	3790169.525	3789999.867				
67	Electric Line	90.155	RAKHI ASHRAM	34°14' 55.910"N	34°14' 48.607"N	465286.973	465233.334	2	231	10	complete
				74°37' 22.813"E	74°37' 20.748"E	3789814.366	3789589.62				
68	Electric Line	95.847	RAKHI ASHRAM	34°14' 26.577"N	34°14' 24.130"N	467309.4966	467114.3534	2	208	10	complete
				74°38' 42.011"E	74°38' 34.392"E	3788903.595	3788828.904				
69	Electric Line	98.08	BABA JENGI	34°11' 53.372"N	34°11' 50.025"N	469449.027	469295.112	2	148	12	complete
				74°40' 6.253"E	74°40' 0.252"E	3784177.507	3784074.895				
70	Elect	99.268	PRIYAG	34°10' 49.590"N	34°10' 46.987"N	470428.1169	470321.2811	2	133	11	complete

S.N	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				
71	Electric Line	101.38	SHIV TEMPLE	74°40' 44.751"E	74°40' 40.587"E	3782209.81	3782129.985	2	187	13	complete
				34°10' 28.320"N	34°10' 22.238"N	471296.2945	471282.419				
72	Electric Line	103.6	MOSQUE	74°41' 18.745"E	74°41' 18.226"E	3781552.002	3781364.694	2	190	11	complete
				34°9' 35.547"N	34°9' 33.518"N	472519.3996	472339.07				
73	Electric Line	104.91	MASJID NOOR	74°42' 6.709"E	74°41' 59.673"E	3779922.892	3779860.924	2	116	10	complete
				34°8' 43.569"N	34°8' 42.447"N	473718.6319	473607.1478				
74	Electric Line	105.27	MUJGUND	74°42' 53.721"E	74°42' 49.371"E	3778318.515	3778284.258	2	197	12	complete
				34°8' 9.259"N	34°8' 8.827"N	473186.0847	472988.8943				
75	Electric Line	107.21	MOSQUE	74°42' 33.043"E	74°42' 25.345"E	3777263.254	3777250.522	2	171	12	complete
				34°7' 59.822"N	34°7' 56.888"N	473263.555	473117.25				
76	Electric Line	107.8	TAKAN WARI PORA	74°42' 36.100"E	74°42' 30.398"E	3776972.359	3776882.414	2	149	11	complete
				34°7' 51.314"N	34°7' 46.742"N	474977.3336	475027.7674				
77	Electric Line	108.45	RAHEEK GROUP	74°43' 43.040"E	74°43' 45.023"E	3776705.588	3776564.653	2	171	11	complete
				34°7' 59.970"N	34°7' 54.804"N	475500.023	475563.163				
78	Electric Line	109.17	MALLURA	74°44' 3.420"E	74°44' 5.901"E	3776970.845	3776811.555	2	202	10	complete
				34°7' 49.150"N	34°7' 48.259"N	476148.0915	475947.5781				
79	Electric	110.17	MASJID BAITUL	74°44' 28.756"E	74°44' 20.930"E	3776635.928	3776608.983	2	121	10	complete
				34°7' 25.861"N	34°7' 25.876"N	476019.925	475898.644				
				74°44' 23.823"E	74°44' 19.089"E	3775918.915	3775919.684				

S.N	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				
	Line		MUKKARAM								
80	Electric Line	111.06	MASJID BAITUL MUKKARAM	34°7' 6.732"N	34°7' 2.763"N	476722.1335	476567.7432	2	196	12	complete
				74°44' 51.294"E	74°44' 45.279"E	3775327.974	3775206.13				
81	Electric Line	111.47	JAMIA MASJID	34°6' 41.971"N	34°6' 38.421"N	477180.8735	477036.608	2	180	13	complete
				74°45' 9.274"E	74°45' 3.653"E	3774564.221	3774455.224				
82	Electric Line	112.11	OLD LEATHER TANNERY	34°6' 30.965"N	34°6' 27.860"N	477402.494	477298.9851	2	140	12	complete
				74°45' 17.957"E	74°45' 13.926"E	3774224.695	3774129.314				
83	Electric Line	113.8	MASJID SAHARIF PARIMPORA	34°6' 26.861"N	34°6' 23.077"N	477935.8306	477959.2525	2	118	10	complete
				74°45' 38.786"E	74°45' 39.711"E	3774097.028	3773980.416				
84	Electric Line	115.32	SANGAM	34°6' 5.877"N	34°6' 1.896"N	479338.1187	479131.7267	2	239	11	complete
				74°46' 33.576"E	74°46' 25.5312"E	3773447.529	3773325.374				
85	Electric Line	115.46	GASSI MOHALLA	34°5' 28.268"N	34°5' 22.354"N	480107.7827	480047.1884	2	191	10	complete
				74°47' 3.710"E	74°47' 1.361"E	3772287.532	3772105.488				
86	Electric Line	117.29	CHATTABAL WEIR	34°5' 27.244"N	34°5' 22.307"N	480219.6191	480202.0972	2	153	12	complete
				74°47' 8.077"E	74°47' 7.406"E	3772255.742	3772103.719				
87	Electric Line	117.61	MASJID HANFIA JAMIA	34°5' 44.351"N	34°5' 42.559"N	481873.2118	481838.728	2	65	13	complete
				74°48' 12.569"E	74°48' 11.227"E	3772779.301	3772724.198				

S.N	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				
			AWAL OWAISI SAHAB								
88	Electric Line	117.74	TOMB OF ZAIN-UL-ABIDIN'S MOTHER	34°5' 39.147"N	34°5' 37.201"N	482177.5255	482088.2626	2	107	11	complete
				74°48' 24.457"E	74°48' 20.978"E	3772618.448	3772558.691				
89	Electric Line	119.73	J & K BANK, ZAINA KADAL	34°5' 35.294"N	34°5' 34.221"N	482250.4714	482153.4889	2	102	10	complete
				74°48' 27.312"E	74°48' 23.530"E	3772499.648	3772466.772				
90	Electric Line	125.82	DC OFFICE	34°4' 30.523"N	34°4' 30.667"N	482229.774	482112.467	2	117	10	complete
				74°48' 26.651"E	74°48' 22.074"E	3770504.73	3770509.395				
91	Electric Line	126.64	DHAR SEED FARM	34°3' 29.710"N	34°3' 30.831"N	484173.5364	484044.7278	2	133	12	complete
				74°49' 42.614"E	74°49' 37.587"E	3768628.232	3768662.985				
92	Electric Line	129.56	MASJID SHARIF	34°3' 20.062"N	34°3' 15.095"N	484689.725	484686.3285	2	153	13	complete
				74°50' 2.769"E	74°50' 2.647"E	3768330.231	3768177.25				
93	Electric Line	130.81	MASJID SHARIF	34°3' 16.837"N	34°3' 13.716"N	486028.6621	486072.2385	2	105	10	complete
				74°50' 55.005"E	74°50' 56.710"E	3768228.822	3768132.617				
94	Electric Line	131.57	SOITANG	34°3' 14.201"N	34°3' 14.249"N	487082.4771	486981.532	2	100	11	complete
				74°51' 36.117"E	74°51' 32.179"E	3768146.134	3768147.744				
95	Electric	133.45	SOITANG	34°2' 52.337"N	34°2' 49.107"N	487097.7294	486995.306	2	142	9	complete
				74°51' 36.747"E	74°51' 32.758"E	3767472.714	3767373.355				

S.N	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				
96	Electric Line	133.87	MASJID AL HADITH	34°2' 18.219"N	34°2' 16.580"N	488286.385	488157.055	2	138	12	complete
				74°52' 23.162"E	74°52' 18.120"E	3766420.331	3766369.999				
97	Electric Line	133.98	BUS STAND-BYPASS SRINAGAR	34°2' 9.587"N	34°2' 3.767"N	488432.9472	488405.8707	2	181	9	complete
				74°52' 28.890"E	74°52' 27.843"E	3766154.278	3765975.052				
98	Electric Line	134.28	BUS STAND-BYPASS SRINAGAR	34°2' 10.500"N	34°2' 3.536"N	488528.656	488536.807	2	214	12	complete
				74°52' 32.622"E	74°52' 32.950"E	3766182.295	3765967.785				
99	Electric Line	134.81	NEAR BUS STAND-BYPASS SRINAGAR	34°2' 12.711"N	34°2' 9.012"N	488756.582	488849.601	2	147	10	complete
				74°52' 41.507"E	74°52' 45.140"E	3766250.126	3766136.082				
100	Electric Line	135.99	MOSQUE	34°2' 20.435"N	34°2' 16.785"N	489275.997	489230.073	2	121	13	complete
				74°53' 1.754"E	74°52' 59.968"E	3766487.403	3766375.029				
101	Electric Line	136.29	HP PETROL PUMP	34°2' 8.372"N	34°2' 4.706"N	490379.223	490343.379	2	118	9	complete
				74°53' 44.796"E	74°53' 43.402"E	3766114.676	3766001.814				
102	Electric Line	138.04	WARIS SERVICE STATION	34°2' 4.919"N	34°2' 1.721"N	490672.6563	490624.7313	2	109	12	complete
				74°53' 56.243"E	74°53' 54.378"E	3766008.036	3765909.587				
103	Electric Line	138.36	PAYAAM EDUCATIONAL	34°1' 17.472"N	34°1' 18.284"N	490399.1354	490278.877	2	122	11	complete
				74°53' 45.634"E	74°53' 40.944"E	3764546.968	3764572.102				

S.N	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				
104	Electric Line	138.83	BAGH SHOKR SHAH	34°1' 9.061"N	34°1' 6.670"N	490437.6	490334.601	2	126	9	complete
				74°53' 47.144"E	74°53' 43.131"E	3764287.861	3764214.329				
105	Electric Line	139.77	BRICK KILN SHALINA	34°1' 5.271"N	34°0' 58.016"N	490738.472	490780.149	2	227	9	complete
				74°53' 58.880"E	74°54' 0.514"E	3764170.827	3763947.334				
106	Electric Line	140.06	BAG I SHKURSH	34°1' 23.700"N	34°1' 19.442"N	491413.455	491476.524	2	145	10	complete
				74°54' 25.179"E	74°54' 27.643"E	3764737.803	3764606.59				
107	Electric Line	140.11	AIJAZ AHMAD DAR	34°1' 28.241"N	34°1' 23.850"N	491699.786	491691.761	2	135	11	complete
				74°54' 36.339"E	74°54' 36.031"E	3764877.419	3764742.17				
108	Electric Line	140.36	AIJAZ AHMAD DAR	34°1' 28.475"N	34°1' 24.309"N	491736.114	491740.314	2	128	13	complete
				74°54' 37.755"E	74°54' 37.923"E	3764884.575	3764756.28				
109	Electric Line	141.42	CHARYAAR	34°1' 27.751"N	34°1' 24.569"N	491992.6626	491983.502	2	98	12	complete
				74°54' 47.760"E	74°54' 47.406"E	3764862.076	3764764.068				
110	Electric Line	141.52	KHADI BANDAAR	34°1' 6.742"N	34°1' 10.005"N	491826.291	491775.11	2	112	11	complete
				74°54' 41.294"E	74°54' 39.295"E	3764215.154	3764315.688				
111	Electric Line	141.91	LALA WANI MOHALLA	34°1' 4.895"N	34°1' 8.920"N	491743.53	491691.632	2	134	9	complete
				74°54' 38.069"E	74°54' 36.041"E	3764158.34	3764282.331				
112	Electric Line	142.5	LALA WANI MOHALLA	34°0' 57.042"N	34°0' 57.909"N	491603.445	491369.297	2	235	13	complete
				74°54' 32.615"E	74°54' 23.485"E	3763916.579	3763943.485				

S.N	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				
113	Electric Line	142.96	KADLABAL BRIDGE AT PAMPOR	34°0' 41.321"N	34°0' 38.607"N	491727.335	491633.9682	2	125	12	complete
				74°54' 37.463"E	74°54' 33.825"E	3763432.255	3763348.774				
114	Electric Line	144.49	MOULVI MASJID	34°0' 27.902"N	34°0' 25.394"N	491955.4124	491811.06	2	163	11	complete
				74°54' 46.369"E	74°54' 40.743"E	3763018.776	3762941.642				
115	Electric Line	144.63	HP PETROL PUMP	33°59' 44.269"N	33°59' 41.113"N	492467.8471	492385.3895	2	127	9	complete
				74°55' 6.388"E	74°55' 3.177"E	3761674.485	3761577.35				
116	HT Line	144.84	HP PETROL PUMP	33°59' 41.330"N	33°59' 38.599"N	492601.644	492485.115	2	143	10	complete
				74°55' 11.607"E	74°55' 7.067"E	3761583.855	3761499.835				
117	Electric Line	145.19	RIVER JEHLUM (VYETH)	33°59' 36.749"N	33°59' 33.020"N	492703.394	492639.831	2	131	12	complete
				74°55' 15.577"E	74°55' 13.103"E	3761442.67	3761327.887				
118	Electric Line	147.48	MOSQUE	33°59' 25.829"N	33°59' 24.648"N	492921.8323	492811.9081	2	115	9	complete
				74°55' 24.102"E	74°55' 19.818"E	3761106.179	3761069.886				
119	HT Line	147.53	MOSQUE	33°58' 44.954"N	33°58' 45.483"N	491298.4121	491188.082	2	111	15	complete
				74°54' 20.868"E	74°54' 16.567"E	3759848.606	3759864.999				
120	Electric Line	151.21	MARVAL PAMPOR	33°58' 43.356"N	33°58' 44.211"N	491306.335	491186.205	2	123	13	complete
				74°54' 21.179"E	74°54' 16.496"E	3759799.39	3759825.831				
121	Electric Line	151.49	JAMIA MASJID	33°57' 14.504"N	33°57' 10.241"N	493066.7398	492924.0752	2	193	11	complete
				74°55' 29.865"E	74°55' 24.311"E	3757061.355	3756930.17				
122	HT Line	151.57	KAKAPORA BRIDGE	33°57' 11.495"N	33°57' 6.140"N	493250.8879	493244.3276	2	165	14	complete
				74°55' 37.043"E	74°55' 36.792"E	3756968.557	3756803.617				

S.N	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				
123	Electric Line	153.74	HUNDREDS	33°57' 11.708"N	33°57' 5.993"N	493348.1593	493308.6342	2	180	13	complete
				74°55' 40.832"E	74°55' 39.297"E	3756975.043	3756799.044				
124	Electric Line	155.18	IRSHAD KA AASHIYAN A	33°57' 45.119"N	33°57' 41.136"N	495049.043	495165.6275	2	169	9	complete
				74°56' 47.081"E	74°56' 51.626"E	3758003.029	3757880.312				
125	Electric Line	155.46	GOVT HIGHER SECOUNDA RY SCHOOL	33°57' 51.266"N	33°57' 47.808"N	496449.4855	496338.8537	2	153	10	complete
				74°57' 41.648"E	74°57' 37.338"E	3758191.738	3758085.259				
126	Electric Line	157.12	ZABAR FOOD & SPECISE	33°57' 42.225"N	33°57' 40.988"N	496596.668	496429.2079	2	171	12	complete
				74°57' 47.387"E	74°57' 40.862"E	3757913.22	3757875.172				
127	Electric Line	157.77	VILL KHANIBUG	33°57' 18.121"N	33°57' 15.037"N	497673.843	497671.189	2	95	11	complete
				74°58' 29.36"E	74°58' 29.264"E	3757170.501	3757075.516				
128	Electric Line	158.15	NISHAT FLOUR MILLS, BARSOO	33°57' 13.067"N	33°57' 9.711"N	498324.918	498246.7957	2	129	9	complete
				74°58' 54.735"E	74°58' 51.692"E	3757014.713	3756911.361				
129	Electric Line	160.53	RIVER JEJLUM, BARSOO	33°56' 59.241"N	33°57' 0.367"N	498358.8935	498246.4014	2	117	10	complete
				74°58' 56.062"E	74°58' 51.679"E	3756588.874	3756623.578				
130	Electric Line	160.71	PETROL PUMP	33°56' 5.443"N	33°56' 3.770"N	499663.5713	499526.2874	2	146	11	complete
				74°59' 46.895"E	74°59' 41.547"E	3754931.819	3754880.291				
131	Electric	162.46	GORI PORA LEFT	33°55' 59.788"N	33°55' 57.847"N	499710.644	499585.349	2	138	12	complete
				74°59' 48.728"E	74°59' 43.848"E	3754757.64	3754697.867				

S.N	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				
	Line		ARIGATION PUMP STATION								
132	Electric Line	162.75	GRAVE YARD	33°55' 26.194"N	33°55' 24.197"N	500958.158	500868.796	2	108	13	complete
				75°0' 37.318"E	75°0' 33.838"E	3753723.029	3753661.49				
133	Electric Line	163.7	SHOP	33°55' 16.668"N	33°55' 17.268"N	501111.4356	500910.2396	2	202	11	complete
				75°0' 43.287"E	75°0' 35.451"E	3753429.641	3753448.102				
134	Electric Line	164.06	GADHANGI PORA	33°54' 55.702"N	33°54' 58.053"N	500365.0453	500274.3001	2	16	10	complete
				75°0' 14.216"E	75°0' 10.682"E	3752783.833	3752856.258				
135	Electric Line	164.45	AB GANI KATHROO' S FARMS LAND	33°54' 47.668"N	33°54' 49.889"N	500101.1689	500031.0669	2	97	9	complete
				75°0' 3.939"E	75°0' 1.209"E	3752536.401	3752604.821				
136	Electric Line	165.56	J. MASJID PAD	33°54' 37.894"N	33°54' 37.841"N	499960.522	499832.7234	2	127	13	complete
				74°59' 58.462"E	74°59' 53.485"E	3752235.366	3752233.753				
137	Electric Line	165.74	PADGAMPORA BRIDGE	33°54' 34.189"N	33°54' 31.822"N	500919.3219	500773.0838	2	163	12	complete
				75°0' 35.8"E	75°0' 30.105"E	3752121.308	3752048.406				
138	Electric Line	165.86	CRPF CAMP	33°54' 28.083"N	33°54' 26.840"N	500954.079	500856.456	2	104	11	complete
				75°0' 37.152"E	75°0' 33.351"E	3751933.24	3751894.97				
139	Electric Line	166.29	CRPF CAMP	33°54' 23.904"N	33°54' 23.040"N	501008.6174	500840.4182	2	170	10	complete
				75°0' 39.276"E	75°0' 32.726"E	3751804.559	3751777.909				

S.N	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				
140	HT Line	166.34	NEAR CRPF CAMP	33°54' 11.810"N	33°54' 8.441"N	501143.384	500913.3009	2	252	15	complete
				75°0' 44.522"E	75°0' 35.562"E	3751432.091	3751328.299				
141	Electric Line	166.77	RIVER JEHLUM (VITASTA)	33°54' 10.853"N	33°54' 7.127"N	501180.1017	500951.8573	2	255	11	complete
				75°0' 45.951"E	75°0' 37.063"E	3751402.625	3751287.819				
142	HT Line	166.88	RIVER JEHLUM (VITASTA)	33°54' 2.080"N	33°53' 58.036"N	501433.824	501352.1887	2	148	15	complete
				75°0' 55.829"E	75°0' 52.650"E	3751132.442	3751007.888				
143	Electric Line	166.9	NEAR RIVER JEHLUM (VITASTA)	33°53' 59.983"N	33°53' 56.906"N	501529.214	501456.1644	2	119	12	complete
				75°0' 59.543"E	75°0' 56.698"E	3751067.89	3750973.102				
144	Electric Line	168.42	NEAR RIVER JEHLUM (VITASTA)	33°53' 59.593"N	33°53' 56.521"N	501551.423	501478.2781	2	119	10	complete
				75°1' 0.408"E	75°0' 57.559"E	3751055.876	3750961.247				
145	Electric Line	170.23	PUMP HOUSE OF RAJPORA	33°53' 29.288"N	33°53' 32.152"N	501082.6781	500973.6122	2	140	9	complete
				75°0' 42.152"E	75°0' 37.906"E	3750122.427	3750210.65				
146	Electric Line	170.92	LIFT IRRIGATION SCHEME, BEGPORA	33°52' 55.401"N	33°52' 51.216"N	501629.875	501673.3014	2	136	13	complete
				75°1' 3.449"E	75°1' 5.139"E	3749078.848	3748949.963				
147	Electric Line	172.84	CHARSOO BRIDGE	33°53' 3.224"N	33°52' 58.813"N	502294.4347	502307.098	2	136	12	complete
				75°1' 29.323"E	75°1' 29.814"E	3749319.9	3749184.05				
148	Elect	173.6	RESHIPORA	33°52' 18.162"N	33°52' 10.976"N	502863.493	502732.691	2	257	9	complete

S.N	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				
	Electric Line			75°1' 51.460"E	75°1' 46.366"E	3747932.213	3747710.864				
149	Electric Line	173.77	RESHI PORA OLAR	33°52' 14.741"N	33°52' 10.407"N	503561.7062	503550.3704	2	133	11	complete
				75°2' 18.636"E	75°2' 18.193"E	3747827.094	3747693.589				
150	Electric Line	175	RESHI PORA OLAR	33°52' 13.964"N	33°52' 9.746"N	503743.508	503707.9206	2	134	9	complete
				75°2' 25.712"E	75°2' 24.325"E	3747803.235	3747673.314				
151	Electric Line	176.1	KAICHAL KOT	33°51' 40.433"N	33°51' 41.464"N	504265.6826	504093.8678	2	174	11	complete
				75°2' 46.019"E	75°2' 39.333"E	3746770.716	3746802.415				
152	Electric Line	177.2	DOGRI PORA	33°51' 6.129"N	33°51' 5.055"N	504223.915	504117.836	2	111	13	complete
				75°2' 44.376"E	75°2' 40.247"E	3745714.191	3745681.073				
153	Electric Line	179.5	SAIL	33°50' 43.820"N	33°50' 40.188"N	504979.8296	504917.8673	2	127	12	complete
				75°3' 13.778"E	75°3' 11.365"E	3745027.456	3744915.574				
154	Electric Line	179.6	SAIL	33°49' 51.876"N	33°49' 48.258"N	506493.4441	506498.172	2	111	9	complete
				75°4' 12.635"E	75°4' 12.816"E	3743428.58	3743317.157				
155	Electric Line	179.79	SANGAM BRIDGE	33°49' 51.220"N	33°49' 48.630"N	506588.9539	506605.606	2	81	12	complete
				75°4' 16.350"E	75°4' 16.996"E	3743408.443	3743328.689				
156	Electric Line	179.79	SANGAM BRIDGE	33°49' 52.420"N	33°49' 49.728"N	506774.7095	506802.108	2	87	10	complete
				75°4' 23.578"E	75°4' 24.642"E	3743445.531	3743362.633				

## 2.3 Current Meter and Discharge Details

**Table 2.9- Current Meter and Discharge Details**

Stretch No.	Chainage (km)	Observed Depth (m) (D)	Velocity (m/sec.)	Average Velocity (m/sec.)	X-Sectional area (sq. m.)	Discharge (Cum/sec)
			0.5 D			
1	00	X sectional area & discharge was not calculated due to dry area.				
2	11.897	3.20	0.418	0.418	526.53	220.090
3	24.732	3.90	0.397	0.397	458.93	182.195
4	34.052	3.50	0.348	0.348	361.55	125.819
5	44.159	2.40	0.389	0.389	325.45	126.600
6	53.002	2.26	X sectional area & discharge was not calculated as survey was not carried from bank to bank as per SOW.			
7	64.105	0.60				
8	64.855	5.32	0.716	0.716	501.13	358.8082
9	74.61	4.86	0.477	0.477	630.22	300.6134
10	85.33	4.06	1.073	1.073	588.36	631.3143
11	96.40	4.38	0.873	0.873	322.59	281.6228
12	104.20	4.26	0.954	0.954	340.48	324.8181
13	114.16	4.58	0.418	0.418	401.71	167.9167
14	125.99	8.05	0.150	0.150	670.63	100.5949
15	134.02	6.57	0.496	0.496	578.64	287.0041
16	143.04	3.98	0.418	0.418	666.71	278.6861
17	147.45	5.52	0.387	0.387	432.41	167.343
18	158.82	4.04	0.477	0.477	340.63	162.4815
19	172.35	7.29	0.180	0.180	593.28	106.7903

## 2.4 Soil Sample Locations

**Table 2.10 - Soil Sample Locations**

Sample No.	Change (Km)	Latitude	Longitude	Easting (m)	Northing (m)	Depth (m)
1	1.107	34°9' 2.517"N	74°12' 16.612"E	426676.974	3779151.123	0.7
2	23.854	34°13' 9.089"N	74°22' 22.242"E	442232.359	3786637.727	3.4
3	43.111	34°17' 12.558"N	74°29' 52.867"E	453799.276	3794072.975	3.2
4	63.527	34°23' 52.428"N	74°36' 40.916"E	464278.565	3806343.857	0.4
5	82.004	34°16' 51.032"N	74°37' 16.111"E	465128.756	3793360.877	4.0
6	102.817	34°8' 54.434"N	74°42' 25.345"E	472992.936	3778655.221	3.8
7	121.745	34°4' 15.874"N	74°49' 11.297"E	483373.228	3770051.466	4.4
8	141.223	34°1' 11.919"N	74°54' 46.985"E	491972.365	3764374.474	3.2
9	158.541	33°56' 47.782"N	74°58' 52.650"E	498271.262	3756235.96	4.4
10	176.207	33°51' 2.753"N	75°2' 44.651"E	504231.045	3745610.227	1.2

## 2.5 Water Sample Locations

**Table 2.11 - Water Sample Location in Jhelum River**

Sample No.	Chainage (km)	Latitude	Longitude	Easting (m)	Northing (m)	Total Depth (d) (m)	Mid-Depth (0.5d) (m)
1	1.107	34°9' 2.517"N	74°12' 16.612"E	426676.974	3779151.123	0.80	0.40
2	23.854	34°13' 9.089"N	74°22' 22.242"E	442232.359	3786637.727	3.90	1.95
3	43.111	34°17' 12.558"N	74°29' 52.867"E	453799.276	3794072.975	2.40	1.20
4	63.527	34°23' 52.428"N	74°36' 40.916"E	464278.565	3806343.857	0.60	0.30
5	82.004	34°16' 51.032"N	74°37' 16.111"E	465128.756	3793360.877	4.86	2.4
6	102.817	34°8' 54.434"N	74°42' 25.345"E	472992.936	3778655.221	4.38	2.2
7	121.745	34°4' 15.874"N	74°49' 11.297"E	483373.228	3770051.466	4.58	2.3
8	141.223	34°1' 11.919"N	74°54' 46.985"E	491972.365	3764374.474	6.57	3.3
9	158.541	33°56' 47.782"N	74°58' 52.650"E	498271.262	3756235.96	5.52	2.8
10	176.207	33°51' 2.753"N	75°2' 44.651"E	504231.045	3745610.227	7.29	3.6

## 2.6 DESCRIPTION OF WATERWAY

Hydrographic Survey was done for whole River reach. One power house (LJHP) is present at Uri 0.4 km, one barrage is present at Gantamulla 9.685km. There were no hindrances along the Jhelum River to doing hydrographic survey from Ningle to up stream of Gantamulla barrage but most of the portion inside Wullar lake there was water hyacinth & dense beads so we did pole sounding in that area. 18 bridges were present and height of these bridges was enough to cross the boat during survey. We have divided waterways of Jhelum River into 3 different stretches and details of stretches are given below from Para 3.1 to 3.5.

## 2.7 Lower Jhelum Power Plant to Gantamulla Barrage (Ch. 00.00 km – 9.685 km)

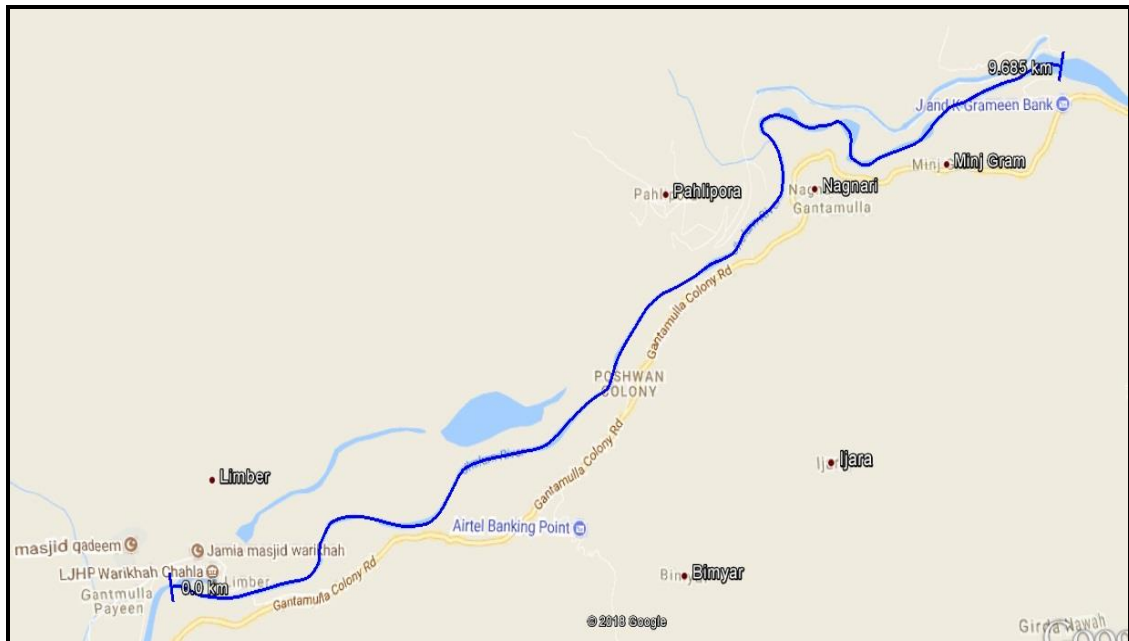


Figure 2.3– Lower Jhelum Power Plant to Gantamulla Barrage

Table 2.12 – Dredging Quantity of Stretch 1, Lower Jhelum Power Plant to Gantamulla Barrage

Class	Chainage		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)
I	0	9.685	0.00	0.80	9.685	278294.38	-0.30	0.00	9.685	499440.49
II	0	9.685	0.00	0.80	9.685	468298.79	-0.30	0.00	9.685	741436.65

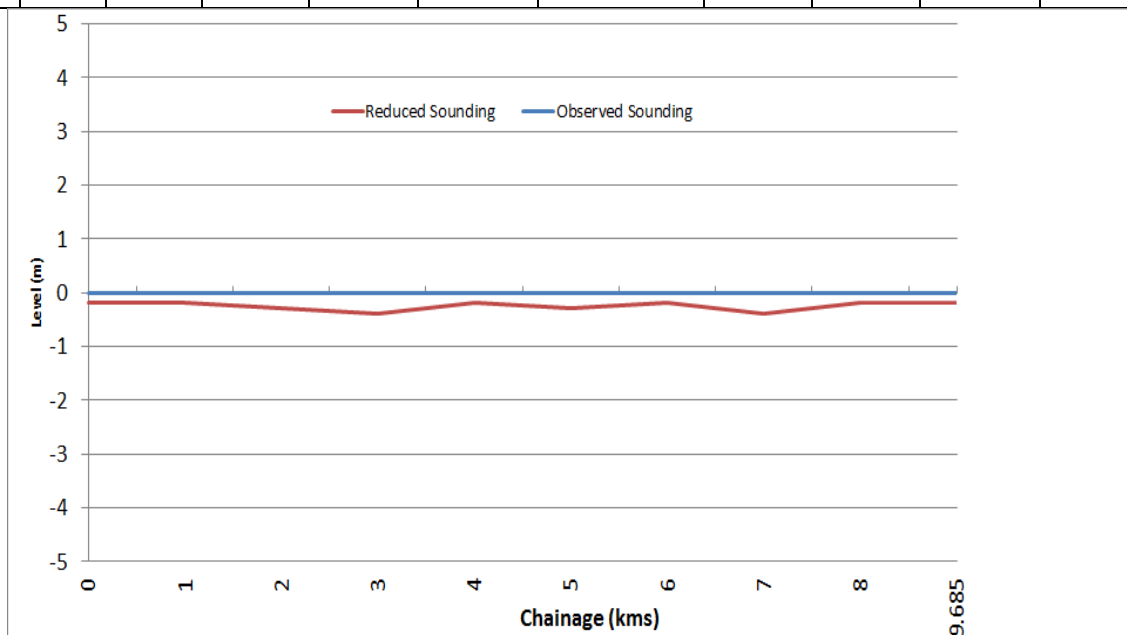


Figure 2.4 – Bed Profile of Lower Jhelum Power Plant to Gantamulla Barrage

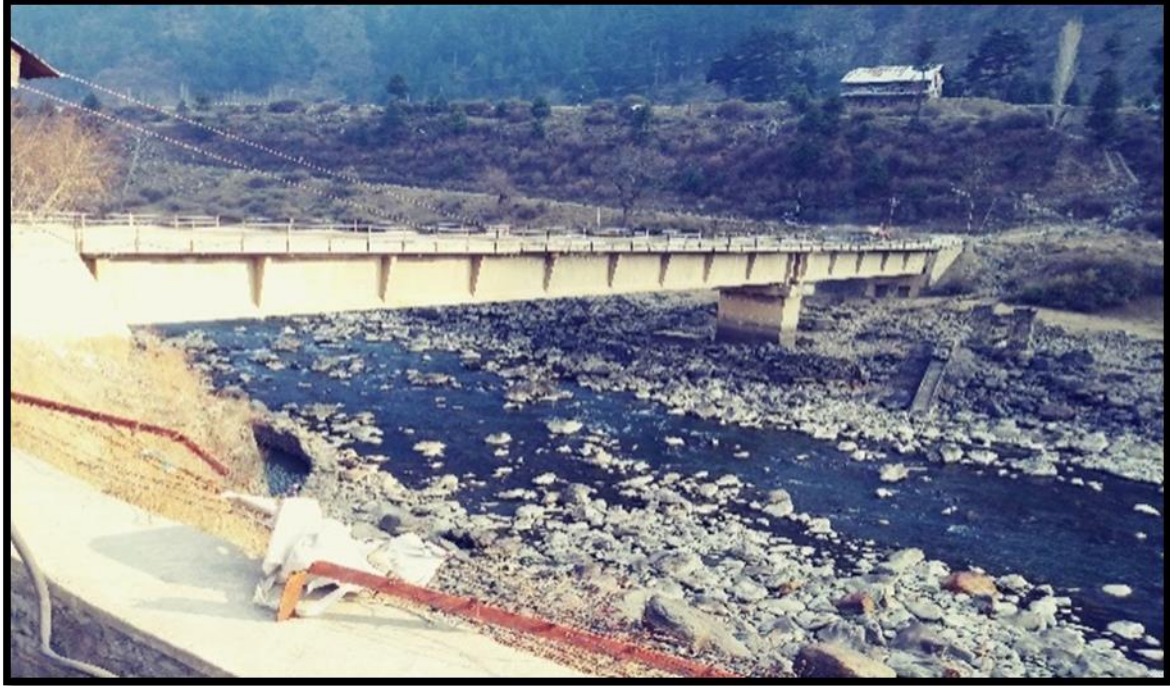
1st stretch (0 to 9.685 km) is from Lower Jhelum Power Plant to Gantamulla Barrage at Jhelum River. The river bed is flat and rocky in nature. The width of the river in this stretch varies from 30m to 170m and depth observed is 0.00m to 0.8 m at deepest channel. The river banks are unprotected, but firm in nature. The gradient of the river is very gentle and there are no rapids or obstructions in this stretch.

Depth required for navigational channel is not good and horizontal and vertical clearance of Bridges is also not suitable. There is no encroachment of waterway present.

Total 3 Bridges & one barrage is present in this stretch of River whose names is given in Table- 7 (List of Cross structures).Main villages in this stretch are Aithsham Pora,Bimyar, Peernian,Nagnari & Minj Gram. Land is generally used for agriculture and residential purpose. Photographs of field observation and cross structure are available in Annexure -XIII.Land use is generally private land and Government.



**Figure 2.5 : CH- 0.40 km Water Supply For Turbine Through To Pipe Line to Generate Power**



**Figure 2.6 : CH- 0.69 km Sahal Bridge, Lower Jhelum (Bimyar)**



**Figure 2.7 : Ch.5.50 Km View of Jhelum River**

## 2.8 Gantamulla Barrage to near Tawheed Bagh (Ch. 9.685 km – 39.685 km)

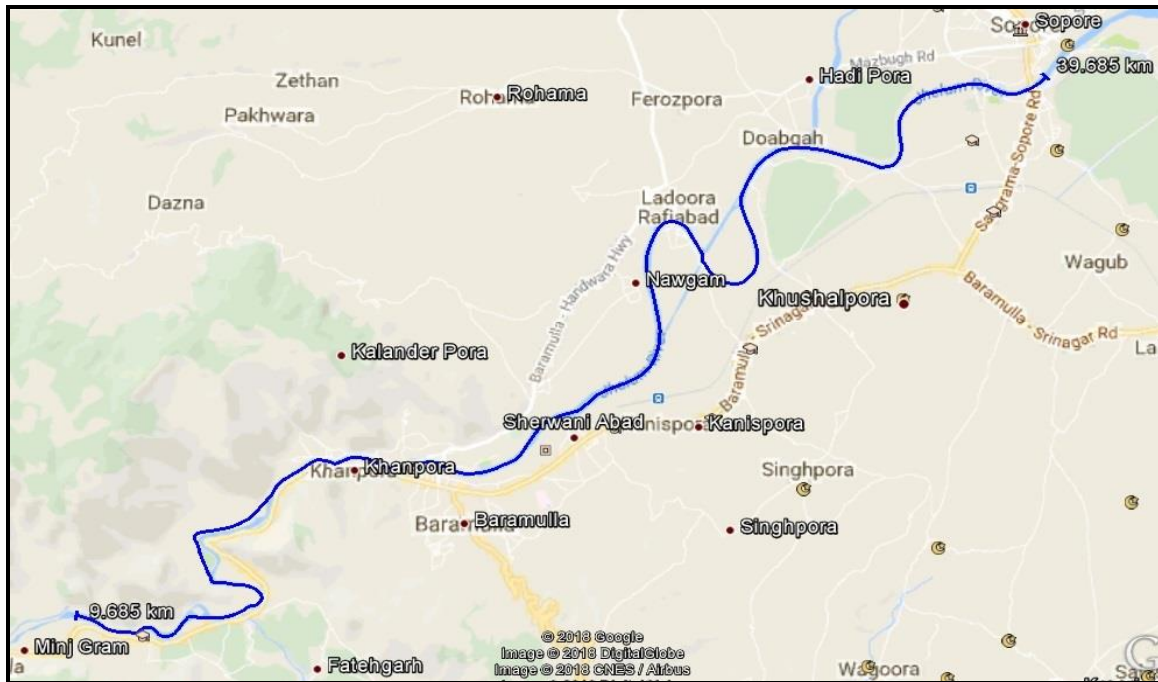
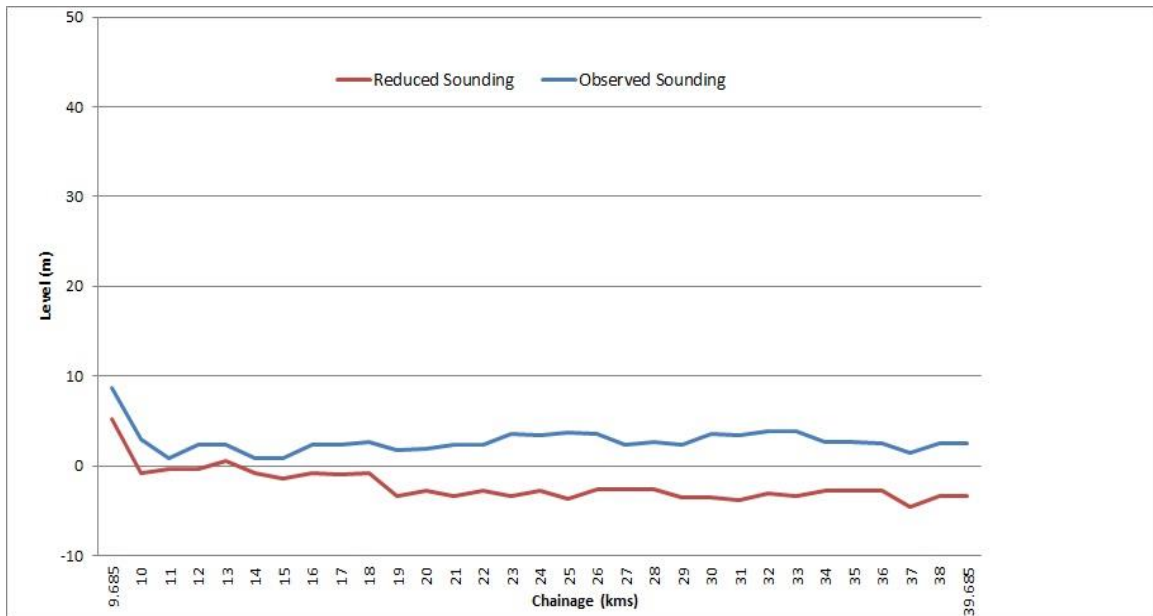


Figure 2.8 Gantamulla Barrage to near Tawheed Bagh (Ch. 9.685 km – 39.685 km)

Table 2.13 – Dredging Quantity of Stretch 2, Gantamulla Barrage to near Tawheed Bagh

Class	Chainage		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)
I	9.685	39.685	0.00	8.13	4.10	43479.16	-0.30	7.73	9.00	316257.92
II	9.685	39.685	0.00	8.13	8.30	92404.35	-0.30	7.73	13.00	499116.97



**Figure 2.9 : Reduced & Observed Bed Profile Gantamulla Barrage to near Tawheed Bagh**



2nd stretch starts from Gantamulla Barrage to near Tawheed bagh Village (CH-9.685 km – 39.685 km). 10 Bridges and 2 pipe Line Bridge are present in this stretch of River of names given in Table- 7 (List of Cross structures). Horizontal and vertical clearance of Bridges is not sufficient as per designed class-I and Class-II for navigation. Width of the river varies from 75 to 200m. depth observed is 0.00m to 8.13 m at deepest channel. Water current is quite low. Discharges are high in monsoon season and low in lean period. Banks are unprotected but firm. There is no encroachment of waterway present. This stretch of river is well connected via road.

Main villages in this stretch are Kitchama, Sheeri, Khanpora, Azad Gunj, Dewan Bagh, Singh Bagh, Nawgam, Ladoora rafiabad, Sadi Pora, Shoga Pora, Logriwal Pora, Doabgah & Kartar Garh. Main city in this stretch are Baramulla and Sapore. Land is generally used for Residential purpose. There was Number of Irrigational water lift tank present on parallel to the

both bank of the river. Photographs of field observation and cross structure are available in **Annexure -XIII**. Baramulla, Sapore railway station are available in this stretch. Apple garden, dry fruits and rice are main crops near the stretch. Fishing of fresh water is available on small scale. Sand mining are present in this stretch.



**Figure 2.10 : CH- 19.94 Km Khanpora Bridge**



**Figure 2.11 : CH- 22.81 Km View Of Jhelum River Pump House**



Figure 2.12 : CH- 36.50 Km Bridge Construction In Jhelum River

2.9 Stretch 3 Near Tawheed Bagh to Baniyari (Ch. 39.685 km – 70.935 km)

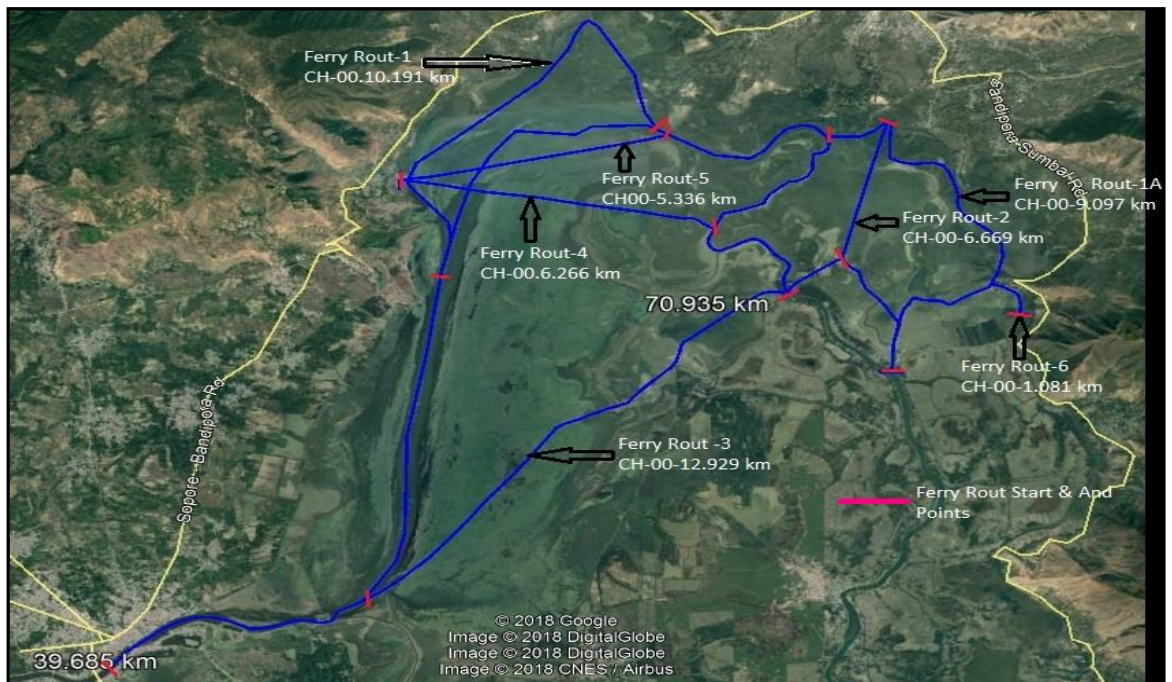
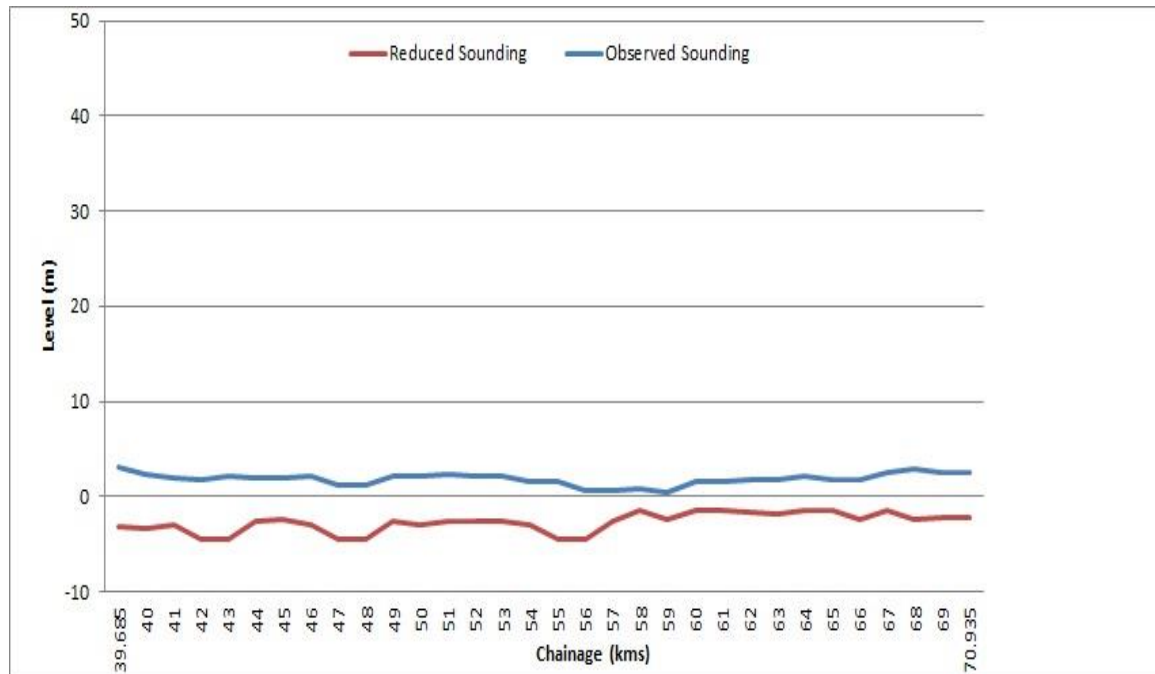


Figure 2.13 Near Tawheed Bagh to Baniyari



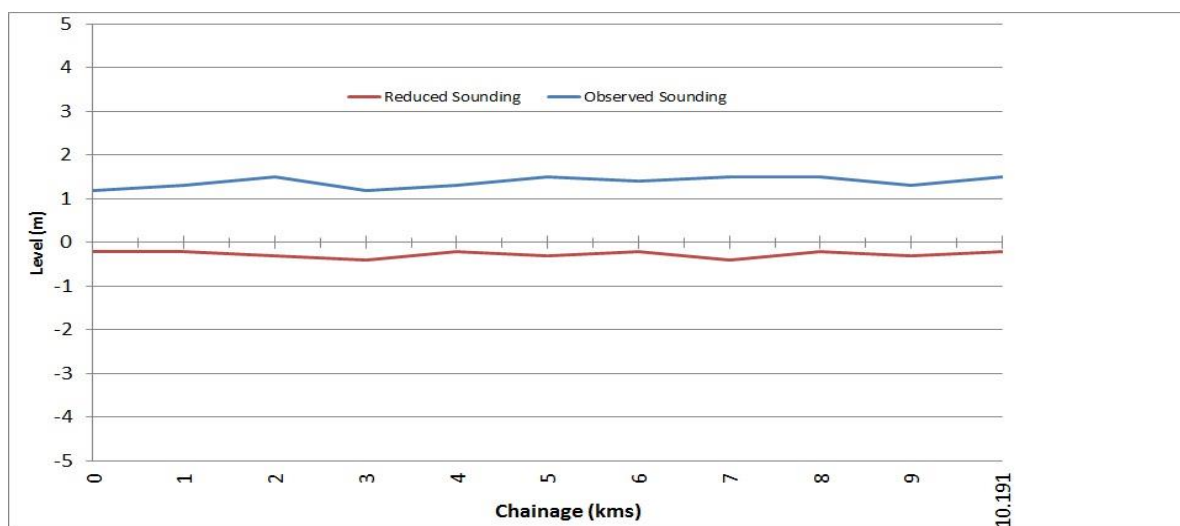
**Figure 2.14 : Bed Profile for Near Tawheed Bagh to Baniyari**

3rd stretch starts from Near Tawheed Bagh and end at Baniyari (**Ch.39.685 km – 70.935 km**). Horizontal and vertical clearance of Bridges is not suitable for Navigation. Banks are mainly unprotected but firm. This stretch of river is well connected via internal road. One bridge is present in this stretch of River which is mentioned in Table- 7 (List of Cross structures).

Main town near to this stretch is Bandipora. Main village in this stretch are Takyabal, Maharaj Pora, Adi Pora, Hasmat Pora, Magri Pora, Watlab, Nusso & Nadihal. Maximum Land is residential and army cantonment along this stretch. There are 7 ferry routes in this stretch namely saderkoot payeen-Wullar vintage park-Zanlank-Ningli-Sopore, Garrora-Zanlank-Ningli-Sopore, Nadihah-Ningli-Sopore, Nasoo-Watlab-Sopore, Kehmoh-Watlab-Sopore, Kehnoosa-Watlab-Sopore & Watlab-Sopore. Photographs of field observation and cross structure are available in **Annexure -XIII**. Sopore Railway station in vicinity of this stretch. Shikara and small boat ferry are present in this stretch for tourist. Many Nalas are present which are directly put water into this stretch of river. Vintage park and picnic spot are present near to this stretch. Land is generally used for Agriculture & main crops along this stretch are Corn, rice, fruits (apple, cherry, grapes, pomegranates) & dry fruits (Almond, Walnut). Hyacinth is present in most of the area in this stretch.

**Table 2.14 – Dredging Quantity of Stretch 3, Near Tawheed Bagh to Baniyari**

Class	Chainage		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)
I	39.685	70.935	0.00	11.98	12.60	302208.39	-0.30	11.58	20.00	608468.50
II	39.685	70.935	0.00	11.98	14.90	509626.39	-0.30	11.58	23.80	974630.51



**Figure 2.15 : Bed Profile for Near Tawheed Bagh to Baniyari (Stretch 3)**

**Table 2.15 – Dredging Quantity of Ferry 1, Kehnoosa Watlab to Ashtongu via Kehmoh**

Class	Chainage		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)
I	0	10.191	1.25	2.32	9.10	258160.99	-0.30	1.75	10.00	407321.02
II	0	10.191	1.2	2.36	9.60	416584.3	0.67	1.78	10.000	614,489.92

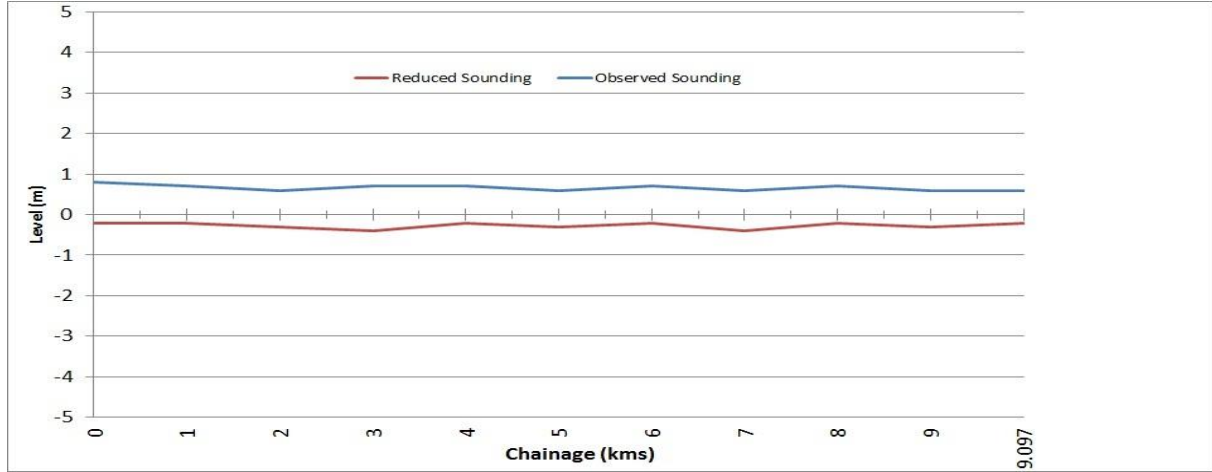


Figure 2.16 : Bed Profile for Kehnoosa Watlab to Ashtongu via Kehmoh Ferry 1

Table 2.16 – Dredging Quantity of Ferry 1A, Nasoo to Banyari via wullar Vintage Park

Class	Chainage		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)
I	0	9.097	0	2.88	9.00	273105.65	-0.3	1.28	9.00	658376.53
II	0	9.097	0	2.88	9.00	436218.06	-0.3	1.28	9.00	930971.31

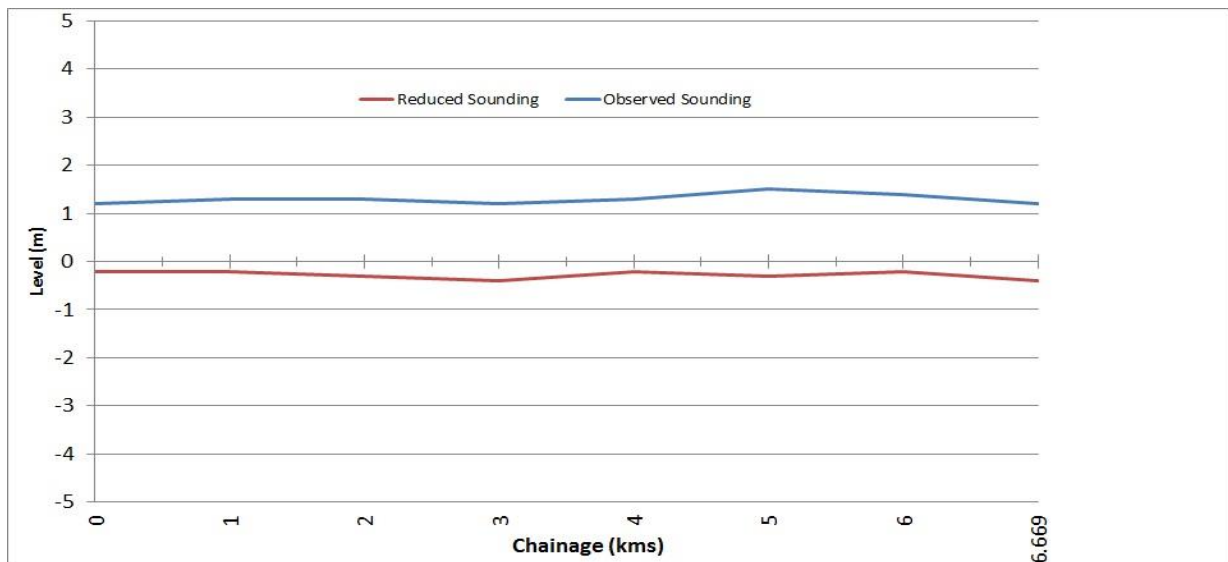
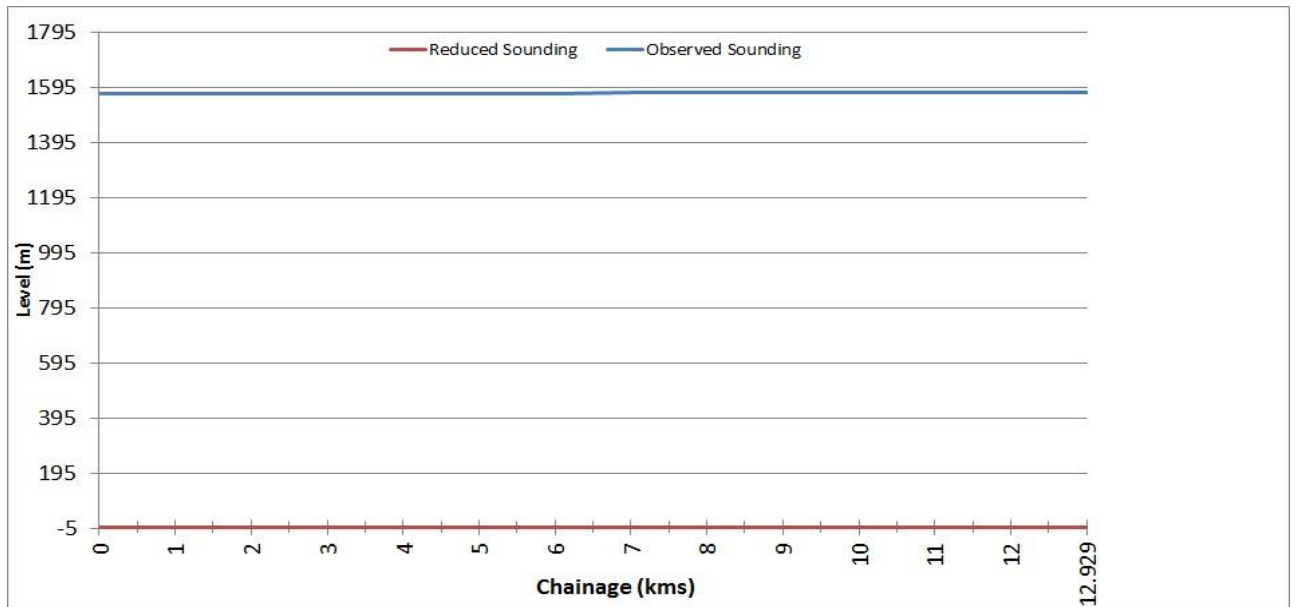


Figure 2.17 : Bed Profile Nasoo to Banuari via wullar Vintage Park Ferry 1A

**Table 2.17 – Dredging Quantity of Ferry 2, Nasoo to Banyari via Zain Lank**

Class	Chainage		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)
I	0	6.669	0	3.67	6.60	235314.17	-0.30	2.03	6.60	352980.48
II	0	6.669	0	3.67	6.60	364679.16	-0.30	2.16	6.60	517150.65



**Figure 2.18 : Bed Profile for Nasoo to Banyari via Zain Lank Ferry 2**

**Table 2.18 – Dredging Quantity of Ferry 3, Nasoo to Banyari via Zain Lank**

Class	Chainage		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)
I	0	12.929	0	0	12.90	539402.60	-0.3	0	12.90	698765.34
II	0	12.929	0	2	12.90	820807.82	-0.3	0	12.90	1025090.53

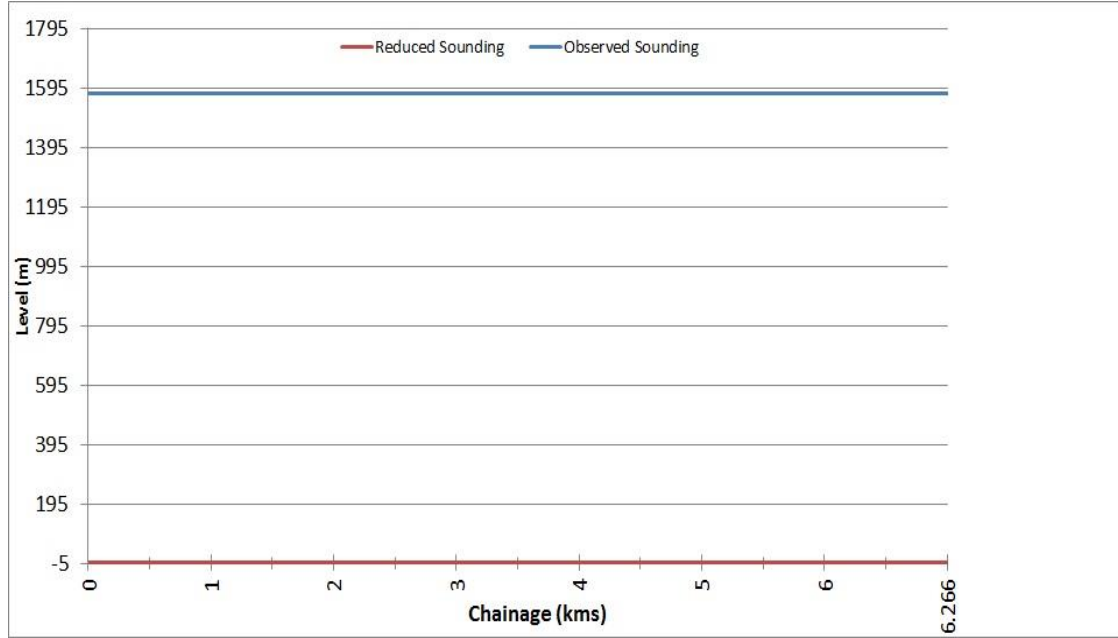


Figure 2.19: Bed Profile for Nassoo to Banyari via zain Lank Ferry 3

Table 2.19 – Dredging Quantity of Ferry 4, Kehnoosa Watlab to Zain Lank

Class	Chainage		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)
I	0	6.266	0	4.32	6.20	183889.38	-0.3	3.74	6.20	242491.11
II	0	6.266	0	4.32	6.20	283571.37	-0.3	3.74	6.20	359802.42

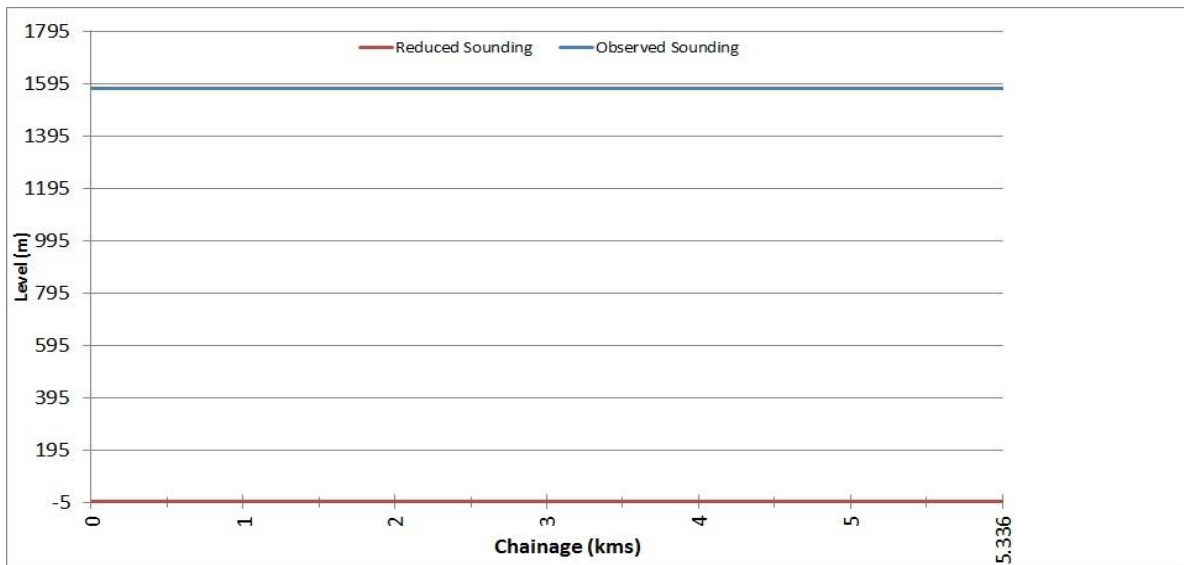
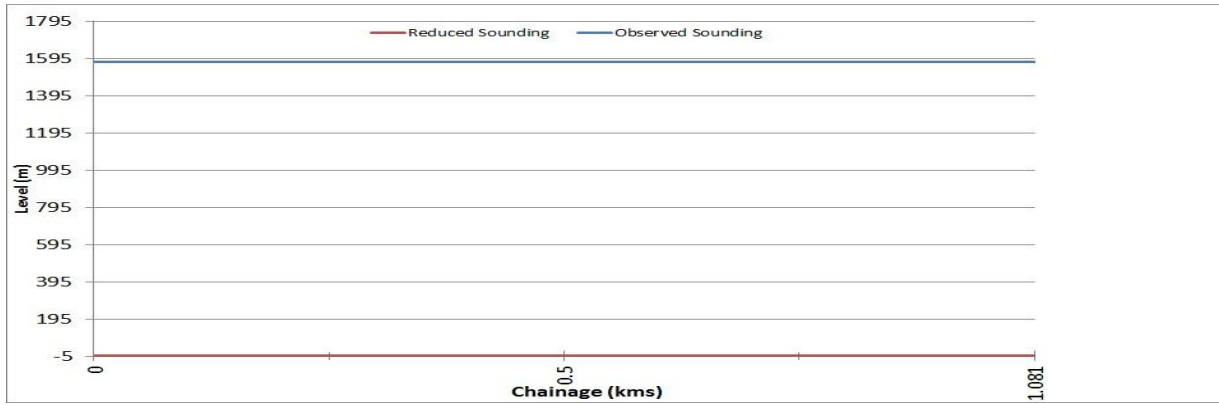


Figure 2.20 : Kehnoosa Watlab to Zain Lank Ferry 4

**Table 2.20 – Dredging Quantity of Ferry 5, Kehnoosa Watlab to Ashtongu**

Class	Chainage		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)
I	0	5.336	0	2.1	4.70	95754.87	-0.3	1.55	5.30	174255.2
II	0	5.336	0	2.1	4.70	164256.57	-0.3	1.55	5.30	268233.81



**Figure 2.21 : Kehnoosa Watlab to Ashtongu Ferry 5**

**Table 2.21 – Dredging Quantity of Ferry 6, wullar Vintage Park to Saderkoot Payeen**

Class	Chainage		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)
I	0	1.081	0.0	00	1.00	38331.07	-0.3	0.0	1.00	49,510.33
II	0	1.081	0.0	0.0	1.00	58,382.91	-0.3	0.0	1.00	72756.59



**Figure 2.22 : CH- 41.50 Km Hydrographic Survey In On Progress**



**Figure 2.23 : CH- 44.20 Km Auto Level in Progress**



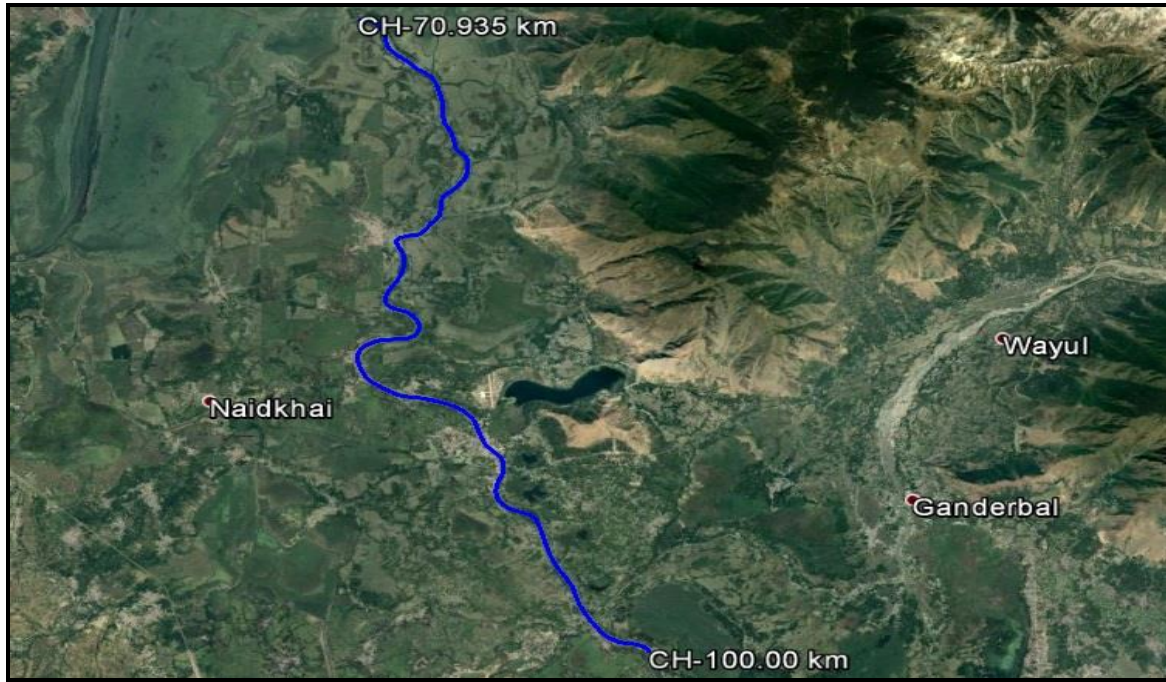
Fig

ure 2.24 : CH- 44.31 Km Bridge At Ningli



Figure 2.25 : CH- 64.50 Km Site Trouble In The Jhelum River Wullar Lake

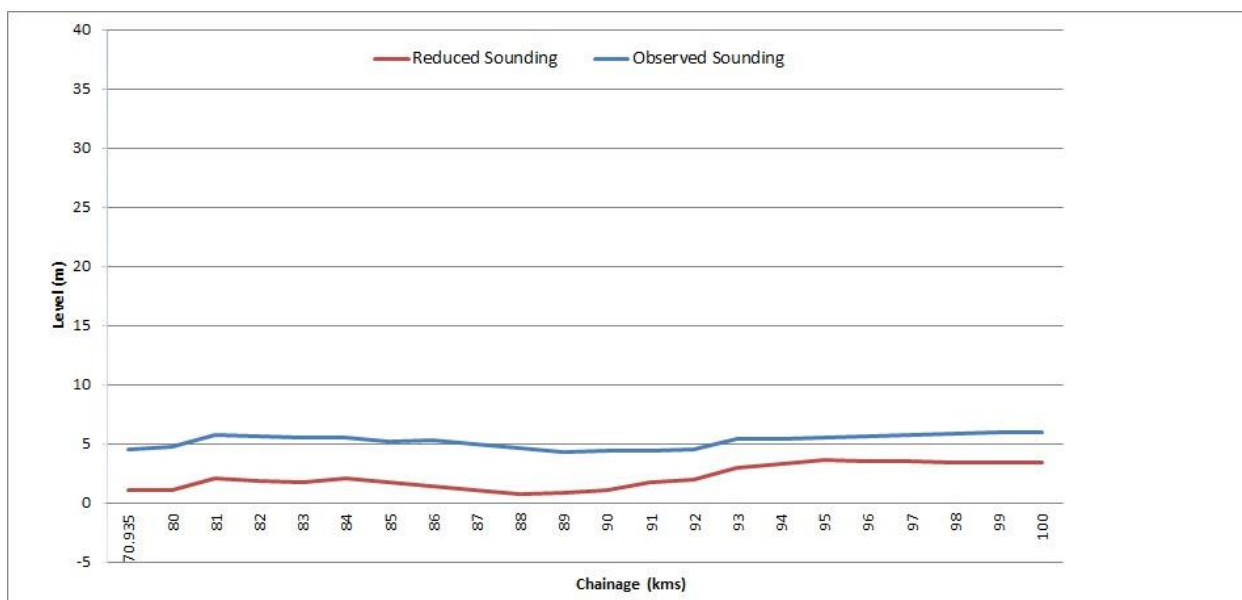
**2.10 Wular Lake to Rabtar Gundi Roshan (Ch. 70.935 km – 100.0 km)**



**Figure 2.26 : Wular Lake to Rabtar Gundi Roshan (Ch. 70.935 km – 100.0 km)**

**Table 2.22 – Dredging Quantity of Stretch 4, Wular Lake to Rabtar Gundi Roshan**

Class	Chainage		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)
I	70.935	100.0	0.40	14.89	1.10	1166.49	-0.30	14.17	8.10	95310.14
II	70.935	100.0	0.07	14.89	3.10	7801.93	-0.30	14.17	11.50	187954.14



**Figure 2.28 : Reduced & Observed Bed Profile Wular Lake to Rabtar Gundi Roshan**

This stretch is from Wular Lake to Rabtar Gundi Roshan (70.935 to 100.0 km at Jhelum River). The river bed is flat and sandy in nature. The width of the river in this stretch varying 55m to 135m and a depth observed is 0.4 m to 14.89 m of deepest channel. The river banks are unprotected, but firm in nature. The gradient of the river is very gentle and there are no rapids or obstructions in this stretch.

Depth required for navigational channel is quite good and horizontal and vertical clearance of Bridges is quite suitable. There is no encroachment of waterway present.

Total 5 Bridges are present in this stretch of River of names given in Table- 8 (List of Cross structures). Main villages in this stretch are Asham, Gundbun, Rakhhajin. Apple garden present on both bank of the river. Land is generally used for agriculture and Residential area. Photographs of field observation and cross structure are available in Annexure -XIII.

Hamre railway station in vicinity of this stretch. Land use is generally private land and some land under forest Department.

Sand mining is prominent in this stretch. Water is fresh and used for drinking and Irrigation purpose.



**Figure 2.29 : Ch-73.73 Km Bridge & Pump House**



**Figure 2.30: Ch-77.01 Km Electric Line**



**Figure 2.31 : Ch-79.95Km Hajin Bridge**



**Figure 2.32 : Ch-87.94 Km Push Wari Bridge**



**Figure 2.33 : Ch-91.01 Km Sumbal Bridge**



**Figure 2.34 : Ch-99.33 Km Electric Line Crossing & Pump House**

## 2.11 Rabtar Gundi Roshan to Soitang (Ch. 100.0 km – 130.0 km)

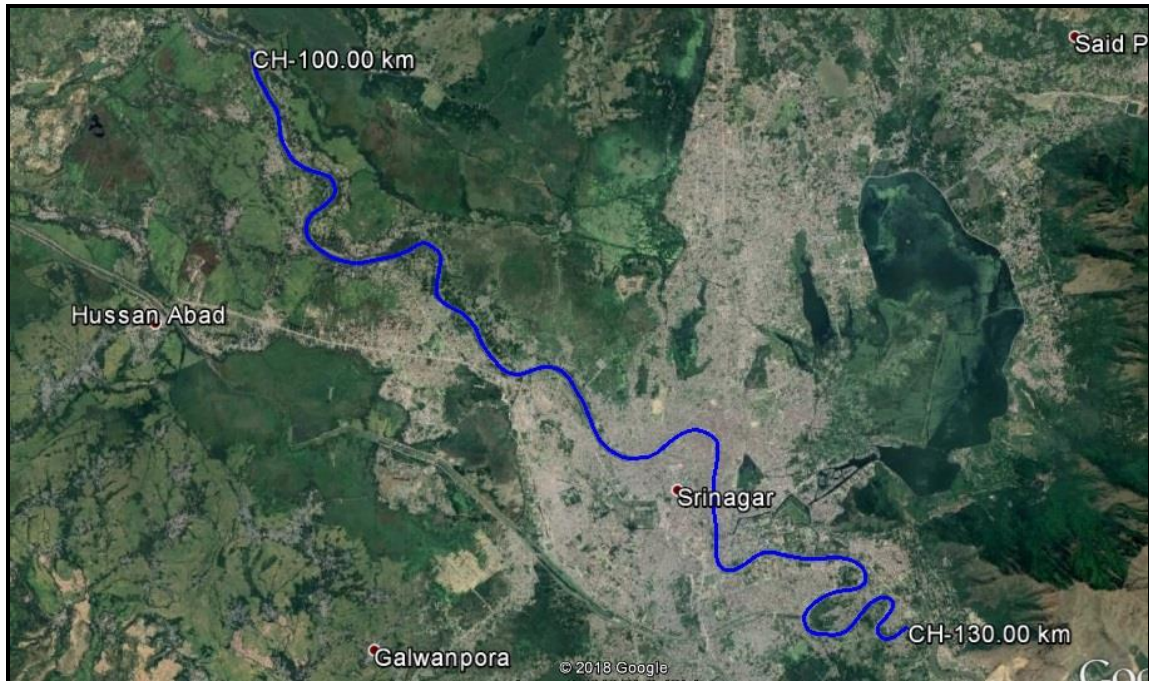
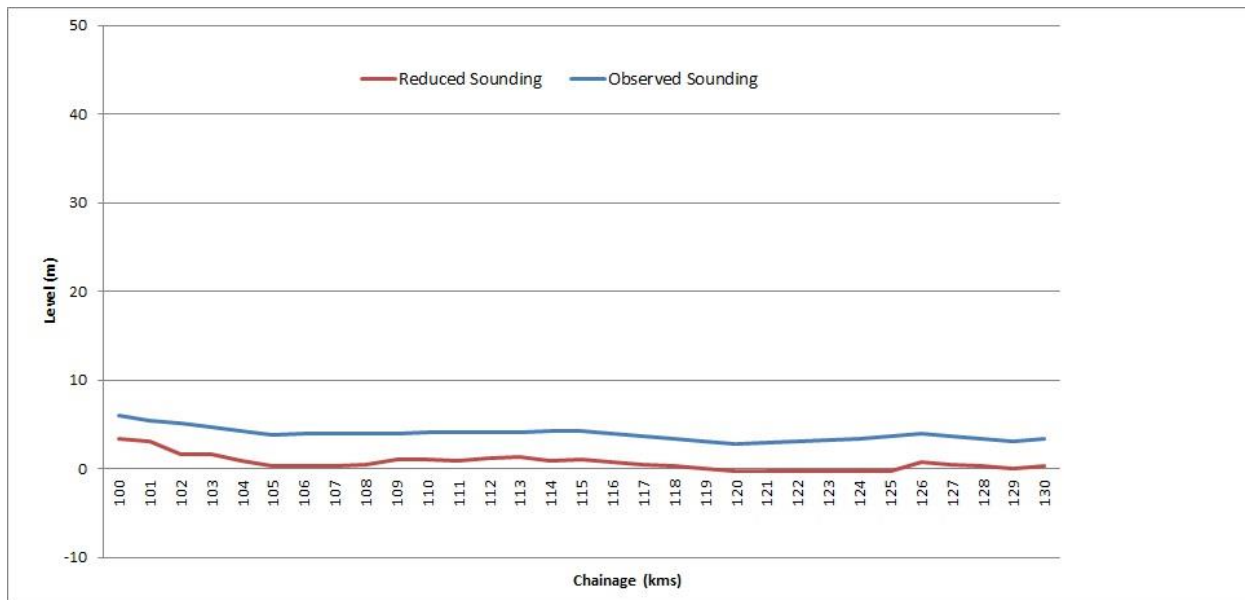


Figure 2.35 Rabtar Gundi Roshan to Soitang (Ch. 100.0 km – 130.0 km)

Table 2.23 – Dredging Quantity of Stretch 5, Rabtar Gundi Roshan to Soitang

Class	Chainage		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)
I	100.000	130.000	0.14	9.93	1.50	4801.36	-0.30	9.54	17.40	377499.59
II	100.000	130.000	0.00	9.93	4.70	17102.50	-0.30	9.54	21.60	653377.39



**Figure 2.36 : Reduced & Observed Bed Profile Rabtar Gundi Roshan to Soitang**

This stretch starts from Rabtar Gundi Roshan to Soitang. At the start of this stretch, Soitang is present. Chattabal weir is present at this stretch (115.425 km). Navigational lock is present at Chattabal weir. Outlet was present on this stretch for supply of fresh water to Srinagar City and Irrigation purpose. 22 Bridges and 1 pipe Line Bridge are present in this stretch of River of names given in Table- 8 (List of Cross structures). Horizontal and vertical clearance of Bridges is not sufficient as per designed class-I and Class-II for navigation. Width of the river varies from 165 to 190m and depths observed are 0.14 m to 9.93 m of deepest channel of the river. Water current is quite low. Discharges are high in monsoon season and low in lean period. Banks are partially unprotected but firm. There is no encroachment of waterway present. This stretch of river is well connected via road.

Main villages in this stretch are Batwina, Kharbag, Shabipora, Panzinara, Sarai danagarpora, Mujgund. Main city in this stretch are Mustafabad, Kumarwadi and Srinagar. Land is generally used for Residential area. There was Number of Irrigational water lift tank present on parallel to the both bank of the river. Photographs of field observation and cross structure are available in Annexure -XIII. Pattan, Mazhom and Badgam railway station are available in this stretch. Apple garden, dry fruits and rice are main crops near the stretch. Fishing of fresh water is available on small scale. Drainage filtering plant is present a on right bank of the river. Sand mining are present in this stretch.

Figure 2.37 : Ch-105.98 Km Takenwari pura Bridge



Figure 2.38 : Ch-111.03 Km Pipe Line Bridge Parimpura



Figure 2.39: Ch-115.98 Km Chattabal Weir



Figure 2.40 : Ch-117.73 Km Zene Kadal New Bridge

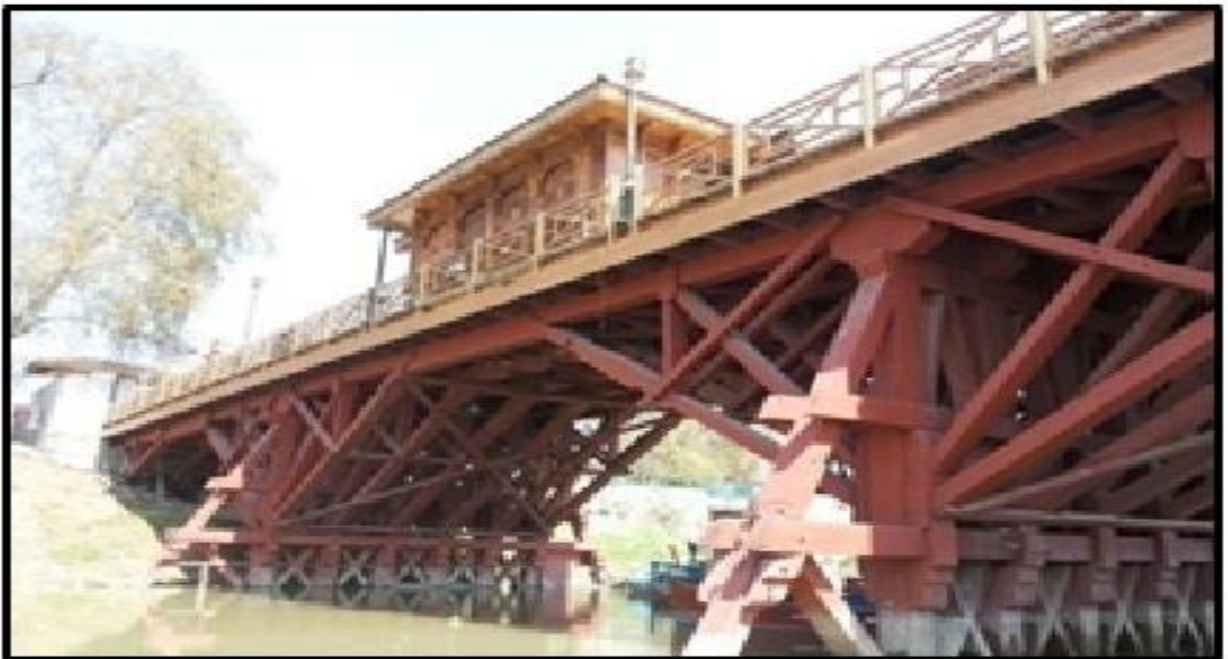
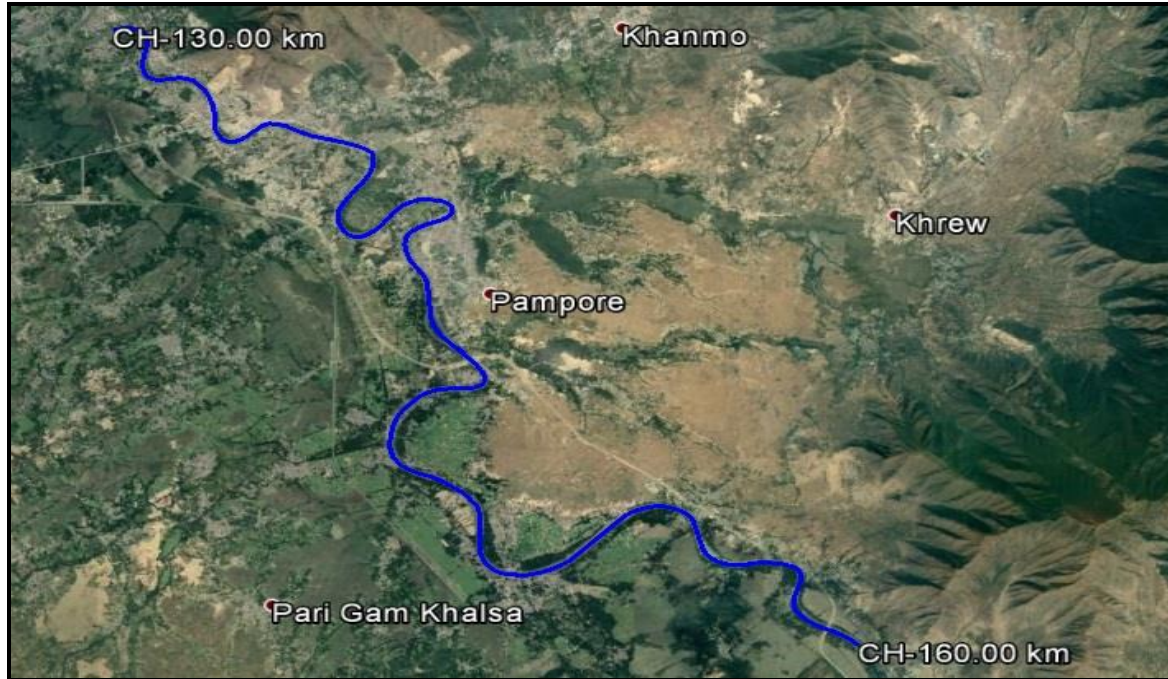


Figure 2.41 : Ch-122.01 Km Zero Bridge

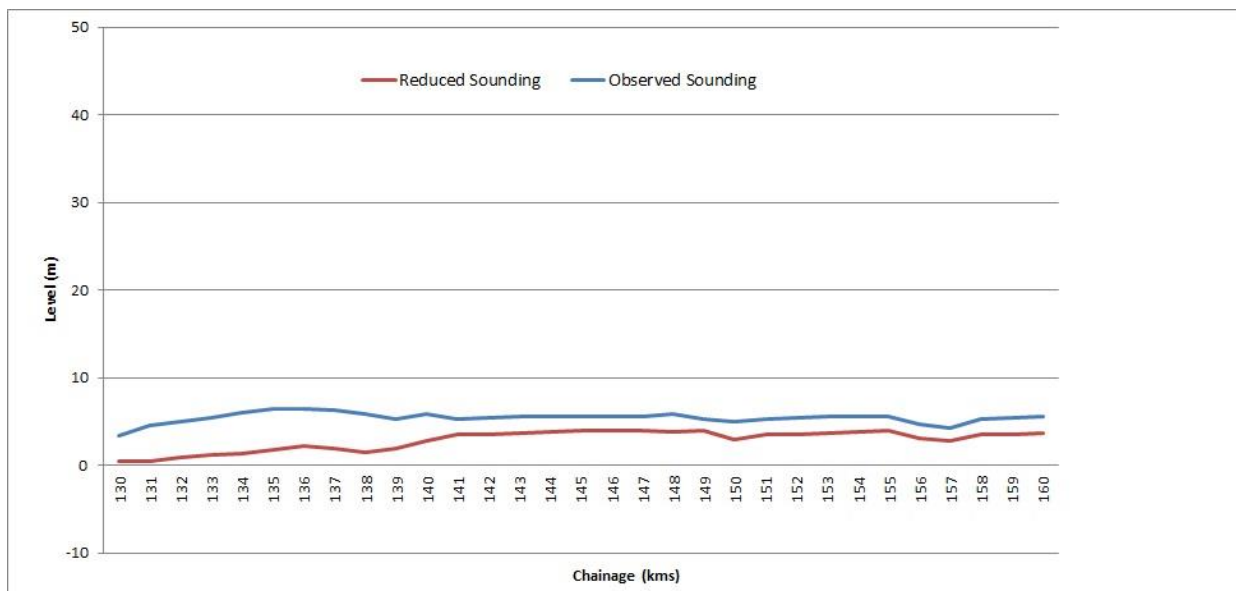
**2.12 Soitang to Kanil Bagh (Ch-130.0 km 160.0 km)**



**Figure 2.42 : Soitang to Kanil Bagh (Ch-130.0 km 160.0 km)**

**Table 2.24 – Dredging Quantity of Stretch 6, Soitang to Kanil Bagh**

Class	Chainage		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)
I	130.000	160.000	0.00	10.20	2.40	21422.72	-0.30	9.40	14.20	116556.76
II	130.000	160.000	0.00	10.20	5.70	47632.66	-0.30	9.40	11.90	225701.38

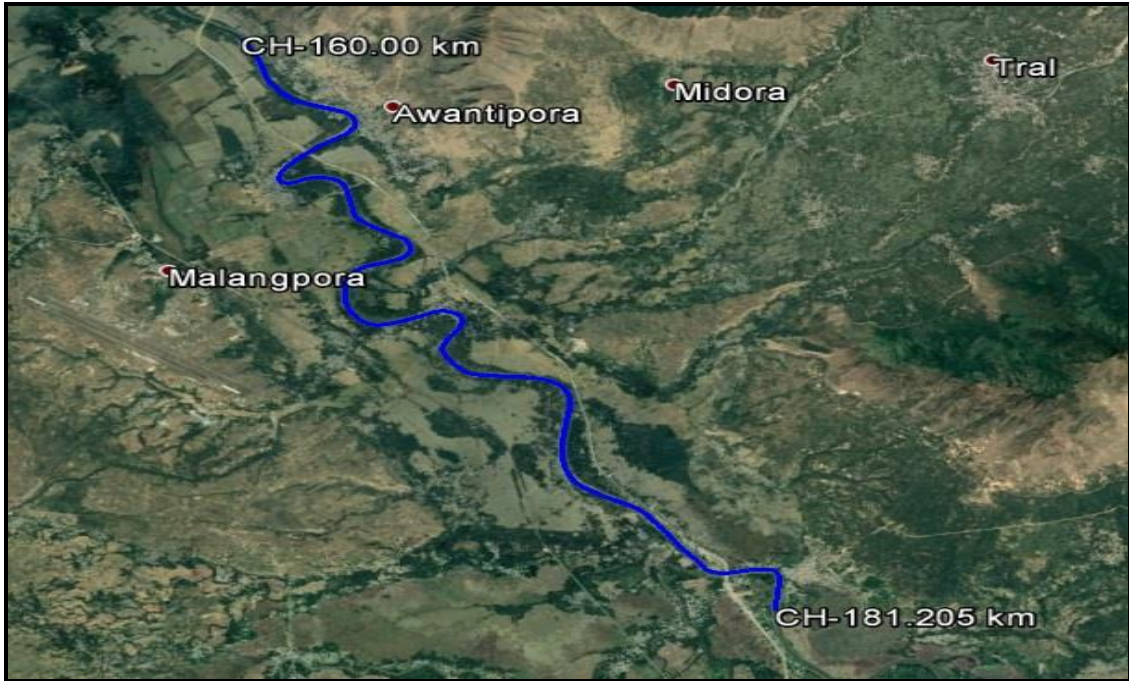


**Figure 2.43 : Reduced & Observed Bed Profile Soitang to Kanil Bagh**

This stretch starts from Soitang and at Kanil Bagh. Horizontal and vertical clearance of Bridges is not suitable for Navigation. Width of river from 50m to 180 m. and depths observed is 0.00 m to 10.20 m of deepest channel of the river. Water current is very low in this stretch of the river. Discharges are high in monsoon season and low in lean period. Banks are mainly unprotected but firmed. There is no encroachment of waterway present. This stretch of river is well connected via road. 11 nos. of bridges are present in this stretch of River of names given in Table- 8 (List of Cross structures).

This stretch exists in the Srinagar city. Main town is Pampore and Main villages in this stretch are Aliabad, Rakhshalina, Zoonipora, Patalbag and Samboora. Maximum Land is residential and army cantonment along this stretch. Land is generally used for Agriculture. Corn, fruits (apple, cherry, grapes, pomegranates), and rice are main crops near to this stretch. Shikara and small boat ferry are present in this stretch for tourist. Water is fresh and used for drinking; Irrigation and industries purpose Outlet was present for supply of drinking water, Irrigation purpose to surrounding areas. Many Nalas are present which are directly put water into this.

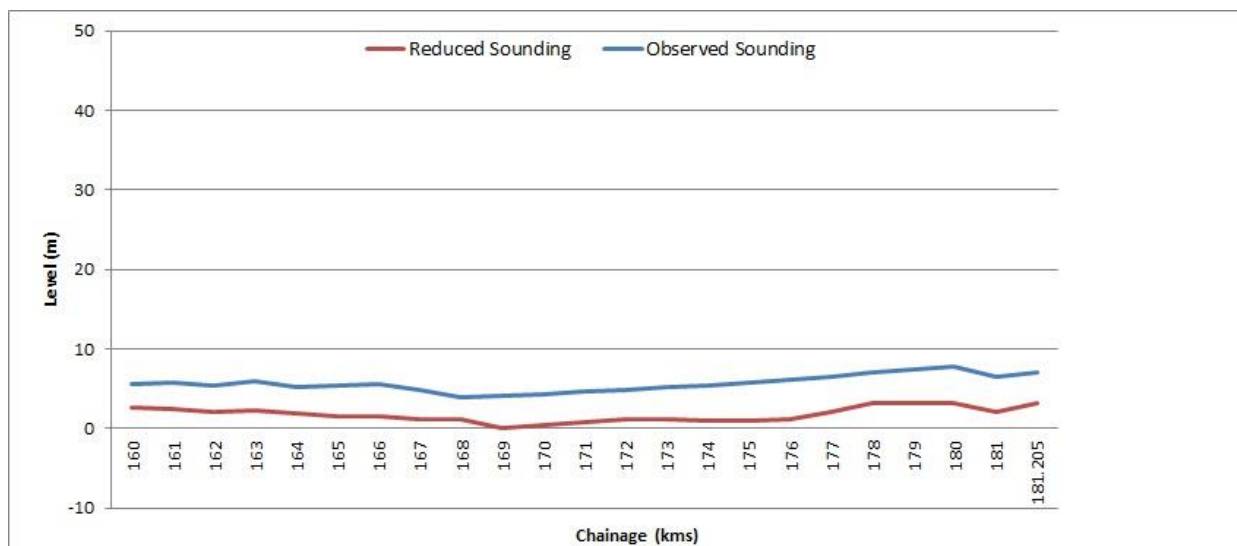
**2.13 Kanil Bagh to Dangpora Village (Ch. 160.0 km – 181.205 km)**



**Figure 2.44 : Kanil Bagh to Dangpora Village (Ch. 160.0 km – 181.205 km)**

**Table 2.25 – Dredging Quantity of Stretch 7, Kanil Bagh to Dangpora Village**

Class	Chainage		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)
I	160.000	181.205	0.00	8.63	5.00	29856.62	-0.30	6.67	14.10	626898.50
II	160.000	181.205	0.00	8.63	7.80	78699.16	-0.30	6.67	18.00	951857.09



**Figure 2.45 : Reduced & Observed Bed Profile Kanil Bagh to Dangpora Village**

This stretch starts from Kanil Bagh and end Dangpora Village. Horizontal and vertical clearance of Bridges is not sufficient for Navigation. Width of river from 75m to 210m and depths observed is 0.00m to 8.63m of deepest channel of the river. Banks are mainly unprotected but firm. There is no encroachment of waterway present. 4 nos. of bridge crossing were present in this stretch of River, names are given in Table-8 (List of Cross structures) with details. NH-1A along the right bank of the river in this stretch.

Main town is Pampore & Avantipora and Main villages in this stretch are Kanilbagh, Gadd Hanjipora. Maximum Land is agricultural and army cantonment along this stretch. Land is generally used for Agriculture. Corn, fruits (apple, cherry, grapes, pomegranates), and rice are main crops near to this stretch. There was some Irrigational water lift tank present in this stretch of the river. Sand mining is present in this stretch. This stretch of river is well connected via road. Photographs of field observation and cross structure are available in Annexure -XIII.

Avantipora a railway station is available in this stretch. Army air strip present on left bank of the river.



Figure 2.46 : Ch-165.63 Km Awanti Pura Bridge



Figure 2.47 : Ch-171.00 Km Charsu Awantipora Bridge



## CHAPTER – 3 FAIRWAY DEVELOPMENT

### 3.1 Classification of Waterway

In India, the inland waterways are classified into seven categories for rivers by the Inland Waterways Authority of India (IWAI) vide Government of India (GOI) Gazette Notification dated 26<sup>th</sup> January 2007 & 07<sup>th</sup> November 2016 including amendments for safe passage of self-propelled vessels up to 2000 Dead Weight Tonnage (DWT) and tug barge formation in push tow units of carrying capacity up to 8000 tonnes. The classification of waterways for Rivers is given below.

**Table 3.1 Inland Waterway classification for Rivers**

Class of Waterway	Rivers				
	Minimum Depth	Bottom Width	Bend Radius	Vertical Clearance	Horizontal Clearance
I.	1.2 m	30 m	300 m	4 m	30 m
II.	1.4 m	40 m	500 m	5 m	40 m
III.	1.7 m	50 m	700 m	6 m	50 m
IV.	2.0 m	50 m	800 m	8 m	50 m
V.	2.0 m	80 m	800 m	8 m	80 m
VI.	2.75 m	80 m	900 m	10 m	80 m
VII.	2.75 m	100 m	900 m	10m	100 m

The above classification for Rivers and Canals shall be effective if:

- Minimum depth of channel should be available for about 330 days in a year (about 90% days in a year).
- Vertical clearance at cross structures over the waterway should be available at least in central 75% portion of each of the spans in entire width of the waterway.

#### **A. Vertical Clearance for Power Cables / Telephone Lines for all Classes**

- Telephone lines and Low Voltage lines 16.5 m
- High Voltage Transmission lines not exceeding 110 KV – 19 m
- High Voltage Transmission lines exceeding 110 KV – 19 m + 1 cm per each KV. In case of underground pipe / power lines and other cables norms to be decided as per conditions and navigational requirement

### B. Reference level for vertical clearance for different types of channels

- Over navigational HFL which is highest flood level at frequency of 5% in any year over a period of last 20 years
- HTL for tidal channels
- For channels design FSL

### C. Type of vessels to be used in different class waterways

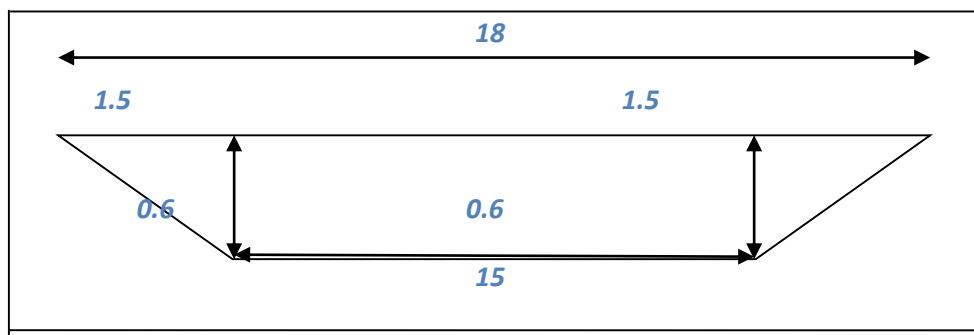
**Table 3.2 Type of vessels to be used in different class waterways**

Class	Self-propelled vessel	Tug with barges
I.	Self-propelled, carrying capacity 100 DWT, Size (32m X 5m), Loaded draft 1m	1 Tug + 2 barges – 200 DWT, length 80m X breadth 5m , loaded draft 1m
II.	Self-propelled, carrying capacity 300 DWT, Size (45m X 8m), Loaded draft 1.2m	1 Tug + 2 barges – 600 DWT, length 110m X breadth 8m , loaded draft 1.2m
III.	Self-propelled, carrying capacity 500 DWT, Size (58m X 9m), Loaded draft 1.5m	1 Tug + 2 barges – 1000 DWT, length 141m X breadth 9m , loaded draft 1.5m
IV.	Self-propelled, carrying capacity 1000 DWT, Size (70m X 12m), Loaded draft 1.8m	1 Tug + 2 barges – 2000 DWT, length 170m X breadth 12m , loaded draft 1.8m
V.	Self-propelled, carrying capacity 1000 DWT, Size (70m X 12m), Loaded draft 1.8m	1 Tug + 2 barges – 2000 DWT, length 170m X breadth 24m , loaded draft 1.8m
VI.	Self-propelled, carrying capacity 2000 DWT, Size (86m X 14m), Loaded draft 2.5m	1 Tug + 2 barges – 4000 DWT, length 210m X breadth 14m , loaded draft 2.5m
VII.	Self-propelled, carrying capacity 4000 DWT, Size (86m X 14m), Loaded draft 2.9m	1 Tug + 4 barges – 8000 DWT, length 210m X breadth 28m , loaded draft 2.5m

All cross structures to be constructed across national waterways should conform to respective requirement of vertical clearance and horizontal clearance before construction of any structure.

#### D. Special Class (15m x 0.6m)

As per the project requirement, channel dimension of 15m x 0.6m with Side slope of 1:2.5 along the deepest route is recommended for Phase-1. Also, sufficient Horizontal and vertical clearance of cross-structures is available at site for navigation.



### 3.2 Development Options

The waterway development must

- i. provide reliable navigation conditions during all seasons of the year;
- ii. have good consideration for safety of navigation;
- iii. prefer using low-impact river training measures, like dredging or low-impact design of embankment protection above high-impact works, where possible;
- iv. include navigation locks with sufficient capacity for swift lock passages;
- v. provide an infrastructure of ports, and, therefore, include the planning of the port locations, their capacities, connection to railway and road networks;
- vi. provide offshore constructions which are resistant to most extreme waves;
- vii. contain measures that prevent negative impacts on groundwater levels and soil conditions in the adjacent terrains;
- viii. provide flood protection to surrounding areas;
- ix. consider all types of environmental impacts of the waterway in operation and during construction, including impacts on flora, fauna, and landscape quality; and
- x. Include mitigating and compensating measures for environmental damage.

All structures to be constructed across waterway classified should conform to respective requirement of vertical clearance and horizontal clearance. Before construction of any structure across the national waterway

### 3.3 Proposed class of waterway:

WAPCOS has studied the possibility of developing waterway as mentioned below –

**Table 3.3 Phase wise classification of River Jhelum (NW-49)**

Sr.No	Phase	Stretch	Length of Waterway	Class of Waterway	Remarks
1	Phase-1	Chhatabal to Pantha Chowk	17.44 Km	Special Class	15m bottom width, 0.6 m depth
2	Phase-2	Gund Parang to Sumbal	17.48 Km	Class-1	Refer table 3.2
	Phase-2	Sumbal to Chhatabal	23.86 Km	Class-1	Refer table 3.2
	Phase-2	Shah-E-Hambam to Sangam Bridge	61.69 Km	Class-1	Refer table 3.2
3	Phase-3	Sopore to Chhatabal	76.21 km	Class-1	Refer table 3.2

Details of Terminal locations are shown in **Dwg No.: WAP-JLM-TML-01 to Dwg No.: WAP-JLM-TL-05.**

### 3.4 Dredging Plan:

Dredging will be carried out into three phases mentioned below i.e.

**Table 3.4 Total Dredging Length at each phase**

Sr. No.	Stretch	Phase	Chainage	Length (KM)
1.	Chhatabal to Pantha Chowk	Phase-1	Ch.115.76 to Ch. 133.20	17.44
2.	Gund Parang to Sumbal	Phase-2	Ch.73.70 to Ch. 91.90	17.48
3.	Sumbal to Chhatabal	Phase-2	Ch.91.90.8 to Ch. 115.76	23.86
4.	Shah-E-Hambam to Sangam Bridge	Phase-2	Ch.117.91 to Ch. 179.60	61.69
5.	Sopore to Chhatabal*	Phase-3	Ch. 39.55 to Ch.115.76	76.21

Based on hydrographic survey report dredging quantities are mentioned below **(Without Barrage):**

**Table 3.5 Total quantity of dredging at each phase for class-I (without barrage)**

Sr.No	Phase	Stretch	Design Vessel	Quantity (Cum)
1	Phase-1	Chhatabal to Pantha Chowk	Special Class	<b>46046</b>
2	Phase-2	Gund Parang to Sumbal	Class-I	<b>19826</b>
		Sumbal to Chhatabal	Class-I	<b>218248</b>
		Shah-E-Hambam to Sangam Bridge	Class-I	<b>738618</b>
3	Phase-3	Sopore to Chhatabal	Class-I	<b>828210</b>

Based on hydrographic survey report dredging quantities are mentioned below **(With Barrage):**

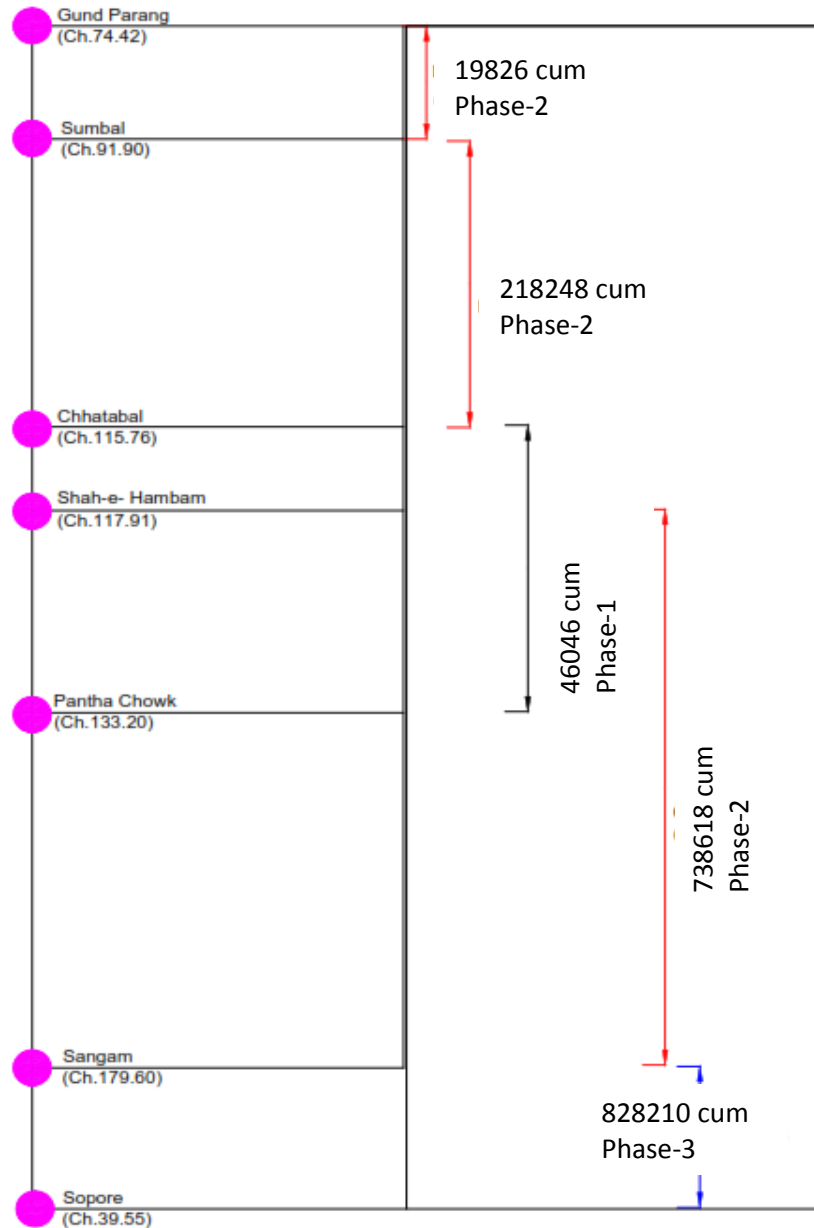
**Table 3.6 Total quantity of dredging at each phase for class-I (with barrage)**

Sr.No	phase	Stretch	Design Vessel	Quantity (Cum)
1	Phase-1	Chhatabal to Pantha Chowk	Special Class	<b>46046</b>
2	Phase-2	Gund Parang to Sumbal	Class-I	-
		Sumbal to Chhatabal	Class-I	-
		Shah-E-Hambam to Sangam Bridge	Class-I	<b>738618</b>
3	Phase-3	Sopore to Chhatabal	Class-I	-

Details of Phases are shown in **Dwg No.: WAP-JLM-TML-01 to Dwg No.: WAP-JLM-TL-05.**

It can be seen from the table 3.5 and table 3.6 that there is no significant reduction in dredging with barrages.

The cost of barrage is very high compared to the dredging in stretches. The implication of barrage on dredging has been done for study purpose only



**Fig. 3.1 Dredging Quantity for Class – I at every phase**

For Dredging **Self-propelled Cutter Section Dredger (CSD)** is recommended to maintain above mentioned stretches for phase-1 & Phase-2.

The main advantages of the cutter suction dredger are as under:

- The ability to dredge a very wide range of material by pumping with water directly to the disposal or reclamation area.
- The ability to operate in shallow water and to produce a uniform level bottom with high rates of production.

- The ability, in case of modern dredgers to dredge to a pre-defined profile e.g. in channels.

### 3.5 Dredger Specifications :

Dredger: 500 CSD with cutter power of 250 KW

1. Length Overall : 37- 42 mtrs (from cutter to spud)
2. Breadth : 8mtrs
3. Dredging Depth : 15-16 mtrs
4. Maximum Draft : 1.5m
5. Trial Speed (Deep Water) : NA
6. Dredge Pump capacity : 3500 Cum/Hr of slurry (500 Cum/Hr solid min)
7. Fuel Oil Bunker Capacity : 60 tonnes (70 KL)
8. Endurance : Dredgers have a life of 20 years depending on the maintenance done. However, usually in tenders, the department asks for new dredgers to ascertain the fitness. Departments keeps an age bar as 6-8 years

**Phase 1** of 4 lakh cum can be completed in 1 to 1.5 months using 2 nos. of 450 CSD dredgers with a cutter power of 250KW

**Table 3.7 Dredger specifications for phase 1**

Solid Quantity m3/ hr	Avg running hours per day	Solid Quantity m3/ day	No. of effective working days in a month	Solid Quantity m3/ month	No of dredgers	Milestone month including contingencies
500	12	6000	10	60000	1	60000

**Phase 2** of 5 lakh cum can be completed in 1 to 1.6 months using 2 nos of 450 CSD dredgers with a cutter power of 250KW

**Table 3.8 Dredger specifications for phase 2**

Solid Quantity m3/ hr	Avg running hours per day	Solid Quantity m3/ day	No. of effective working days in a month	Solid Quantity m3/ month	No of dredgers	Milestone month including contingencies
500	12	6000	25	150000	1	1.5

**Phase 3:** Dredging Quantity – **828210 cum**

Solid Quantity m <sup>3</sup> / hr	Avg running hours per day	Solid Quantity m <sup>3</sup> / day	No. of effective working days in a month	Solid Quantity m <sup>3</sup> / month	No of dredgers	Milestone month including contingencies
500	12	6000	25	150000	1	1.5

**Table 3.9 Equipment type and characteristics for phase - 3**

Sr. No.	Equipment	Minimum Capacity
1	Cutter Suction Dredger	500 CSD
2	Work Boat/ Tugs	360 BHP Multi-Cat Tug
3	Accommodation Boats (if required)	NA since Tugs have accommodation facility
4	Any other vessel	-
5	Vessel and equipment for Survey Work	Inflated boat with min 9.9 HP OBM with carrying capacity Max 05 Persons along with equipment/ IHO Standard Hydrographic Data Acquisition System(Hypack), Echo Sounder/ DGPS

#### Disposal of dredged material:

A total of 46000 m<sup>3</sup> of material in phase-1, 0.98 Mm<sup>3</sup> of material in phase-2 & 0.83 Mm<sup>3</sup> of material in phase-3 have been calculated as described above. In principle, dredged material is being dumped in 3 ways:

- (i) Into the river
- (ii) Outside the river
- (iii) On the bank of the river

From economical consideration the dredged material is proposed to be dumped in the bank with the provision of dowel/ Parapet wall so that dredged material may not slipped back into the river. Clearance would be taken from the competent authorities before dumping the dredged material. Otherwise, material can be dumped at the locations identified by Irrigation & Flood Control (J&K).

### 3.6 Bank Protection / Embankment Strengthening

#### 3.6.1 Protection works Details

**Table 3.10 Characteristics of River Jhelum (NW-49)**

Stretch No.	Latitude	Longitude	Start Chainage	River Bank	Condition	Distance	Remarks
1	34° 9.035'N	74° 12.203'E	0.0 km	Left+Right	Unprotected	1.0 km	Bank is Unprotected from chainage 0.0 km to 1.0 km upstream.

2	34° 9.285'N	74° 12.714'E	1.0 km	Left+Right	Unprotected	2.0 km	Bank is Unprotected from chainage 1.0 km to 2.0 km upstream.
3	34° 9.480'N	74° 13.201'E	2.0 km	Left+Right	Unprotected	3.0 km	Bank is Unprotected from chainage 2.0 km to 3.0 km upstream.
4	34° 9.722'N	74° 13.778'E	3.0 km	Left+Right	Unprotected	4.0 km	Bank is Unprotected from chainage 3.0 km to 4.0 km upstream.
5	34°10.124'N	74° 14.180'E	4.0 km	Left+Right	Unprotected	5.0 km	Bank is Unprotected from chainage 4.0 km to 5.0 km upstream.
6	34°10.412'N	74° 14.698'E	5.0 km	Left+Right	Unprotected	6.0 km	Bank is Unprotected from chainage 5.0 km to 6.0 km upstream.
7	34°10.827'N	74° 14.866'E	6.0 km	Left+Right	Unprotected	7.0 km	Bank is Unprotected from chainage 6.0 km to 7.0 km upstream.
8	34°10.603'N	74° 15.367'E	7.0 km	Left+Right	Unprotected	8.0 km	Bank is Unprotected from chainage 7.0 km to 8.0 km upstream.
9	34° 10.895'N	74° 15.905'E	8.0 km	Left+Right	Unprotected	9.0 km	Bank is Unprotected from chainage 8.0 km to 9.0 km upstream.
10	34° 10.880'N	74° 16.516'E	9.0 km	Left+Right	protected	10.0 km	Bank is protected from chainage 9.0 km to 10.0 km upstream.
11	34° 10.801'N	74° 17.136'E	10.0 km	Left+Right	Unprotected	11.0 km	Bank is Unprotected from chainage 10.0 km to 11.0 km upstream.
12	34° 10.889'N	74° 17.660'E	11.0 km	Left+Right	Unprotected	12.0 km	Bank is

							Unprotected from chainage 11.0 km to 12.0 km upstream.
13	34° 10.965'N	74° 18.261'E	12.0 km	Left+Right	Unprotected	13.0 km	Bank is Unprotected from chainage 12.0 km to 13.0 km upstream.
14	34° 11.313'N	74° 18.389'E	13.0 km	Left+Right	Unprotected	14.0 km	Bank is Unprotected from chainage 13.0 km to 14.0 km upstream.
15	34° 11.517'N	74° 17.891'E	14.0 km	Left+Right	protected	15.0 km	Bank is protected from chainage 14.0 km to 15.0 km upstream.
16	34° 11.783'N	74° 18.021'E	15.0 km	Left+Right	protected	16.0 km	Bank is protected from chainage 15.0 km to 16.0 km upstream.
17	34° 12.116'N	74° 18.582'E	16.0 km	Left+Right	protected	17.0 km	Bank is protected from chainage 16.0 km to 17.0 km upstream.
18	34° 12.451'N	74° 19.028'E	17.0 km	Left+Right	Unprotected	18.0 km	Bank is Unprotected from chainage 17.0 km to 18.0 km upstream.
19	34° 12.591'N	74° 19.610'E	18.0 km	Left+Right	Unprotected	19.0 km	Bank is Unprotected from chainage 18.0 km to 19.0 km upstream.
20	34° 12.501'N	74° 20.306'E	19.0 km	Left+Right	Unprotected	20.0 km	Bank is Unprotected from chainage 19.0km to 20.0km upstream.
21	34° 12.475'N	74° 20.819'E	20.0 km	Left+Right	Unprotected	21.0 km	Bank is Unprotected from chainage 20.0 km to 21.0 km upstream.
22	34° 12.588'N	74° 21.431'E	21.0 km	Left+Right		22.0 km	Bank is

					Unprotected		Unprotected from chainage 21.0 km to 22.0 km upstream.
23	34° 12.910'N	74° 21.929'E	22.0 km	Left+Right	Unprotected	23.0 km	Bank is Unprotected from chainage 22.0 km to 23.0 km upstream.
24	34° 13.238'N	74° 22.402'E	23.0 km	Left+Right	Unprotected	24.0 km	Bank is Unprotected from chainage 23.0 km to 24.0 km upstream.
25	34° 13.426'N	74° 23.043'E	24.0 km	Left+Right	Unprotected	25.0 km	Bank is Unprotected from chainage 24.0 km to 25.0 km upstream.
26	34° 13.864'N	74° 23.433'E	25.0 km	Left+Right	Unprotected	26.0 km	Bank is Unprotected from chainage 25.0 km to 26.0 km upstream.
27	34° 14.410'N	74° 23.187'E	26.0 km	Left+Right	Unprotected	27.0 km	Bank is Unprotected from chainage 26.0 km to 27.0 km upstream.
28	34° 14.931'N	74° 23.309'E	27.0 km	Left+Right	Unprotected	28.0 km	Bank is Unprotected from chainage 27.0 km to 28.0 km upstream.
29	34° 14.957'N	74° 23.677'E	28.0 km	Left+Right	Unprotected	29.0 km	Bank is Unprotected from chainage 28.0 km to 29.0 km upstream.
30	34° 14.467'N	74° 24.074'E	29.0 km	Left+Right	Unprotected	30.0 km	Bank is Unprotected from chainage 29.0km to 30.0km upstream.
31	34° 14.712'N	74° 24.574'E	30.0 km	Left+Right	Unprotected	31.0 km	Bank is Unprotected from chainage 30.0km to 31.0km upstream.

32	34° 15.248'N	74° 24.422'E	31.0 km	Left+Right	Unprotected	32.0 km	Bank is Unprotected from chainage 31.0km to 32.0km upstream.
33	34° 15.689'N	74° 24.574'E	32.0 km	Left+Right	Unprotected	33.0 km	Bank is Unprotected from chainage 32.0km to 33.0km upstream.
34	34° 15.845'N	74° 25.105'E	33.0 km	Left+Right	Unprotected	34.0 km	Bank is Unprotected from chainage 33.0km to 34.0km upstream.
35	34° 15.747'N	74° 25.721'E	34.0 km	Left+Right	Unprotected	35.0 km	Bank is Unprotected from chainage 34.0km to 35.0km upstream.
36	34° 15.876'N	74° 26.315'E	35.0 km	Left+Right	Unprotected	36.0 km	Bank is Unprotected from chainage 35.0km to 36.0km upstream.
37	34° 16.343'N	74° 26.424'E	36.0 km	Left+Right	Unprotected	37.0 km	Bank is Unprotected from chainage 36.0km to 37.0km upstream.
38	34° 16.504'N	74° 26.997'E	37.0 km	Left+Right	Unprotected	38.0 km	Bank is Unprotected from chainage 37.0km to 38.0km upstream.
39	34° 16.427'N	74° 27.597'E	38.0 km	Left+Right	Unprotected	39.0 km	Bank is Unprotected from chainage 38.0km to 39.0km upstream.
40	34° 16.835'N	74° 28.213'E	39.0 km	Left+Right	Unprotected	40.0 km	Bank is Unprotected from chainage

							39.0km to 40.0km upstream.
41	34° 17.084'N	74° 28.663'E	40.0 km	Left+Right	Unprotected	41.0 km	Bank is Unprotected from chainage 40.0km to 41.0km upstream.
42	34° 17.275'N	74° 29.187'E	41.0 km	Left+Right	Unprotected	42.0 km	Bank is Unprotected from chainage 41.0km to 42.0km upstream.
43	34° 17.114'N	74° 29.803'E	42.0 km	Left+Right	Unprotected	43.0 km	Bank is Unprotected from chainage 42.0km to 43.0km upstream.
44	34° 17.254'N	74° 30.462'E	43.0 km	Left+Right	Unprotected	44.0 km	Bank is Unprotected from chainage 43.0km to 44.0km upstream.
45	34° 17.320'N	74° 31.025'E	44.0 km	Left+Right	Unprotected	45.0 km	Bank is Unprotected from chainage 44.0km to 45.0km upstream.
46	34° 17.963'N	74° 31.098'E	45.0 km	Left+Right	Unprotected	46.0 km	Bank is Unprotected from chainage 45.0km to 46.0km upstream.
47	34° 18.415'N	74° 31.316'E	46.0 km	Left+Right	Unprotected	47.0 km	Bank is Unprotected from chainage 46.0km to 47.0km upstream.
48	34° 18.866'N	74° 31.320'E	47.0 km	Left+Right	Unprotected	48.0 km	Bank is Unprotected from chainage 47.0km to 48.0km upstream.

49	34° 19.406'N	74° 31.282'E	48.0 km	Left+Right	Unprotected	49.0 km	Bank is Unprotected from chainage 48.0km to 49.0km upstream.
50	34° 20.155'N	74° 31.623'E	49.0 km	Left+Right	Unprotected	50.0 km	Bank is Unprotected from chainage 49.0km to 50.0km upstream.
51	34° 20.553'N	74° 31.375'E	50.0 km	Left+Right	Unprotected	51.0 km	Bank is Unprotected from chainage 50.0km to 51.0km upstream.
52	34° 21.045'N	74° 31.635'E	51.0 km	Left+Right	Unprotected	52.0 km	Bank is Unprotected from chainage 51.0km to 52.0km upstream.
53	34° 21.550'N	74° 31.981'E	52.0 km	Left+Right	Unprotected	53.0 km	Bank is Unprotected from chainage 52.0km to 53.0km upstream.
54	34° 22.210'N	74° 31.820'E	53.0 km	Left+Right	Unprotected	54.0 km	Bank is Unprotected from chainage 53.0km to 54.0km upstream.
55	34° 22.714'N	74° 32.020'E	54.0 km	Left+Right	Unprotected	55.0 km	Bank is Unprotected from chainage 54.0km to 55.0km upstream.
56	34° 23.354'N	74° 31.838'E	55.0 km	Left+Right	Unprotected	56.0 km	Bank is Unprotected from chainage 55.0km to 56.0km upstream.
57	34° 24.006'N	74° 32.462'E	56.0 km	Left+Right	Unprotected	57.0 km	Bank is Unprotected from chainage

							56.0km to 57.0km upstream.
58	34° 24.090'N	74° 33.448'E	57.0 km	Left+Right	Unprotected	58.0 km	Bank is Unprotected from chainage 57.0km to 58.0km upstream.
59	34° 24.260'N	74° 33.909'E	58.0 km	Left+Right	Unprotected	59.0 km	Bank is Unprotected from chainage 58.0km to 59.0km upstream.
60	34° 23.903'N	74° 35.061'E	59.0 km	Left+Right	Unprotected	60.0 km	Bank is Unprotected from chainage 59.0km to 60.0km upstream.
61	34° 23.822'N	74° 35.451'E	60.0 km	Left+Right	Unprotected	61.0 km	Bank is Unprotected from chainage 60.0km to 61.0km upstream.
62	34° 23.528'N	74° 35.893'E	61.0 km	Left+Right	Unprotected	62.0 km	Bank is Unprotected from chainage 61.0km to 62.0km upstream.
63	34° 23.699'N	74° 36.283'E	62.0 km	Left+Right	Unprotected	63.0 km	Bank is Unprotected from chainage 62.0km to 63.0km upstream.
64	34° 23.841'N	74° 37.054'E	63.0 km	Left+Right	Unprotected	64.0 km	Bank is Unprotected from chainage 63.0km to 64.0km upstream.
65	34° 23.381'N	74° 36.964'E	64.0 km	Left+Right	Unprotected	65.0 km	Bank is Unprotected from chainage 64.0km to 65.0km upstream.

66	34° 22.965'N	74° 36.565'E	65.0 km	Left+Right	Unprotected	66.0 km	Bank is Unprotected from chainage 65.0km to 66.0km upstream.
67	34° 22.680'N	74° 36.022'E	66.0 km	Left+Right	Unprotected	67.0 km	Bank is Unprotected from chainage 66.0km to 67.0km upstream.
68	34° 22.381'N	74° 35.565'E	67.0 km	Left+Right	Unprotected	68.0 km	Bank is Unprotected from chainage 67.0km to 68.0km upstream.
69	34° 22.369'N	74° 36.030'E	68.0 km	Left+Right	Unprotected	69.0 km	Bank is Unprotected from chainage 68.0km to 69.0km upstream.
70	34° 21.922'N	74° 36.484'E	69.0 km	Left+Right	Unprotected	70.0 km	Bank is Unprotected from chainage 69.0km to 70.0km upstream.
71	34°21'37.22"N	74°36'36.5"E	70.0 km	Left+Right	Unprotected	71.0 km	Bank is unprotected from chainage 70.0km to 71.0km upstream.
72	34° 21.281'N	74° 37.055'E	71.0 km	Left+Right	Unprotected	72.0 km	Bank is unprotected from chainage 71.0km to 72.0km upstream.
73	34° 20.839'N	74° 37.438'E	72.0 km	Left+Right	Unprotected	73.0 km	Bank is unprotected from chainage 72.0km to 73.0km upstream.
74	34° 20.491'N	74° 37.872'E	73.0 km	Left+Right	Unprotected	74.0 km	Bank is unprotected from chainage

							73.0km to 74.0km upstream.
75	34° 19.996'N	74° 38.048'E	74.0 km	Left+Right	protected	75.0 km	Bank is protected from chainage 74.0km to 75.0km upstream.
76	34°19'31.32"N	74°38'15.74"E	75.0 km	Left+Right	Unprotected	76.0 km	Bank is unprotected from chainage 75.0km to 76.0km upstream.
77	34° 19.013'N	74° 38.486'E	76.0 km	Left+Right	Unprotected	77.0 km	Bank is unprotected from chainage 76.0km to 77.0km upstream.
78	34° 18.565'N	74° 38.252'E	77.0 km	Left+Right	Unprotected	78.0 km	Bank is unprotected from chainage 77.0km to 78.0km upstream.
79	34° 18.057'N	74° 38.066'E	78.0 km	Left+Right	Unprotected	79.0 km	Bank is unprotected from chainage 78.0km to 79.0km upstream.
80	34° 17.693'N	74° 37.550'E	79.0 km	Left+Right	Unprotected	80.0 km	Bank is unprotected from chainage 79.0km to 80.0km upstream.
81	34°17'24.44"N	74°37'24.01"E	80.0 km	Left Side	Protected	81.0 km	Bank is protected (Retaining Walls) from chainage 80.0km to 81.0km upstream (Right Bank unprotected)
82	34°16'53.73"N	74°37'16.28"E	81.0 km	Left+Right	Unprotected	82.0 km	Bank is unprotected from chainage 81.0km to

							82.0km upstream.
83	34° 16.382'N	74° 37.242'E	82.0 km	Left+Right	Unprotected	83.0 km	Bank is unprotected from chainage 82.0km to 83.0km upstream.
84	34° 16.084'N	74° 37.623'E	83.0 km	Left+Right	Unprotected	84.0 km	Bank is unprotected from chainage 83.0km to 84.0km upstream.
85	34° 15.924'N	74° 37.157'E	84.0 km	Left+Right	Unprotected	85.0 km	Bank is unprotected from chainage 84.0km to 85.0km upstream.
86	34°15'39.13"N	74°36'38.08"E	85.0 km	Left+Right	Unprotected	86.0 km	Bank is unprotected from chainage 85.0km to 86.0km upstream.
87	34° 15.077'N	74° 36.771'E	86.0 km	Left+Right	Unprotected	87.0 km	Bank is unprotected from chainage 86.0km to 87.0km upstream.
88	34° 14.801'N	74° 37.352'E	87.0 km	Left+Right	Unprotected	88.0 km	Bank is unprotected from chainage 87.0km to 88.0km upstream.
89	34° 14.684'N	74° 38.001'E	88.0 km	Left+Right	Unprotected	89.0 km	Bank is unprotected from chainage 88.0km to 89.0km upstream.
90	34° 14.439'N	74° 38.517'E	89.0 km	Left+Right	Unprotected	90.0 km	Bank is unprotected from chainage 89.0km to 90.0km upstream.
91	34°14'1.74"N	74°38'49.05"E	90.0 km	Left+Right	Unprotected	91.0 km	Bank is

							unprotected from chainage 90.0km to 91.0km upstream.
92	34° 13.561'N	74° 39.098'E	91.0 km	Left+Right	Unprotected	92.0 km	Bank is unprotected from chainage 91.0km to 92.0km upstream.
93	34° 13.012'N	74° 39.001'E	92.0 km	Left+Right	Unprotected	93.0 km	Bank is unprotected from chainage 92.0km to 93.0km upstream.
94	34° 12.593'N	74° 39.478'E	93.0 km	Left+Right	Unprotected	94.0 km	Bank is unprotected from chainage 93.0km to 94.0km upstream.
95	34° 12.284'N	74° 39.792'E	94.0 km	Left+Right	Unprotected	95.0 km	Bank is unprotected from chainage 94.0km to 95.0km upstream.
96	34°11'49.14"N	74°40'4.73"E	95.0 km	Left+Right	Unprotected	96.0 km	Bank is unprotected from chainage 95.0km to 96.0km upstream.
97	34° 11.297'N	74° 40.330'E	96.0 km	Left+Right	Unprotected	97.0 km	Bank is unprotected from chainage 96.0km to 97.0km upstream.
98	34° 10.814'N	74° 40.652'E	97.0 km	Left+Right	Unprotected	98.0 km	Bank is unprotected from chainage 97.0km to 98.0km upstream.
99	34° 10.405'N	74° 41.113'E	98.0 km	Left+Right	Unprotected	99.0 km	Bank is unprotected from chainage 98.0km to

							99.0km upstream.
100	34° 10.243'N	74° 41.632'E	99.0 km	Left+Right	Unprotected	100.0 km	Bank is unprotected from chainage 99.0km to 100.0km upstream.
101	34° 9'46.78"N	74°41'53.65"E	100.0 km	Left+Right	Unprotected	101.0 km	Bank is Unprotected from chainage 100.0km to 101.0km upstream
102	34° 9.224'N	74° 42.051'E	101.0 km	Left+Right	Unprotected	102.0 km	Bank is Unprotected from chainage 101.0km to 102.0km upstream
103	34° 8.886'N	74° 42.542'E	102.0 km	Left+Right	Unprotected	103.0 km	Bank is Unprotected from chainage 102.0km to 103.0km upstream
104	34° 8.556'N	74° 42.775'E	103.0 km	Left+Right	Unprotected	104.0 km	Bank is Unprotected from chainage 103.0km to 104.0km upstream
105	34° 8.103'N	74° 42.425'E	104.0 km	Left+Right	Unprotected	105.0 km	Bank is Unprotected from chainage 104.0km to 105.0km upstream
106	34° 7'46.77"N	74°42'55.19"E	105.0 km	Left+Right	Unprotected	106.0 km	Bank is Unprotected from chainage 105.0km to 106.0km upstream
107	34° 7.737'N	74° 43.625'E	106.0 km	Left+Right	Unprotected	107.0 km	Bank is Unprotected from chainage 106.0km to 107.0km upstream
108	34° 7.872'N	74° 44.182'E	107.0 km	Left+Right	Unprotected	108.0	Bank is

						km	Unprotected from chainage 107.0km to 108.0km upstream
109	34° 7.525'N	74° 44.319'E	108.0 km	Left+Right	Unprotected	109.0 km	Bank is Unprotected from chainage 108.0km to 109.0km upstream
110	34° 7.050'N	74° 44.639'E	109.0 km	Left+Right	Unprotected	110.0 km	Bank is Unprotected from chainage 109.0km to 110.0km upstream
111	34° 6'43.48"N	74°45'3.34"E	110.0 km	Left+Right	Unprotected	111.0 km	Bank is Unprotected from chainage 110.0km to 111.0km upstream.
112	34° 6.365'N	74° 45.585'E	111.0 km	Left+Right	Unprotected	112.0 km	Bank is Unprotected from chainage 111.0km to 112.0km upstream.
113	34° 6.378'N	74° 46.155'E	112.0 km	Left+Right	Unprotected	113.0 km	Bank is Unprotected from chainage 112.0km to 113.0km upstream.
114	34° 5.948'N	74° 46.470'E	113.0 km	Left+Right	Unprotected	114.0 km	Bank is Unprotected from chainage 113.0km to 114.0km upstream.
115	34° 5'31.45"N	74°46'49.43"E	114.0 km	Left Side	Protected	115.0 km	Bank is protected (Retaining Walls) from chainage 114.0km to 115.0km upstream (Right Bank unprotected)
116	34° 5'25.13"N	74°47'26.07"E	115.0 km	Left+Right	Protected	116.0	Bank is

						km	Pprotected (Retaining Walls) from chainage 115.0km to 116.0km upstream
117	34° 5.716'N	74° 48.024'E	116.0 km	Left+Right	Protected	117.0 km	Bank is Pprotected (Retaining Walls) from chainage 116.0km to 117.0km upstream
118	34° 5.429'N	74° 48.404'E	117.0 km	Left+Right	Protected	118.0 km	Bank is Pprotected (Retaining Walls) from chainage 117.0km to 118.0km upstream
119	34° 4.901'N	74° 48.288'E	118.0 km	Left+Right	Protected	119.0 km	Bank is Pprotected (Retaining Walls) from chainage 118.0km to 119.0km upstream
120	34° 4.362'N	74° 48.329'E	119.0 km	Left+Right	Protected	120.0 km	Bank is Pprotected (Retaining Walls) from chainage 119.0km to 120.0km upstream
121	34° 4'5.40"N	74°48'43.44"E	120.0 km	Left+Right	Protected	121.0 km	Bank is Protected (Retaining Walls) from chainage 120.0km to 121.0km upstream
122	34° 4.214'N	74° 49.342'E	121.0 km	Left+Right	Protected	122.0 km	Bank is Protected (Retaining Walls) from chainage 121.0km to 122.0km upstream
123	34° 4'12.04"N	74°49'57.12"E	122.0 km	Left+Right	Protected	123.0 km	Bank is Protected (Retaining Walls)

							from chainage 122.0km to 123.0km upstream
124	34° 4.009'N	74° 50.507'E	123.0 km	Left+Right	Protected	124.0 km	Bank is Protected (Retaining Walls) from chainage 123.0km to 124.0km upstream
125	34° 3.815'N	74° 50.054'E	124.0 km	Left+Right	Unprotected	125.0 km	Bank is unprotected from chainage 124.0km to 125.0km upstream
126	34° 3'26.71"N	74°49'40.46"E	125.0 km	Left+Right	Unprotected	126.0 km	Bank is unprotected from chainage 125.0km to 126.0km upstream
127	34° 3.285'N	74° 50.314'E	126.0 km	Left+Right	Unprotected	127.0 km	Bank is unprotected from chainage 126.0km to 127.0km upstream
128	34° 3'41.71"N	74°50'40.83"E	127.0 km	Left+Right	Unprotected	128.0 km	Bank is unprotected from chainage 127.0km to 128.0km upstream
129	34° 3'26.30"N	74°50'47.00"E	128.0 km	Right Side	Protected	129.0 km	Bank is protected (Retaining Walls) from chainage 128.0km to 129.0km upstream (Left Bank unprotected)
130	34° 3.332'N	74° 51.189'E	129.0 km	Left+Right	Protected	130.0 km	Bank is protected (Retaining Walls) from chainage 129.0km to 130.0km upstream (Left

							Bank unprotected)
131	34° 3'10.23"N	74°51'32.99"E	130.0 km	Right Side	Protected	131.0 km	Bank is protected (Retaining Walls) from chainage 130.0km to 131.0km upstream (Left Bank unprotected)
132	34° 2.782'N	74° 51.860'E	131.0 km	Left+Right	Unprotected	132.0 km	Bank is unprotected from chainage 131.0km to 132.0km upstream
133	34° 2.515'N	74° 52.265'E	132.0 km	Left+Right	Unprotected	133.0 km	Bank is unprotected from chainage 132.0km to 133.0km upstream
134	34° 2.059'N	74° 52.577'E	133.0 km	Left+Right	Unprotected	134.0 km	Bank is unprotected from chainage 133.0km to 134.0km upstream
135	34° 2.235'N	74° 53.118'E	134.0 km	Left+Right	Unprotected	135.0 km	Bank is unprotected from chainage 134.0km to 135.0km upstream
136	34° 2'6.91"N	74°53'42.15"E	135.0 km	Left+Right	Unprotected	136.0 km	Bank is unprotected from chainage 135.0km to 136.0km upstream
137	34° 1.777'N	74° 54.033'E	136.0 km	Left+Right	Unprotected	137.0 km	Bank is unprotected from chainage 136.0km to 137.0km upstream
138	34° 1.299'N	74° 53.800'E	137.0 km	Left+Right	Unprotected	138.0 km	Bank is unprotected from chainage 137.0km to

							138.0km upstream
139	34° 1.027'N	74° 54.136'E	138.0 km	Left+Right	Unprotected	139.0 km	Bank is unprotected from chainage 138.0km to 139.0km upstream
140	34° 1.385'N	74° 54.574'E	139.0 km	Left+Right	Unprotected	140.0 km	Bank is unprotected from chainage 139.0km to 140.0km upstream
141	34° 1'15.05"N	74°54'57.53"E	140.0 km	Left+Right	Unprotected	141.0 km	Bank is unprotected from chainage 140.0km to 141.0km upstream
142	34° 0.896'N	74° 54.398'E	141.0 km	Left+Right	Unprotected	142.0 km	Bank is unprotected from chainage 141.0km to 142.0km upstream
143	34° 0'27.46"N	74°54'43.16"E	142.0 km	Left+Right	Unprotected	143.0 km	Bank is unprotected from chainage 142.0km to 143.0km upstream
144	33° 59.934'N	74° 54.951'E	143.0 km	Left+Right	Unprotected	144.0 km	Bank is unprotected from chainage 143.0km to 144.0km upstream
145	33° 59.534'N	74° 55.347'E	144.0 km	Left+Right	Unprotected	145.0 km	Bank is unprotected from chainage 144.0km to 145.0km upstream
146	33°59'16.30"N	74°54'59.53"E	145.0 km	Left+Right	Unprotected	146.0 km	Bank is unprotected from chainage 145.0km to 146.0km upstream
147	33° 59.034'N	74° 54.348'E	146.0 km	Left+Right	Unprotected	147.0	Bank is

						km	unprotected from chainage 146.0km to 147.0km upstream
148	33° 58.455'N	74° 54.292'E	147.0 km	Left+Right	Unprotected	148.0 km	Bank is unprotected from chainage 147.0km to 148.0km upstream
149	33° 58.275'N	74° 54.942'E	148.0 km	Left+Right	Unprotected	149.0 km	Bank is unprotected from chainage 148.0km to 149.0km upstream
150	33° 57.813'N	74° 55.387'E	149.0 km	Left+Right	Unprotected	150.0 km	Bank is unprotected from chainage 149.0km to 150.0km upstream
151	33°57'19.33"N	74°55'20.67"E	150.0 km	Left+Right	Unprotected	151.0 km	Bank is unprotected from chainage 150.0km to 151.0km upstream
152	33° 57.109'N	74° 55.964'E	151.0 km	Left+Right	Unprotected	152.0 km	Bank is unprotected from chainage 151.0km to 152.0km upstream
153	33° 57.397'N	74° 56.525'E	152.0 km	Left+Right	Unprotected	153.0 km	Bank is unprotected from chainage 152.0km to 153.0km upstream
154	33° 57.845'N	74° 56.909'E	153.0 km	Left+Right	Unprotected	154.0 km	Bank is unprotected from chainage 153.0km to 154.0km upstream
155	33° 57.925'N	74° 57.591'E	154.0 km	Left+Right	Unprotected	155.0 km	Bank is unprotected from chainage 154.0km to

							155.0km upstream
156	33°57'26.67"N	74°57'49.12"E	155.0 km	Left+Right	Unprotected	156.0 km	Bank is unprotected from chainage 155.0km to 156.0km upstream
157	33° 57.306'N	74° 58.407'E	156.0 km	Left+Right	Unprotected	157.0 km	Bank is unprotected from chainage 156.0km to 157.0km upstream
158	33° 57.087'N	74° 58.886'E	157.0 km	Left+Right	Unprotected	158.0 km	Bank is unprotected from chainage 157.0km to 158.0km upstream
159	33° 56.552'N	74° 58.976'E	158.0 km	Left+Right	Unprotected	159.0 km	Bank is unprotected from chainage 158.0km to 159.0km upstream
160	33° 56.346'N	74° 59.607'E	159.0 km	Left+Right	Unprotected	160.0 km	Bank is unprotected from chainage 159.0km to 160.0km upstream
161	33°55'51.85"N	74°59'48.52"E	160.0 km	Left+Right	Unprotected	161.0 km	Bank is unprotected from chainage 160.0km to 161.0km upstream
162	33° 55.466'N	75° 0.310'E	161.0 km	Left+Right	Unprotected	162.0 km	Bank is unprotected from chainage 161.0km to 162.0km upstream
163	33° 55.132'N	75° 0.622'E	162.0 km	Left+Right	Unprotected	163.0 km	Bank is unprotected from chainage 162.0km to 163.0km upstream
164	33° 54.857'N	75° 0.044'E	163.0 km	Left+Right	Unprotected	164.0	Bank is

						km	unprotected from chainage 163.0km to 164.0km upstream
165	33° 54.591'N	75° 0.254'E	164.0 km	Left+Right	Unprotected	165.0 km	Bank is unprotected from chainage 164.0km to 165.0km upstream
166	33°54'21.25"N	75° 0'36.97"E	165.0 km	Left+Right	Unprotected	166.0 km	Bank is unprotected from chainage 165.0km to 166.0km upstream
167	33° 53.989'N	75° 1.073'E	166.0 km	Left+Right	Unprotected	167.0 km	Bank is unprotected from chainage 166.0km to 167.0km upstream
168	33° 53.575'N	75° 0.935'E	167.0 km	Left+Right	Unprotected	168.0 km	Bank is unprotected from chainage 167.0km to 168.0km upstream
169	33° 53.223'N	75° 0.523'E	168.0 km	Left+Right	Unprotected	169.0 km	Bank is unprotected from chainage 168.0km to 169.0km upstream
170	33° 52.920'N	75° 0.919'E	169.0 km	Left+Right	Unprotected	170.0 km	Bank is unprotected from chainage 169.0km to 170.0km upstream
171	33°53'1.05"N	75° 1'30.07"E	170.0 km	Left+Right	Unprotected	171.0 km	Bank is unprotected from chainage 170.0km to 171.0km upstream
172	33° 52.600'N	75° 1.467'E	171.0 km	Left+Right	Unprotected	172.0 km	Bank is unprotected from chainage 171.0 km to

							172.0km upstream
173	33° 52.165'N	75° 1.916'E	172.0 km	Left+Right	Unprotected	173.0 km	Bank is unprotected from chainage 172.0 km to 173.0km upstream
174	33° 52.139'N	75° 2.554'E	173.0 km	Left+Right	Unprotected	174.0 km	Bank is unprotected from chainage 173.0 km to 174.0km upstream
175	33° 51.678'N	75° 2.645'E	174.0 km	Left+Right	Unprotected	175.0 km	Bank is unprotected from chainage 174.0 km to 175.0km upstream
176	33°51'10.6"N	75° 2'40.64"E	175.0 km	Left+Right	Unprotected	176.0 km	Bank is unprotected from chainage 175.0km to 176.0 km upstream
177	33° 50.709'N	75° 3.073'E	176.0 km	Left+Right	Unprotected	177.0 km	Bank is unprotected from chainage 176.0 km to 177.0 km upstream
178	33° 50.445'N	75° 3.636'E	177.0 km	Left+Right	Unprotected	178.0 km	Bank is unprotected from chainage 177.0km to 178.0km upstream
179	33° 50.007'N	75° 4.031'E	178.0 km	Left+Right	Unprotected	179.0 km	Bank is unprotected from chainage 178.0km to 179.0km upstream
180	33° 49.913'N	75° 4.533'E	179.0 km	Left+Right	Unprotected	180.0 km	Bank is unprotected from chainage 179.0 km to 180.0 km upstream
181.205	33° 49.473'N	75° 4.791'E	180.0 km	Left+Right	Unprotected	181.205	Bank is

						km	unprotected from chainage 180.0 km to 181.205km upstream
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### 3.6.2 Proposed bank protection

**Table 3.11 Details of Bank Protection on River Jhelum (Chainage-wise)**

Sr. No.	Chainage	Location	Length (m)	Remarks
1	Ch.179.60	Sangam Bridge	100	100m Both side of terminal
2	Ch.133.20	Pantha Chowk	100	100m Both side of terminal
3	Ch.122.36	Zero Bridge	100	100m Both side of terminal
4	Ch.120.15	Amira Kadal	100	100m Both side of terminal
5	Ch.117.91	Shah-e-Hambam bridge	100	100m Both side of terminal
6	Ch.115.76	Safa Kadal / Chattabal	100	100m Both side of terminal
7	Ch.91.90	Sumbal Bridge	100	100m Both side of terminal
8	Ch.73.70	Gund Parang	100	100m Both side of terminal
9	Ch.39.55	Sopore	100	100m Both side of terminal

The bank protection near terminals can be done using Gabion gravity structure

### 3.7 Navigation Marking/ Navigation Aids

The terms Aids to Navigation, Nav-aids and Navigational aids used interchangeably, are all meant to convey marks, including floating marks, such as buoys and beacons, transit and clearing marks as well as signalling systems, radio aids and communications, electronic systems, radar etc. which are installed on land or in water for guidance to all ships for safe and regulated navigation in the channels, anchorages, berths, docks etc. It is envisaged that navigation will be carried out throughout the year, by day and night except during times of high wind speeds and low visibility. For day navigation, channel is demarcated by conventional bamboo marks but when frequency of IWT mode increases it becomes essential to provide night navigation facilities.

Marine Lantern @ 2km C/C along the river Jhelum has been provided. Designed aid is on the basis of light intensity, soil condition and wind direction and velocity

#### **RIS (River Information System):**

##### **LIST OF EQUIPMENTS:**

##### **Base Station**

- 1) AIS Base Station with Hot stand
- 2) Mono pole tower
- 3) Porta Cabin 20'X 8'X8'
- 4) VHF sets with Antenna
- 5) Leased Line – Wide Area Network

- 6) Metrological Equipment
- 7) Gen Set 10 KVA
- 8) UPS (UPS APC- SRC6KUXI-6KVA)
- 9) BSNL Leased line

#### Control Station Servers

- 1) Central RIS Operating Processor
- 2) Central Monitoring and Storage Processor
- 3) Web Server & Time Server
- 4) Workstation
- 5) Operator Display 52" LED Wide Screen + With operator display
- 6) RIS Software
- 7) Installation, testing, Training and commissioning

### 3.8 Modification Requirement in existing Bridges / Cables / Dams / Barrages / Locks / Weirs / Anicuts / Aqueducts

*Table 3.12 details of existing structures o River Jhelum (NW-49)*

Sr. No.	Existing Structures	Total	Class-I	Class-II
1	Existing Bridges	57	7- UC, 50-Not having Vertical Clearance 12 Bridges not satisfying Horizontal Clearance	7- UC, 52-Not having Vertical Clearance, 26- Bridges not satisfying Horizontal Clearance
2	Existing Barrages	1	Gantamulla Barrage Cofferdam near Sopore	
3	Navigational Lock	1	at Chattabal Weir	
3	Navigational channel	1	at Sopore bridge near Crude wier	
4	Weir /Dam	2	Chattabal & Crude Weir	
5	High Tension Lines / Electric lines / Tele-communication lines	156	155 nos. Vertical clearance not available	

- For special class there are sufficient clearances. Hence, demolition of bridges are not required as 15m horizontal clearance

Details of Existing Bridges are shown in **Dwg No.: WAP-JLM-CS-01 to Dwg No.: WAP-JLM-CS-07.**

### 3.9 Proposed Dams / Barrages / Locks / Weirs to improve depth

Not recommended

## CHAPTER – 4 DATA ANALYSIS

### 4.1 Data Collection

All relating data of bathymetric and topographic survey carried out by the IWAI for Jhelum River from downstream of Lower Jhelum Hydroelectric power Project to Sangam stretch for an average width of 100m for cross sectional surveys at 100 m interval was collected. Ten year hydrological data was collected from IWAI and State Irrigation Department/Flood Control Departments concerned. The satellite imageries of the project area were collected from National Remote Sensing Agency (NRSA). The data related to similar studies on other major rivers in India and the recommendations of previous Master Plan studies was collected from WAPCOS reports and IWAI. The traffic related data on road, rail and other modes of transport serving the NW-49 hinterland was collected from Centre and State Transport Department, Ministry of Railways, Industries etc.

### 4.2 Hydrological data analysis

Hydrological data for the gauge sites along the River Jhelum under study stretch has been analysed and water depth round the year have been ascertained. Gauge- discharge, collected from Irrigation and Flood control department (I&FC) J&K for mainly 4 gauging stations i.e Sangam, Ram Munshibagh, Asham and Sopore on River Jhelum and the data of the same were analyzed. Following table gives details of gauging stations with location.

**Table 4.1 Details of Gauging Station on River Jhelum**

Site Name	Location	State	Basin	Sub Tributary	Local River	Zero of the Gauge (m) w.r.t. MSL	Type of Site
Sangam	33°49' 54.79"N 75°4' 3.56"E	J&K	Indus	Chenab	Jhelum	1584.80	GD-CWC
Ram Munshibagh	34° 4'14.40"N 74°49'48.90"E	J&K	Indus	Chenab	Jhelum	1584.80	GDQ-I&FC
Chattabal D/s	34° 5'23.19"N 74°46'59.01"E	J&K	Indus	Chenab	Jhelum	1578.70	GD-I&FC
Asham	34°14'47.88"N 74°37'23.93"E	J&K	Indus	Chenab	Jhelum	1576.31	GD-I&FC
Sopore	34°17'44" N 74°37'29" E	J&K	Indus	Chenab	Jhelum	1573.81	GDQ-I&FC
Baramulla	34°12'30.01"N 74°20'44.64"E	J&K	Indus	Chenab	Jhelum	1572.15	G-I&FC

*Source: I&FC J&K, CWC, Govt. of India*

The abstract of water level variation from 2006-2017 at each Gauge stations is given in table and the same has been presented in fig. below:

**Table 4.2 Water Level Variation at each Gauge station**

Gauge Station	Chainage (in Km)	Average Min WL (2006-2017) (wrt MSL)	Average Max WL (2006-2017) (wrt MSL)	High FL (wrt MSL)	Lowest WL (wrt MSL)
Sangam	106.259	1586.20	1587.56	1595.38	1584.66
Ram Munshibagh	51.793	1586.15	1587.33	1593.79	1585.15
Chattabal D/s	44.335	1579.70	1581.15	1584.61	1578.94
Asham	17.116	1577.34	1578.14	1581.91	1576.41
Sopore	44.122 (Stretch-B)	1574.28	1574.95	1579.55	1572.74

Source: I&FC J&K, CWC

The minimum and maximum water level and discharge observed at each Gauge stations is given in table below:

**Table 4.3 Min and Max Water Level and Discharge at each Gauge Stations**

STATION NAME	CHAINAGE	PERIOD	Zero of Gauge (m)	CD w.r.t MSL(m)				
				Last 6 years Data Analysis	MIN WL (m)	MINQ (m <sup>3</sup> /s)	MAX WL (m)	MAX Q (m <sup>3</sup> /s)
Sangam	106.259	2007-2016	1584.8	1585.07	1584.66	11.97	1595.38	3260.66
RamMunshi bagh	51.793	2007-2016	1584.8	1585.423	1585.15	17.23	1593.79	2054.16
Chattabal D/S	44.335	2009-2016	1578.70	NA	1578.94	NA	1584.61	NA
Asham	17.116	2007-2016	1576.32	1576.738	1576.41	14.72	1581.91	1347.08
Sopore (StretchB)	44.122	2007-2016	1573.81	1573.182	1572.75	11.55	1579.55	920.06

Source: I&FC J&K, CWC

From the monthly minimum and maximum data for the period 2006 to 2017 variations in minimum water level and maximum water level as well as variation in minimum and maximum discharge during the data period is established below:

**Table 4.4 Variation in Min & Max Water Level as well as Min & Max Discharge**

Gauge Station Name	Chainage (in km)	Variation in Minimum Water level (wrt MSL)	Variation in Maximum Water level (wrt MSL)	Variation in Minimum Discharge (m <sup>3</sup> /s)	Variation in Maximum Discharge (m <sup>3</sup> /s)
Sangam	106.259	1584.66 to 1586.51	1586.63 to 1595.38	11.97 to 58.06	66.27 to 3260.66
RamMunshi Bagh	51.793	1585.15 to 1585.96	1586.81 to 1593.79	17.23 to 66.22	77.26 to 2054.16
Asham	17.116	1576.4 to 1577.72	1577.54 to 1581.91	14.71 to 23.72	130.58 to 1347.08
Sopore	44.122	1572.75 to 1575.13	1574.16 to 1579.56	11.52 to 37.82	68.77 to 920.06

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Monthly Maximum and minimum water level data for various stations was further analysed to compute monthly average minimum and maximum water level over the period of data 2006 to 2017. These data helps us to get some insight into the minimum and maximum depth available with respect to chart datum during different months of the year. These data for 4 nos. of stations i.e Sangam,Ram Munshibagh,Asham and Sopore in the reach under consideration is given in table 4.5 to 4.8 below:

**Table 4.5 WATER LEVEL VARIATION AT SANGAM**

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
<b>AVG. MIN WL</b>	1585.738	1585.864	1586.194	1586.891	1587.278	1586.829	1586.488	1586.264	1586.141	1585.888	1585.781	1585.666
<b>AVG. MAX WL</b>	1585.988	1586.47	1587.474	1588.096	1588.667	1588.138	1588.075	1587.781	1588.91	1586.134	1585.928	1585.913
<b>Lowest WL(LWL)</b>	1584.66	1584.66	1584.66	1584.66	1584.66	1584.66	1584.66	1584.66	1584.66	1584.66	1584.66	1584.66
<b>HFL</b>	1595.38	1595.38	1595.38	1595.38	1595.38	1595.38	1595.38	1595.38	1595.38	1595.38	1595.38	1595.38
<b>CD</b>	1585.07	1585.07	1585.07	1585.07	1585.07	1585.07	1585.07	1585.07	1585.07	1585.07	1585.07	1585.07

**Table 4.6 WATER LEVEL VARIATION AT RAM MUNSHIBAGH**

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
<b>AVG. MIN WL</b>	1585.534	1585.67	1586.1	1586.894	1587.201	1586.674	1586.376	1586.235	1586.091	1585.84	1585.729	1585.529
<b>AVG. MAX WL</b>	1585.923	1586.451	1587.878	1588.423	1588.485	1588.333	1587.991	1587.852	1588.551	1586.207	1586.013	1585.943
<b>Lowest WL(LWL)</b>	1585.15	1585.15	1585.15	1585.15	1585.15	1585.15	1585.15	1585.15	1585.15	1585.15	1585.15	1585.15
<b>HFL</b>	1593.79	1593.79	1593.79	1593.79	1593.79	1593.79	1593.79	1593.79	1593.79	1593.79	1593.79	1593.79
<b>CD</b>	1585.423	1585.423	1585.423	1585.423	1585.423	1585.423	1585.423	1585.423	1585.423	1585.423	1585.423	1585.423

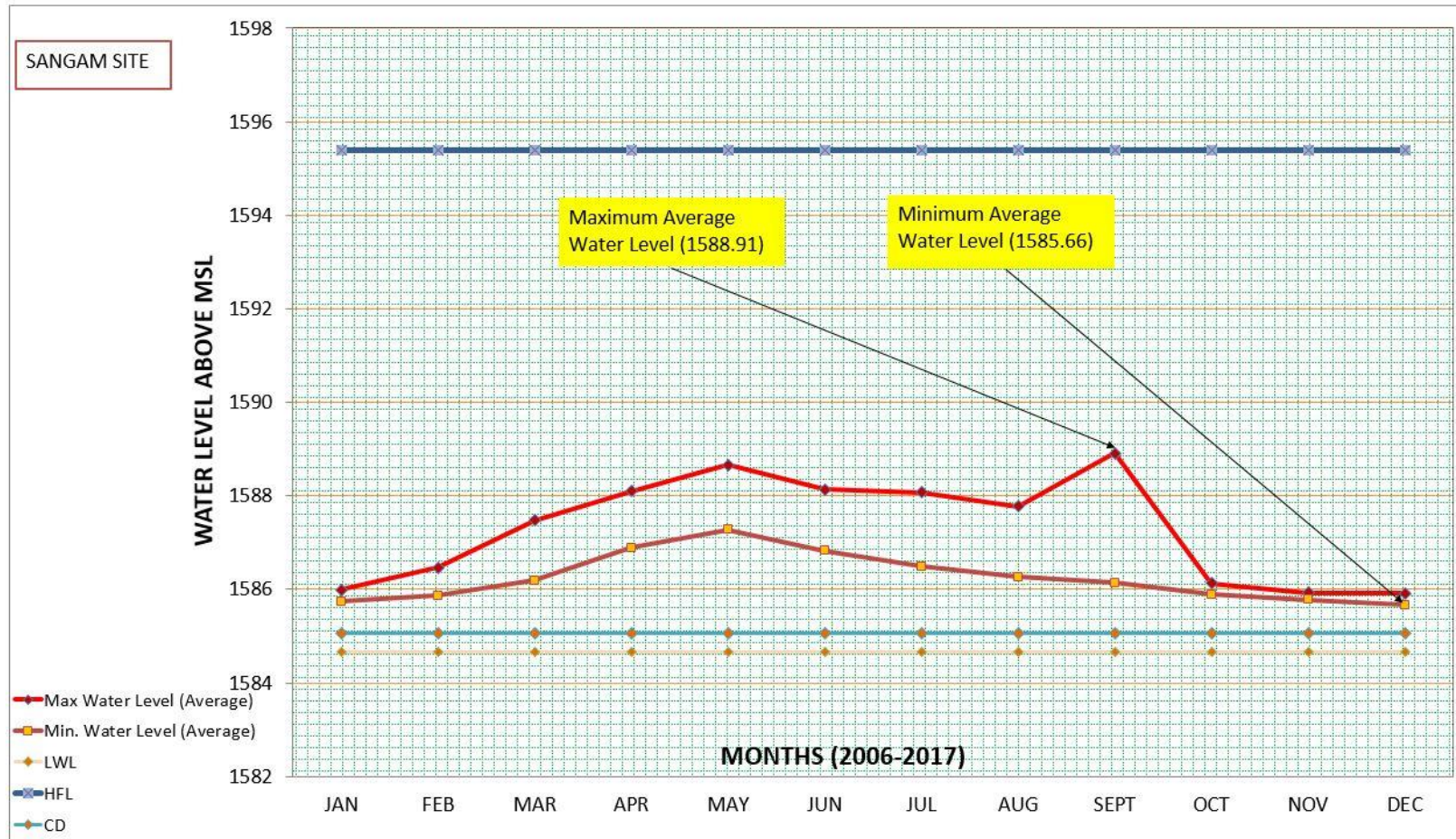
**Table 4.7 WATER LEVEL VARIATION AT ASHAM**

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
<b>AVG. MIN WL</b>	1576.778	1576.869	1577.282	1577.943	1578.396	1578.119	1577.77	1577.385	1577.27	1576.853	1576.767	1576.727
<b>AVG. MAX WL</b>	1577.041	1577.628	1578.245	1578.884	1579.373	1579.272	1578.826	1578.666	1578.756	1577.201	1576.938	1576.951
<b>Lowest L(LWL)</b>	1576.41	1576.41	1576.41	1576.41	1576.41	1576.41	1576.41	1576.41	1576.41	1576.41	1576.41	1576.41
<b>HFL</b>	1581.91	1581.91	1581.91	1581.91	1581.91	1581.91	1581.91	1581.91	1581.91	1581.91	1581.91	1581.91
<b>CD</b>	1576.738	1576.738	1576.738	1576.738	1576.738	1576.738	1576.738	1576.738	1576.738	1576.738	1576.738	1576.738

**Table 4.8 WATER LEVEL VARIATION AT SOPORE**

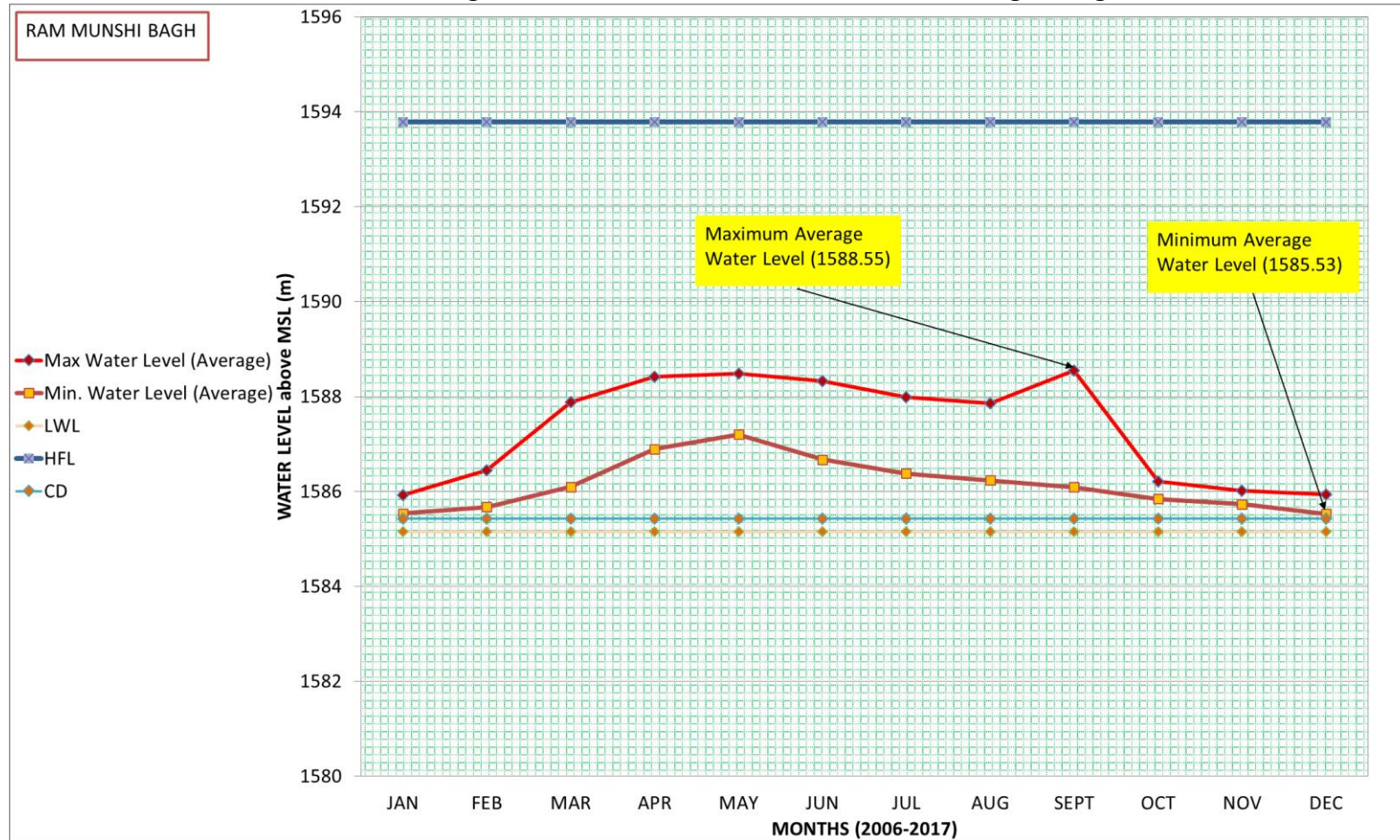
Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
<b>AVG. MIN WL</b>	1573.342	1573.523	1574.227	1575.412	1575.836	1575.492	1574.966	1574.161	1574.136	1573.592	1573.44	1573.322
<b>AVG. MAX WL</b>	1573.559	1574.101	1575.263	1576.122	1576.441	1576.32	1575.521	1575.08	1575.446	1574.321	1573.682	1573.543
<b>Lowest WL(LWL)</b>	1572.749	1572.749	1572.749	1572.749	1572.749	1572.749	1572.749	1572.749	1572.749	1572.749	1572.749	1572.749
<b>HFL</b>	1579.559	1579.559	1579.559	1579.559	1579.559	1579.559	1579.559	1579.559	1579.559	1579.559	1579.559	1579.559
<b>CD</b>	1573.182	1573.182	1573.182	1573.182	1573.182	1573.182	1573.182	1573.182	1573.182	1573.182	1573.182	1573.182

**Fig. 4.1 Water Level Variation at Sangam Gauge**



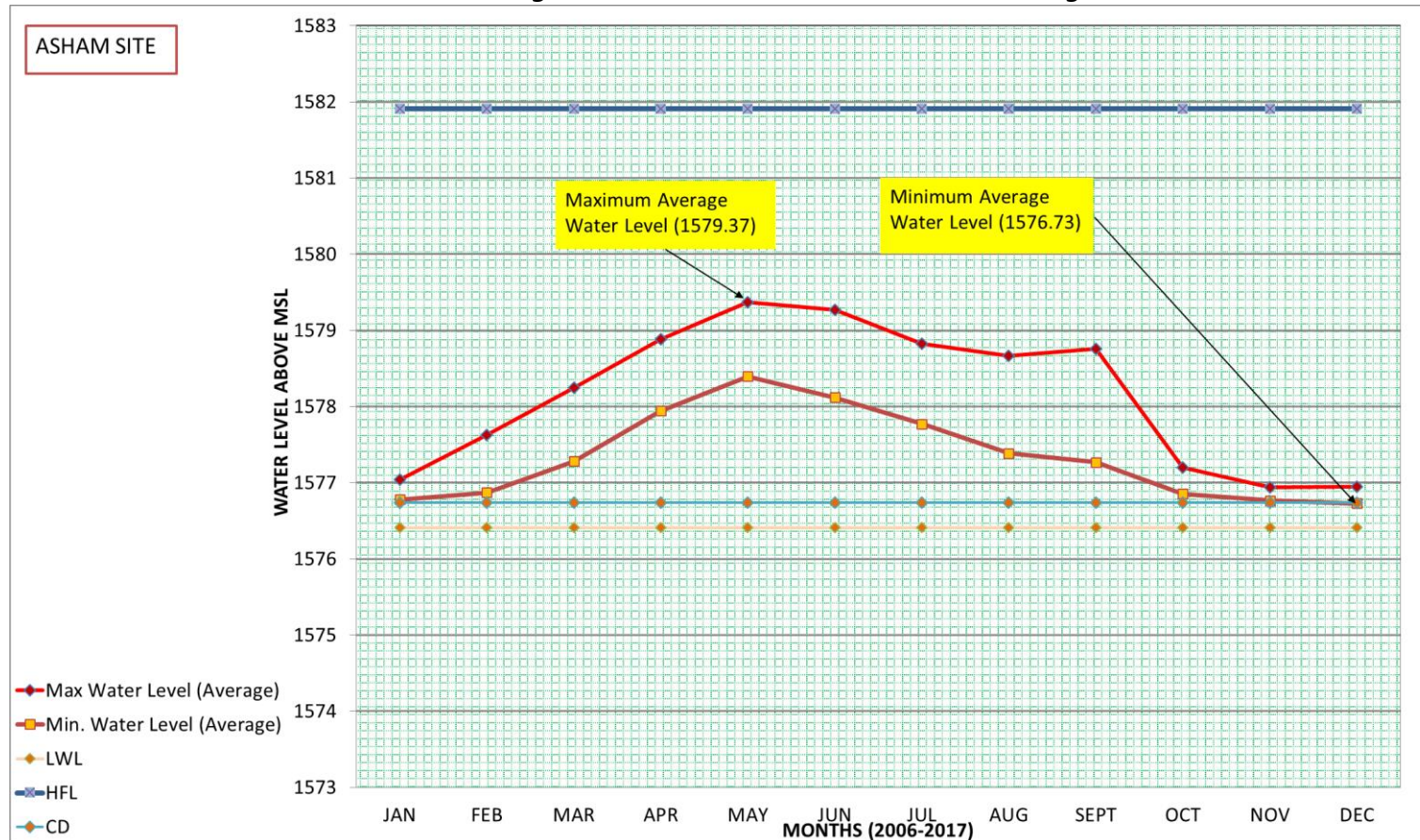
From the graph fig 4.1 it is clearly understood that Maximum average water level is 1588.91 m and Minimum average water level is 1585.66 m Which occurred in the months of September and December respectively. The water level increases linearly from January to may then recedes till the month of December with some maximum discharges in the period of September due to flood.

**Fig. 4.2 Water Level Variation at Rammunshi Bagh Gauge**



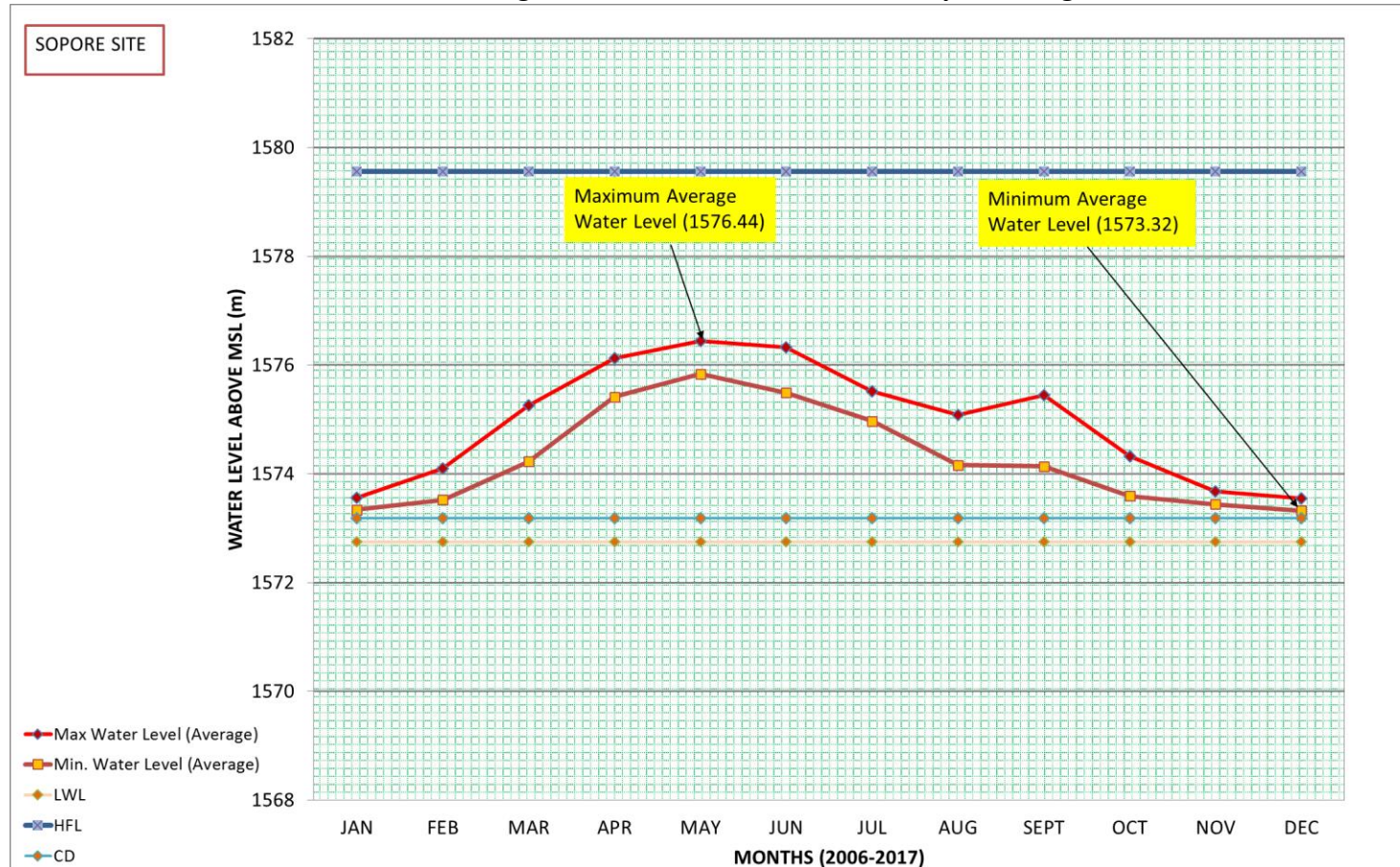
From the graph fig 4.2 it is clearly understood that Maximum average water level is 1588.55 m and Minimum average water level is 1585.53 m Which occurred in the months of September and December respectively. The water level increases from January to may then recedes till the month of December with some maximum discharges in the period of September due to flood.

**Fig. 4.3 Water Level Variation at Asham Gauge**



From the graph fig 4.3 it is clearly understood that Maximum average water level is 1579.37 m and Minimum average water level is 1576.73 m which occurred in the months of May and December respectively. The water level increases from January to may then recedes till the month of December with some maximum discharges in the period of September due to flood.

**Fig. 4.4 Water Level Variation at Sopore Gauge**



From the graph fig 4.4 it is clearly understood that Maximum average water level is 1576.44 m and Minimum average water level is 1573.32 m Which occurred in the months of May and December respectively. The water level increases from January to may then recedes till the month of December with some maximum discharges in the period of September due to flood.

### 4.3 Average Ten daily flow data analysis

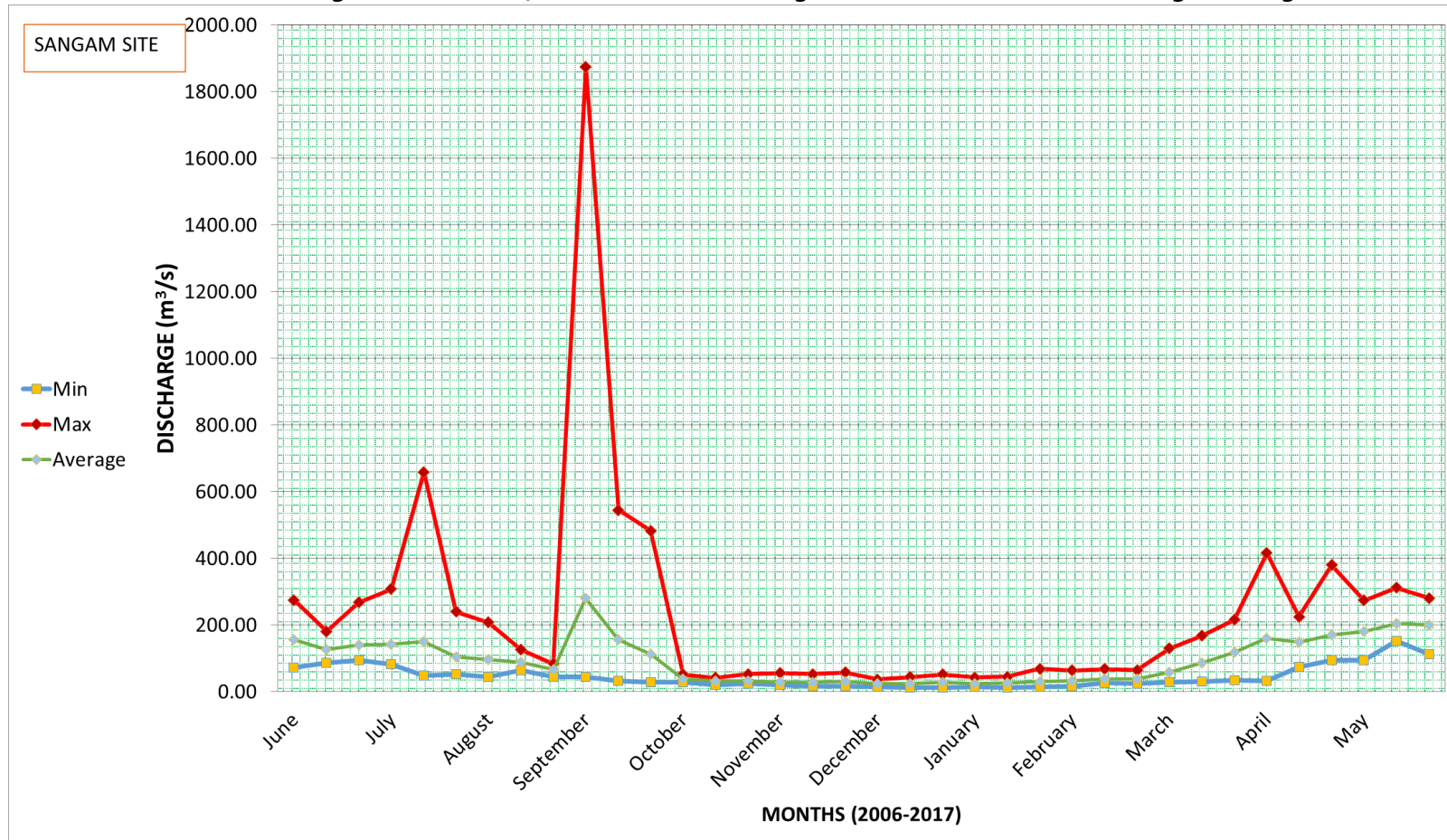
The daily gauge discharge data for four stations namely Sangam, Ram Munshibagh, Asham and Sopore was analysed for computation of ten daily average flow. Results of these analysis is shown in the table below, these analysis indicates rise in ten daily flows from January to July then reduction from August to December and high discharges in the month of September due to flood.

**Table 4.9 Ten Daily Average Flow at Sangam**

Year	June			July			August			September			October			November		
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
2006-2007	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2007-2008	73.590	123.504	140.499	168.065	98.610	78.009	85.456	119.610	65.368	56.059	68.124	58.566	46.841	39.662	36.417	33.219	29.283	26.408
2008-2009	157.643	132.028	109.627	103.566	87.650	79.862	70.630	111.227	73.632	67.874	64.371	50.551	31.407	41.262	39.818	25.318	31.095	58.056
2009-2010	129.281	96.835	116.523	92.309	93.173	115.404	77.583	66.535	60.270	77.707	33.276	29.255	31.254	29.141	25.133	24.103	29.368	27.365
2010-2011	160.019	112.052	NA	102.518	64.201	NA	126.368	125.741	NA	43.844	64.814	NA	28.775	20.036	NA	29.233	26.232	NA
2011-2012	88.812	118.831	108.890	113.960	60.350	64.315	45.170	86.688	45.369	55.847	408.332	65.986	40.129	29.821	25.913	21.240	23.789	19.654
2013-2014	155.848	86.287	138.670	111.757	93.277	80.966	111.150	71.247	61.806	215.523	113.455	71.175	42.648	32.771	24.564	21.282	17.150	17.122
2014-2015	275.048	181.403	155.169	308.498	156.414	124.180	72.448	63.760	84.447	1873.815	544.834	90.249	NA	NA	NA	NA	NA	NA
2015-2016	237.805	180.130	268.595	204.949	659.588	240.607	208.005	72.165	51.987	62.656	51.506	483.477	51.959	42.705	52.893	56.176	53.034	44.346
2016-2017	129.076	111.615	94.805	82.268	48.223	52.015	70.750	76.891	84.334	80.032	64.779	48.223	32.205	30.706	24.225	24.593	22.866	18.480
Min	73.590	86.287	94.805	82.268	48.223	52.015	45.170	63.760	45.369	43.844	33.276	29.255	28.775	20.036	24.225	21.240	17.150	17.122
Max	275.048	181.403	268.595	308.498	659.588	240.607	208.005	125.741	84.447	1873.815	544.834	483.477	51.959	42.705	52.893	56.176	53.034	58.056
Average	156.347	126.965	141.597	143.099	151.276	104.420	96.396	88.207	65.902	281.484	157.055	112.185	38.152	33.263	32.709	29.395	29.102	30.204

Year	December			January			February			March			April			May		
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
2006-2007	NA	NA	NA	43.386	40.795	40.923	43.174	44.462	40.852	45.949	127.044	200.557	197.410	204.941	180.753	189.857	186.303	113.666
2007-2008	25.219	26.423	22.540	25.094	31.591	26.312	29.198	30.925	42.197	81.250	79.565	75.388	79.579	113.563	95.608	114.923	160.631	181.068
2008-2009	28.702	37.963	51.748	26.154	45.085	69.204	64.598	68.577	65.455	62.785	70.262	73.812	103.906	114.668	113.804	124.806	155.137	156.996
2009-2010	26.771	26.465	26.044	25.596	25.012	24.710	34.681	27.606	25.028	32.608	29.824	34.494	33.109	74.649	129.097	162.319	203.592	280.813
2010-2011	24.842	22.528	NA	22.656	20.051	25.573	36.080	32.398	NA	83.629	59.359	160.178	98.469	164.001	181.163	252.360	194.927	189.404
2011-2012	18.748	18.918	16.596	15.791	16.938	NA	17.320	61.680	NA	41.573	43.865	68.911	123.303	146.481	127.209	95.201	152.311	122.228
2013-2014	15.365	15.127	NA	13.726	13.046	13.895	25.470	28.809	36.422	29.602	168.102	150.471	164.706	172.432	210.722	274.623	273.661	262.115
2014-2015	NA	NA	NA	18.112	16.867	16.556	22.753	26.800	31.611	130.576	95.031	216.325	416.236	224.730	380.041	237.437	312.517	261.351
2015-2016	37.243	44.035	38.120	30.819	27.621	25.640	23.517	29.008	35.517	28.385	116.087	86.541	223.400	123.841	124.294	167.055	206.760	238.116
2016-2017	14.093	13.075	12.240	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Min	14.093	13.075	12.240	13.726	13.046	13.895	17.320	26.800	25.028	28.385	29.824	34.494	33.109	74.649	95.608	95.201	152.311	113.666
Max	37.243	44.035	51.748	43.386	45.085	69.204	64.598	68.577	65.455	130.576	168.102	216.325	416.236	224.730	380.041	274.623	312.517	280.813
Average	23.873	25.567	27.881	24.593	26.334	30.352	32.977	38.918	39.583	59.595	87.682	118.520	160.013	148.812	171.410	179.842	205.093	200.640

**Fig. 4.5 Minimum , Maximum and Average Water Level variation at Sangam Gauge**

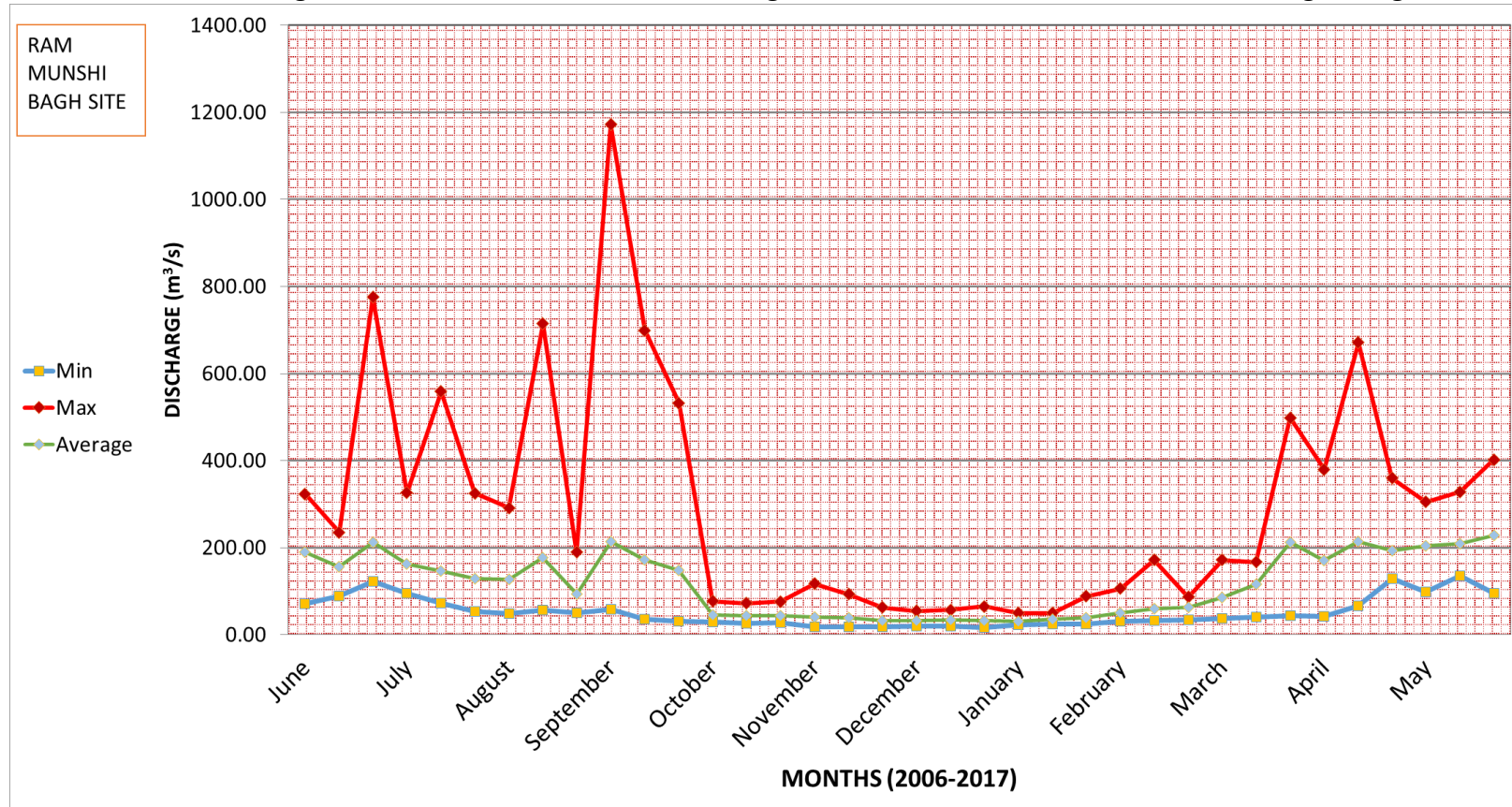


**Table 4.10 Ten Daily Average Flow at RamMunshibagh**

Year	June			July			August			September			October				
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	
2006-2007	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2007-2008	71.7405	131.479	156.9644	237.055	115.6366	86.61601	96.45772	149.9051	85.13772	64.1561	80.372	73.6083	52.6097	46.9497	39.06686	37.9503	
2008-2009	171.4414	160.7723	134.5382	133.8307	115.2376	88.93918	48.2798	144.1885	93.86167	62.197111	79.0419	52.8361	33.06855	53.204	36.507	29.9414	
2009-2011	149.1099	130.9526	138.0616	113.4038	106.9259	131.2497	92.70231	55.99155	49.7514	88.84502	35.45424	30.65173	29.16598	27.44534	28.18937	25.53792	
2010-2011	318.375	234.8981	260.36	135.84	104.71	325.45	291.49	244.7667	189.61	75.278	168.102	112.2944	29.149	26.036	41.035	32.828	
2011-2012	91.4373	121.5202	126.3595	125.3124	75.4195	68.7407	53.2606	101.7385	56.9396	64.8636	76.0987	309.6303	43.8084	43.1009	41.0633	36.6485	
2012-2013	191.7042	88.4375	135.7834	116.9922	103.2384	79.1268	240.6915	94.805	86.5697	372.61749	391.8807	83.7114	43.6386	36.9881	35.7146	24.8474	
2013-2014	181.3747	199.1188	126.9538	94.3522	73.1555	53.487	55.8076	714.3203	111.0775	65.3164	73.9196	51.2513	42.9877	46.412	41.0916	40.5539	
2014-2015	323.6954	180.1295	155.084	326.2141	132.8968	119.3411	71.0896	68.6558	79.6079	1172.0455	699.4985	173.0828	77.259	71.9386	59.9111	45.5347	
2015-2016	266.7275	181.0634	775.4908	235.0315	558.925	255.7188	232.2581	97.0124	82.919	57.9018	48.9024	532.0966	69.3067	58.864	76.6364	117.1903	
2016-2017	138.2455	134.0571	121.7183	114.5584	78.5325	74.6837	92.2297	104.2006	96.0785	116.5111	71.7405	63.3071	37.8371	29.7999	32.0073	18.2818	
Min	71.741	88.438	121.718	94.352	73.156	53.487	48.280	55.992	49.751	57.902	35.454	30.652	29.149	26.036	28.189	18.282	
Max	323.695	234.898	775.491	326.214	558.925	325.450	291.490	714.320	189.610	1172.045	699.499	532.097	77.259	71.939	76.636	117.190	
Average	190.385	156.243	213.131	163.259	146.468	128.335	127.427	177.558	93.155	213.973	172.501	148.247	45.883	44.074	43.122	40.931	

Year	December			January			February			March			April			
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I
2006-2007	NA	NA	NA	49.59575	47.827	48.76444	51.02	53.6002	47.33175	61.19875	166.7012	348.8824	257.8073	245.8676	190.5099	204.5552
2007-2008	33.35155	33.09685	27.56677	29.5169	47.58645	38.50086	37.1296	39.7615	68.58033	114.36344	113.1576	81.55545	95.9653	162.2241	128.1424	149.5938
2008-2009	35.75233	51.80315	65.373	29.98385	50.091	88.47609	84.00006	92.97965	87.03311	78.97398	87.7583	100.676	143.7442	154.985	158.5225	168.985
2009-2011	31.95919	31.96768	31.5828	31.27999	31.0734	31.31009	37.10979	34.96748	33.79374	38.0635	40.56805	43.36692	42.44717	66.85026	188.9619	253.3614
2010-2011	32.828	32.262	27.1963	25.8945	25.0172	24.7342	105.7854	171.9791	74.3158	123.388	99.9556	163.2627	113.2849	191.4212	240.267	245.2195
2011-2012	33.6204	31.4413	25.5266	24.8191	25.7247	26.9416	31.2715	49.0439	62.26	85.0698	65.7409	106.0401	115.3225	133.4628	154.9991	98.3142
2012-2013	27.9604	29.7716	28.1585	28.2434	29.7433	28.6396	37.9503	32.8563	73.6366	86.1735	147.3864	199.6848	78.3061	96.2483	160.0365	141.0755
2013-2014	24.055	23.206	24.8191	23.2626	25.6115	29.3188	40.2992	40.3275	46.412	43.5537	160.6591	498.1366	196.8548	671.0496	215.8158	305.3853
2014-2015	36.6768	34.0732	30.0263	25.6398	24.4512	25.0455	35.2335	32.4884	79.8909	171.7244	126.6708	471.8035	379.3615	265.9068	359.976	293.1314
2015-2016	54.336	57.1943	52.1569	45.9875	46.9497	42.5349	38.6295	43.1009	52.8644	49.0722	149.424	109.5493	290.5844	150.3579	139.1511	175.8845
2016-2017	20.1213	19.3855	17.2347	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Min	20.121	19.386	17.235	23.263	24.451	24.734	31.272	32.488	33.794	38.064	40.568	43.367	42.447	66.850	128.142	98.314
Max	54.336	57.194	65.373	49.596	50.091	88.476	105.785	171.979	87.033	171.724	166.701	498.137	379.362	671.050	359.976	305.385
Average	33.066	34.420	32.964	31.422	35.408	38.427	49.843	59.110	62.612	85.158	115.802	212.296	171.368	213.837	193.638	203.551

**Fig. 4.6 Minimum, Maximum and Average Water Level Variation at Rammunshi Bagh Gauge**



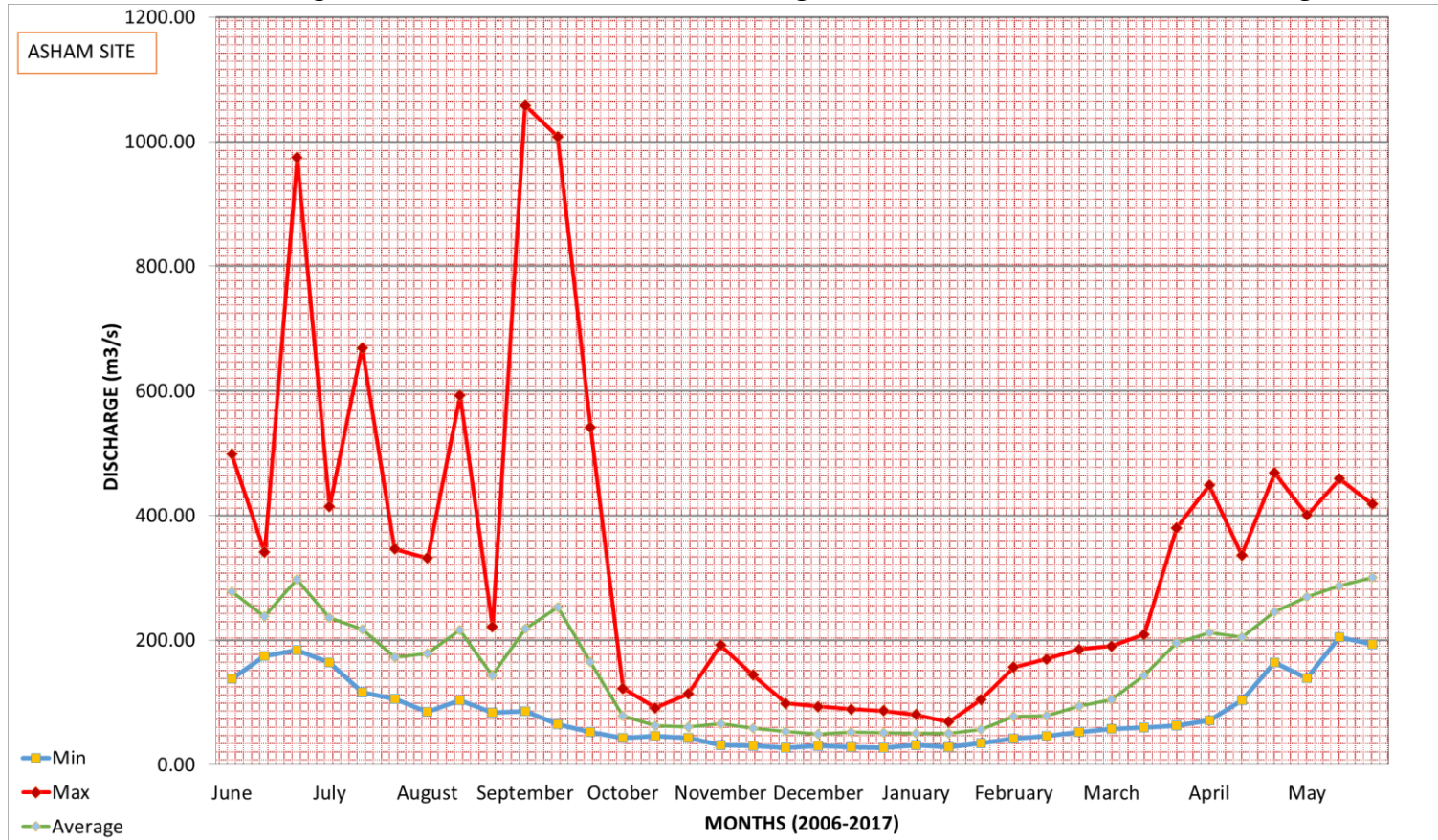
Plotting the data of ten daily average flow, minimum and maximum as shown in the fig 4.6 it clearly indicates rise in ten daily flows from January to July then reduction from August to December and high discharges in the month of September due to flood.

**Table 4.11 Ten Daily Average Flow at Asham**

Year	June			July			August			September			October			November	
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II
2006-2007	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2007-2008	137.518	221.647	183.989	363.349	190.323	153.646	147.432	200.624	128.940	91.013	112.719	107.002	69.943	46.381	44.765	43.285	38.955
2008-2009	252.408	246.861	186.497	182.648	139.830	125.112	84.419	195.751	119.426	86.060	108.927	68.882	42.860	47.742	43.271	34.102	36.564
2009-2010	259.186	174.574	200.106	176.289	168.979	187.549	159.182	103.629	83.230	113.158	64.581	52.163	48.280	47.179	43.237	37.376	43.607
2010-2011	362.684	192.517	NA	168.725	126.331	NA	311.809	327.742	221.136	144.627	190.601	NA	116.978	65.826	NA	67.637	62.628
2011-2012	177.696	221.787	219.891	165.046	148.377	121.605	101.993	151.801	130.322	123.926	421.359	123.926	72.080	62.854	56.628	55.355	55.808
2012-2013	296.975	178.348	265.067	217.544	193.121	150.949	253.564	139.666	126.894	178.831	309.766	112.554	73.526	60.446	57.809	88.938	71.718
2013-2014	255.865	309.753	183.385	164.249	116.200	107.495	97.567	592.404	160.716	104.461	117.398	81.705	59.430	60.379	52.067	49.978	42.478
2014-2015	498.736	341.201	276.419	413.990	294.557	249.367	147.133	123.416	153.018	1058.306	1008.321	292.905	122.794	91.409	74.995	59.147	62.034
2015-2016	324.997	264.067	974.652	323.469	669.238	346.081	331.478	158.423	133.123	99.899	87.249	541.393	102.276	87.985	113.851	192.072	143.849
2016-2017	211.543	234.437	187.799	186.723	126.727	105.984	152.679	172.234	173.536	187.771	109.295	104.993	NA	NA	NA	32.036	30.649
<b>Min</b>	<b>137.518</b>	<b>174.574</b>	<b>183.385</b>	<b>164.249</b>	<b>116.200</b>	<b>105.984</b>	<b>84.419</b>	<b>103.629</b>	<b>83.230</b>	<b>86.060</b>	<b>64.581</b>	<b>52.163</b>	<b>42.860</b>	<b>46.381</b>	<b>43.237</b>	<b>32.036</b>	<b>30.649</b>
<b>Max</b>	<b>498.736</b>	<b>341.201</b>	<b>974.652</b>	<b>413.990</b>	<b>669.238</b>	<b>346.081</b>	<b>331.478</b>	<b>592.404</b>	<b>221.136</b>	<b>1058.306</b>	<b>1008.321</b>	<b>541.393</b>	<b>122.794</b>	<b>91.409</b>	<b>113.851</b>	<b>192.072</b>	<b>143.849</b>
<b>Average</b>	<b>277.761</b>	<b>238.519</b>	<b>297.534</b>	<b>236.203</b>	<b>217.368</b>	<b>171.976</b>	<b>178.726</b>	<b>216.569</b>	<b>143.034</b>	<b>218.805</b>	<b>253.022</b>	<b>165.058</b>	<b>78.685</b>	<b>63.356</b>	<b>60.828</b>	<b>65.992</b>	<b>58.829</b>

Year	December			January			February			March			April			
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I
2006-2007	NA	NA	NA	80.276	61.366	54.776	59.572	69.335	59.642	84.900	209.310	380.349	312.160	273.466	261.976	294.266
2007-2008	36.564	38.431	34.680	34.894	47.827	41.189	42.167	45.761	76.693	123.513	134.298	106.562	121.939	191.761	164.112	196.657
2008-2009	34.314	65.614	77.208	50.416	60.053	104.787	94.564	108.488	101.296	92.046	99.927	115.083	164.748	186.016	195.229	224.810
2009-2010	49.202	50.074	50.207	49.853	49.502	49.605	52.497	55.193	52.528	58.881	59.809	62.767	71.189	103.405	246.122	260.691
2010-2011	51.633	45.648	NA	42.323	47.091	NA	156.570	169.687	NA	137.878	125.256	189.186	159.584	246.436	305.074	381.937
2011-2012	49.582	53.261	45.959	41.346	40.469	46.469	57.845	73.099	82.976	126.954	73.325	147.528	152.827	161.896	166.801	139.349
2012-2013	93.142	88.960	86.419	68.797	68.797	87.164	150.982	89.169	150.982	100.578	178.601	245.729	99.050	117.438	207.382	182.369
2013-2014	31.300	31.272	31.102	31.130	28.442	34.724	57.987	56.996	60.873	57.821	189.412	220.712	220.542	224.334	251.983	384.015
2014-2015	47.261	43.865	41.318	37.356	34.951	34.951	46.384	52.044	185.365	190.601	200.506	308.753	448.414	336.572	468.478	400.502
2015-2016	73.750	78.193	69.760	64.269	61.892	55.157	54.279	63.307	76.070	72.873	164.593	181.346	372.258	203.562	187.261	234.013
2016-2017	30.253	28.894	27.593	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<b>Min</b>	<b>30.253</b>	<b>28.894</b>	<b>27.593</b>	<b>31.130</b>	<b>28.442</b>	<b>34.724</b>	<b>42.167</b>	<b>45.761</b>	<b>52.528</b>	<b>57.821</b>	<b>59.809</b>	<b>62.767</b>	<b>71.189</b>	<b>103.405</b>	<b>164.112</b>	<b>139.349</b>
<b>Max</b>	<b>93.142</b>	<b>88.960</b>	<b>86.419</b>	<b>80.276</b>	<b>68.797</b>	<b>104.787</b>	<b>156.570</b>	<b>169.687</b>	<b>185.365</b>	<b>190.601</b>	<b>209.310</b>	<b>380.349</b>	<b>448.414</b>	<b>336.572</b>	<b>468.478</b>	<b>400.502</b>
<b>Average</b>	<b>49.700</b>	<b>52.421</b>	<b>51.583</b>	<b>50.066</b>	<b>50.039</b>	<b>56.536</b>	<b>77.285</b>	<b>78.308</b>	<b>94.047</b>	<b>104.604</b>	<b>143.504</b>	<b>195.802</b>	<b>212.271</b>	<b>204.489</b>	<b>245.442</b>	<b>269.861</b>

**Fig. 4.7 Minimum, Maximum and Average Water Level Variation at Asham Gauge**



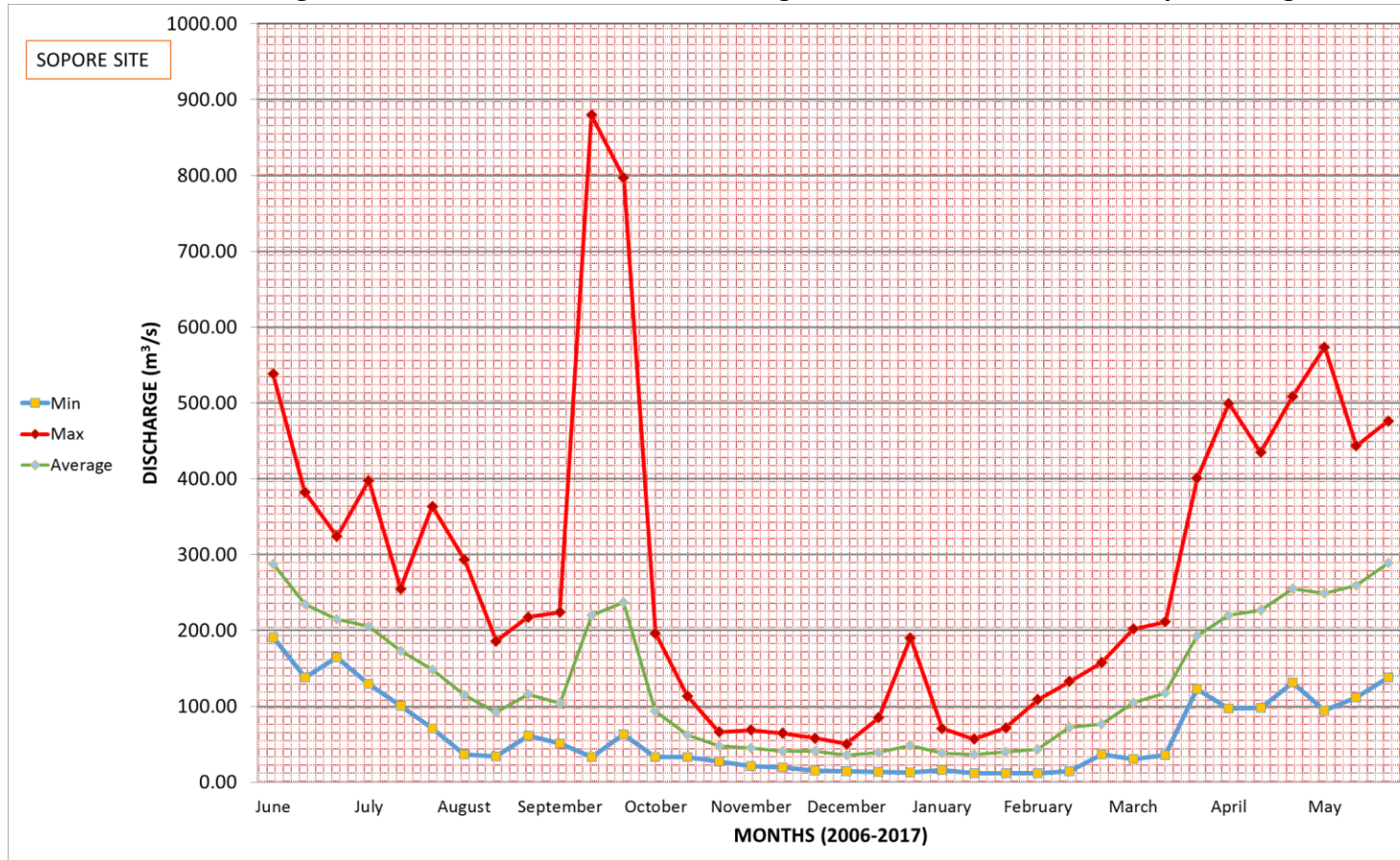
From the graph it is clearly understood that the water flow increases from January to July then recedes till the month of December with some maximum discharges in the period of September due to flood.

**Table 4.12 Ten Daily Average Flow at Sopore**

Year	June			July			August			September			October				
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	
2006-2007	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2007-2008	196.600	137.821	180.809	235.145	255.294	148.830	120.134	109.408	143.226	NA	NA	113.681	106.550	84.560	66.165	60.251	
2008-2009	294.377	264.435	250.908	208.741	184.573	161.848	86.400	72.250	168.951	74.401	87.730	80.966	58.751	45.450	54.308	42.733	
2009-2010	282.547	237.862	216.552	NA	128.312	102.446	129.274	105.842	65.373	72.250	102.361	63.845	32.658	33.253	26.687	24.961	
2010-2011	538.294	382.333	267.152	NA	214.514	NA	NA	NA	NA	224.108	171.696	NA	NA	84.843	49.893	68.769	
2011-2012	298.254	202.345	184.742	174.045	139.293	118.068	98.201	71.401	91.494	101.682	94.267	191.365	116.200	64.835	47.544	45.167	
2012-2013	243.918	215.505	164.423	197.676	172.489	126.614	52.666	59.289	61.128	50.544	402.426	796.645	83.089	38.318	34.922	41.771	
2013-2014	272.133	228.438	205.656	129.246	100.408	70.609	36.535	33.705	217.797	113.738	76.127	63.732	62.939	44.091	47.544	39.931	
2014-2015	190.912	232.909	172.630	154.405	160.235	125.878	106.634	66.279	86.174	71.684	879.690	668.418	196.418	113.285	62.101	40.441	
2015-2016	329.950	248.757	323.894	397.672	250.059	363.429	293.131	185.988	74.542	51.280	32.856	91.834	91.239	48.619	37.922	62.062	
2016-2017	224.674	194.591	180.837	144.104	124.096	119.935	109.776	120.473	129.954	174.017	133.944	62.741	NA	NA	NA	21.480	
<b>Min</b>	<b>190.912</b>	<b>137.821</b>	<b>164.423</b>	<b>129.246</b>	<b>100.408</b>	<b>70.609</b>	<b>36.535</b>	<b>33.705</b>	<b>61.128</b>	<b>50.544</b>	<b>32.856</b>	<b>62.741</b>	<b>32.658</b>	<b>33.253</b>	<b>26.687</b>	<b>21.480</b>	
<b>Max</b>	<b>538.294</b>	<b>382.333</b>	<b>323.894</b>	<b>397.672</b>	<b>255.294</b>	<b>363.429</b>	<b>293.131</b>	<b>185.988</b>	<b>217.797</b>	<b>224.108</b>	<b>879.690</b>	<b>796.645</b>	<b>196.418</b>	<b>113.285</b>	<b>66.165</b>	<b>68.769</b>	
<b>Average</b>	<b>287.166</b>	<b>234.499</b>	<b>214.760</b>	<b>205.129</b>	<b>172.927</b>	<b>148.628</b>	<b>114.750</b>	<b>91.626</b>	<b>115.404</b>	<b>103.745</b>	<b>220.122</b>	<b>237.025</b>	<b>93.480</b>	<b>61.917</b>	<b>47.454</b>	<b>44.756</b>	

Year	December			January			February			March			April				
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	
2006-2007	NA	NA	NA	70.693	56.713	51.563	50.940	57.138	60.449	77.938	80.202	400.870	441.395	362.948	387.653	245.078	
2007-2008	50.233	48.025	48.506	46.638	55.242	60.166	47.686	NA	59.911	87.815	146.622	146.622	97.041	123.643	161.027	204.496	
2008-2009	46.327	84.928	190.431	43.978	40.554	71.458	108.729	132.501	157.490	119.596	105.955	138.500	130.831	280.934	257.360	237.890	
2009-2010	24.763	24.395	23.914	23.036	21.112	20.433	23.008	113.823	86.711	159.640	114.785	146.481	146.453	134.651	234.296	263.332	
2010-2011	44.969	43.299	42.082	38.941	38.573	45.789	42.903	129.982	130.520	98.371	119.879	181.799	224.674	210.665	320.865	321.403	
2011-2012	42.110	45.167	46.412	45.563	42.648	41.148	39.535	42.252	62.458	87.419	120.332	122.596	165.272	173.309	131.397	151.688	
2012-2013	37.752	39.139	39.790	37.752	39.196	39.167	46.638	69.901	56.911	201.949	211.344	211.316	112.351	97.578	143.057	145.745	
2013-2014	28.442	33.451	28.555	28.583	30.140	30.140	27.140	54.025	36.309	30.451	60.336	236.390	264.181	289.594	272.642	252.606	
2014-2015	28.866	21.367	19.386	15.565	11.773	11.546	11.518	14.546	50.997	136.519	178.007	219.976	499.354	435.056	508.127	573.754	
2015-2016	35.573	33.139	31.696	27.451	27.734	30.394	35.347	33.366	61.071	47.572	35.573	125.709	115.068	158.027	135.868	94.550	
2016-2017	14.433	13.188	12.169	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
<b>Min</b>	<b>14.433</b>	<b>13.188</b>	<b>12.169</b>	<b>15.565</b>	<b>11.773</b>	<b>11.546</b>	<b>11.518</b>	<b>14.546</b>	<b>36.309</b>	<b>30.451</b>	<b>35.573</b>	<b>122.596</b>	<b>97.041</b>	<b>97.578</b>	<b>131.397</b>	<b>94.550</b>	
<b>Max</b>	<b>50.233</b>	<b>84.928</b>	<b>190.431</b>	<b>70.693</b>	<b>56.713</b>	<b>71.458</b>	<b>108.729</b>	<b>132.501</b>	<b>157.490</b>	<b>201.949</b>	<b>211.344</b>	<b>400.870</b>	<b>499.354</b>	<b>435.056</b>	<b>508.127</b>	<b>573.754</b>	
<b>Average</b>	<b>35.347</b>	<b>38.610</b>	<b>48.294</b>	<b>37.820</b>	<b>36.368</b>	<b>40.180</b>	<b>43.344</b>	<b>71.948</b>	<b>76.283</b>	<b>104.727</b>	<b>117.304</b>	<b>193.026</b>	<b>219.662</b>	<b>226.641</b>	<b>255.229</b>	<b>249.054</b>	

**Fig. 4.8 Minimum, Maximum and Average Water Level Variation at Sopore Gauge**

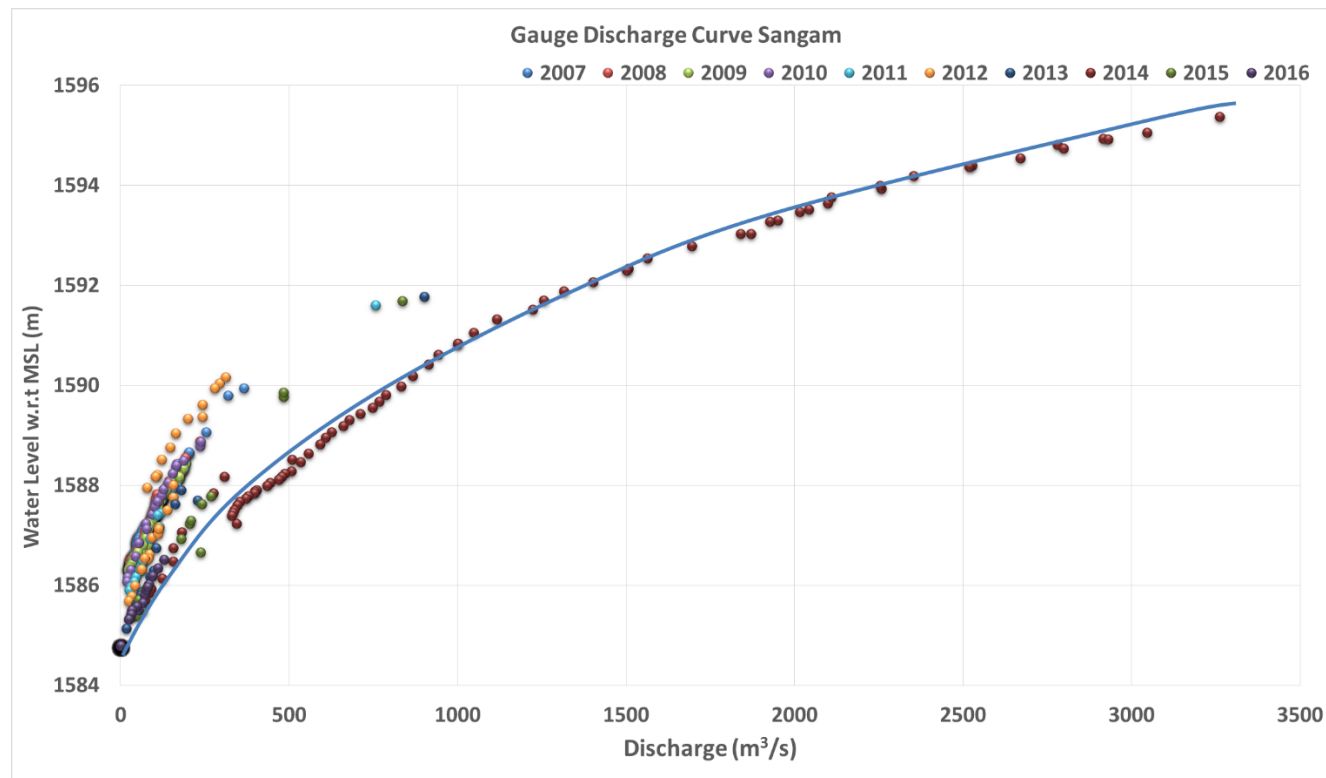


From the graph it is clearly understood that the water flow increases from January to June then recedes till the month of December with some maximum discharges in the period of September due to flood.

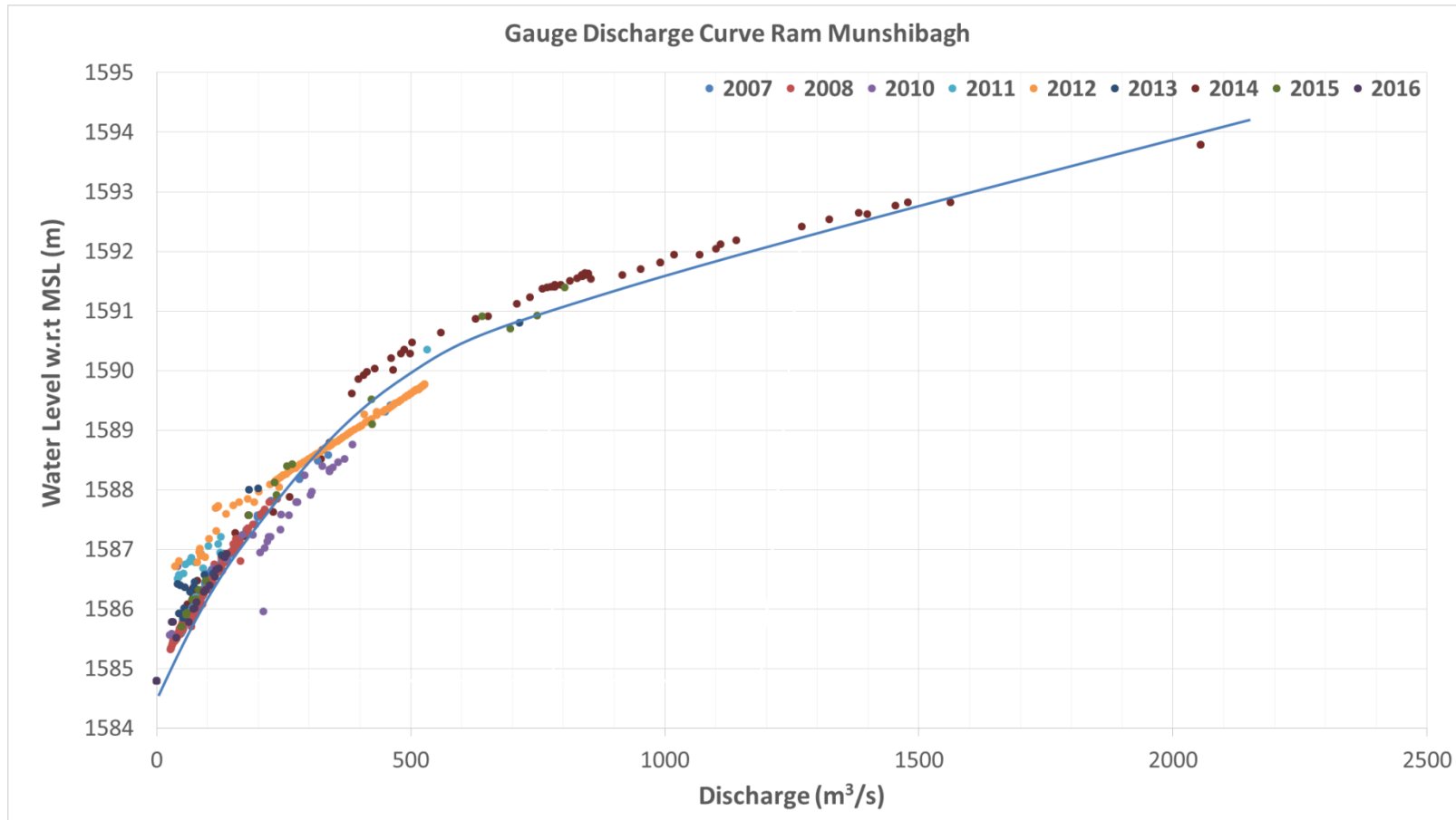
#### 4.4 Gauge-Discharge Data Analysis

The daily gauge discharge data for four stations namely Sangam, Ram Munshibagh, Asham and Sopore Was analysed for the period of 2006 to 2017 to develop gauge discharge relationship. These gauge discharge relationship will be useful for estimation of flood discharge for different water levels. Graphs presenting these relationships are shown below, these will be useful for estimation of discharge required to maintain different flow depths from 1.2-2.5 m flow depth under the existing conditions of river channels.

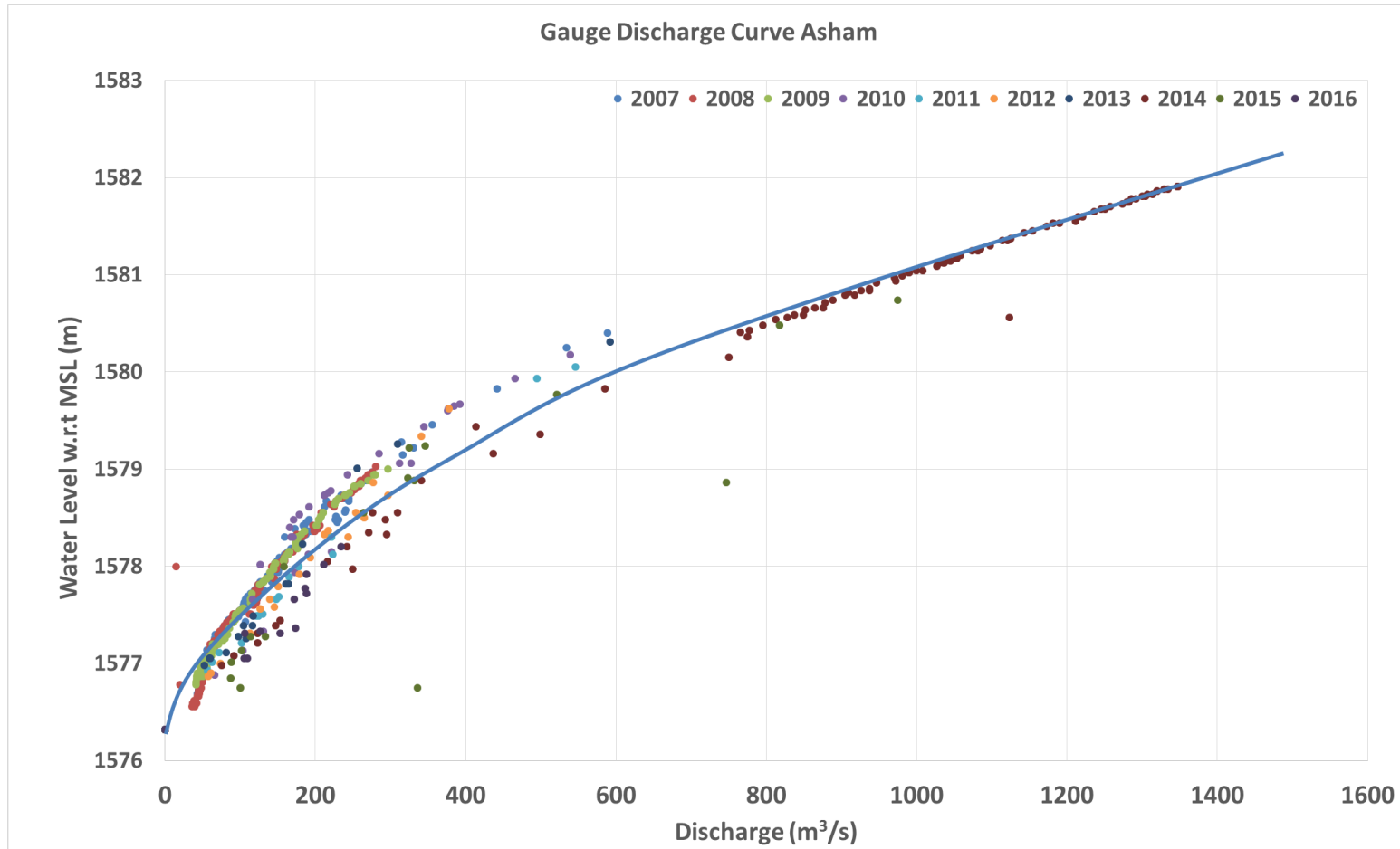
**Fig 4.9 Gauge Discharge Curve at Sangam Gauge**



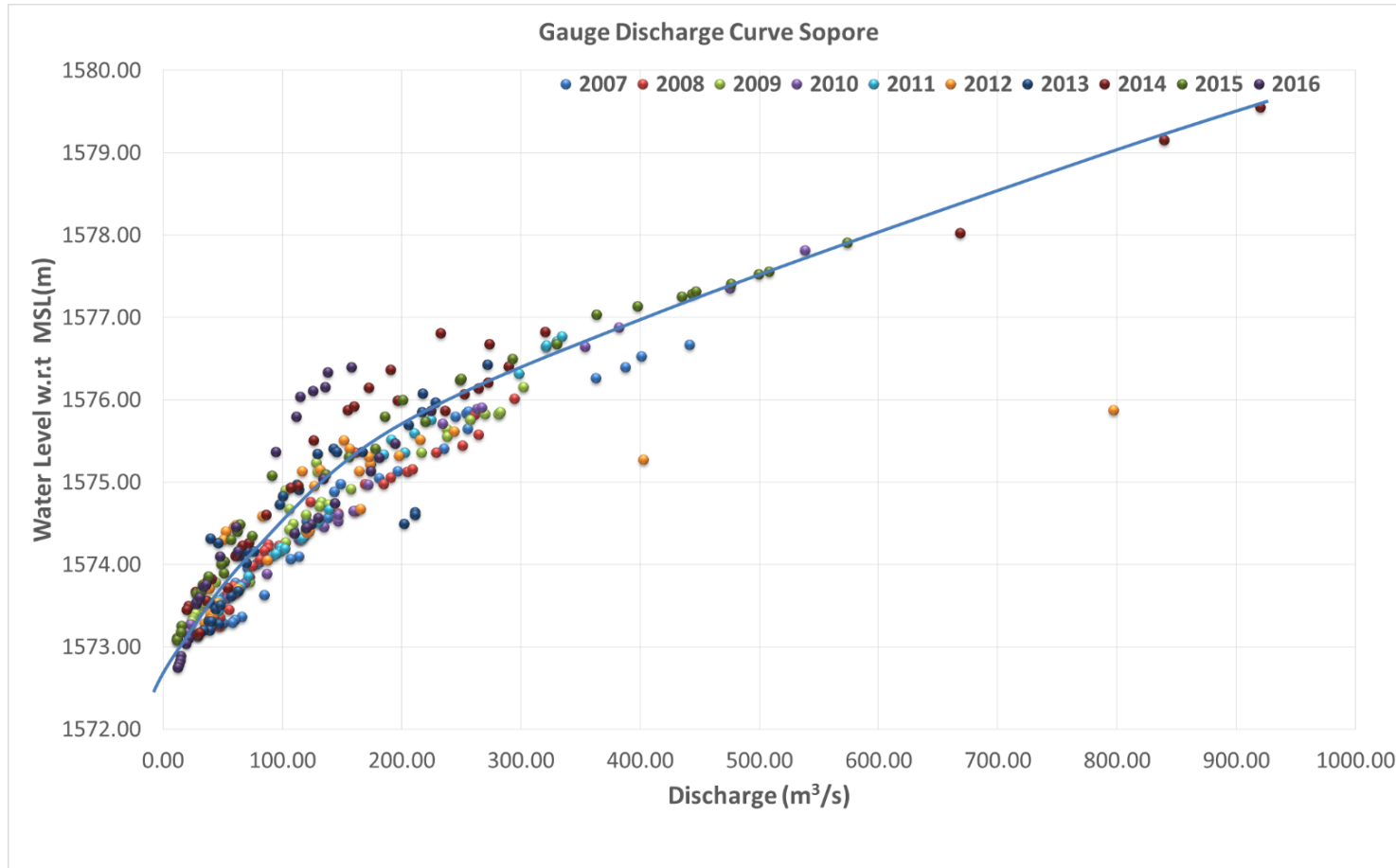
**Fig 4.10 Gauge Discharge Curve at Rammunshi Bagh Gauge**



**Fig 4.11 Gauge Discharge Curve at Asham Gauge**



**Fig 4.12 Gauge Discharge Curve at Sopore Gauge**



## CHAPTER – 5 TRAFFIC STUDY

### 5.1 General

The market analysis to identify opportunities for River Transportation is essential. This would enable planning of optimum size infrastructure with scope for future expansion. It would also enable identifying type of terminals to be created, location of terminal and volume of passenger or cargo proposed to be handled. Bad terrain, narrow width of Jhelum restricts water transport activities. Data collected from the site for transportation network has found highly subsidised road and rail transportation network existing in the stretch of River Jhelum. IWAI would be developing River Jhelum (NW-49) to enable transportation of goods and passengers. The market study report would play a prominent component in planning facility for the same.

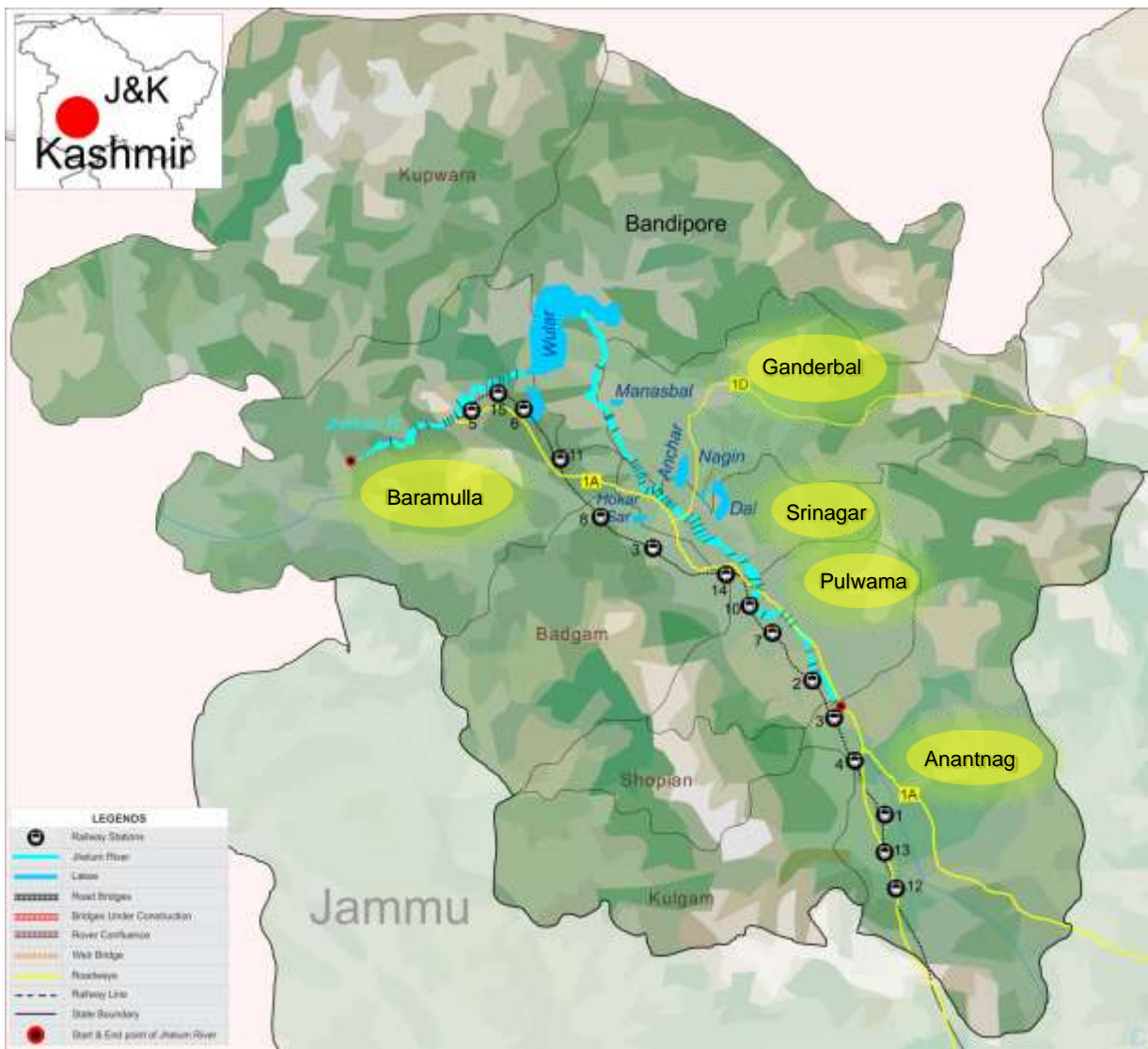
The Jammu and Kashmir government has also planned to start water transport project on historic Jhelum river at least in Srinagar City. The primary objective is to decongest Srinagar City roads, which are struggling to cope with growing number of vehicles.

The present Market Analysis Report and eventually Detailed Project Report is being prepared with an objective to identify various nodes as well as origin and destination points, where there is a need for water transport. The existing infrastructure along with connectivity makes it possible to implement water transportation projects. The study identifies points of origin of cargo and destination of cargo on the hinterland of River Jhelum. Shifting the present mode of transportation from Road to waterways would enable decongestion of road and enable transportation using environment-friendly mode.

River Jhelum, passing through various districts and cities of Kashmir, has water availability. It could be classified under class I and Class II waterways. Availability of water round the year enables prospect of using Jhelum for intercity and intracity water transportation.

### 5.2 HINTERLAND ANALYSIS

The hinterland of Jhelum constitute areas that would generate opportunities for transportation of cargo and passenger along with tourist. The L shaped Jhelum runs around 178 km passing through 5 districts of Kashmir. It originates at the northern tip of Anantnag and passes through Pulwama, Srinagar, Ganderbal, Bandipora and finally reaches Baramulla before entering Pakistan. The L-shaped river is connected to several waterbodies intermittently while passing through various districts of Kashmir. The broad map with earmarking of hinterland and major districts falling in the hinterland is described in Figure 5-1.



**Figure 5-1 Hinterland of Jhelum River**

The River does not integrate with any other water bodies outside its stretch, except for few small tributaries that discharge water in the river. Hence, any opportunities generated on the River Jhelum related to transportation of goods and passengers has to be limited to the 178 km declared as NW-49. stretch of Jhelum. There could be 3 types of opportunities of river transportation of goods and passenger on any river. Some of them are as follows

- Transportation of goods and passengers along the river
- Transportation of passengers and goods across the river wherever there is absence of bridges connecting two banks
- Transportation of goods and passengers to other zones and states by connecting the river with those zones or states.

River Jhelum generates only 1st type of opportunity mentioned above where cargo and passenger transportation could happen along the stretch of the river. There is no

possibility of transporting goods and passengers across River Jhelum to about 55 existing or planned bridges at strategic locations connecting both the banks. Some of these bridges support transportation of cars and other vehicles, rest of them are limited to transportation of passenger on foot or by two wheelers. There does not exist any scope of cargo or passenger transportation connecting hinterland of River Jhelum with other Zones and states as the stretch of Jhelum is limited to 178 kms and it does not get connected to major water bodies.

### 5.3 Population of Hinterland Area

Jhelum hinterland has a population of about 3.5 million spread over 5 districts namely Baramulla, Bandipora, Ganderbal, Srinagar and Pulwama. It also touches the district of Anantnag at the point of origin on National Waterways (NW) - 49. However, as Anantnag's population is away from river, it would not contribute to business prospects for Jhelum. Table 5-1 summarises population distribution all the 5 prominent districts on the hinterland of Jhelum

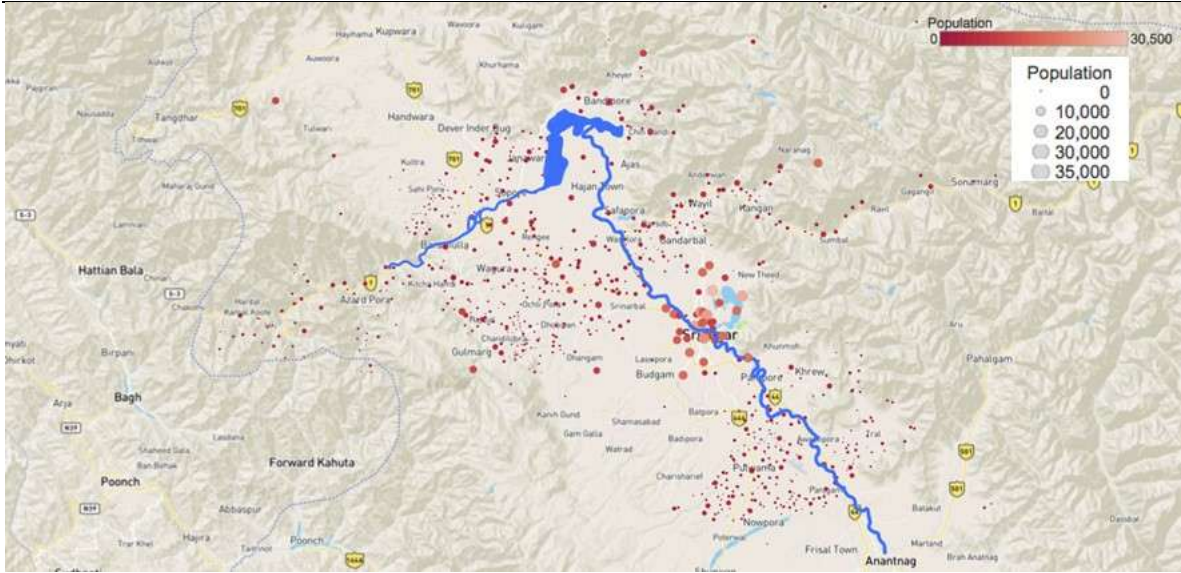
**Table 5-1 Demography Summary of Jhelum Hinterland**

Sr. no	District	Blocks	Area (hec)	Population	Households	Connected to			Major Mandis
						NH	SH	MDR	
1	Pulwama	5	1,39,800	5,60,440	86,241	Y	Y	Y	01
2	Srinagar	2	1,97,900	12,53,561	1,94,359	Y	Y	Y	02
3	Ganderbal	4	23,437	3,16,252	48,338	Y	Y	Y	00
4	Bandipora	4	34,500	3,92,232	58,392	Y	Y	Y	00
5	Baramulla	12	3,35,300	10,31,614	1,56,145	Y	Y	Y	01
	Total	27	7,30,937	35,54,099	5,43,475				

Note: Y-Yes

Source: Census 2011

Srinagar is the most populous District in the hinterland of Jhelum followed by Baramulla. The cities namely Bandipora, Ganderbal and Pulwama are less populous compared to Srinagar and Baramulla. Figure 5-2 describes the demographic distribution of villages all over the hinterland of Jhelum. The sizes of bubble and the intensity of colour donate the population of every village. Smaller bubble and lighter colour denotes villages with lower population. Larger and darker Bubbles donates densely populated villages. As can be seen in the figure Srinagar has higher density population concentrated in srinagar city. This area is roughly spread over around 2,000 km<sup>2</sup>. Other districts following hinterland of Jhelum has distributed population spread over larger area. A substantial number of villages in these districts are located very far away from River Jhelum.



**Figure 5-2 Mapping of Population and Villages- Jhelum Hinterland**



**Figure 5-3 View of Jhelum in Ganderbal District**

#### **5.4 Infrastructure in Hinterland Area**

Infrastructure plays a vital role in the economy of any region, as it boosts industrial, tourism and other sectors. This section would study the existing and upcoming infrastructure of the catchment of River Jhelum.

## 5.5 City Infrastructure

- Heritage Bridges & Kadal

The River Jhelum (NW-49) is famous for its nine ancient bridges. Some the older bridges have been renovated and others have totally been replaced by advanced modern structure. Rise of population and traffic needed the bridges to be modernised. Some of the bridges were too old to be modernised, so were replacement. These bridges connect various cities and villages with one other over the River Jhelum. Out of nine, total seven historical bridges are in Srinagar City itself. As this river divides Srinagar district into two parts, bridges on it plays very important role for transportation of freight, passengers and tourism across the river. Some of the bridges are discussed in detail below,

Zero bridge is the most ancient bridge in Srinagar. It is located very close to the tourist reception centre. It was constructed by wooden planks in 1950's and still is maintained in same way. The bridge have been renovated in the year 2017. It provides good view of the river. There are restaurants around the bridge. Bridge has been provided with ample space and facilities for people to sit and enjoy their view of the river, mountains and weather. The photographs taken during site visit of Zero bridge is shown in Figure 5-44



**Figure 5-4 Zero Bridge on River Jhelum**

Amira Kadal is 2nd most popular bridge on the river Jhelum. It is also called first bridge. It was built by Amir Khan. It was built in 1774 and later converted into concrete stone. Local fisherwomen will be seen on this bridge selling fish. This is the main attraction of Srinagar after Zero Bridge, many tourists visit this to have a feel of local life of Kashmir. There exists one drift between these two bridges i.e zero

bridge and the Amira Kadal beside the bund. Surpassing that bank the Shri Pratap Singh Musuem is situated.

Habba Kadal is the second bridge built in 1551, it was effected by flood in 1893 and reconstructed. A new bridge was constructed in 2001 next to this old bridge called as New Habba Kadal. Badshah Bridge and Habba Kadal handles heavy traffic. Both are located just next to Amira Kadal. The left bank of the river comes in between the two bridges which forms the royal palace where the former Maharajas used to reside. It is distant from the riverbank and has now become a government building. One can also find nearby a newly constructed secretariat building and the Mahatma Gandhi Memorial Park. Towards the right direction the Tsont-i-Kul or Apple Canal joins the Jhelum River. This canal begins from The Dal Gate and across the Jhelum it forms itself as a part of Srinagar in to an island. The busiest part of the old city is found near the Habba Kadal Bridge in an area where the national hospital as well as the Raghunath Mandir, Kashmir's biggest temple along with the twin golden-spired temple of Jammu is established.

Fateh Kadal, third bridge, is located just before the Shah Hamdan Mosque and now a new concrete bridge has recently been built just upstream of it. The Zaina Kadal is the next bridge and crosses the river near to the tomb of its builder, the famous Kashmiri ruler Zain-ul-Abidin. It is the fourth bridge and has been heavily used by traders. New concrete bridge is just few meter ahead to this bridge.

Next of Fateh Kadal, there are three more bridges namely, Ali Kadak, Kawa Kadal and Saffa Kadal. All these three bridges depicts the old architecture of Kashmir. The important trade centre i.e Maharaja Ranbir Gang Bazar is located near to these bridges. A canal, called Kota canal, enters the Jhelum River below Nawa Kadal bridge. This canal deflects the river's flow during flood. The Jhelum River is dispensed by the Kota Canal between the Amira Kadal and the Habba Kadal.

- Bridges (Kadal)

River jhelum has well developed bridge network from across the connectivity. Table 5-2 shows the list of bridges built on the River Jhelum (NW-49). Availability of large number of bridges discards any scope for across transportation passenger or cargo on the river.

**Table 5-2 List of bridges on the defined stretch of Jhelum River**

Sr. no	Type of Bridge	Bridge name	Location	District	Connectivity
1	Road	Sangam	Sangam	Anantnag	-
2	Road	Chersoo	Awantipora	Pulwama	Chersoo awantipora to Ghattokna
3	Road	Padgampora	Awantipora		Kanji nagh to Padgampora
4	Road	Un-named	Awantipora		-
5	Road	Un-named	Barsoo		Padgampora road to Awantipora road
6	Road	Un-named	Barsoo		Srinagar kanayakumari Hwy to

Sr. no	Type of Bridge	Bridge name	Location	District	Connectivity
					kakapora padgampora road
7	Road	Un-named	Lethipora		Banderpora cherat to candid english medium school
8	Road	Galander	Kakapora		Ganie masjid to masjid sharief
9	Road	Un-named	Kandizal		Kandizal to srinagar kanyakumari hwy
10	Road	Kadlabal	Pampore		Masjid sharief to Pampore kakapora road
11	Road	Un-named	Pampore		Zoonipora to national highway A1
12	Road	Un-named	Zaffaran colony Road		AliAbad to Zaffaran colony road
13	Road	Lasjan	Lasjan		Qasim Bagh to Athwagan
14	Road	NH1 new	Soitang		NH1, Near Lasjan Bridge, Srinagar, Jammu and Kashmir 191101
15	Road	Sonwar Bagh foot	Sonwar Bund		Honey villa to Sonwar main market
16	Road	Zero Bridge	GPO Bund		Sonwar in the north to Rajbagh
17	Road	Abdullah	TRC Road		New bridge replacing the nearby Zero Bridge to connect Sonwar and Rajbagh
18	Road	Footbridge	Lal Mandi		Lal Chowk to Lal Mandi
19	Road	Amira kadal	Lal Chowk		Saraibadal street to lal chowk
20	Road	Budshah	M.A Road		Connectsto Lal Chowk
21	Road	Habba kadal	Tanki Pora		Newly constructed concrete bridge, which is few meters upstream the old bridge.
22	Road	Old Habba kadal	Habba Kadal		Newly constructed concrete bridge, which is few meters upstream the old bridge.
23	Road	Fateh Kadal	Zaldagar	Srinagar	Jaldagar fateh kadal road, which connects to Dewan mandir
24	Road	Old Fateh Kadal	Zaldagar		Jaldagar fateh kadal road which connects to Dewan mandir
25	Road	New Zaina Kadal	Bohri Kadal		Connects new zaina kadal road to khan kha road
26	Road	Old zaina kadal	Bohri Kadal		Kaad kocho to J&K zaina kadal
27	Road	Ail Kadal	Sokalipora		Sokalipora to kanimazar
28	Road	Nawa Kadal	Lokriyar		Connects khanda bhawan to kanimazar
29	Road	Kak sarai safa kadal	Nalbandpora		Sekidaffar to nalbandpora
30	Weir	Chattabal	Palayarbal		Wier park to malik shaeb cement kadal road
31	Road	cement kadal	Waniyar		Qamawari road to edgah road
32	Road	Un-named	Parimpora		Parimpora to Guri pora
33	Road	Un-named	Shalteng		Badi Udewr to Shalteng
34	Road	Shalteng Palpora	Shalteng		Shalteng to Palpora
35	Road	Un-named	-		-
36	Road	Un-named	Takhan Wari pora		Takhanwaripora to Rakh mujh gund

Sr. no	Type of Bridge	Bridge name	Location	District	Connectivity
37	Road	Sadipora	Shadipora	Ganderbal	Shadipora to Bat Pora Dab
38	Road	Sumbal	Sumbal		Sumbal to Nasbal to Waskura
39	Road	Unnamed	Pushwari	Bandipora	Pushwari to Bhar Abad
40	Road	hajin	Hajan		Rakh Hajin to Hajan
41	Road	Un-named	Adi Pora	Baramulla	Adi Pora to Trumb Gund
42	Road	Sopore( jamia kadeem)	Sopore		Sopore masjid to tarzoo sopore road
43	Road	Sangraama sopore(old)	Sopore		Tawheed Bahg to Seer Jageer & New Light Colony
44	Road	Sangrama sopore(new)	Sopore		Tawheed Bahg to Seer Jageer & New Light Colony
45	Road	Bypass	Sopore		Badam bagh to Kartar Garh
46	Confluence	Phoru-Jhelum	-		-
47	Road	Un-named	Ladoora Rafiabab		Ladoora to Jahama
48	Road	Baramulla Dewaan Bagh Suspension	Gulnar Park		Connects public play ground to D.C. Office baramulla
49	Road	Azad Gunj	Azad Gunj		Azad Gunj to old hospital
50	Road	Un-named NH701	Azad Gunj		Azad Gunj to old hospital
51	Road	Baramulla old	Bus Stand		Iqbal market to bus stand and fish market
52	Road	New Brige	Jabaaz Colony		Khanpora & NH(uri-leh) to old town
53	Road	Eco Park Suspension	Minj Gram		Eco Park to NH1 Baramulla
54	Road	Peernia Footbridge	Pahlipora		Peernia and Pahlipora to Nagnari Gantamulla
55	Road	Sahal	Lower Jhelum Project Road		Bimyar to NH1(Uri-Leh)

Note: Red Marked bridges are Under-Construction

Source: Secondary Sources

- Weirs

River Jhelum has 2 Weirs to control and maintain flow of water in the river. Chattabal Weir is located in Srinagar. Figure 5-6 and Figure 5-7 shows the location and configuration of Chattabal Weir. Chattabal weir is constructed by flexible temporary structures with the help of wooden blades. These are not concrete structures. The blades are supported by steel frames. Figure 5-6 and Figure 5-7 shows different height of Chattabal weir. The height of Chattabal weir is adjusted to maintain depth and water level in the river. The height is lowered when discharge of water in Jhelum increases. Figure 5-6 and Figure 5-7 shows difference in height of 9 inches in the height of Chattabal weir. The photograph of Figure 5-6 was taken on March 8th and Figure 5-7 was taken on March 11, while height reduction was in process. The Irrigation and Flood control department undertakes maintenance of Weirs.

There is a small bypass provided. It has 2 gates to maintain water level in the river. Excess water is also allowed to be discharged using these gates and channel. This channel could be used to support water transport without modification to the existing weirs



**Figure 5-5 Lock Gates and Channel near Weir**



**Figure 5-6 Chattabal Weir in Original Form**



**Figure 5-7 Chattabal Weir after removal of 9” blades**

- Canals – Monitor Water level of Dal Lake

Dal Lake in Srinagar is a closed and land locked water body. There are hundreds of house boats and Shikara permanently stationed on the lake. The water level of Dal Lake has to be maintained for safety of house boats and Shikara. Any change in water level, especially rise of water level, disturbs the safety and stability of house boats. Rise in water level of Dal Lake also leads to flooding in surrounding city areas. Hence, 4 man-made canals have been made to connect Dal Lake with river Jhelum. The Irrigation and Flood control department of Kashmir and Lakes and Waterways Development Authority (LAWDA) operates these canals. These canals have gates, which is used to monitor the discharge of surplus water in Dal Lake. All 4 canals are located in Srinagar. They are the only source of discharge of additional water accumulated in Dal Lake, parts of Shimoga, other tributaries from Srinagar. 5-8 shows the canal connecting Dal lake with River Jhelum.



**Figure 5-8 Canal connecting Dal Lake with Jhelum**

- Lakes around Jhelum

There are 7 lakes around River Jhelum. Some of these lakes directly impact the flow of water and prospects of water transport in the river. Table 5-3 summaries all the lakes and their possible impact on the river.

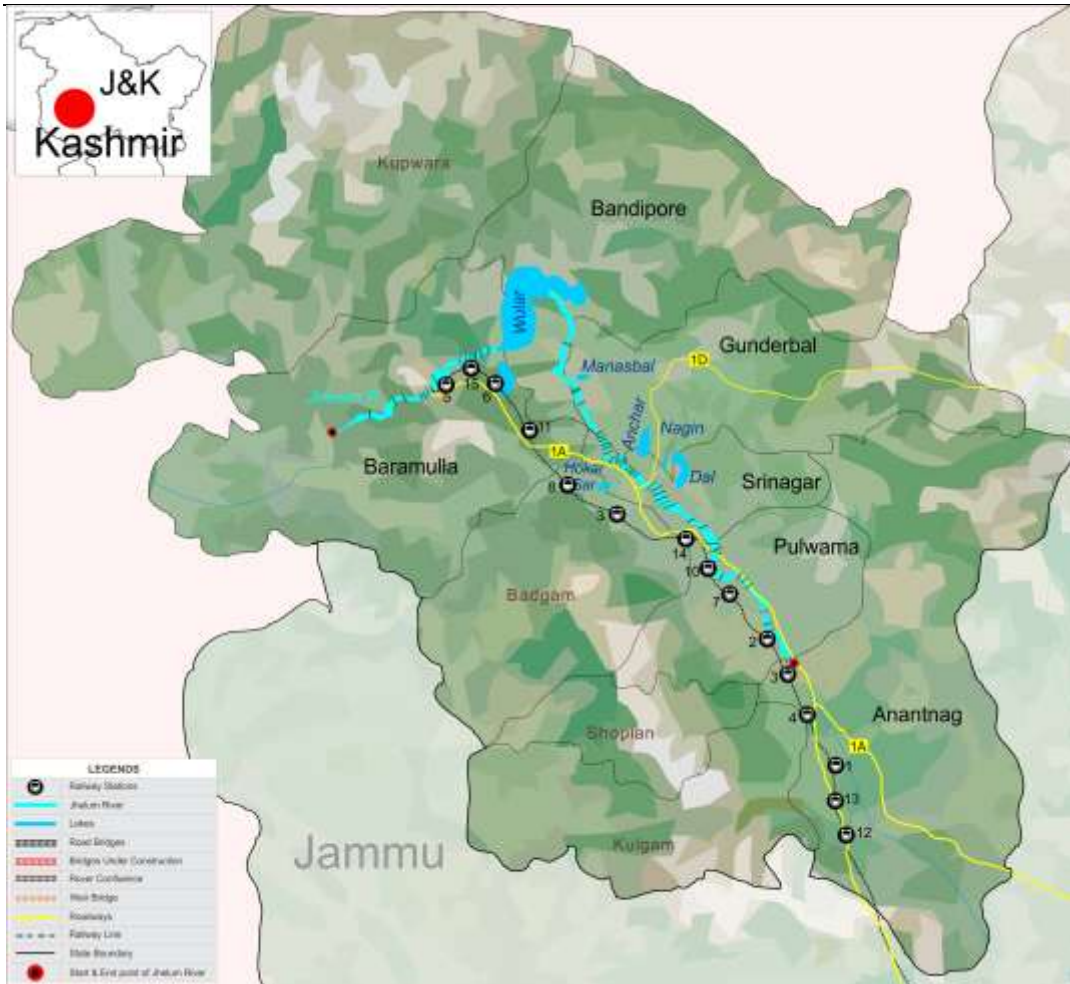
**Table 5-3 List of lakes and their relevance with Jhelum River**

Sr. No	District	Lakes	Connection with Jhelum	Distance from Jhelum (Km)	Activity	Type of Tourism
1	Srinagar	Dal	Formed from the oxbows of Jhelum. Water drains out from lake into the tributary of Jhelum, Amir Khan Nallah connects Lake and the River.	3	Cultivation and Tourism	Leisure, Conventional - Swimming and Sailing in Shikaras/Moto rboats
2	Srinagar	Nagin	Connected to Jhelum via Dal Lake	5	Torism	Boating and Shikaras for sight seeing
3	Bandipora and Baramulla	Wular	Lies in between Jhelum i.e Enters from south east and leave from west	0	Cultivation and Tourism	Leisure, Adventure - Floating Garden, and Sailing in Shikaras/Moto rboats
4	Srinagar	Anchar	This lake connects to Dal through Amir Khan Nallah via Gilsar and Khusalsar. and Further Dal connects to Jhelum.	10	Surrounde d by Agricultural fields, used for Apple, Vegetable and Willow plantation	It has been stopped due to deterioration of lake
5	Ganderbal	Manasbal	Connected to Jhelum by Canal near Sumbal	2	Tourism	Boating and Shikaras for sight seeing
7	Srinagar	Hokarsar	Drained by a channel to Jhelum at Sozenth Narbal Village	1	Tourism	Boating and Shikaras for sight seeing

Source: Secondary Sources

- Transport Infrastructure

Prospects for handling cargo, passenger, and tourism can receive a tremendous boost by good connectivity. Connectivity like approach road, proximity to state and national highway, and proximity to railway station can enhance the terminal's prospect for water transportation. Collectively, these features become a deciding factor in choosing one evacuation mode over the other.



**Figure 5-9 Connectivity around River**

- **Water Transport**

Waterway using River Jhelum was used as traditional means of transportation in the Kashmir Valley. This was predominantly the reason why several cities, commercial establishment, educational institution, etc developed around River Jhelum. The whole city developed around Waterway. Roads and now the railways were not available. The development of faster mode of transportation using roads led to gradual shift from waterways. Roads provided faster, efficient along with door-to-door services to residents of Kashmir. This led to neglect of waterways over a period of time. The transportation using waterways predominantly happening using river Jhelum stopped. All the transportation needs for passenger as well as cargo gradually shifted to roads. The fundamental reason for shifting transportation mode from waterways to roads were reliability, faster services and efficiency. However, with passage of time the roads have now become congested and the advantage of faster commuting, along with convenience has reduced. This has led to evaluation for reviving water transportation using river for intercity as well as intracity movement of passenger and cargo. The proposed waterways route would be successful provided it is at par with road on time and cost of transportation.

River transportation on Jhelum would have to be cheaper compared to the existing mode of transportation. The time-saving is Paramount for passenger transportation and may not be applicable so much for cargo transportation.

**Table 5-4 Fare comparison between Rail and Road transportation, from Srinagar**

Sr. No.	Routes - From Srinagar	Fare (INR/Passenger)		
		Railway	Bus	Sumo/Taxi
1	Baramulla	15	48	100
2	Sopore	15	46	90
4	Badgum	10	14	-
5	Pampore	10	40	30
6	Awantipora	10	17	40
7	Anantnag	10	56	90

Source: Field Visit

The interaction and interviewing of persons travelling between Srinagar and Anantnag, local commuting in the city, etc indicated a need for substantial saving of time and cost for passengers to shift from Railways/roadways to the waterways. Inter city travel is highly subsidised. The tariff offered by existing public modes of transportation such as Railways, public buses, small vehicles such as Tata sumo and likewise have variable transportation cost. Railway offers the least tariff. Railways tariffs are followed by smaller buses, larger buses and eventually the smaller private road vehicles. Personal intending to use list committing time using public transportation generally prefer to travel by Tata sumo and likewise. Buses and other road transportation mode takes higher tariffs compared to Railways.



**Figure 5-10 Houseboat on River Jhelum**

- Road Transport

The roads of Srinagar city is mostly narrow and congested. These roads were predominantly built during early 70s. Hence, these roads were mostly designed to carry smaller vehicles. Their load bearing capacity is lower and might not be able to accommodate modern vehicles of larger size. This was one of the fundamental reason for restricting movement of large commercial buses by the High Court of Jammu and Kashmir. The High Court of Jammu and Kashmir passed a ruling in the year 2006 to restrict use of large commercial busses in city. Smaller Tata 407 buses with a maximum capacity of 40 people in a sitting position and maximum 40 people with a combination of sitting as well as standing position were allowed to ply in the city. The procurement of larger buses for city transportation has virtually stopped since then. The smaller busses capacity was augmented by deployment of vans, Tata Sumo and other vehicles of similar size. Jammu Kashmir Transportation Corporation, that has larger buses is operating mostly in inter-district areas. The company has not expanded its fleet of large vehicles for a long period of time. However, the company is procuring close to 200 electric buses to be deployed for road transportation in Kashmir.

Employing smaller buses on a route leads to lower capacity of passengers moving from location to their final destination. This eventually leads to larger number of buses increasing congestion on the roads. The large buses could accommodate close to 100 persons (factoring in people with sitting as well as standing capacity). The smaller buses on the other hand could get to maximum of 40 persons. The restriction on upgradation of internal roads due to narrow lanes along with construction on both sides of roads as well as High Court guidelines are likely to restrict public transportation to buses of smaller size. The rising population along with need for additional number of commuting Journeys would create more congestion on road. Waterways using River Jhelum could come as an alternative mode of transportation and take of a fair share of passengers from road to waterways. The proposed waterways development on the River Jhelum is most suitable to undertake this. The River passes through city. Most of the commercial, educational installations are located on the banks of river. Most of the densely populated localities are also located on the banks of river. Hence it would become easier to bring a modal shift of passengers and small consignments of cargo from road to Waterway using river Jhelum.

**Table 5-5 Public Transport in the Hinterland of River Jhelum (Upto March, 2018)**

S.No	Hinterland	Buses	M.Buses	Truck/ Trailor	Taxis	3-Wheelers
1	Srinagar	3,517	4,110	16,596	9,507	20,889
2	Baramulla	187	978	7,492	4,021	2,192
3	Anantnag	202	1,175	8,361	5,963	2,977
4	Pulwama	94	639	4,830	1,497	2,394
5	Ganderbal	4	58	1,323	195	646
6	Bandipora	12	27	1,212	494	933

S.No	Hinterland	Buses	M.Buses	Truck/ Trailer	Taxis	3-Wheelers
	Total	4,016	6,987	39,814	21,677	30,031
	Total - Kashmir	4,589	8,177	52,908	31,584	35,824
	Total - J&K	13,008	19,092	109,261	45,623	65,992

Source: Directorate of Economic & Statistics Govt. of J&K

**Table 5-6 Private Transport in the Hinterland of River Jhelum (Upto March, 2018)**

S.No	Hinterland	Cars	Jeeps	2-Wheelers	Others	Total
1	Srinagar	107,403	6,518	141,437	5,820	315,797
2	Baramulla	27,319	276	26,098	2,158	70,721
3	Anantnag	24,148	152	26,581	2,373	71,932
4	Pulwama	16,139	74	20,463	1,718	47,848
5	Ganderbal	4,843	36	7,533	108	14,746
6	Bandipora	4,046	1	5,233	59	12,017
	Total	183,898	7,057	227,345	12,236	533,061
	Total - Kashmir	228,957	7,765	275,683	15,140	660,627
	Total - J&K	471,812	15,371	877,700	39,574	1,657,433

Source: Directorate of Economic & Statistics Govt. of J&K

**Table 5-7 Passenger Movement in J & K Fy 17**

Service Name	Net Revenue (Rs. Mn.)	Net Kms (lacs)	EPK (Rs.)	Traffic (Lakhs)
Tourist - Kashmir	86.6	16.0	15.3	2.4
Tourist - Jammu	28.3	9.7	29.1	3.2
Tourist - Other Divisions	2.8	67.1	2.4	3.7
Total	117.7	92.8	46.9	9.2

Source: JKRTC

**Table 5-8 Cargo Movement in J & K Fy 17**

Service Name	Net Revenue (Rs. Mn.)	Net Kms (lacs)	EPK (Rs.)	Traffic (Quintals in Lakhs)
Cargo - Kashmir	235.9	34.5	68.4	2.7
Cargo - Jammu	116.0	23.3	49.7	1.1
Total	351.9	57.8	118.1	3.9

Source: JKRTC

**Table 5-9 Key Statistics of J&K Road Transportation, FY17**

Components	Units	Value/Volume
Buses	Nos.	610.0
Trucks	Nos.	354.0
Average Revenue	Vehicle/Day	4,509.0
Average Vehicle Utilisation	Nos.	132.0
Net Kms	Lakhs	150.6
Routes	Nos.	153.0
Passengers Carried	Per Annum (Lakhs)	9.2
Cargo Loaded	MMPA	3.9

Source: JKRTC

- Railways

Train operation in the Kashmir region is highly subsidised. It has recently started with the laying of tracks of about 137 kms connecting Baramulla to Banihal. The railway station passes through Ganderbal, Srinagar, Pulwama and Anantnag. Its railway network of Kashmir is not yet connected to Jammu and rest of India. However, there are plans to connect the railway network of Kashmir with the mainline railways. The Banihal to Katra rail link is proposed to be developed by 2020. Once developed, the stretch is likely to change the passenger, tourist and cargo transportation in the whole of Kashmir. Table 5-10 and Table 5- shows the prominent stations and tariff charged for passenger transportation using Indian railways in Kashmir.

**Table 5-10 Railway Stations in the Hinterland and Connecting Routes**

Sr. No	District	Station Code	Station Name	Type	Connecting Route	Distance from Jhelum (Km)
1	Anantnag	ANT	Anantnag	Passengers	Srinagar - Anantnag Anantnag - Quazigund	3.4
2		BJBA	Bijbiara	Passengers	Srinagar - Anantnag	3.2
3		SDUA	Sadura	Passengers	Anantnag - Quazigund	22.3
4	Pulwama	ATPA	Awantipura	Passengers	Srinagar - Anantnag	5.3
5		KAPE	Kakapora	Passengers	Srinagar - Anantnag	3.4
6		PJGM	Panjgam	Passengers	Srinagar - Anantnag	3.4
7		PMPE	Pampora	Passengers	Srinagar - Anantnag	3.5
8	Srinagar	SINA	Srinagar	Passengers	Srinagar - Mozhom	3.8
9	Baramulla	BRML	Baramulla	Passengers	Mozhom - Baramulla	3.1
10		HME	Hamre	Passengers	Mozhom - Baramulla	11.4
11		SXZM	Sopore	Passengers	Mozhom - Baramulla	1.5
12		PTTN	Pattan	Passengers	Mozhom - Baramulla	18

Source: FOIS, RBS Indian Rail

**Table 5-11 Passenger Fare List from (Nawgon) Srinagar Railway Station**

Sr. No.	Railway Stations	Distance from Srinagar (Km)	Adult Fare	Child Fare	Monthly Fare	Quarterly Fare
1	Baramulla	57.02	15	10	270	730
2	Sopore	49.4	15	10	270	730
3	Hamre	41.71	10	10	185	500
4	Pattan	33.93	10	10	185	500
5	Mazhom	25.76	10	10	185	500
6	Badgam	11.53	10	10	100	270
7	Pampore	6.14	10	10	100	270
8	Kakpor	11.73	10	10	100	270
9	Awantipora	22.33	10	10	185	500
10	Panzgom	28.83	10	10	185	500
11	Bijbiara	35.93	10	10	185	500

Sr. No.	Railway Stations	Distance from Srinagar (Km)	Adult Fare	Child Fare	Monthly Fare	Quarterly Fare
12	Anantnag	42.44	10	10	185	500
13	Sadura	50.15	15	10	270	730
14	Qazi Gund	60.85	15	10	270	730
15	Hillar-Shahabad-Halt	65.03	20	10	270	730
16	Banihal	78.19	20	10	355	960

Source: Srinagar Railway Station (Site Visit)

The tariff charged by Railways is negligible compared to the cost of actual transportation. Table 5- shows the tariff charged for passenger transportation using Indian railways in Kashmir. It would be impossible for waterways on River Jhelum to match the time and tariff offered by railways. The Indian railways have invested thousands of crores in infrastructure creation. Additionally, the route has operational losses year on year. Indian railways spends about INR 80 Crores annual on operations and maintenance against a revenue of INR 10 Crores. This is excluding additional security provided at the stations.

Any attempt to modal shift passenger transportation to railways would require matching tariff and time of transportation. This would require huge allocation towards operational subsidy by IWAI.

- Water Transport (2012-2014)

As per the finding of the official inauguration of water transport /inland water transport in River Jhelum has been done in the month of June 2012 by Irrigation and Flood Control (IFC) department Jammu and Kashmir Government, through M/S Kashmir Motors under clause 37 chapter 3rd rules 2011 reflected at page No 105 of J & K water resource regulation and management Act 2010 . The water taxies in River Jhelum were allotted for use of local transport and tourism related activities against which permission for 5 mechanized boats were allowed to ply between the destinations mentioned below.

- Destination of Mapping

Route starting from Pantha Chowk to Chattabal Weir which covers a stretch of 14 Km's to and fro. Listing of the Ghats/terminals made for water transport are given below

### 1. Pantha Chowk Ghat/Terminal

Outskirt boundary of Srinagar City touching most famous site of Pampore which lies on the other side of the bank of River Jhelum mostly know for Saffron cultivation and being visited /viewed by all most all the tourists coming by route to the valley. A good number of artisans dealing with hand carved stones have established their

work place on the bank of river that gives a cultural look of this city in respect of stone age of the civilization.

## **2. Sonwar Ghat/Terminal**

Sonwar town is one of the most strategic and important location as for as the local commuters are concerned. The catchment area of the Sonwar Ghats/terminal are as under:-

- UNO Office (United Nations Military Operation Group)
- Burn Hall Secondary School
- Amar Singh Club
- Ziyarat Syed Yaqoob Shrine
- Army Cantonment Board and army school
- Matta Durganag temple.

## **3. Zero Bridge/ Rajbagh Ghat**

Ghat Zero Bridge Rajbagh is main station for water transport and for maintenance of the boats allotted by the irrigation and flood control department stationed there is adjacent to the Jhelum Park which is main attraction for tourists and a huge footpath, Heritage wooden Zero Bridge gives an attractive look from its wood carved Baladaries developed on the bridge recently. This bridge has turned a master piece of Kashmir culture of wood carving works.

## **4. Pirzoo Ghat/Terminal near JK Bank /Grindlays Bank /Residency Road.**

This is one of the most busiest location in Srinagar city being a commercial capital for economic and employment activities. Residency road caters to a large business community followed by hundreds of employees and thousands of customers walk in for which we have a very limited parking space available. Another important aspect of Residency Road is in the fact that all most all the financial institutions like Banks and co-operatives have their offices in the same location which adds to the routine transport hassles of the area congesting over all traffic system.

## **5. Historical Lal Chowk –Amira Kadal Ghat /terminal**

Lal Chowk being the oldest retails and wholesale market with hundreds of retails shops , showrooms , restaurants , hotels , cafeterias , making it most busiest market of the valley , Being connected with the heritage markets known as Mahraj Bazar, Jahangir Chowk , Old Amira Kadal Bridge, Hanuman Mandir ,Missionery School, of the valley namely, Tyndale Biscoe School, and Mallinson School, cater the most areas of the river transport .Apart from being commercial hub it is also known for its historical /political significance . Ganta Ghar where the first Prime minister of India used to deliver the speeches to the Kashmiri locals before and after the

independence. It is also adjacent to the ABI GUZAR which was than a TAX collection point for water transport and has huge historic significance.

#### **6. DC Office Ghat/terminal**

Like other places situated on the shores of River Jhelum DC office Ghat/terminal has its significance for established government office like that of, Old Assembly of JK Govt, High Court, Accountability Court, and other high profile offices established since Maharjas rule in J&K. Being center for government establishments this place experience heavy rush of public and commuters. This this play an important role for being as center for boarding and de-boarding of surface transport for different locations/distances/areas.

#### **7. Habba Kadal Ghat/terminal.**

Habba Kadal being the oldest city of the valley is known for its old residential building mostly of the minority community of the state like pandiths ,Hindu. This place is also known for culture of harmony of various people with different thoughts. Mostly the Hindus have their residential houses on both side of the famous River Jhelum. As such this terminal has a very good significance as for water transport is concerned and was also a famous terminal in the time of Maharaja when water transport was the main source of transport for cargo and public.

#### **8. Aile Kadal Ghat /terminal**

This terminal is adjacent to the Aile Kadal Bridge is the 5th bridge of the Srinagar City which was constructed by Sultan Ali Shah in 1415 , it was created this bridge to have a paramedic view of the splashing water and to enjoy the gentle breeze . Since this Ghat is near to the famous market of Maharaj Gunj a good deal of business was carried out there in the times before independence. The dealers of for flung areas used to buy their good from the said market during summers & storing it for the cut off areas during winter seasons.

#### **9. Nawa Kadal Ghat/terminal.**

Nawa Kadal Ghats/terminal is equally significant for operating the water transport in the River Jhelum like that of Aile kadal and shall cater the commuters from all the areas of old cities of valley , Water transport shall certainly play a pivotal role in making an alternative route for carrying goods and passenger to the various places coming between the seven bridges of the city of Srinagar .Nawa Kadal Ghat being near the educational institutions like Women’s College, Higher Secondary School and a good number of business establishments. So, this terminal has its own importance and shall facilitate the commuters in getting easy transport facilities to the various distances

## 10. Safakadal Ghat/terminal

Safa Kadal Ghat/terminal has its historical background as it situated near the oldest bridge in the league. This Ghat represents the old Kashmiri Architecture and depicts the saga of the skilled workers who crafted this bridge with heavy logs of wood on gushing Jhelum. This city is known as fish market and is being linked with the main water bodies like Manasbal, Wullar Lake etc where from fishermen used to carry their fishes to the main market of Safa Kadal . As such this Ghat shall play a pivotal role in the fish trade through River Jhelum.

## 11. Chattabal Weir Ghat/terminal

Being the starting point of water transport in the city of Srinagar Chattabal Weir Ghat shall be a place of rest and entertainment for the commuters. The commuters while waiting for the boats shall enjoy the water fall of the Weir constructed in the river Jhelum by irrigation and flood control department. This is also known as Gate for water transport for both the destinations for up and down. Presently Irrigation and flood control department had constructed a guest house at the site which can be used as waiting place for the local and tourists.

It has been observed that the Ghats which were identified for water transport at the initial were 11 in number and these Ghats were mostly in existence since ages when inland water ways used to be the actual and the only mode of transport mostly used for cargo.

The suggested sites for water transport accesses to the main corridors of Jhelum leaving apart the streams and flood channels connecting the interiors of the Srinagar City are given below.

- *Zero Bridge.*
- *Pirzoo iland*
- *General Post Office*
- *Govt. Silk Factory*
- *S. P. Museum*
- *Grindlays Bank*
- *Amira Kadal Bridge*
- *Hanuman Mandir*
- *Budshah Bridge*
- *Old Secretariate*
- *Rani Tample*
- *D C Office*
- *Habba Kadal*
- *Ragnath Mandir*
- *Old Fatch Kadal*
- *Shahi Hamdan Shrine*
- *Pather Masjid*
- *Mehraj Gunj Market*
- *Budshah Tomb*
- *Alie Kadal*
- *Womens College N Kadal*
- *Bulbul Lanker Shrine*

- Rinchen Shah Grave yard



**Figure 5-11 Seater Boat for jhelum**



**Figure 5-12 Seater Boat for Jhelum River**

- Operational & Commercial

The operations and commercials approved by the department of IFC Kashmir through their order issued vide their endorsement No PS/491-95 dated 1.5.2012 for operation of the boats /vessels carried in the assigned /designed corridors from 8

AM to 8 PM on all days including Sundays and Holidays during summer season while as timing for plying has been fixed form 9 AM to 5 PM during the winter season.

It was also observed that the maximum speed of 15 KM's per hour was approved on the higher side wherein the permissions holder of the boat /vessel had to pay a non-refundable registration fees of Rs. 1000 and permission fees of Rs. 500 per month.

The tariff charges for the public has been fixed as under as per the same order by irrigation and flood control Department Kashmir.

**Table 5-112 Tariff charged by Govt., and its comparision with other modes**

Sr. No	Route	INR/Passenger		
		IWT (2014)	Road (Bus/Sumo)	Rail
1	Ghta to Ghat	25	15	NA
2	Pantha Chowk to Lal Chowk Ghat	60 (=1+5 < stops)	12/20	NA
3	Chattabal to Lal Chowk Ghat	60 (=1+5 < stops)	6/ 10	NA

Source: Field Visit

Since the operations started from the year 2012 till September 2014 and despite the ground work done the infrastructure could not be completely created by the department except the two stations viz a viz Rajbagh –Zero Bridge Station and Chattabal Weir where at boarding and de-boarding facilities were not provided by the department but an alternate arrangement was kept in place at the launching pad station Rajbagh.

Two Stations one at Rajbagh and other at Chattabal Weir for a strach of 7 KM's one way could be made operational where 3 boats each with a capacity of 13 passengers and one of 9 passengers carrying capacity were pushed into service.



**Figure 5-13 Picture Taken when the water transport was functional 2013**

- Bottlenecks/ Current Issues faced for the operation of water transport.

- ✓ Removal of debris and parts of old bridges existing adjacent to the newly constructed bridges at especially at Aali Kadal, Nawa Kadal and Safa Kadal
- ✓ Unable to maintain the minimum water depth of 2 mtrs at the water corridors.
- ✓ Floating Pontoon Jetty at all the identified Ghats/terminals for safe and easy boarding and de-boarding of passengers.
- ✓ Development of existing Ghats/Embankments
- ✓ Old city river side residential houses facet improvement
- ✓ Toilet facilities at the Ghats/terminals
- ✓ Cleanness of the Jhelum Corridors by SMC /Local Bodies

### 5.5.1 Existing and Proposed Industries

Figure 5-14 shows the industrial areas located in the districts, which fall under the hinterland of Jhelum River. There exists no industry, which produces bulk commodities. Most of the industries in the hinterland are involved in Food, Textile and Wooden products manufacturing.

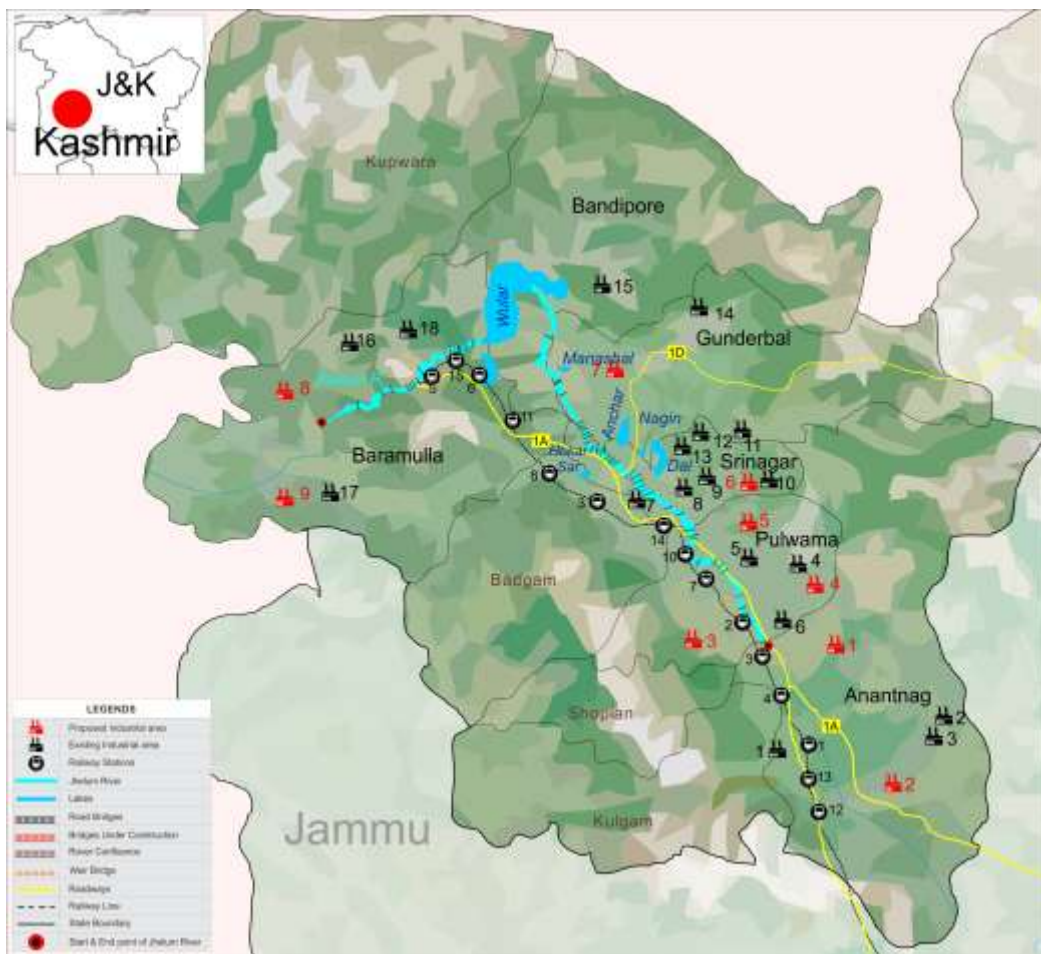


Figure 5-14 Industrial Areas in the Hinterland of River Jhelum

## 5.5.2 Industrial Cargo

There exists small industrial areas mainly managed by SICOP, DIC and SIDCO in Kashmir Valley. Food products and Wooden products are the major industrial units found in the hinterland. Srinagar is the important trading hub, which also deals in export of Woolen Shawls, Silk and Fabrics. While production in other districts of the valley is very small and consumes locally. The table shows the existing and proposed industrial areas located in the hinterland i.e Kashmir Valley.

**Table 5-123 Existing Industrial Areas in Hinterland**

Sr. No	District	Existing	Managed by	Products Manufactured	Exports
1	Anantnag	Bijbehara	SICOP	Food Products, Kitchen Racks, Wooden Products, Sports Products, etc.	Nil
2		Anchidoora	NA		
3		Anantnag	DIC		
4	Pulwama	Chotpora	NA	Food products, Wooden Doors & Windows, Steel Rolling Shutter	Nil
5		Pulwama	DIC		
6		Lassipora	NA		
7	Srinagar	Shalteng	SIDCO	Food products, Coir Foam, Cricket Bat, Mineral water, etc. Bus Truck Body Building	Woolen Shawls, Rilk, Fabric
8		Khanmoh III	SIDCO		
9		Khanmoh I&II	SIDCO		
10		Zakoora, Silk Park	SICOP		
11		Zakoora	SICOP		
12		Baghi Ali Mardan	NA		
13	Zainakote	SICOP			
14	Ganderbal	Dooderhama	DIC	Agriculture Implements, dairy Products, etc.	Nil
15	Bandipora	Simbal	DIC	Food Products, Oil Extraction, Inverters & Coverters etc.	Nil
16	Baramulla	Doabgah, Food Park	NA	Furniture, Food Products, Bee Keeping Honey Processing, Bakery Products.	Nil
17		Sopore	SIDCO		
18		Baramulla	DIC		

Source: J&K SIP, J&K Economic Survey, Digest of Statistics

**Table 5-14 Upcoming Industrial Units in Hinterland**

Sr. No	District	Upcoming/Under Developed Industries
1	Anantnag	Lakhiripor Hafizabad
2		Shestergam
3	Pulwama	Land of J&K Minerals, Wuyan Khrew
4		Takia Razak Shah Tral
5		Khrew Near Khanmoh
6	Srinagar	Srinagar Khanmoh
7	Ganderbal	Barsoo, Manasbal
8	Baramulla	Govt. of Match Factory
9		Johama

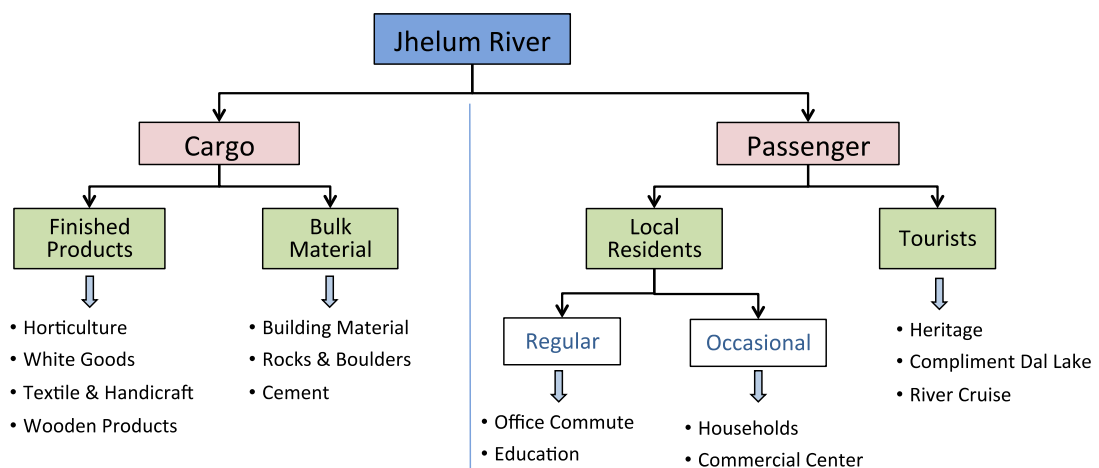
**Table 5-135 Total No. of Industrial Estates in the hinterland of River Jhelum**

Sr. No	Districts	No. of IE	
		Existing	Proposed
1	Anantnag	3	2
2	Pulwama	3	3
3	Srinagar	7	1
4	Ganderbal	1	1
5	Bandipora	1	Nil
6	Baramulla	3	2

Source: Consultant

### 5.5.3 Opportunity Prospects

Prospects for transportation on Jhelum could broadly be divided into 2 categories namely cargo transportation and passenger transportation. Economy of whole of Kashmir is predominantly dependent on tourism followed by Horticulture. There is limited manufacturing activities undertaken in Kashmir. The manufacturing activity is limited to textile, cement, etc. There exist mines constituting limestone, precious stones, building materials, etc. The produce from cement plants are consumed locally.



**Figure 5-15 Opportunity Prospects for Water Transportation on River Jhelum (NW-49)**

### 5.5.4 Cargo

Bulk materials get transported in smaller quantities using roadways. Bulk materials are used for construction of houses, roads and other city infrastructure.

Horticulture is one of the predominant contributor to the economy of Kashmir. The horticulture produced in Kashmir is sold locally and it is also sold in other parts of India. The produce is transported using roadways. The earnings from tourism and horticulture is driving the local economy. The earnings from tourism and horticulture

is mostly used for procurement of finished products from other parts of India including import.

Prospect of transporting finished products procured from rest of the India using River Jhelum could be explored.

#### 5.5.5 Passenger

Transportation of passengers could be broadly divided between transportation required for people residing locally as well as transportation for tourist. The transport infrastructure for both the categories would be similar and hence have been club together.

Norther part of Srinagar district has grown very close to the river. Several populated colonies and commercial centres located close to River. Hence, an attempt would be made to shift population travelling on the roads to the river by developing suitable infrastructure.

Sailing on river Jhelum provides scenic beauty. This has been one of the prominent desires for tourist to take a tour of city using boat and enjoy the natural beauty of Kashmir. Apart from boating experience, tourist could also use River Jhelum for commuting from one location another. The advantages of tourist transportation on river Jhelum is that tourists have ample time. The transport mode on waterways does not have to compete with the transport mode of the road or railways. The passenger transportation for the local residents would always desire the waterways to match the speed and efficiency of road and railways. Narrow width along with large number of sharp curves, unprotected bunds, etc creates restrictions on speed. Such restrictions are not available for tourist transportation. Hence tourists may offer larger prospect for passenger transportation and tourists transportation. Following image shows landscape view of River Jhelum during lean season (Non tourists season). Tourist seasons provides greenery all around with trees laden with flowers.



Figure 5-16 View of Landscape for Tourists from River Jhelum (NW-49)

## 5.6 Commodity Composition / Categorization

### 5.6.1 Minerals & Mining

The state of Jammu and Kashmir has limited mineral resources. The prominent minerals in the state which has comparatively higher reserve share in India constitutes sapphire stones, and other lightweight minerals that is predominantly used for making ornaments. There exist several other bulk minerals. These minerals are mostly processed to be used mostly in construction industry. Some of these minerals include Limestone, Gypsum, Granite, Quartzite, etc. Table 5- shows the availability of prominent minerals in the hinterland of River Jhelum.

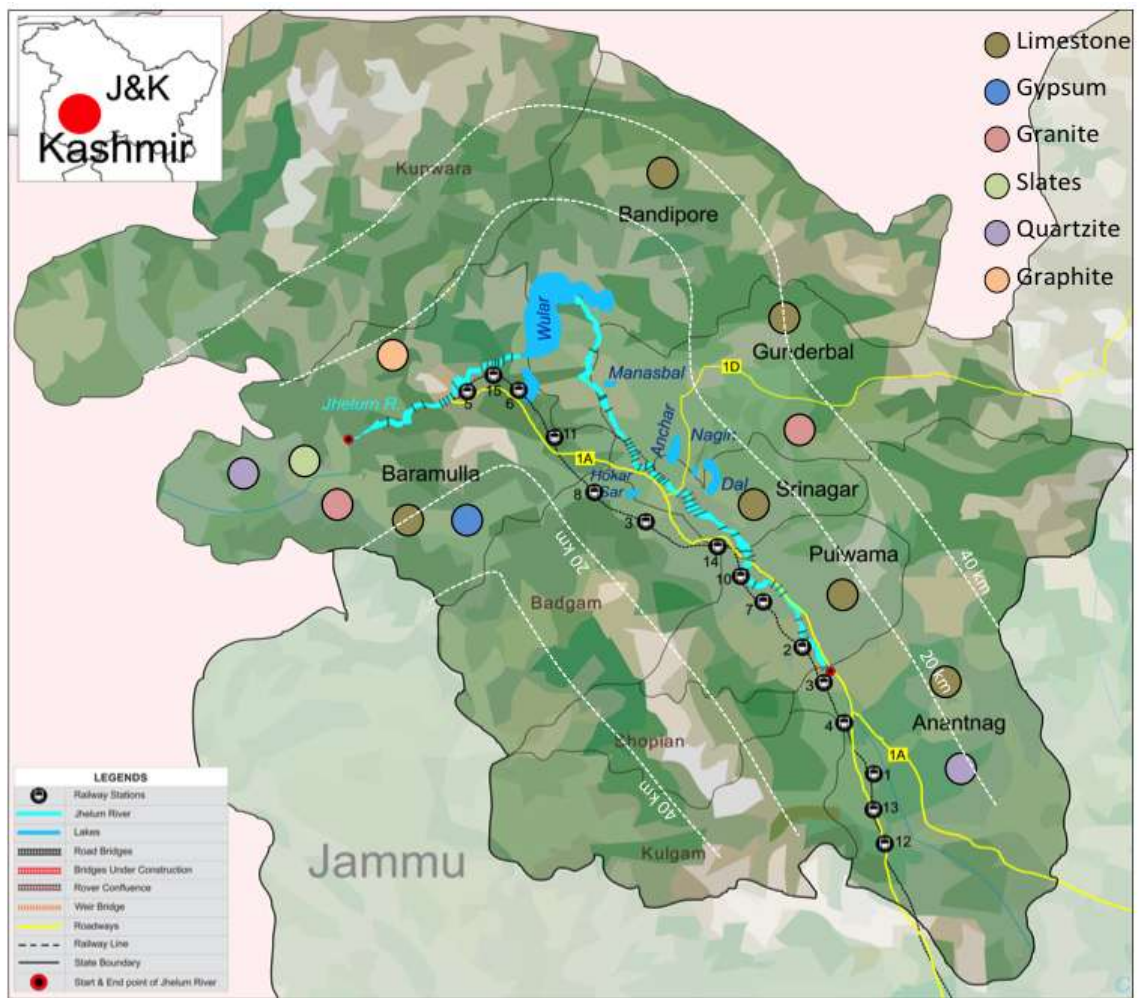


Figure 5-17 Availability of Minerals in the Hinterland of River Jhelum

**Table 5-16 Availability of Minerals in the Hinterland**

Minerals	Availability	Units	Reserves (J&K)	Uses
Limestone	Kashmir Valley	MMT	6,081	Manufacture of Cement, Calcium Carbide, Quicklime, Bleaching- Powder, Glass, Paper, paints
Gypsum	Baramulla	MMT	150	Cement, fertilizer, Filler in Paper, Paints, Rubber, Textile industry, Plaster of Paris & sanitary ware,
Granite	Ganderbal & Baramulla	Mn. Cu.Mt.	5.2	Decorative building stone.
Slates	Baramulla	Mn. Cu.Mt.	9.6	Building Material
Quartzite	Anantang & Baramulla	MMT	2	Glass & IT industry
Graphite	Baramulla	MMT	62 (Baramulla)	Crucibles, foundry, refractory, paints

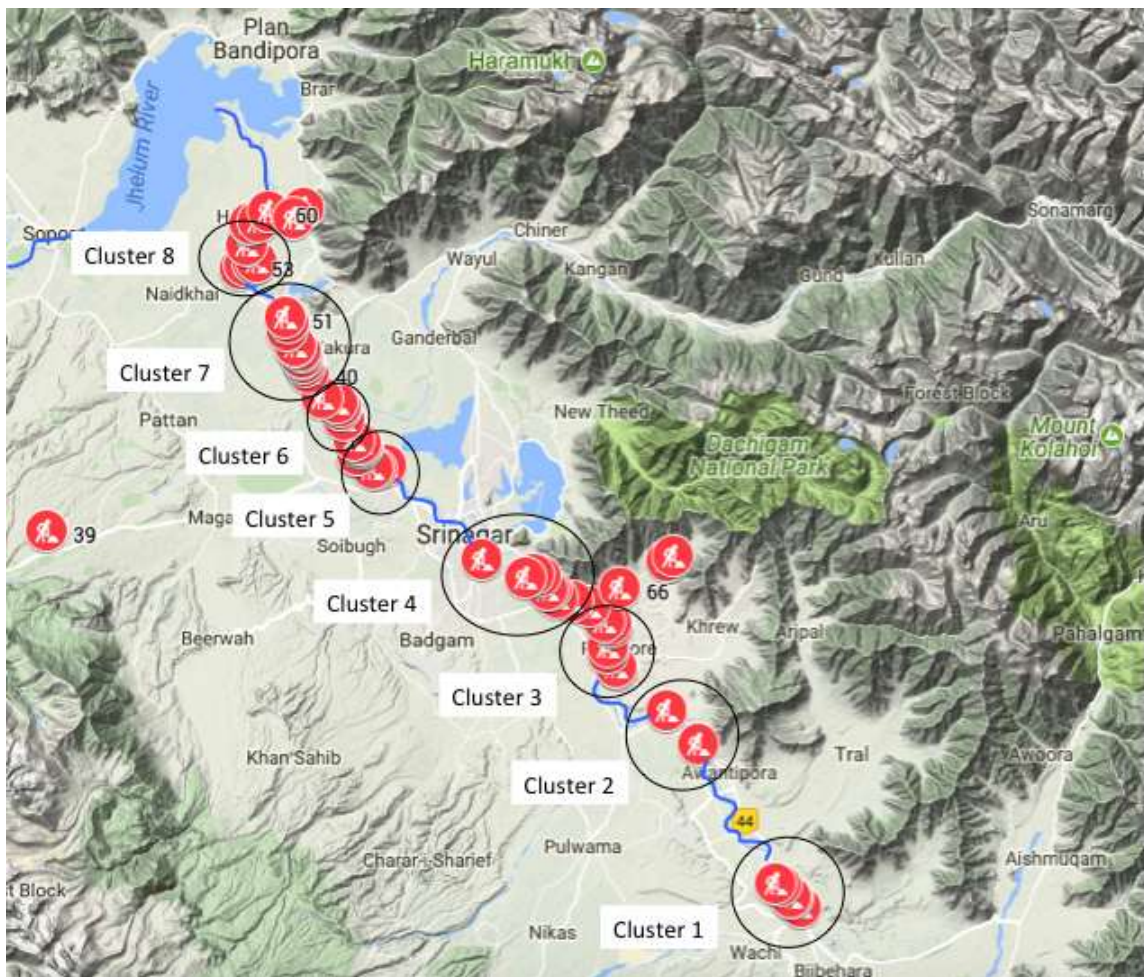
Source: J&K Geology & Mining

The reserves of these minerals are lower compared to rest of the India. Hence, the companies have setup small capacity processing plants to generate finished products. Some of them include cement, marbles, etc. There are total 8 mineral based units in Anantanag, 9 in Pulwama, 11 in Srinagar and 2 in Baramulla. Ganderbal and Bandipora do not have any such unit or plants. All these units are located far away from Jhelum River and the finished products generated from these locations are consumed locally. There has been no instances of transporting either raw minerals or finished product from Kashmir to other states of India. They are mostly transported to the other cities locally in Kashmir for consumption. The lower volume of minerals reduces scope for transportation of minerals or their finished products using River Jhelum.

The consumption centre of these minerals are largely fragmented and distributed in the Kashmir. This leads to transportation for distribution of finished products in smaller quantity across various districts of Jammu and Kashmir. Smaller quantity distribution along with multiple handling while using waterways makes end to end logistics cost associated with transporting minerals and other finished products in bulk form higher compared to existing mode of transportation.

### 5.6.2 Sand Mining

The growth in infrastructure development in Kashmir Valley has led to a sharp increase in the demand of sand. The 2014 floods further increased the demand for sand due to redevelopment of infrastructure. Sand mining is legally allowed in Jammu & Kashmir. The sand mining in the state is governed by Mines and Minerals (Development and Regulation) Act of 1957, Government of India. This requires miners to obtain license from state authorities. The sand miners pay a royalty to the government based on the volume of mined sand. The sand is sold to the open market after paying royalty to the government. Figure 5-18 below depicts the cluster wise sand mining locations in the River Jhelum.



**Figure 5-18 Mapping of Cluster wise Locations of Sand Mining in Jhelum River**

Mining of sand is allowed under certain conditions. Some of the conditions essential for undertaking River mining of sand in Jhelum are

- a) Extraction of minerals should take place up to 3 meter in depth or up to ground water level or whichever is reached first
- b) No mining within 10 meters from embankments of the river
- c) Mining activity should not disturb fauna-flora
- d) It should not affect infrastructure developed on the river such as hydraulic points, Lift irrigation schemes of villages
- e) The sand collected should be stored and transported properly

Persons involved in Sand Mining have small boats with flat platform. They get their boats to the location of sand mining. The mined sand is collected using manual methods on the flat platform of the boats. The boats are not motorised boats. Hence, the mined sand cannot be taken to a different or far location using the boats. Hence, the sand is unloaded to the nearest dumping point near a bund. The location of sand mining is determined based on market demand. It is mostly undertaken during the lean season when the water level in the river Jhelum is low. This enables minors to take their small boats in the river and mine sand. There were instances of

mechanical mining and dredging using hydraulic JCB mounted on floating pontoons. The dredged sand is mostly put alongside River Jhelum. It is then traded to local market.



**Figure 5-19 Sand Mining near Sambul Bridge**

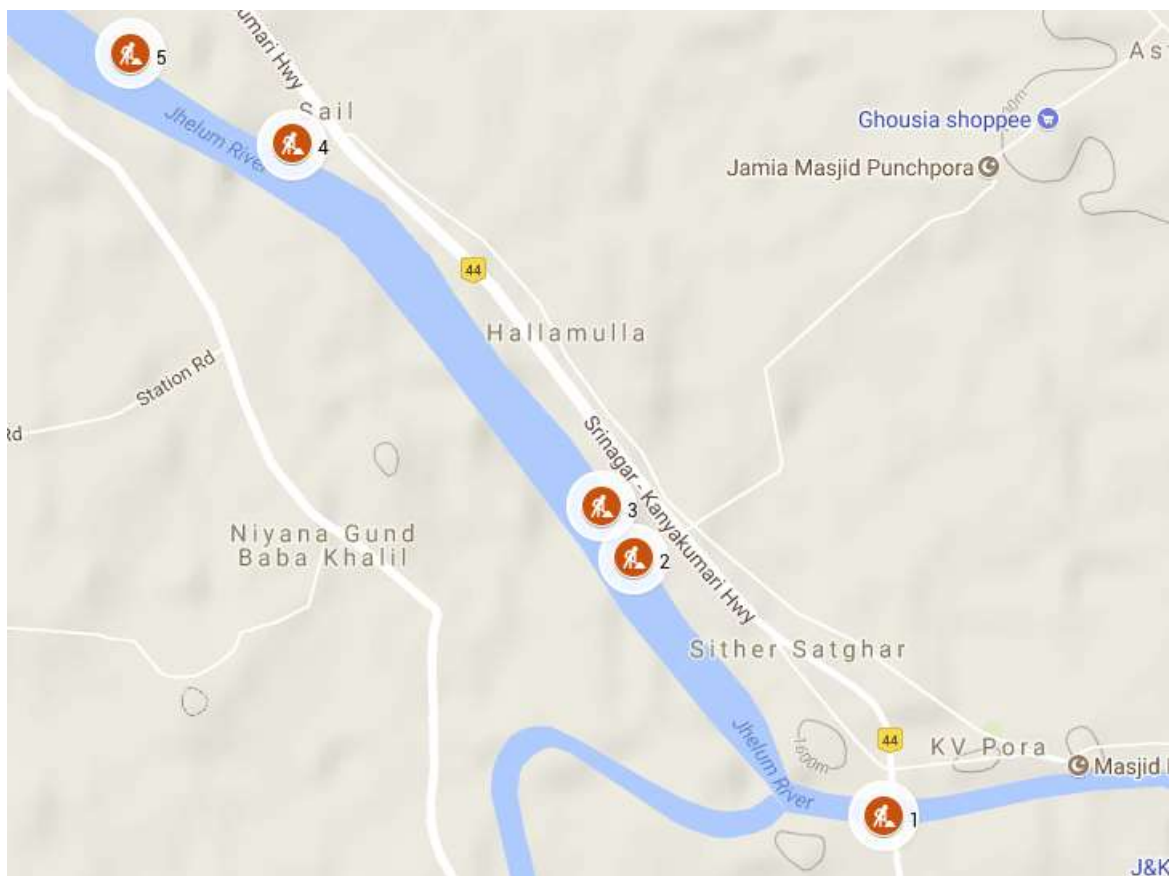
Following image shows instance of small-scale sand mining in River Jhelum. Zero Bridge on River Jhelum is as one of the most prominent archaeological structure. This has recently been renovated by the tourism ministry of State Government of J&K. It is believed to be more than hundred years old. However, at times of need miners even mine sand near Zero bridge. Following figure shows image of small scale sand mining near Zero Bridge of Srinagar.



**Figure 5-20 Sand Mining near Zero Bridge**

Sand is a low value asset and hence the transportation cost of sand from river to the final consumption centre has to be nominal for viability of the trade. A truck load with a volume of 200 cubic ft sand is sold in the market at a price between Rs 4500 to 6500. This includes the cost of material, labour and cost of transportation. It is a low value commodity used for the construction. Hence the industry tries to keep minimum bare minimum logistics costs associated with sand mining. The cost of transportation and labor together is not more than 30 percent of the sale. Hence, the cost associated with transportation of Sand extracted from river beds of Jhelum has to be mostly sold in the local market. Rise in distance or handling of material to increase total logistics cost. The use of river transportation of mined sand to involve multiple loading and unloading along with additional cost associated with transportation on the river. Hence, This is unlikely to over a commercially viable proposition for transporting sand on River Jhelum.

Since the mining of sand is local in nature. Hence, there does not exist any scope for river transportation of mined sand on the stretch of river Jhelum.



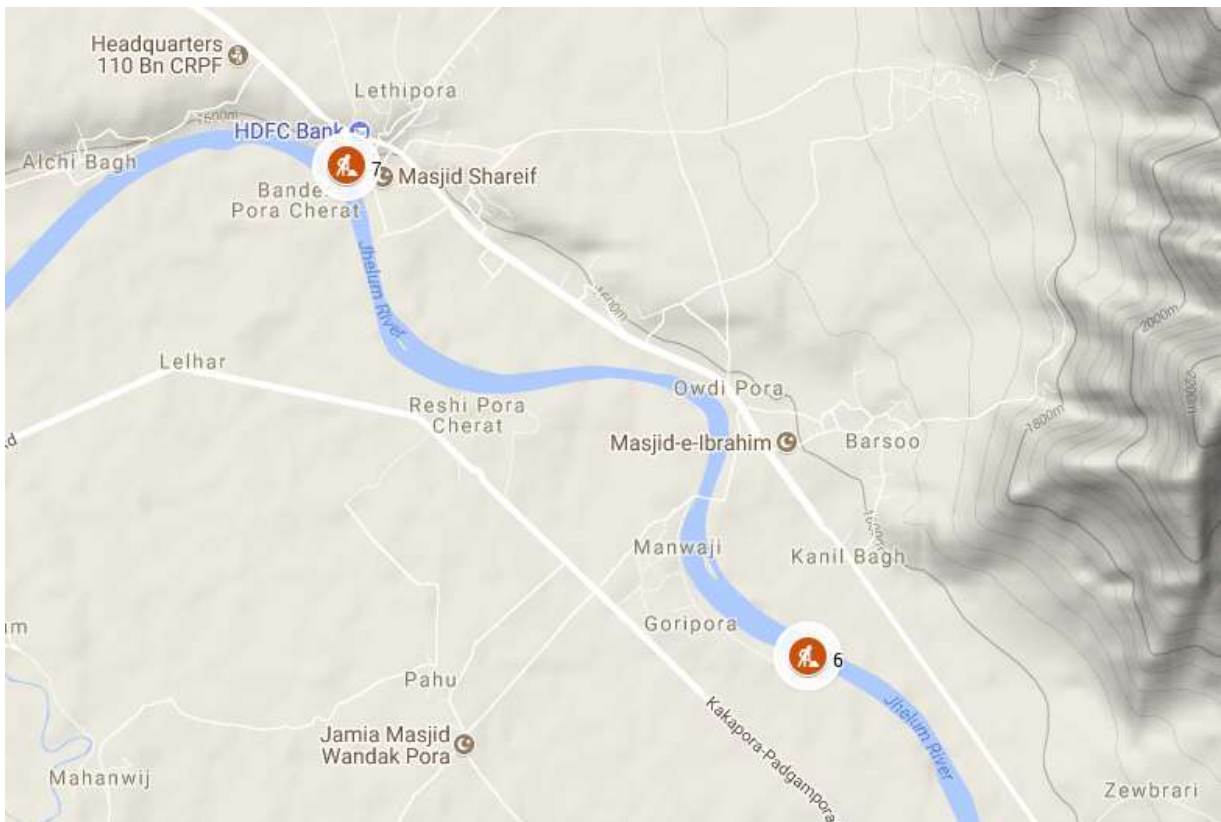
**Figure 5-21 Mining Locations in Cluster 1**

**Table 5-147 List of Mining Areas and volume produced in Cluster 1**

Sr. No	Area	Destination	Production Volume (ft/Month)	Vehicle used	Capacity (Ft)	INR/Truck	Boats/Machines Used (No.)
1	Sangam	Kashmir Valley	86,400	Tipper/ Truck	160 -200	5,000-6,000	18
2	Sither		19,200	Tractor	60	2,000	4
3	Sagar		19,200	Tractor	60	2,000	4
4	Sail		57,600	Tipper/ Truck	160-200	5,000-6,000	12
5			48,000	Tipper/ Truck	160-200	5,000-6,000	10

Source: Site Visit

In Cluster 1, sand is mined by local bodies in Sangam, Sither Sagar and Sail areas in Kashmir Valley. Volume of mined sand in Sangam is more than other areas. Mined sand is used mainly for local construction. Sand mining in these areas provides livelihood and easy money for locals. Mined sand is moved to the destination by roadways.



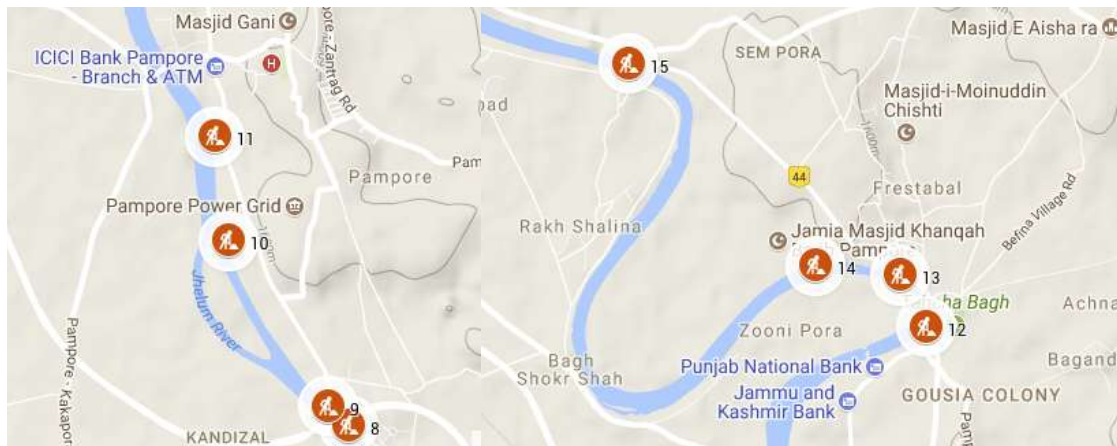
**Figure 5-22 Mining Locations in Cluster 2**

**Table 5-18 List of Mining Areas and volume produced in Cluster 2**

Sr. No	Area	Destination	Production Volume (ft/Month)	Vehicle used	Capacity (Ft)	INR/Truck	Boats Used (No.)
6	Goripora	Kashmir Valley	720,000	Tipper/ Truck	160 -200	5,000-6,000	15
7	Bander Pora Cherat		19,200	Tractor	60	5,000-6,000	4

Source: Site Visit

In Cluster 2, sand is mined by local bodies in Goripora and Bander Pora Cherat areas. Volume of mined sand in Goripora is more. Mined sand is used mainly for local construction. Sand mining in these areas provides livelihood and easy money for locals. Mined sand is moved to the destination by roadways.



**Figure 5-23 Mining Locations in Cluster 3**

**Table 5-159 List of Mining Areas and volume produced in Cluster 3**

Sr. No	Area	Destination	Production Volume (ft/Month)	Vehicle used	Capacity (Ft)	INR/Truck ('000)	Boats Used (No.)
8	Kandizal	Kashmir Valley	9,600	Tipper/ Truck	160 -200	5-6	2
9			33,600	Tipper/ Truck	160 -200	5-6	7
10	Pampore		19,200	Tipper/ Truck	160 -200	5-6	4
11	Power Grid		72,000	Tipper/ Truck	160 -200	5-6	15
12	Zooni Pora		72,000	Tipper/ Truck	160 -200	5-6	9
13			19,200	Tipper/ Truck	160 -200	5-6	4
14			28,800	Tipper/ Truck	160 -200	5-6	6
15	Sem Pora			2,40,000	Tipper/ Truck	160 -200	5-6

Source: Site Visit

In Cluster 3, sand is mined by local bodies in Kandizal, Pampore Power Grid, Zooni Pora and Sem Pora Cherat areas. Volume of mined sand in Sem Pora is more. Mined sand is used mainly for local construction. Sand mining in these areas provides livelihood and easy money for locals. Mined sand is moved to the destination by roadways.



**Figure 5-24 Mining Locations in Cluster 4**

**Table 5-20 List of Mining Areas and volume produced in Cluster 4**

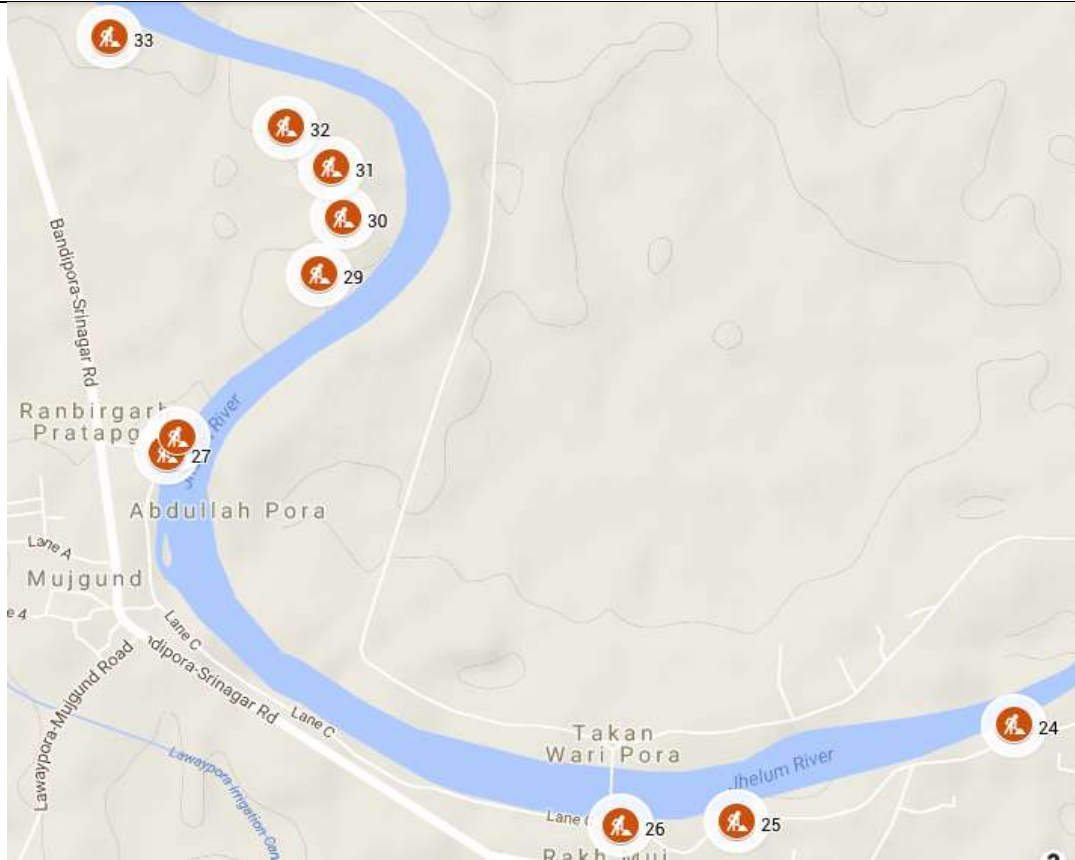
Sr. No	Area	Destination	Production Volume (ft/Month)	Vehicle used	Capacity (Ft)	INR/Truck ('000)	Boats Used (No.)
16	Ali Abad	Kashmir Valley	38,400	Tipper/ Truck	160-200	5-6	8
17	Athwajan		72,000	Tipper/ Truck	160-200	5-6	15
18	Lasjan		9,600	Tipper/ Truck	160-200	5-6	2
19			9,600	Tipper/ Truck	160-200	5-6	2
20	Soitang		19,200	Tipper/ Truck	160-200	5-6	4
21			19,200	Tipper/ Truck	160-200	5-6	4
22			19,200	Tipper/ Truck	160-200	5-6	4
23	Lal Chowk, Srinagar		48,000	Tipper/ Truck	160-200	5-6	3-4

Source: Site Visit

In Cluster 4, sand is mined by local bodies in Ali Abad, Athwajan, Lasjan, Soitang and Lal Chowk area of Srinagar. Volume of mined sand in Lal Chowk area is more than other areas in this cluster. In Lal Chowk, sand is being dredged by a Kolkata based company.

Mined sand is used mainly for local construction. Sand mining in these areas provides livelihood and easy money for locals. Mined sand is moved to the destination by roadways.

Figure 5-25 shows sand mining locations in Cluster 5. There are total 10 locations in this Cluster where sand is being mined.



**Figure Error! No text of specified style in document.-25 Mining Locations in Cluster 5**

The below table depicts sand mining areas in Cluster 5 along with their production volume.

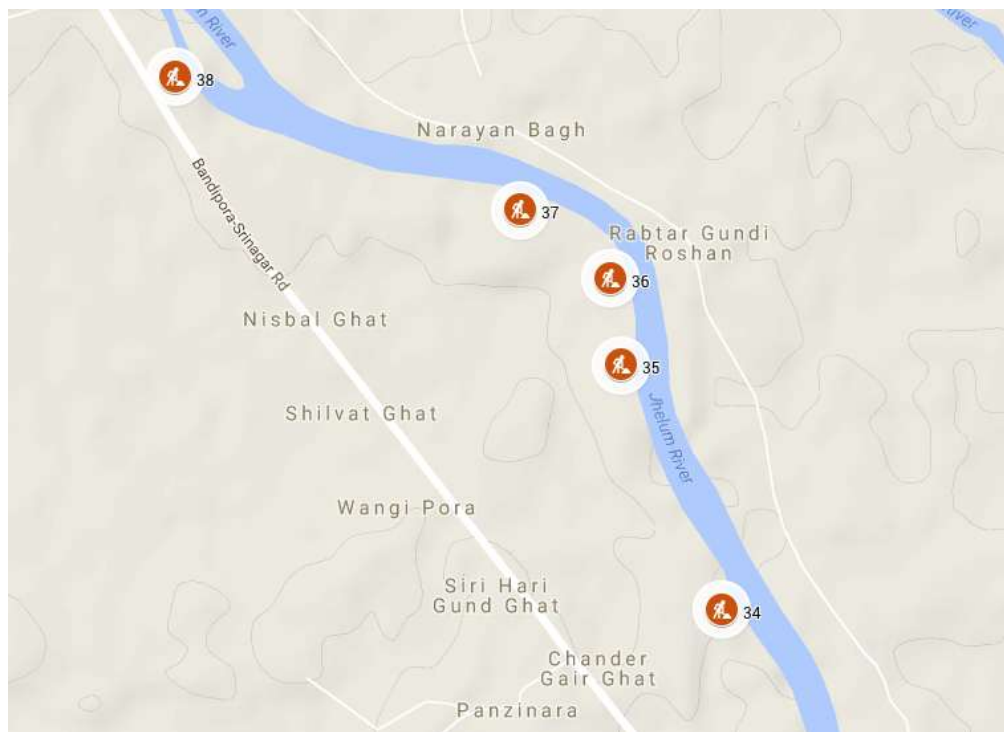
**Table 5-21 List of Mining Areas and volume produced in Cluster 5**

Sr. No	Area	Destination	Production Volume (ft/Month)	Vehicle used	INR/Truck	Boats (No.)
24	Rakh Muj Gund	Kashmir Valley	2,40,000	Tipper/Truck	5,000-6,000	50
25	Rakh Muj Gund		48,000	Tipper/Truck	5,000-6,000	10
26	Rakh Muj Gund		96,000	Tipper/Truck	5,000-6,000	20
27	Ranbirgarh Pratapgarh		24,000	Tipper/Truck	5,000-6,000	5
28	Ranbirgarh Pratapgarh		48,000	Tipper/Truck	5,000-6,000	10
29	Ranbirgarh Pratapgarh		9,600	Tipper/Truck	5,000-6,000	2
30	Ranbirgarh Pratapgarh		24,000	Tipper/Truck	5,000-6,000	5
31	Ranbirgarh Pratapgarh		24,000	Tipper/Truck	5,000-6,000	5
32	Ranbirgarh Pratapgarh		48,000	Tipper/Truck	5,000-6,000	10
33	Sarai Danger Pora		42,000	Tipper/Truck	5,000-6,000	10

As shown in the above table, major sand mining areas in Cluster 5 are located in Ranbirgarh Pratapgarh and Rakh Muj Gund. Other sand mining area is Sarai Danger Pora, which produces 42,000 ft. sand per month. Area in Rakh Muj Gund produces highest volume of sand, i.e. 2,40,000 ft/month. Small wooden boats are used in every

location for extracting sand from the river. Maximum number of boats are used in Rakh Muj Gund. Extracted sand is loaded in tippers/ trucks for distribution in different parts of Kashmir Valley. Capacity of each tipper/ truck is 160-200 ft. Transportation cost of each truck is INR 5,000-6,000. Mined sand from these areas are consumed in different parts of Kashmir valley. Sand is mostly used as construction material and is used in construction sites in Kashmir Valley.

Figure 5-26 shows sand mining locations in Cluster 6. There are total 5 areas in this Cluster where sand is being mined.



**Figure 5-26 Mining Locations in Cluster 6**

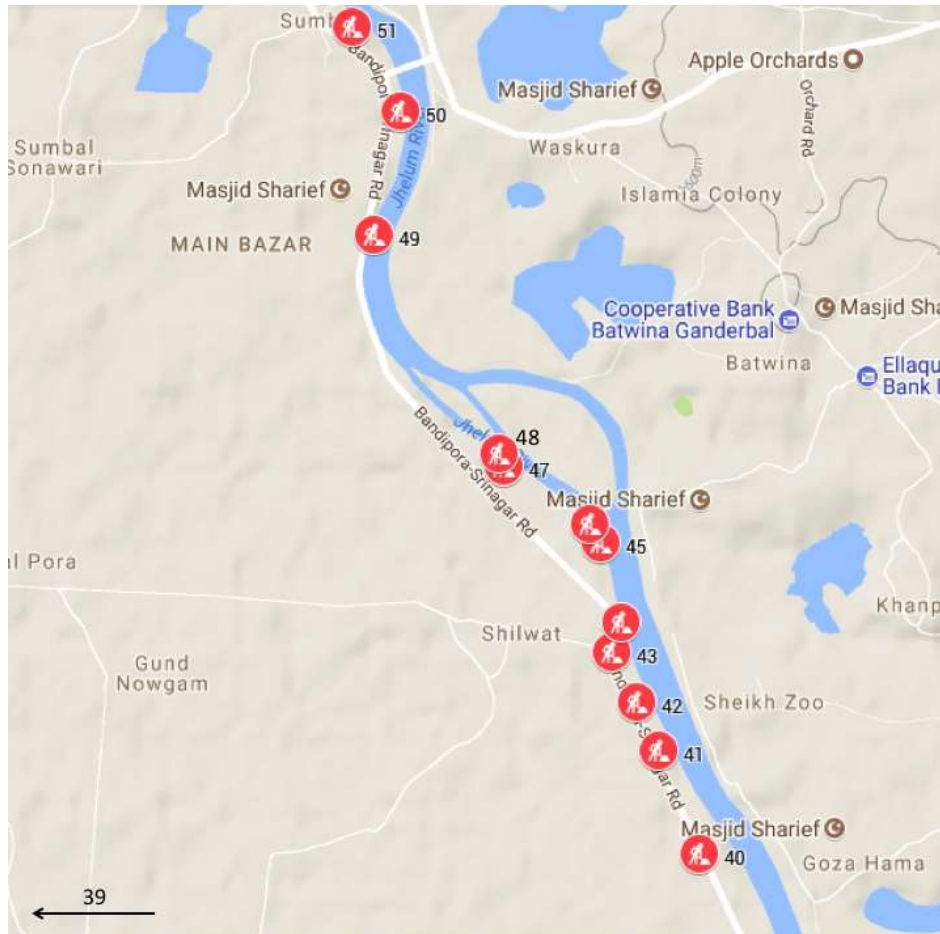
The below table depicts sand mining areas in Cluster 6 along with their production volume.

**Table 5-22 List of Mining Areas and volume produced in Cluster 6**

Sr. No	Area	Destination	Production Volume (ft/Month)	Vehicle used	INR/Truck	Boats (No.)
34	Chander Gair Ghat	Kashmir Valley	24,000	Tipper/Truck	5,000-6,000	5
35	Shilvat Ghat		33,600	Tipper/Truck	5,000-6,000	7
36	Nisbal Ghat		48,000	Tipper/Truck	5,000-6,000	10
37	Nisbal Ghat		96,000	Tipper/Truck	5,000-6,000	20
38	Chander Ghair Ghat		24,000	Tipper/Truck	5,000-6,000	5

As shown in the above table, major sand mining areas in Cluster 6 are located in Chander Gair Ghat, Nisbal Ghat and Shilvat Ghat. Area in Nisbal Ghat produces

highest volume of sand, i.e. 1,44,000 ft/month. Boats are used in every location for extracting sand from the river. Maximum number of boats are used in Nisbal Ghat. Tipper/trucks are used for distribution of extracted sand in different parts of Kashmir Valley. Transportation cost of each truck is INR 5,000-6,000. Mined Sand is mostly used in construction sites in different parts of Kashmir Valley. Locals are mostly involved in sand mining in all the clusters. Sand mining is a lucrative business and is the source of livelihood of locals



**Figure 5-27 Mining Locations in Cluster 7**

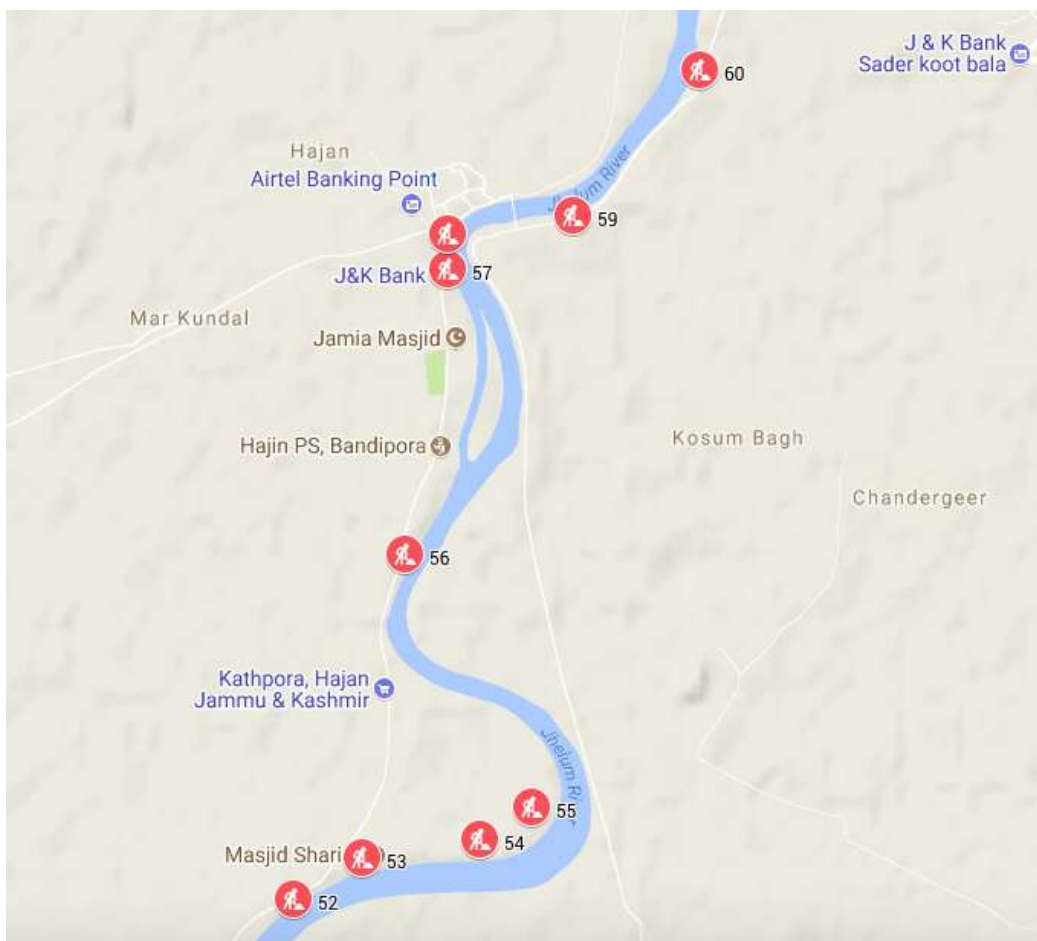
The below table depicts sand mining areas in Cluster 7 along with their production volume.

**Table 5-23 List of Mining Areas and volume produced in Cluster 7**

Sr. No	Area	Destination	Production Volume (ft/Month)	Vehicle used	INR/Truck	Boats (No.)
40	Imam Bada, Sumbal	Kashmir Valley	19,200	Tipper/Truck	5,000-6,000	4
41	Baba Jengi		9,600	Tipper/Truck	5,000-6,000	2
42	Baba Jengi		48,000	Tipper/Truck	5,000-6,000	10
43	Baba Jengi		1,44,000	Tipper/Truck	5,000-6,000	30

Sr. No	Area	Destination	Production Volume (ft/Month)	Vehicle used	INR/Truck	Boats (No.)
44	Baba Jengi		96,000	Tipper/Truck	5,000-6,000	20
45	Baba Jengi		19,200	Tipper/Truck	5,000-6,000	4
46	Baba Jengi		19,200	Tipper/Truck	5,000-6,000	4
47	Baba Jengi		9,600	Tipper/Truck	5,000-6,000	2
48	Baba Jengi		96,000	Tipper/Truck	5,000-6,000	20
49	Wangipora Bala Graveyard		48,000	Tipper/Truck	5,000-6,000	10
50	Sumbal		48,000	Tipper/Truck	5,000-6,000	10
51	Sumbal		48,000	Tipper/Truck	5,000-6,000	10

As shown in the above table, major sand mining in Cluster 7 takes place in Baba Jengi. There are 8 different locations of sand mining in Baba Jengi. Other places of sand mining are located in Sumbal and Wangipora Bala Graveyard. In Cluster 7, highest volume of sand is extracted from areas in Baba Jengi. In this cluster, maximum number of boats are used in Baba Jengi for sand extraction from the river. Sumbal also produces high volume of sand. Most of the mining happens near Sumbal Bridge



**Figure 5-28 Mining Locations in Cluster 8**

The below table depicts sand mining areas in Cluster 8 along with their production volume.

**Table 5-24 List of Mining Areas and volume produced in Cluster 8**

Sr. No	Area	Destination	Production Volume (ft/Month)	Vehicle used	INR/Truck	Boats (No.)
52	Gund Bun	Kashmir Valley	48,000	Tipper/Truck	5,000-6,000	10
53	Masjid Sharief		38,400	Tipper/Truck	5,000-6,000	8
54	Kath Pora		48,000	Tipper/Truck	5,000-6,000	10
55	Kath Pora		19,200	Tipper/Truck	5,000-6,000	4
56	Bandipora		19,200	Tipper/Truck	5,000-6,000	4
57	J&K Bank, Hajin		9,600	Tipper/Truck	5,000-6,000	2
58	Dangar Mohalla, Hajin		28,800	Tipper/Truck	5,000-6,000	6
59	Rakh Hajin		19,200	Tipper/Truck	5,000-6,000	4
60	Rakh Hajin		19,200	Tipper/Truck	5,000-6,000	4

As shown in the above table, major sand mining in Cluster 8 takes place in different areas of Hajin. These areas are J&K Bank, Dangar Mohalla and Rakh Hajin. Other places of sand mining are located in Gund Bun, Masjid Sharief, Kath Pora and Bandipora. In Cluster 8, highest volume of sand is extracted from areas in Hajin. Volume of extracted sand from four different locations in Hajin is 76,800 ft/month. Like other clusters, sand mining in Cluster 8 is done by using small wooden boats and then loaded in tippers or trucks for transportation. Transportation cost of each tipper/truck is same in all the clusters. Mined sand from Cluster 8 is distributed in different parts of Kashmir Valley for construction purpose.

**Table 5-25 Historic Volume of Sand Extraction from River Jhelum, Srinagar**

	Units	2013-14	2014-15	2015-16
Production	MT	27,524	15,171	12,565
Royalty	INR	4,67,906	2,57,910	2,13,605

The below table shows historic volume of extracted sand from river Jhelum and its tributaries near Baramulla.

**Table 5-26 Historic Volume of Sand Extraction from River Jhelum, Baramulla**

	Units	2013-14	2014-15	2015-16
Production	MT	52,990	40,898	35,201
Royalty	INR	9,00,830	6,95,266	6,36,542

The above table shows historic volume of extracted sand from river Jhelum and its tributaries near Srinagar. The table depicts that in 2013-14 sand was being mined in larger volume compared to next years, i.e. 2014-15 and 2015-16. The volume decreased in these years due to ban on sand mining in river Jhelum.

In 2014, there was a massive flood in Kashmir region, which had destroyed many infrastructures. After the flood, for reconstruction and rehabilitation, demand of sand increased. Increase in demand led to increase in mining in many areas in river Jhelum. Due to excessive sand mining, there was siltation problem in river Jhelum. To stop siltation and to protect the river, the Government later banned sand mining in the areas around river Jhelum. Despite the ban, sand mining from the riverbed continue illegally. Royalty from these illegal mining is not captured, hence not included in the below tables.

### 5.6.3 Stone Mining

Stone mining is done from hills around river Jhelum. In entire Kashmir region, stone mining takes place in many areas, but for the study we have considered only those places which are observed during site visit. During site visit, stone mining was observed in different places around the river. For better understanding, these areas are grouped in two clusters, Cluster 9 and Cluster 10. Stone mining is done by local bodies. Local people are involved in mining activities for livelihood. Like sand mining, stone mining also provides them opportunity to earn easy money. The below images show mining locations in different parts around river Jhelum.

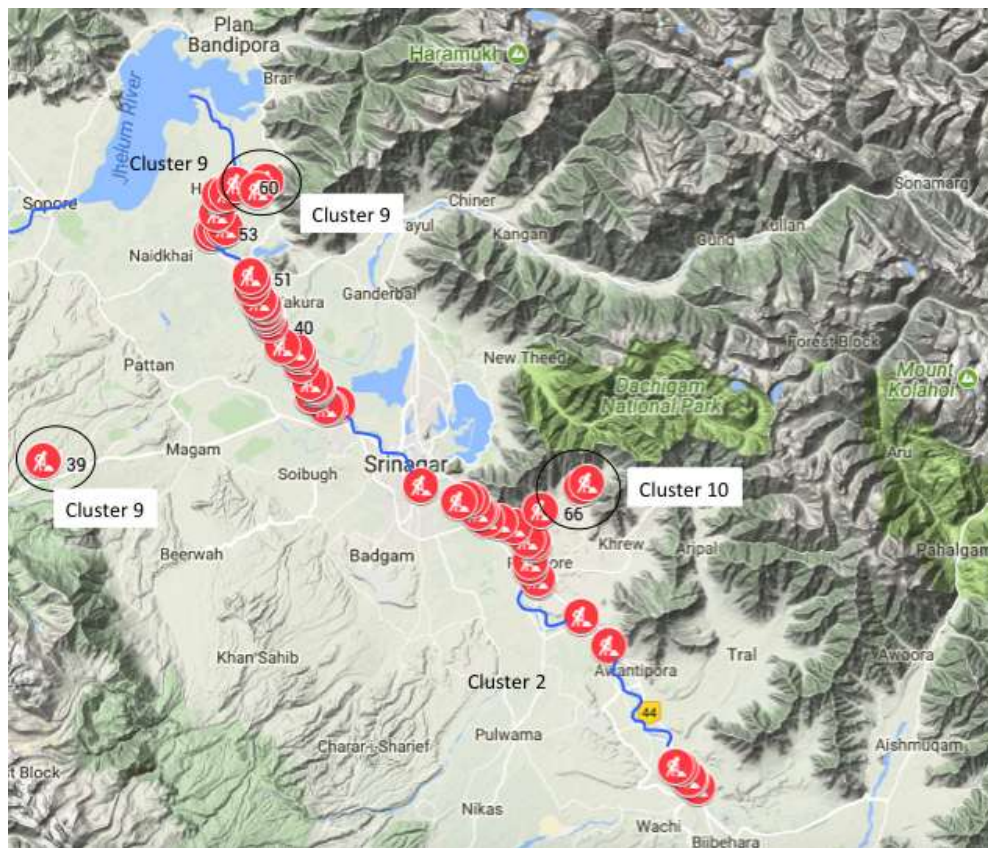
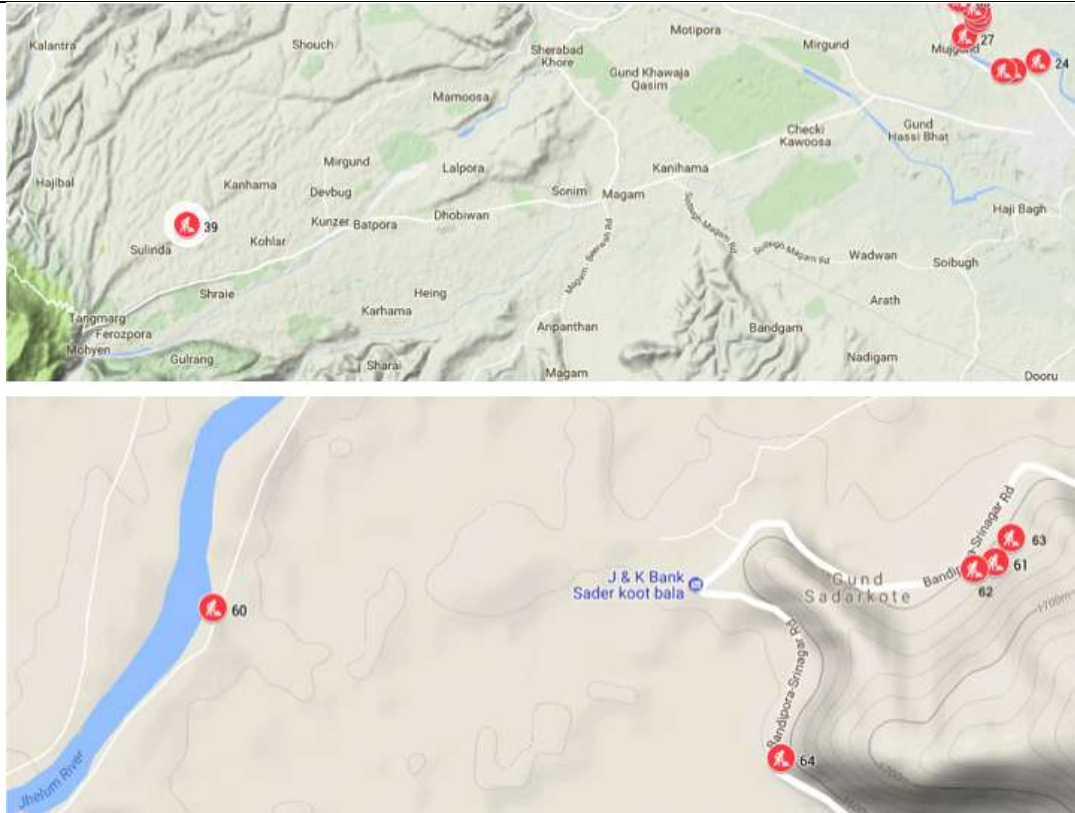


Figure 5-29 Stone mining areas in the hinterland



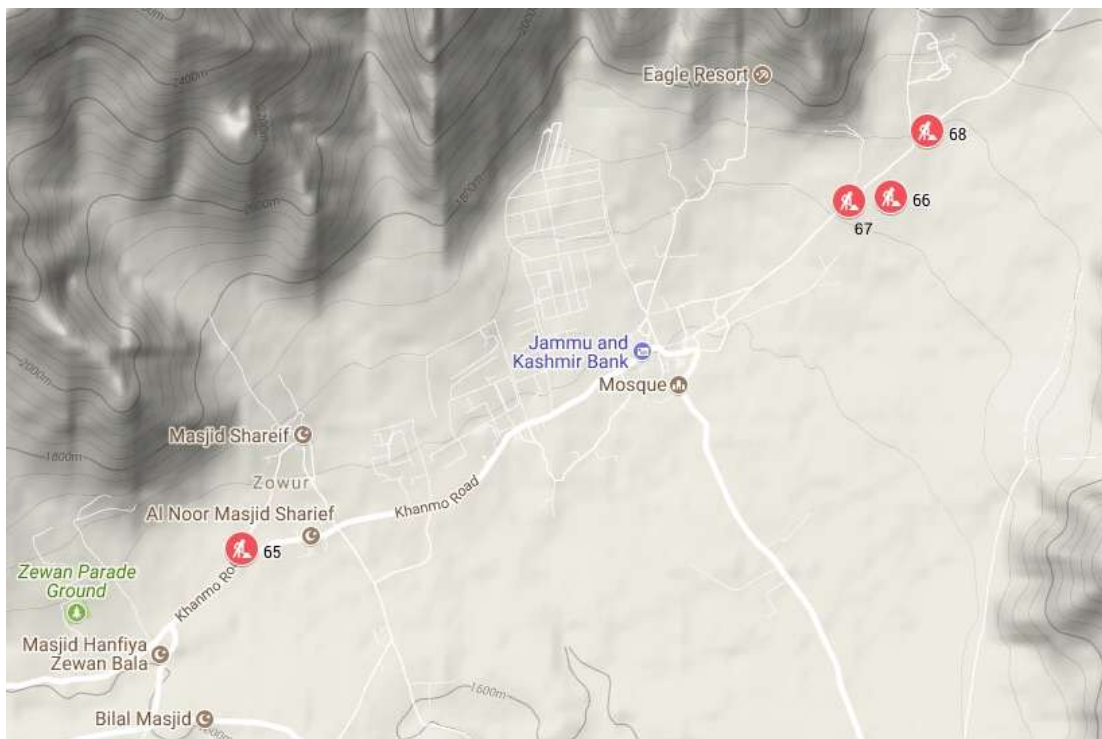
**Figure 5-30 Mining Locations in Cluster 9**

The below table depicts stone mining areas in Cluster 9 along with their production volume.

**Table 5-27 List of Stone Mining Areas and volume produced in Cluster 9**

Sr. No	Area	Destination	Production Volume (ft/Month)	Vehicle used	INR/Truck	Machines Used for extraction (No.)
39	Gul Badan	Kashmir Valley	1,200	Tipper/Truck	3,000-14,000	3
61			800	Tipper/Truck	3,000-14,000	2
62	Gund Sadarkote		1,600	Tipper/Truck	3,000-14,000	4
63			1,600	Tipper/Truck	3,000-14,000	4
64	Chew		3,200	Tipper/Truck	3,000-14,000	8

The above table shows that major stone mining areas in Cluster 9 are located in Gul Badan, Gund Sadarkote and Chew. Heavy machines, like JC are used for stone extraction. There are three locations under Gund Sadarkote, where stone mining takes place. These three areas in Gund Sadarkote, collectively produce highest volume of stone in Cluster 9, i.e. 4,000 ft/month. Mined stones are loaded into 100 ft trucks or tippers for transportation to different parts of Kashmir Valley. Mined stone is mostly used in construction sites. It is transported by roadways and distributed in entire Kashmir Valley for local construction. Transportation cost of each truck varies based on distance of destination. Transportation cost of each truck is INR 3,000-14,000.



**Figure 5-31 Mining Locations in Cluster 10**

The below table depicts stone mining areas in Cluster 10 along with their production volume

**Table 5-28 List of Stone Mining Areas and volume produced in Cluster 10**

Sr. No	Area	Destination	Production Volume (ft/Month)	Vehicle used	INR/Truck	Machines Used for extraction (No.)
65	Zowur	Kashmir Valley	1,600	Tipper/Truck	3,000-14,000	4
66	Near Khanmo Ridge		3,200	Tipper/Truck	3,000-14,000	8
67			1,600	Tipper/Truck	3,000-14,000	4
68			1,600	Tipper/Truck	3,000-14,000	4

As shown in the above table, major stone mining areas in Cluster 10 are located in Zowur and near Khanmo Ridge. There are three locations near Khanmo Ridge, where stone mining takes place. These three areas collectively produce stone 6,400 ft/month. Like, cluster 9, machines are used for sand mining in these areas of cluster 10. Tipper/ trucks are used for distribution of extracted stone in different parts of Kashmir Valley. Transportation cost of each truck is between INR 3,000-14,000.

#### 5.6.4 Minor Minerals

Apart from Sand and Stone, Minor Minerals are also mined from and around River Jhelum. The table below shows the volume of minor minerals extracted from Jhelum in last 3 years i.e FY15 to FY17.

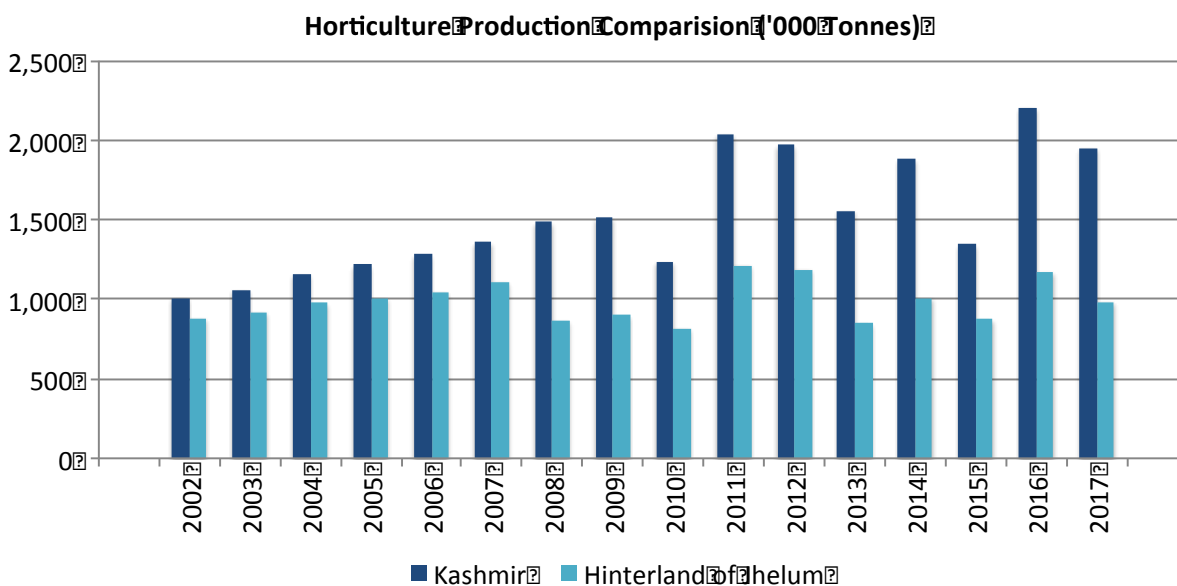
**Table 5-29 Minor Minerals Extracted from River Jhelum and its Tributaries**

Minor Mineral	2014-15	2015-16	2016-17
Sand	172,501.4	108,092.0	66,155.0
Crusher Boulder	65,991.7	72,267.0	62,202.6
Nallah Mukh	3,426.0	6,437.8	1,898.0
Brick Earth	70,159.0	142,365.0	83,452.8
Clay	38,135.0	3,382.5	485.0

All the above listed minerals are mostly used for construction purpose only by residents of Kashmir Valley. As per the historical data, the volume extracted from river is very less. Presently, extracted materials are transported by roadways using trucks and tippers to the entire valley. Diversion of this transportation from roadways to waterways would not be available because of less volume. Hence, no opportunity exists from minor minerals for water transportation on River Jhelum.

### 5.6.5 Horticulture

Horticulture is one of the primary agricultural produce in Jammu and Kashmir. Horticulture constitutes close to 2 million tonnes of annual production in Kashmir Valley. Of this, around 50% of the total production in Kashmir Valley is contributed from cities/districts located in the hinterland of River Jhelum. Figure 5-3232 shows the comparison of Horticulture production in hinterland with Kashmir.

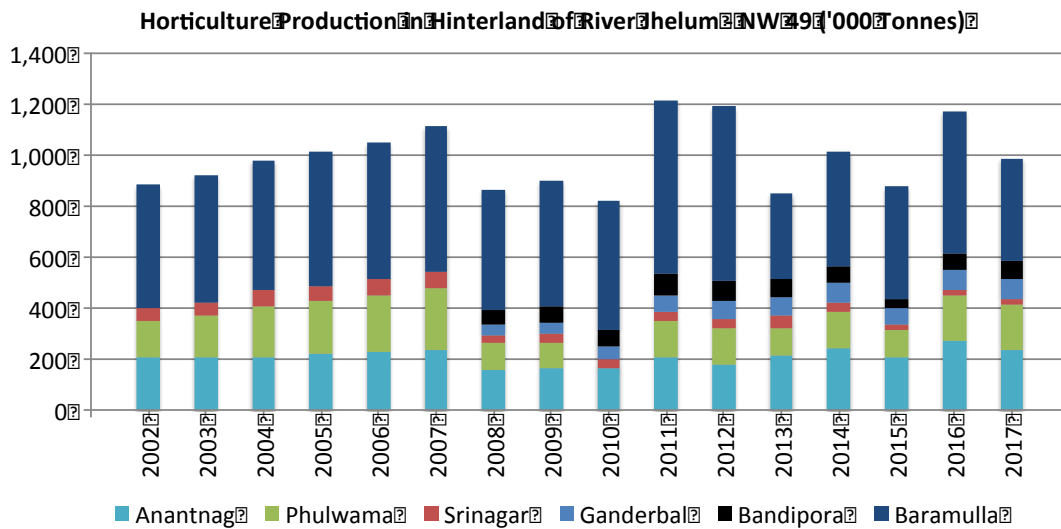


**Figure 5-32 Comparison of Horticulture Production in Hinterland with Kashmir**

Source: Directorate of Horticulture, J&K

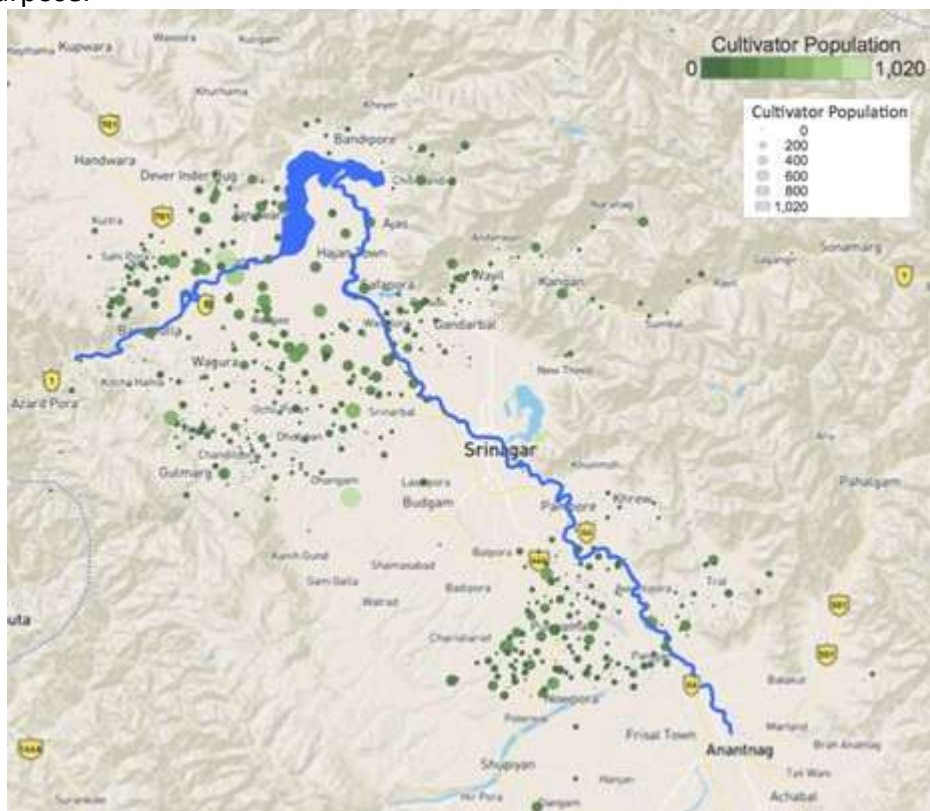
Last 15 years statistics shows stagnating production of horticulture in cities located in the hinterland of River Jhelum. The production has increased in other parts of Kashmir. In the year 2002 the districts falling in the hinterland of River Jhelum constituted close to 90% of horticulture produce of the Kashmir Valley. However, in the span of 15 years the

production in Kashmir valley has increased to 2 million tonnes with hinterland of Jhelum constituting 50% of the total production. Last six years has witnessed an average production of horticulture in Kashmir Valley including hinterland of Jhelum.



**Figure 5-33 Horticulture Production in Hinterland of River Jhelum (NW-49)**  
Source: Directorate of Horticulture, J&K

Horticulture Department of Kashmir have build infrastructure like various types of mandis and Markets. These Mandies are the places where farmers come with their cultivation for selling purpose.



**Figure 5-34 Mapping of Horticulture Cultivation - Hinterland of Jhelum**

**Table 5-30 List of Mandis in the hinterland of River Jhelum**

District	Location	Type of Market	Status	Distance from River (Km)
Anantnag	Jablipora	Terminal	Under Development	6
Pulwama	Pulwama Pachhar	Satellite	Functional	21
Srinagar	Parimpora	Terminal	Functional	3
Ganderbal	Zazna Ganderbal	Satellite	Under Development	3
Baramulla	Sopore	Terminal	Functional	2
	Baramulla	Satellite	Under Development	2

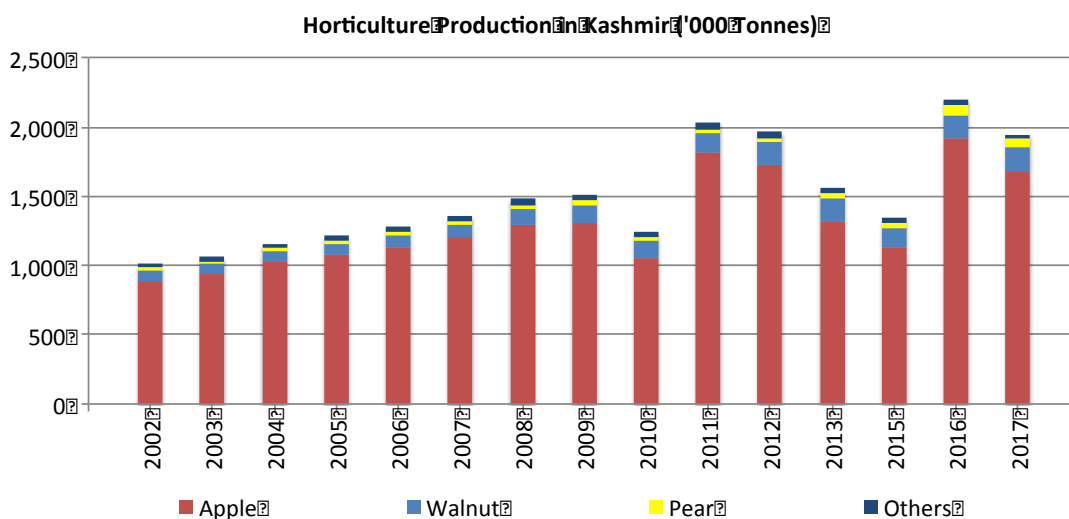
Source: Govt. of J&K, Horticulture Department

In Kashmir, there are total 16 mandis (3 terminal, 11 Satellite and 2 APNI) for fruits and vegetables, out of which 8 (1 terminal, 5 Statellite and 2 APNI) are under development while others are fully functional. The table above shows the mandis located within the hinterland of Jhelum river.

### 5.6.6 Commodity wise production (Fruits & Dry Fruits)

Apple and Walnut are 2 prominent horticulture products from Kashmir, followed by Pear. Together they constitute about 98% of the total produced averaged over last 15 years. Rest 2% of the produce is contributed by several other products categorized as others. The other horticulture products of Kashmir include Plum, Apricot, Peach, Almond, Cherry, etc. The total cumulative annual volume of other product is around 34,000 tonnes.

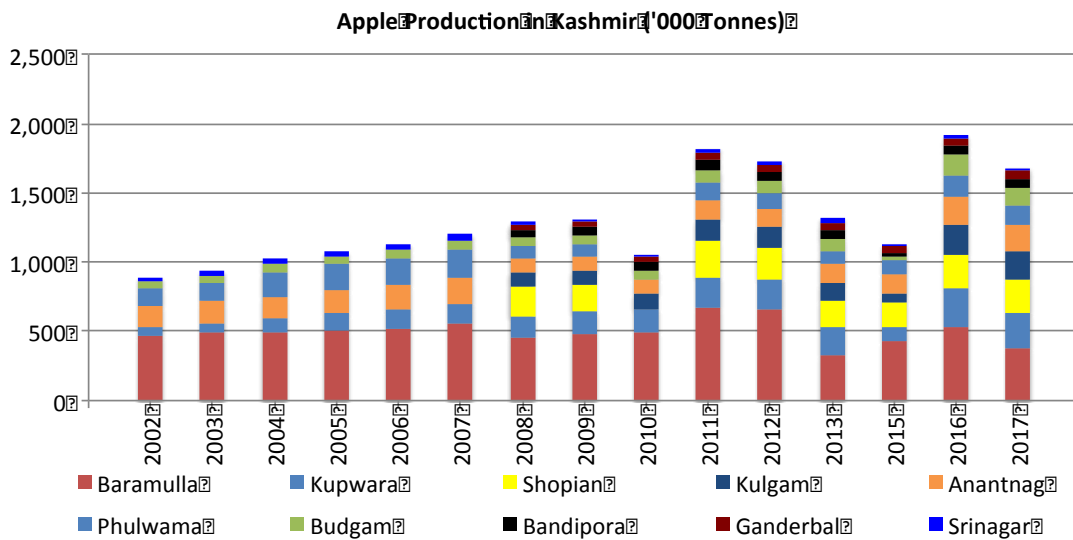
The primary focus of transporting horticulture produce using River Jhelum has been focused on Apples. Apples along constitute about 87% of the annual produce. The 15 years average volume of apple produced in Kashmir is about 1.3 million tonnes.



**Figure 5-35 Production of Main Products in Kashmir**

- Apple Production

India is 6th largest producer of Apple globally. Apple is cultivated almost across all regions of Kashmir valley with Baramulla and Shopian districts being the major producers. Apple is a non-climacteric fruit and requires extra care while transporting it to different markets.



**Figure 5-36 Apple Production in Kashmir Valley**

Kashmir contributes to more than 70% of Apple production in India followed by Himachal Pradesh 25% and 2% to 35 in Uttarakhand. Kashmir is estimated to account for more than 40% of Apple exported from India. It is one of the largest horticultural industries employing maximum people. It also has maximum area under cultivation in Kashmir. The prominent districts producing Apple in India constitute Baramulla including supore, Kulgaon, Anantnag, etc. Majority of Apples produced from Kashmir is transported to other parts of India using roadways. The distance to the consumption Centre from Kashmir is very high. This has led to deterioration in quality of quality of apples finally reaching its consumers. It takes around 40 hours for Kashmiri apples to reach Delhi and other cities of North India. The time taken is much more for Maharashtra and central India. The distribution of Kashmiri Apples to southern India has gradually reduced due to deterioration in quality linked to transportation problems and far of locations.

Allowing imported apples to be sold in Indian market is also one of the reasons for falling Kashmiri Apple sales in southern states of India. This has led to increase in conscious among industry for faster delivery of apples to the market.

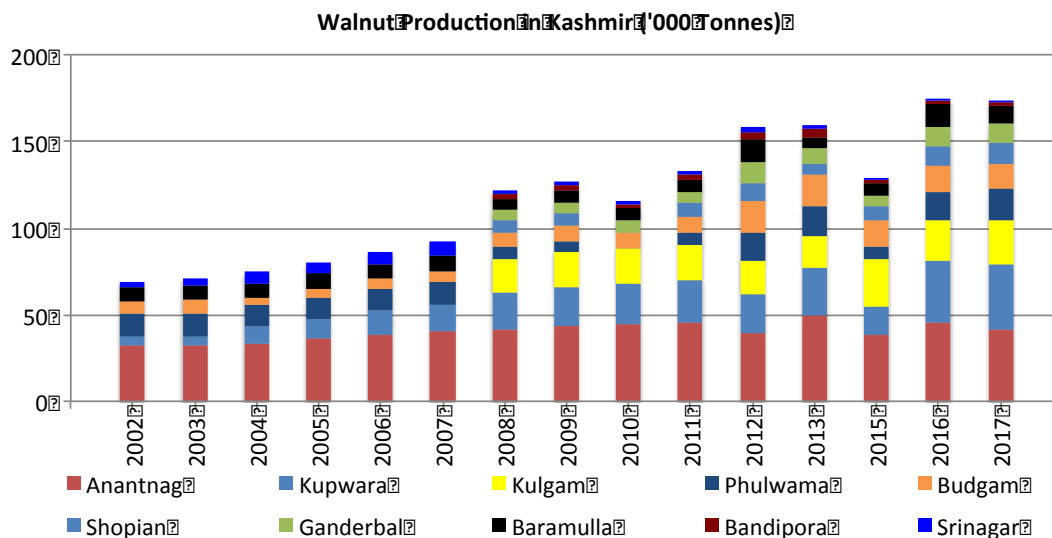
Planning transportation of Apples is very essential as that determines the final quality of Apple reaching the consumers. The apples are transported on un-refrigerated Trucks. Efforts are made by producers to ship apples as soon as they are ready to final destination. Any kind of political disturbances during harvesting season also impacts quality and eventually sales of Apple. This is primarily due to delay in product reaching market.

Several prominent apple growing areas are located on the hinterland of River Jhelum. Use of River Jhelum for transportation of apples would be of limited use. The Apples produced in orchards are packed and directly sent to other states by large producers. The smaller producer aggregate them in mandis and collectively sent them to market outside Kashmir.

River Jhelum does not fall in the route of trade to other states of India. Hence, there is no scope for transporting Apples destined for trade outside Kashmir using Jhelum.

- **Walnut Production**

Walnut is the 2nd largest horticulture produce after apple in Kashmir. It is also estimated to be the 2nd largest securement of horticulture with a value of INR 800 Crores. Walnuts, though high value specialised, product is handled in common mandis developed for other horticulture products. The share of walnut would be less than 5% of the total horticulture produce in Kashmir spread over 6 districts. Low volume of production along with high value of produce makes Walnut an unlikely choice for transportation using waterways.



**Figure 5-37 Walnut Production in Kashmir Valley**

Walnuts are rich in proteins, fats and minerals and are a concentrated source of energy. These contain a good amount of vitamin B group and are the richest in vitamin B6 among all the nuts. The major walnut growing countries are China, USA, Iran, Ukraine, Turkey and Mexico. India is the 7th largest producer of Walnuts globally. In India, walnuts are grown in Jammu & Kashmir, Arunachal Pradesh, Himachal Pradesh and Uttarakhand. Kashmir is the largest producer and supplier of Walnuts to whole of India. There has been imports of Walnuts from overseas in recent years. However, Kashmir contributes more than 90% of the production in India. Walnut is a high value nutritious eatable which could cost around INR 1,400/ kg to 1,600/kg. The lower quality walnuts could also be found in the range of INR 400/kg to INR 500/kg. Walnuts

is mostly grown districts of Anantnag, Shopian, Pulwama, Kupwara, Baramulla and Bandipora.

- Pear Production

Kashmir Valley’s soil and climate is suitable for pear cultivation. Pear is one of the most grown and traditional fruits of the valley. Kashmir Valley yields good produce of pear. Kashmiri pear have been favored and are produced in many varieties. Pears produced in the valley have gained a wide market and are being distributed to other parts of the country.

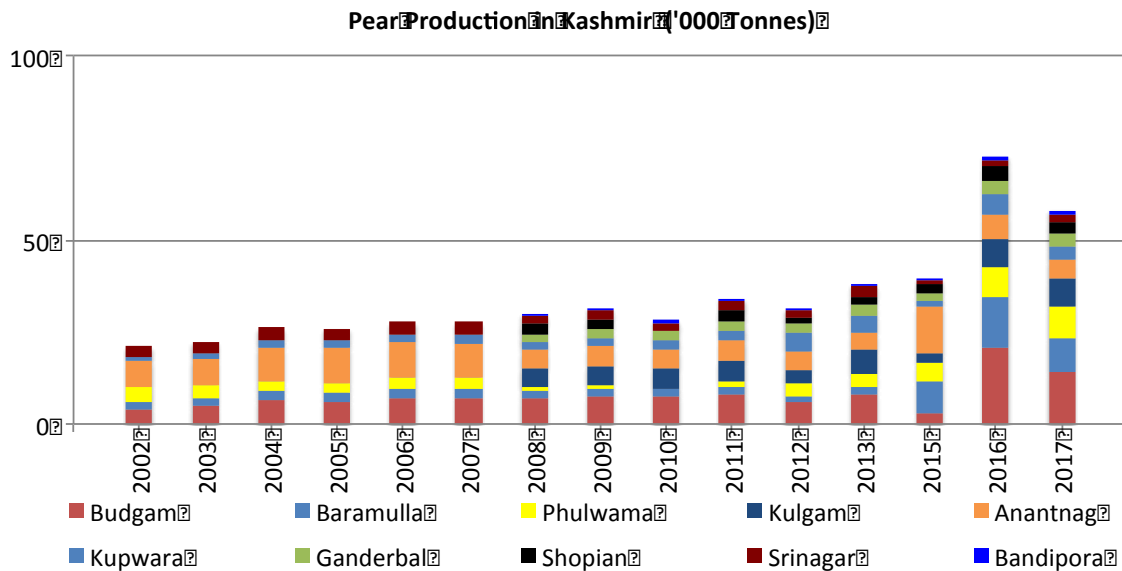


Figure 5-38 Pear Production in Kashmir Valley

- Other Fruits Production

Other fresh and dry fruits are also produced in Kashmir Valley. Their production volume is shown in Figure 5-39.

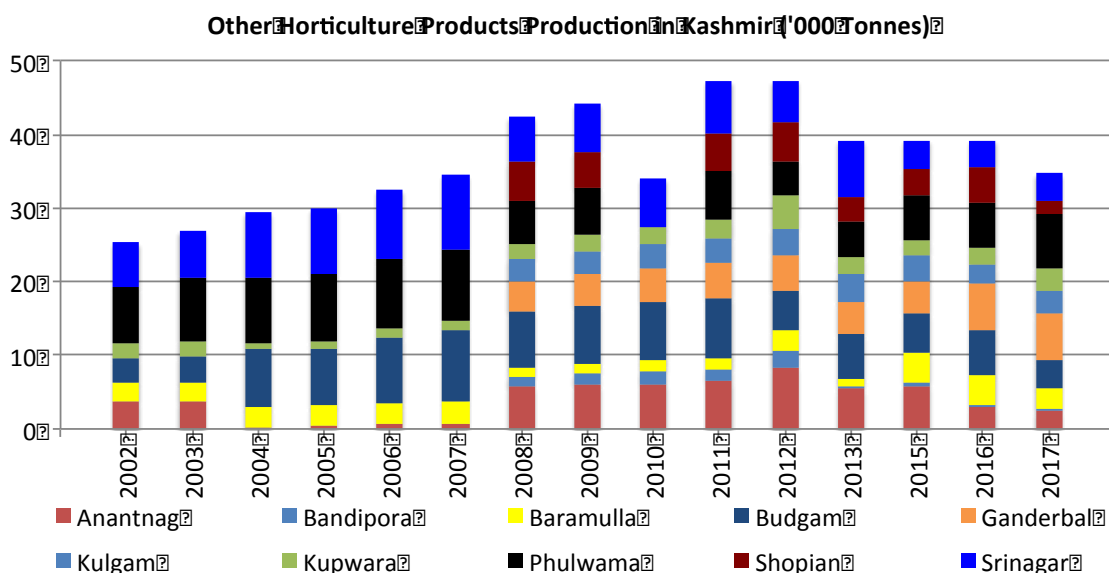
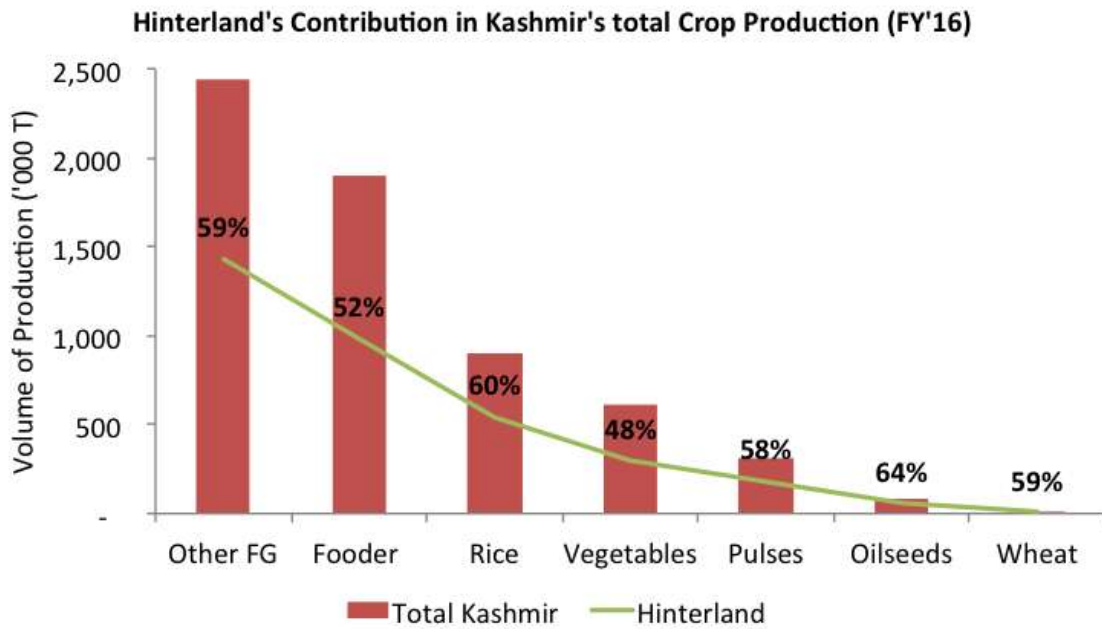


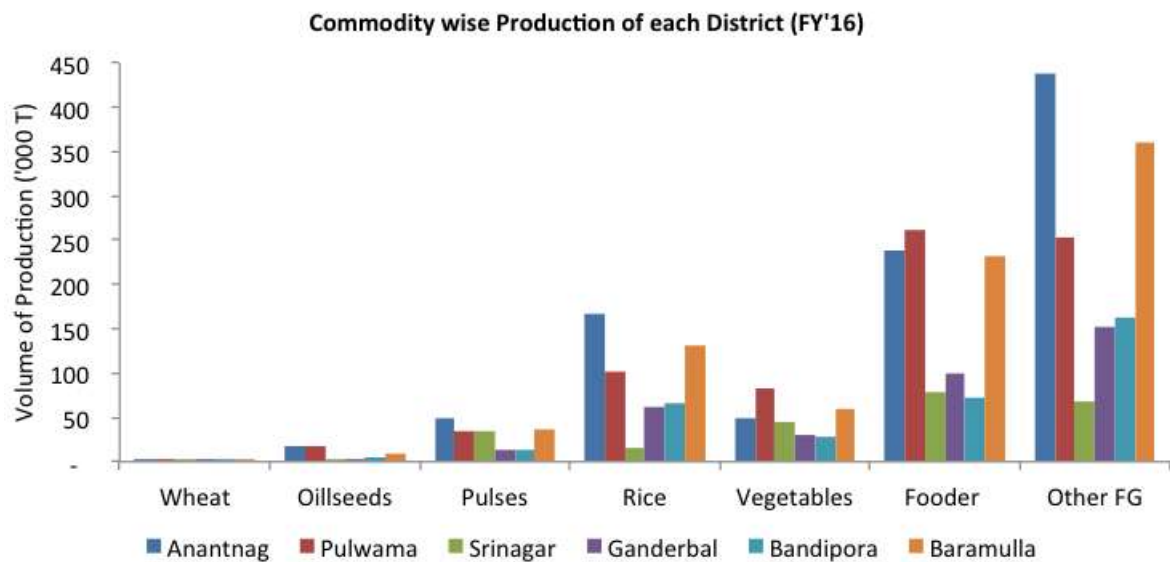
Figure 5-39 Other Fruits Production in Kashmir Valley

## 5.7 Agri Products



Source: FCI

**Figure 5-40 % share of hinterland in Kashmir's total Agricultural Production**



**Figure 5-41 Commodity wise crop production in the hinterland of River Jhelum**

## 5.8 Warehouse and Storage

There are warehouses and storage facilities in the hinterland of river Jhelum for storing food grains, fruits, vegetables, meats and other food items. Kashmir Valley produces fruits and dry fruits in abundance. Apple, pear, dry fruits etc. are transported to other states for national distribution. These fruits, especially apples are stored in cold storage to retain their quality. Apples stay best in modernised storage facilities, called controlled atmosphere units. The storage units in Baramulla, Anantnag and Pulwama have facilities to store apples, as shown in the below table. These cold storages ensure greater shelf life and also help to regulate apple prices.

Other seasonal fruits, which are not produced in the hinterland, like oranges, bananas, watermelon etc. are procured from different states in non-peak season, i.e. November- March. After procurement, these fruits are stored in cold storage for short time before getting distributed. Vegetables are also grown in the valley, but the production is mostly consumed locally.

The below table depicts locally produced food and types of processed food in the districts that fall in the hinterland of river Jhelum. In food grains, paddy, wheat and maize are produced in the hinterland. In dry fruit, walnut is produced majorly in Anantnag and Pulwama. There is no production of fruits and vegetables in Ganderbal district.

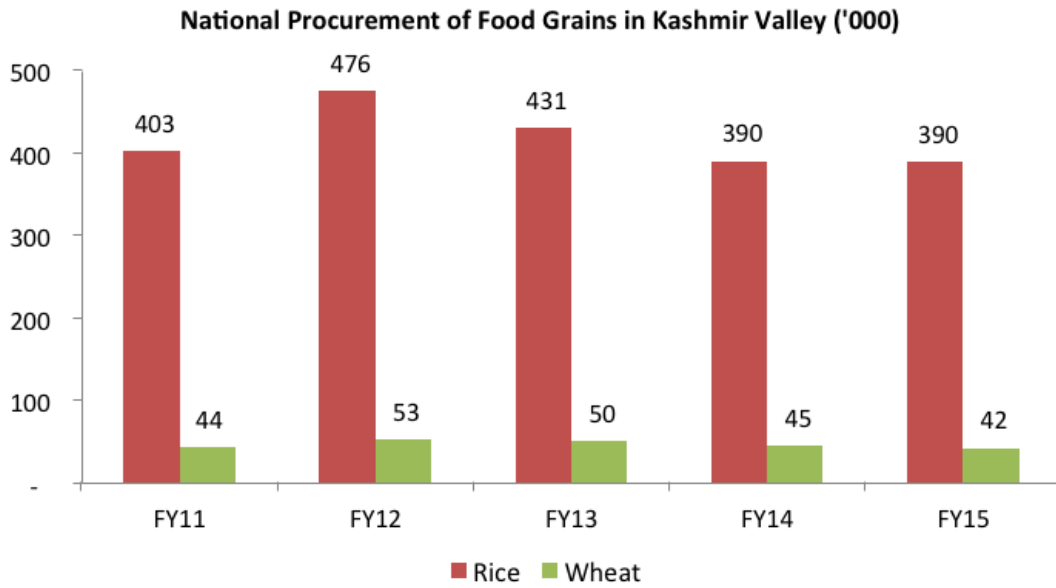
**Table 5-31 District wise production and processing clusters**

Districts	Food Production	Food Processing
Baramulla	Paddy, Pear, Apple, Meat, Eggs	Dry Fruits, Fruits and vegetables, Confectionary
Bandipora	Potato	-
Ganderbal	-	Beverages
Anantnag	Walnut, Wheat, Pear, Apple, Peas, Potato, Milk, Meat	Dairy Product, Dry Fruits, Cereals and cereal products, Spices, prepared Food
Pulwama	Walnut, Pear, Maize, Apple, Meat	Dry Fruits, Fruits and vegetables, Beverages
Srinagar	Maize, Meat	Dairy Products, Dry fruits, Fruits and vegetables, Confectionary, Cereals and cereal products, Spices, Beverages, Prepared Food

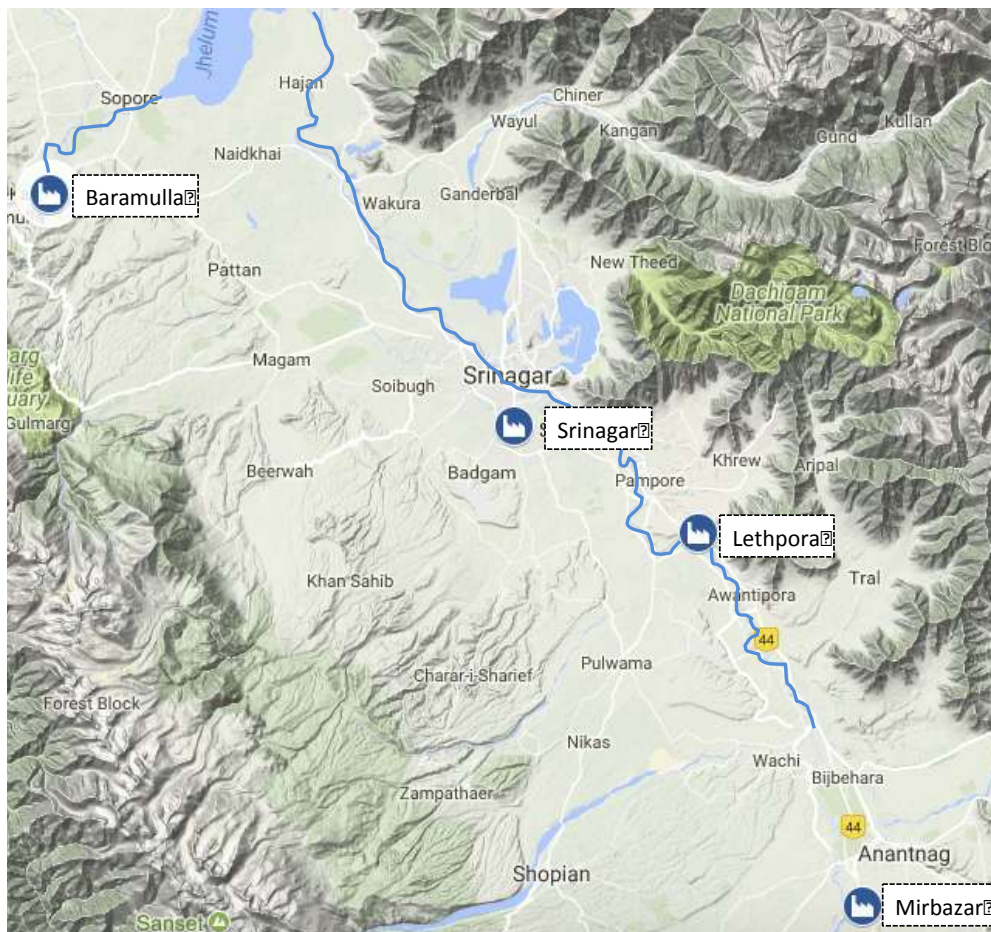
Source: Consultant's research

## 5.9 Food Corporate of India

The Food Corporation India is the nodal agency for transportation, storage and distribution of all prominent food products to Kashmir from other states of India. These products are stored in godowns of Food Corporation of India located in Anantnag, Srinagar, Pulwama and Baramulla. The products are transported from other states (mostly Punjab) in larger trucks. The stored products are distributed over various districts for consumption.



**Figure 5-42 National Procurement of Food Grains**



**Figure 5-43 Food Corporation of India Godowns in Kashmir Valley**

**Table 5-32 Capacity of FCI's Godowns in Kashmir Valley**

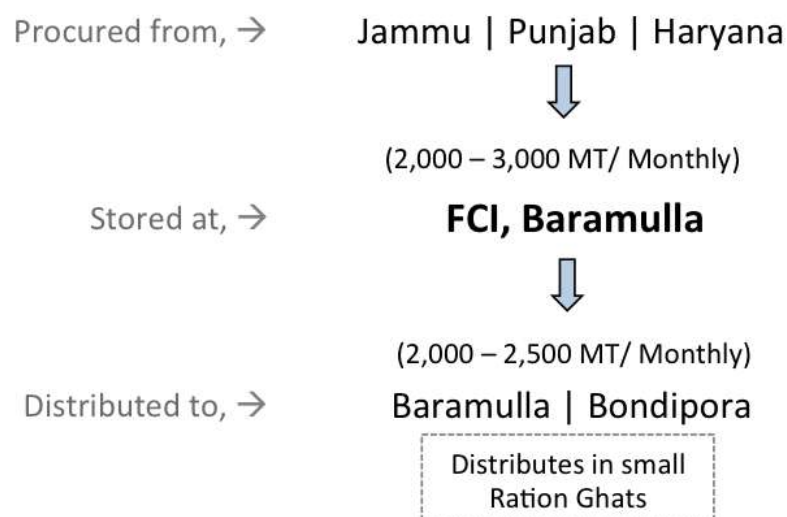
Sr. No	District	Depot	Storage Capacity (MT)		
			Owned	Hired/PEG	Total
1	Srinagar	Srinagar	8,330	-	8,330
		PEG Srinagar	-	17,500	17,500
3	Pulwama	Lethpora	-	10,000	10,000
4	Anantnag	Mirbazar	8,500	-	8,500
5	Baramulla	Baramulla	5,000	-	5,000

Source: Food Corporation of India

- FCI, Baramulla

FCI Baramulla undertakes procurement of wheat and rice for local consumption and distribution in other areas. This FCI procures food grains from Jammu, Punjab and Haryana. Around 2,000-3,000 MT food grains are procured on a monthly basis through roadways. 200-250 trucks transport food grains to Baramulla FCI from Jammu, Punjab and Haryana. Procurement is done mostly on peak season in winter, i.e. November, December and January. During winter season, there is no local production in the region and demand of food grains increases for local consumption; hence winter season is considered as peak season.

Procured food grains are distributed to Baramulla and Bandipora by trucks. Around 2,000-2,500 MT food grains are distributed on a monthly basis from FCI Baramulla. Food grain is distributed to Ration Ghats (government distribution centers in villages). Other than Baramulla and Bandipora, this FCI does not distribute to any other district. The below image shows procurement and distribution of food grains from FCI Baramulla.



**Figure 5-44 In-Out trade movement of FCI, Baramulla**

The major problem faced by FCI Baramulla is inadequate storage to meet growing demand. FCI Baramulla distributes food grains to Bondipura and Baramulla only. When FCI Baramulla's capacity gets exhausted and there is demand for food grains from other districts, like Kupwara and Handwara, FCI Baramulla struggles to meet this extra

demand. It doesnot have capacity for large storage. FCI godowns in Kupwara and Handwara are not sufficient to handle the local demand; hence they approach Baramulla to procure wheat and rice. To fuffill the demand of Kupwara and Handwara, FCI Baramulla sends those trucks directly to these districts, which transport procured food grains from Jammu, Punjab and Haryana. Instead of storing the procured food grains in FCI Baramulla, these trucks directly move to Kupwara and Handwara for food grain supply. Other problems faced by FCI Baramulla are frequent strikes and closure of roads in winter season.

Production of food grains in Kashmir is not sufficient to meet the local demand. Hence, the state procures food grains from other states. At present, roadway is used to procure food grain from Punjab and Haryana to Baramulla by covering distance of approx 650 km. After development of waterway, it is proposed that this roadway movement of food grains would be shifted partially to the waterway on river Jhelum. It is proposed that food grains from Punjab and Haryana would be transported to Sangam by roadways, covering a distance of approx 600 km and from Sangam food grains would be moved further via waterway till Baramulla, by covering a distance of approx 140 km. Use of proposed route, i.e. combination of roadway and waterway would take longer distance than the present route. The proposed route is approx 100 km longer than the present route. Shifting cargo from FCI Baramulla to proposed waterway from Sangam could be evaluated in later stage.

- FCI, Srinagar

Srinagar FCI is the major FCI in the hinterland and it administers other FCIs in the hinterland. Srinagar FCI decides Logistics Cost and other costs of FCIs located in the hinterland.

The below image shows FCI located in Srinagar. A representative of the consultant visited this FCI, but he was not granted permission to go inside the FCI and gather more information.



**Figure 5-45 FCI Godown of Srinagar**

- FCI, Lethpora

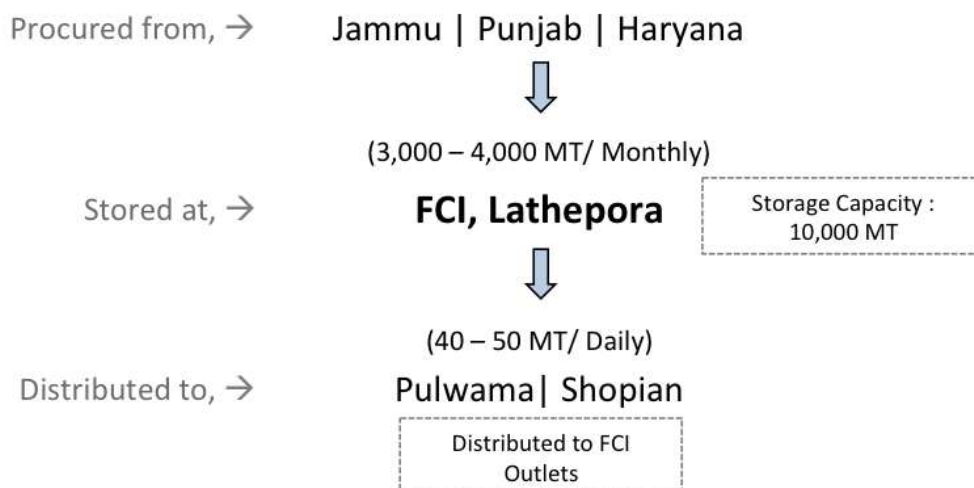
There is a FCI located in Lethpora of Pulwama district. Its storage capacity is 10,000 MT. FCI Lethpora undertakes procurement of wheat and rice for local consumption and distribution in other areas.



**Figure 5-46 FCI Godown of Lethpora, Pulwama**

This FCI procures food grain from Jammu, Punjab and Haryana. Around 3,000-4,000 MT food grains are procured on a monthly basis. Procurement is done through roadways. 250-300 trucks transport food grains to FCI Lethpora from Jammu, Punjab and Haryana. Procurement and distribution is mostly done on peak season in winter, i.e. November, December and January.

Procured food grains are distributed to Pulwama and Shopian districts by trucks. Volume of food grains for distribution varies as per demand, but around 40-50 MT food grains are distributed on a monthly basis from FCI Lethpora. Food grain is distributed to FCI outlets. Other than Pulwama and Shopian, this FCI does not distribute to any other district. The below image shows procurement and distribution of food grains from FCI Lethpora



**Figure 5-47 In-Out trade movement of FCI, Lethpora, Pulwama**

The major problem faced by FCI Lethpora is that roads remain closed during harsh winter season. Due to this obstacle, despite surplus storage in FCI, it could not distribute food grains in Pulwama and Shopian, which further causes shortage of food grains in these districts. Other problems faced by FCI Lethpora are frequent strikes which affect distribution.

At present, roadway is used to procure food grain from Punjab and Haryana to Lethpora by covering distance of approx 550 km. If this roadway movement of food grains is shifted partially to the waterway on river Jhelum, then food grains from Punjab and Haryana would be transported to Sangam first by roadways, covering a distance of approx 600 km and from Sangam food grains would be moved further via waterway till Lethpora, by covering a distance of approx 25 km. Use of proposed route, i.e. combination of roadway and waterway would take longer distance than the present route.

FCI Lethpora would not provide much opportunity to the proposed waterway. Waterway could be used only for internal distribution in Kashmir from FCI Lethpora. For procurement of food grains, waterway would not be commercially viable as Lethpora is very close to Sangam. If trucks from Jammu, Punjab and Haryana reach Sangam, then it would not be feasible to unload at Sangam and move food grains on waterway till Lethpora. Using waterway for such short distance would not only increase transportation cost but also increase transportation time.

### 5.10 Cold Storage

There are cold storages in the hinterland to store perishable items, like fruits, meat, dairy products etc. As shown in the below map, these cold storages are located in Nowpora, Sangrama, Rangreth and Lassipora.

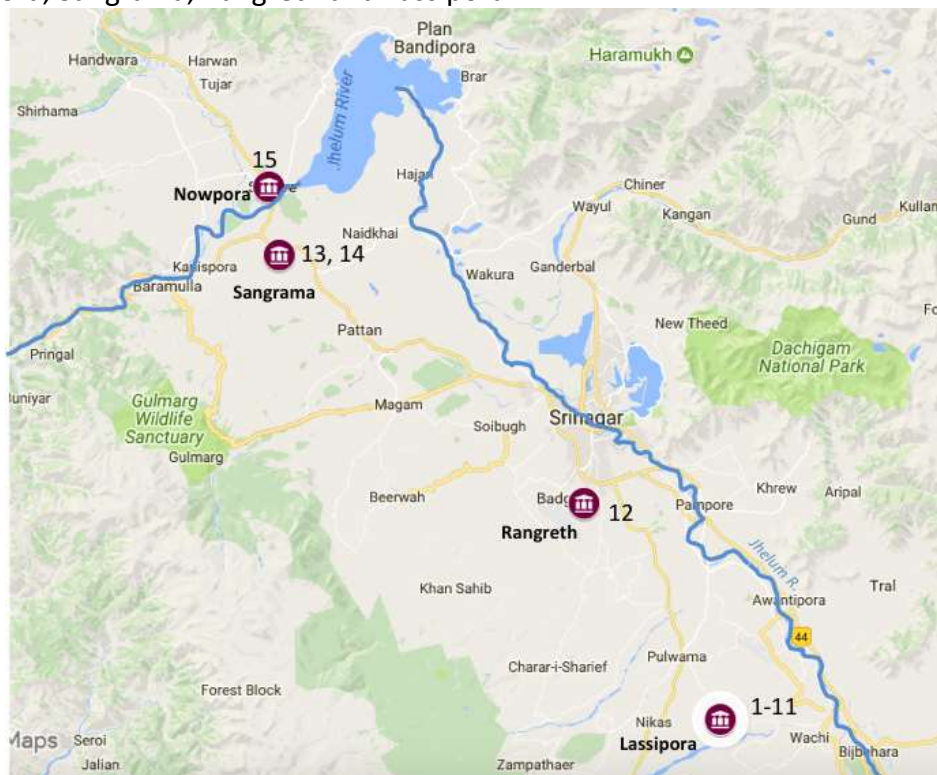


Figure 5-48 Mapping of Cold Storage in the hinterland of River Jhelum

The below table depicts cold storage facilities located in three districts, Pulwama, Srinagar and Baramulla. Majority of cold storage facilities are located in Pulwama. All these cold storages are located within 20 km distance from river Jhelum. These cold storages mostly store fruits and vegetables.

**Table 5-33 Cold Storage in the Hinterland of River Jhelum**

Sr. No	Storage name	Location	District	Capacity (MT)	Distance from Jhelum (KM)
1	Golden Apple Agro Fresh	I.G.C Lassipora	Pulwama	5,000	16.8
2	Fruit Master Agro Fresh	I.A. Lassipora		5,000	17.4
3	Harshna Naturals	I.A. Lassipora		5,200	17.4
4	M/s Kashmir Fruit Preservers	Lassipora		3,000	18.1
5	M/s Valley Fresh Cold Chain	I.G.C Lassipora		5,000	16.8
6	M/s Say Infra and Storage	Lassipora		3,000	18.1
7	Mir Agro Industries	I.G.C Lassipora		5,000	16.8
8	Snowdrop Tradecom	Lassipora		3,000	18.1
9	M/s Kehwah Square	I.G.C Lassipora		5,000	19.4
10	M/s Kashmir Premium Apples	I.G.C Lassipora		6,388	19.4
11	M/s Shaheen Agro Fresh	I.G.C Lassipora		6,000	16.8
12	Fill Industries	SIDCO, Rangreth	Srinagar	10,000	9.8
13	Kachroo Integrated Cold Chain	Sangrama, Sopore	Baramulla	2,000	9.5
14	Itfaq Integrated Cold Storage	Sangrama, Sopore		5,000	9.5
15	M/s Alpine Fresh	Nowpora, Sopore		3,000	13.7

Source: Consultant's Research

There are total 38 cold storages in the state of Jammu & Kashmir, with a total capacity of 1,12,516 MT as of 2017. Currently, out of these 38 cold storages, 15 major cold storages are located in the hinterland of Jhelum. These cold storages have a total capacity of 72,000 MT and are mainly owned by private companies.

As of 2016, Lassipora in Pulwama district has 52,000 MT of storage capacity. This storage capacity is not sufficient to meet the total requirement of 3,00,000 MT storage. To meet the growing demand, there is a need to upgrade and expand the existing cold storage facilities.

A Mega Food park is being promoted by RFK Greens at Lassipora village in Pulwama district with cold storage capacity of 2,000 MT. Another Food park is being established by J&K SIDCO at Sopore in Baramulla district, which will have 1,000 MT cold storage capacity.

### 5.11 Passenger Traffic

The passenger transportation on Jhelum could be evaluated for inter District movement of passengers as well as intra-district movement of passengers. All the 5 important districts with high population distribution is located in the hinterland of Jhelum. This section analyses prospects of passenger transportation on level Jhelum. **Error! Reference source not found.** describes the various prospects that has been evaluated for river transportation of passengers.

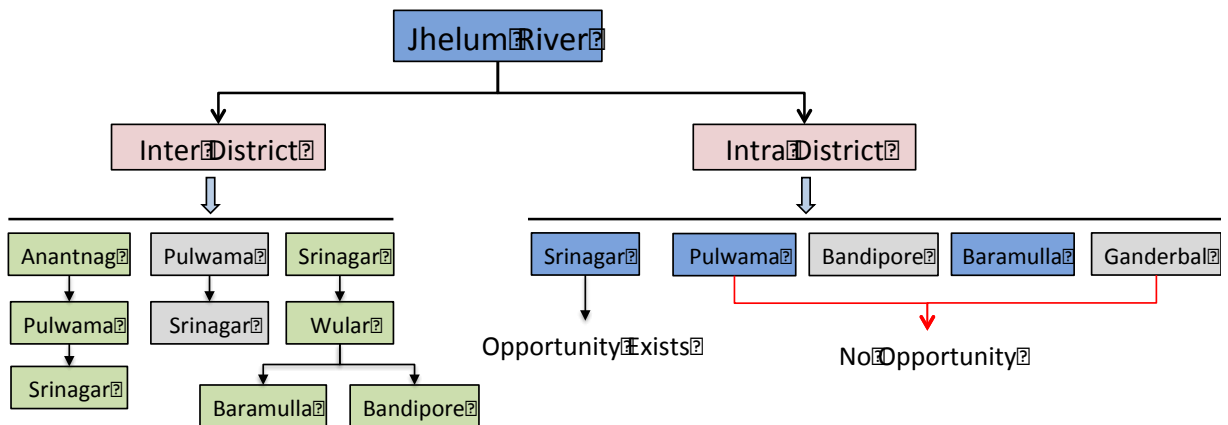


Figure 5-49 Prospects of Passenger Transportation on River Jhelum (NW-49)

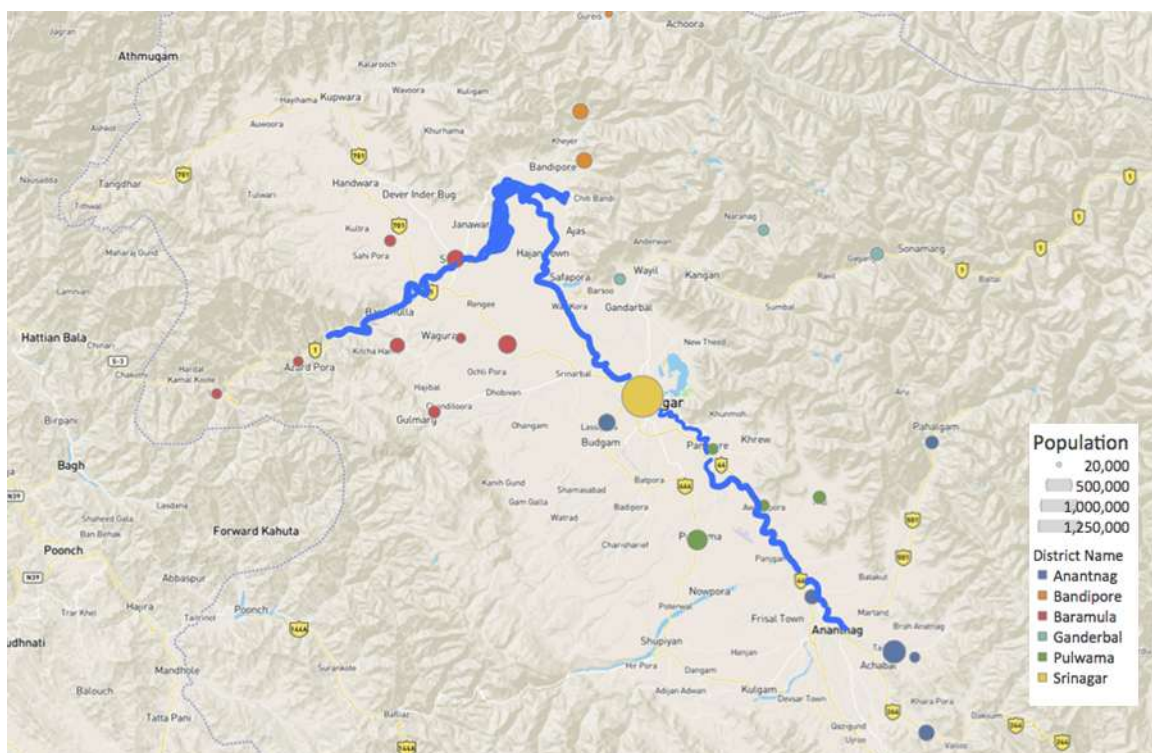


Figure 5-50 Taluka wise population in residing in the hinterland

**Table 5-34 Type of Population in residing in the hinterland**

District	Tehsil	Household	Population	Kids (0-6 age)	Workers		Non-Workers
					Main	Marginal	
Bandipora	Bandipora	28,360	1,77,738	30,109	29,653	33,030	84,946
	Gurez	5,026	37,992	6,085	9,638	6,312	15,957
	Hajan	15,370	1,08,036	15,779	22,298	20,773	49,186
	Sumbal	9,636	68,466	9,781	13,584	14,029	31,072
Baramulla	Baramulla	24,503	1,50,986	20,610	34,217	12,037	84,122
	Boniyar	11,131	67,494	12,815	8,026	9,894	36,759
	Gulmarg	77	1,965	-	1,962	-	3
	Kunzer	10,672	72,250	12,528	10,800	9,765	39,157
	Pattan	14,064	1,18,536	21,854	19,234	13,524	63,924
	Rafiabad	5,550	35,735	5,423	7,369	7,336	15,607
	Rohama	7,696	49,889	7,743	12,103	7,325	22,718
	Singhpora	10,289	78,897	14,894	12,626	10,052	41,325
	sopore	19,700	1,30,596	17,923	32,082	10,059	70,532
	Tangmarg	10,027	59,805	9,815	11,307	9,107	29,576
	Uri	12,890	79,937	15,794	14,495	10,393	39,255
	Wagura	14,276	86,013	11,996	13,463	8,868	51,686
	Zaingeer	15,270	99,511	15,990	16,900	8,964	57,657
Ganderbal	Ganderbal	12,159	77,944	12,924	14,662	15,478	34,880
	Kangan	17,046	1,11,700	21,219	14,117	17,123	59,241
	Lar	6,862	45,505	7,438	10,289	6,215	21,563
	Safa Pora	1,548	10,471	1,688	2,305	802	5,676
	Wail	1,429	8,335	1,559	967	1,698	4,111
	Wakura	9,294	62,297	9,013	13,881	9,125	30,278
Pulwama	Awantipora	1,083	12,647	1,910	5,280	1,516	3,941
	Kakapora	12,595	81,374	13,644	14,162	11,450	42,118
	Keller (Shadimarg)	11,522	74,341	17,048	10,598	11,012	35,683
	Khrew	1,343	9,851	1,686	2,168	2,793	3,204
	Pampore	12,714	82,293	12,417	16,475	13,573	39,828
	Pulwama	23,010	1,52,719	26,135	24,849	22,686	79,049
	Tral	23,974	1,47,215	24,534	24,774	27,084	70,823
Srinagar	Badami Bagh	3,324	22,214	1,799	11,001	1,123	8,291
	Ganderbal	1,316	9,654	1,107	2,891	1,265	4,391
	Khonmoh	216	2,664	170	1,660	215	619
	Lasjan	876	5,281	544	1,106	425	3,206
	Now Gam	420	2,490	299	687	123	1,381
	Srinagar	1,88,207	12,11,258	1,55,940	3,18,429	-2,29,093	6,62,191

## 5.12 Inter District

- Srinagar – Wular - Bandipora

Bandipora is one of the most prominent tourist location at Wular Lake. Wular Lake spread over 37 km<sup>2</sup> has calm and settled water, mesmerising view. There are Parks located around Wular Lake that becomes one of the prominent hangout point along with stopovers for photography by tourist. Road Transportation is the only mode to reach Wular lake. There is no rail connectivity, at present, to reach Bandipora or Wular Lake. The roads connecting Srinagar with Wular Lake, Bandipora is narrow. Development of water transport could work as an alternative means of connecting tourist arriving in Srinagar to Wular Lake. The Wular Development Authority have plans of restoring the vegetation and enhancing tourism infrastructure at the Wular lake. The Lake is surrounded by close in 30 villages housing more than 50,000 people. Fishing in wular lake is main source of revenue and livelihood for the local population in villages located around wular lake.

Developing water transport for passengers Jhelum connecting Srinagar with Wular Lake could act as an alternative transportation both for passengers as well as tourists. Tourists would find the water transport an alternative mode to reach Wular lake.

- Srinagar – Wular - Baramulla

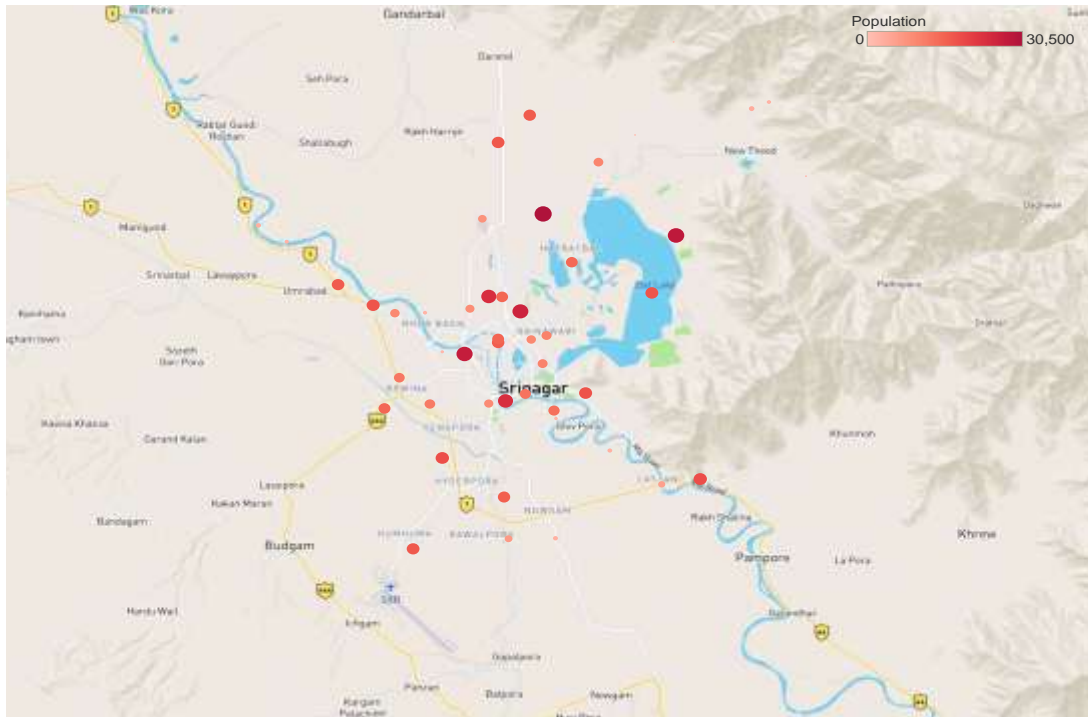
The Baramulla - Wular - Srinagar segment could be explored by the tourist of Kashmir Valley. Small ferry service would be operated between this route. Visitors of Gulmarg and other known tourist places of Baramulla would generate traffic for this route.

- Anantnag – Pulwama- Srinagar

The starting point of River Jhelum is close to Anantnag. Anantnag does not have large tourist attraction. Some of tourism facilities and locations are far away from Jhelum located in Anantnag. The nearest tourist location is about 25 km from Jhelum in Anantnag. Hence there may not be any direct opportunity for developing tourism transportation between Srinagar to Anantnag. However, there could be one possible scope to modal shift passengers going to Anantnag to waterways. Anantnag is presently connected by both Railways and roadways. The transportation cost to reach Anantnag is minimal using the railways. It cost around INR 15 is to reach Anantnag from Nowgam station by railways, Around ₹35 to reach Anantnag from Pantha Chowk, Srinagar by using roadways by bus. A passenger wanting a faster transportation would have to pay around INR 90/- to take shared smaller vehicle such as Sumo, etc. The competitive price offered by road and railways would make it challenging for waterways to compete.

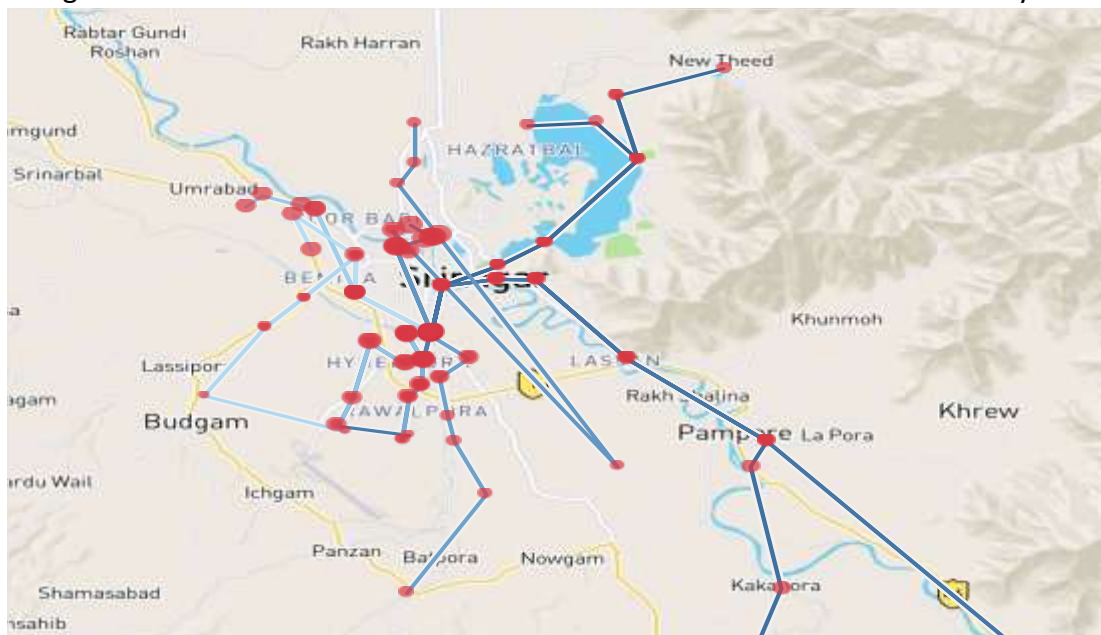
### 5.13 Intra District

- Srinagar

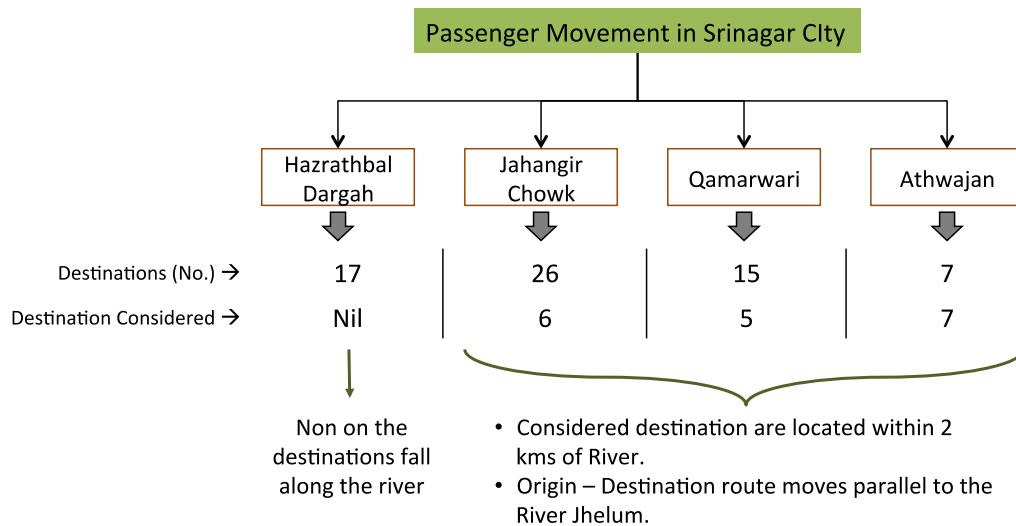


**Figure 5-51 Mapping of Population and Villages- Srinagar**

We have conducted Road Survey on in Srinagar City and surround. The 4 locations namely Jahangir Chowk, Hazrathbal Dargah, Qamarwari and Athwajan are busiest locations in Srinagar city and hence they are considered for road survey. Destinations, which are considered for survey in 3 locations, i.e. Hazrathbal Dargah, Qamarwari and Athwajan fall along Jhelam river. Destinations under Jahangir Chowk are not located along the river. Vehicles like Bus and sumo taxis are considered for road survey.



**Figure 5-52 Road Survey Summary of Srinagar**



**Figure 5-53 O-D Survey of Busiest routes for Intra-City passenger movement**

- Route Survey – Jahangir Chowk (O-Origin)

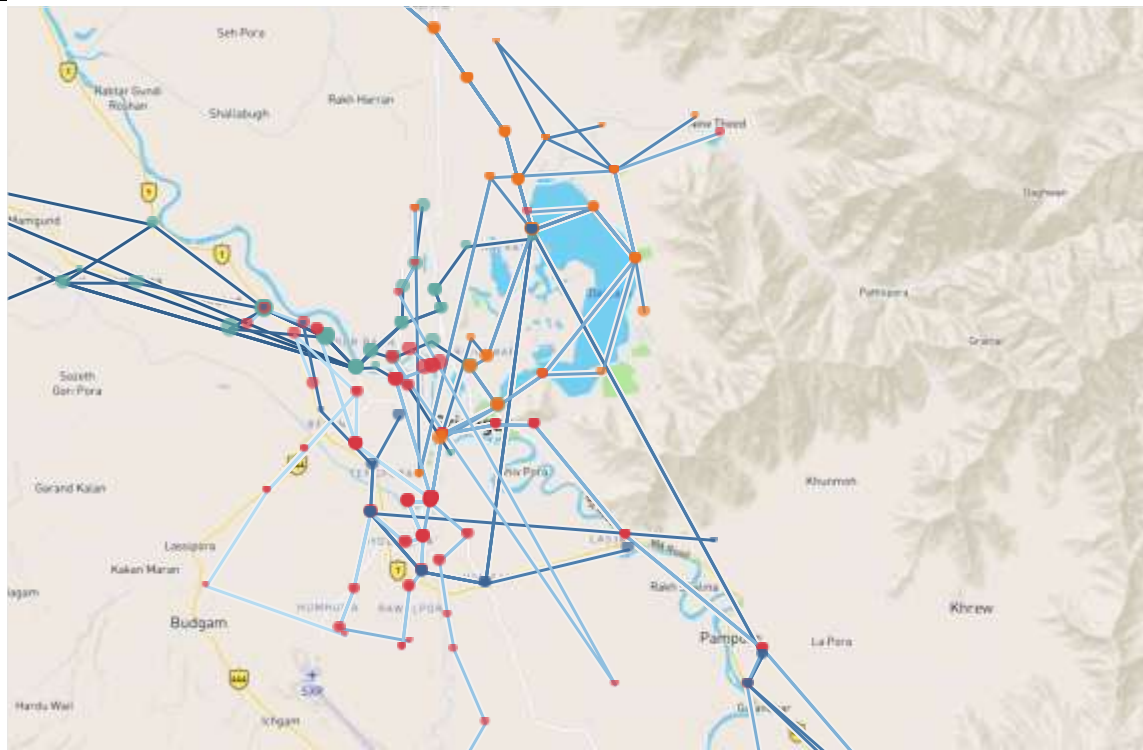
All the destinations that originate from Jahangir Chowk are listed down in table below. The table also shows route covered by each origin – Destination along with daily traffic moving on it.

**Table 5-35 Route Identification for proposed IWT, originating from Jahangir Chowk**

Sr. No	Destination (D)	Route (O-via-D)	Daily Traffic (No.)		Type of Service	Considerable for Proposed IWT
			Working Day	Non-Working Day		
1	Bemina (JVC)	O-Batamalo-Bemina Grid-Ansari Toyota-D	1620	1029	Bus	X
2	Budgam (Via Khomeni Chowk)	O-Batamalo-Bemina Grid-Hamdaniya cIny-Khomeni chk-Mirgund-sD	460	308	Bus	X
3	Khomeni Chowk	O-Batamalo-BeminaGrid-Hamdaniya cIny-D	750	524	Bus	X
4	Qamarwari	O-Batamaloo –Police colony-D	1785	1323	Bus	X
5	HMT	O-Batamaloo-Police colony-Qamarwari-Parimpora – Shalteng-D	1600	931	Bus	✓
6	HumHama	O-Rambagh- Barzulla-Baghat-Parry Pora-Hyderpora-Peerbagh-D	1600	1068	Bus	X
7	Hydepora	O-Rambagh- Barzulla-Baghat-ParrayPora-D	2160	1353	Bus	X
8	Bhaghat	O-Rambagh-Barzulla-D	2100	1115	Bus	X
9	Sanat nagar	O-Rambagh- Barzulla-Baghat-D	1100	672	Bus	X

Sr. No	Destination (D)	Route (O-via-D)	Daily Traffic (No.)		Type of Service	Considerable for Proposed IWT
			Working Day	Non-Working Day		
10	Rangreth	O-Rambagh- Barzulla-Baghat-Sanat Nagar-Rawalpora-D	950	490	Bus	X
11	Rawalpura	O-Rambagh- Barzulla-Baghat-Sanat Nagar-D	1680	848	Bus	X
12	Chadora	O-Rambagh-Natipora-Chanpora-Bagh eMehtab-Moochuwa-wathora-D	850	360	Bus	X
13	Chanapora	O-Rambagh-Natipora-D	1610	672	Bus	X
14	Soura	O-Karan Nagar-SMHS Hospital-Safa Kadal-EidGaH-Saidpura-Zoonimar-D	800	376	Bus	X
15	Safa kadal via SMHS	O-Karan Nagar-SMHS Hospital-D	2040	972	Bus	X
16	Zaina kadal	O-Karan Nagar-Pathar Masjid-Dalaal Mohalla -D	2700	1544	Bus	X
17	Nawa kadal	O-Karan Nagar-Pathar Masjid-Nawa Kadal-D	2520	1372	Bus	✓
18	Rangreth	O-Rambagh-Baghat-Sanat Nagar-Rawalpora-D	560	428	Sumo/Taxi	✓
19	Gogo (Via Humhama)	O-Rambagh-Baghat-Parry Pora-Hyderpora-Peerbagh-Humhama-D	560	405	Sumo/Taxi	✓
20	Islamabad	O-M.A Road-TRC-Sonwar-Athwajan-Pampore-Awantipora-Sangam-Bijbehara-Khanabal-D	1150	892	Sumo/Taxi	X
21	Pulwama	O-M.A Road-TRC-Sonwar-Athwajan-Pampore-Galandar-Kakapora-D	1380	1012	Sumo/Taxi	X
22	Harwan	O-M.A Road-Dalgate-Nehru Park-Nishat-Shalimar-D	980	672	Sumo/Taxi	X
23	Shalimar	O-M.A Road-Dalgate-Nehru Park-Nishat-D	770	528	Sumo/Taxi	X
24	Kashmir University (Hazratbal)	O-M.A Road-Dalgate-Nehru Park-Nishat-Foreshore-D	900	712	Sumo/Taxi	X
25	Awantipora	O-M.A Road-TRC-Sonwar-Athwajan-Pampore-D	650	504	Sumo/Taxi	✓
26	Pampore	O-M.A Road-TRC-Sonwar-Athwajan-D	850	666	Sumo/Taxi	✓

Source: Site Visit



**Figure 5-54 Passenger Movement Route Mapping to and from Jahangir Chowk**

The figure above shows the routes originating from Jahangir Chowk to various destinations. Along with the routes, traffic moving from origin to each destination is also depicted in round dots, size of dots shows the volume of traffic.

**Table 5-36 Existing Public Transportation Route from Jahangir Chowk to Banks of River**

Sr. No	Origin	Destination	Type of Service	No. of Vehicles	No. of Trips
1	Jahangir Chowk	HMT	Bus	10	80
2		Nawa kadal	Bus	10	110
3		Rangreth	Bus	8	56
4		Gogo (Via Humhama)	Taxi/Sumo	8	56
5		Awantipora	Taxi/Sumo	14	70
6		Pampore	Taxi/Sumo	18	90

Source: Site Visit

**Table 5-37 Tariff for routes originating from Jahangir Chowk**

Sr. No	Origin	Destination	Travel Purpose	Tariff (INR/Passenger)	Off Season
1	Jahangir Chowk	HMT	Residential, Northern and Central Bus Terminal	12	NA
2		Nawa kadal	Residential	9	NA
3		Rangreth	Residential, Tech Park	20	NA
4		Gogo (Via Humhama)	Residential	25	NA
5		Awantipora	Residential, IUST university	40	NA
6		Pampore	Residential, Business	30	NA

Source: Site Visit

**Table 5-38 Volume count of Passengers on Public Transport from Jahangir Chowk**

Sr. No	Origin	Destination	Daily Traffic (No.)		
			Peak Hrs	Moderate Hrs	Total
1	Jahangir Chowk	HMT	640	960	1,600
2		Nawa kadal	1,080	1,440	2,520
3		Rangreth	160	400	560
4		Gogo (Via Humhama)	160	400	560
5		Awantipora	130	520	650
6		Pampore	170	680	850

Source: Site Visit

- Route Survey – Qamarwari (O-Origin)

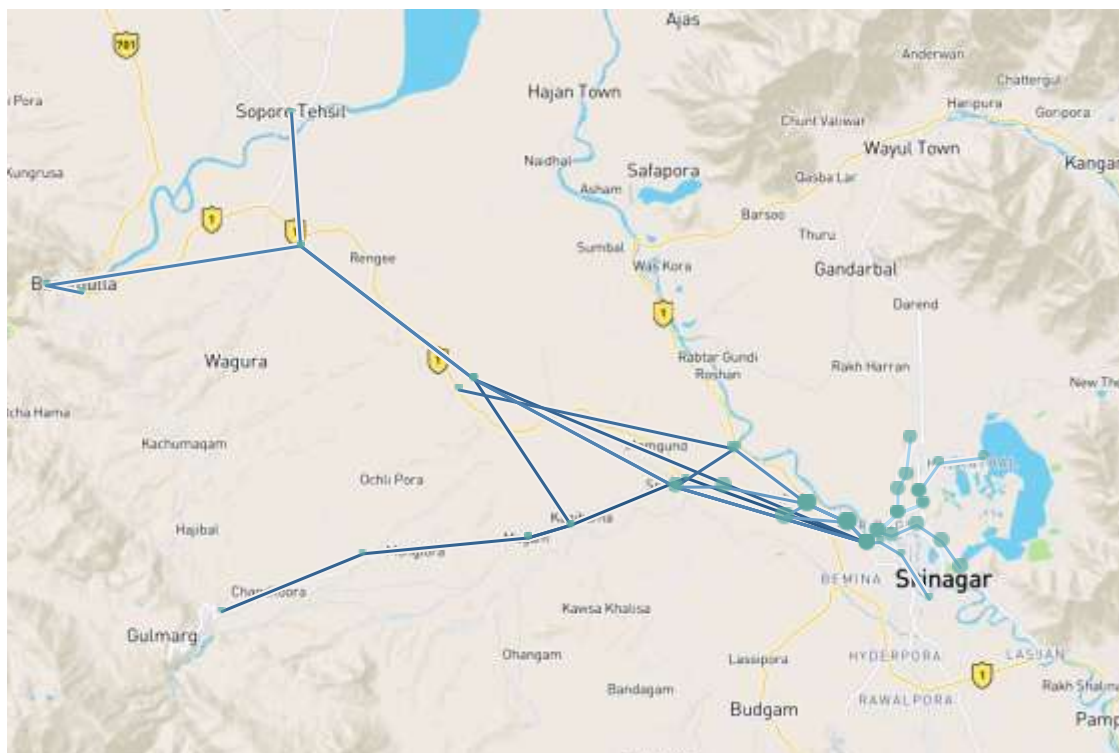
All the destinations that originate from Qamarwari are listed down in table below. The table also shows route covered by each origin – Destination along with daily traffic moving on it.

**Table 5-39 Route Identification for proposed IWT, originating from Qamarwari**

Sr. No	Destination (D)	Route (O-via-D)	Daily Traffic (No.)		Type of Service	Considerable for Proposed IWT
			Working Day	Non-Working Day		
1	Soura (Via Hawal)	O-Eidgah-Hawal-Alamgari Bazar-D	2160	1412	Bus	X
2	Soura(via Zoonimar)	O-Noorbagh-Eidgah-AliJanRoad-zoonimar-D	2240	1319	Bus	X
3	Dargah Hazratbal	O-Eidgah-Hawal-Alamgari Bazar-LalBazar-D	1200	668	Bus	X
4	Dalgate	O-Noorbagh-SafaKadal-RajouriKadal-Khanyar-D	2640	1500	Bus	✓
5	SMHS Hospital	O-ChatabalWeir-D	780	512	Bus	✓
6	Mandi	O-D	16020	6048	Bus	✓
7	HMT	O-ParimporaMandi-Shalteng-D	3840	1844	Bus	✓
8	Shalteng	O-ParimporaMadi -D	2720	1344	Bus	✓
9	Narbal	O-ParimporaMandi-Shalteng-Umerabad-D	1760	960	Bus	X
10	Mujgund Maloora	O-ParimporaMandi-Shalteng-D	1160	582	Bus	✓
11	Baramulla	O-Narbal-Pattan-Sangrama-Khanpora-D	600	388	Sumo/Taxi	X
12	Sopore	O-Narbal-Pattan-Sangrama-D	640	466	Sumo/Taxi	X

Sr. No	Destination (D)	Route (O-via-D)	Daily Traffic (No.)		Type of Service	Considerable for Proposed IWT
			Working Day	Non-Working Day		
13	Pattan	O-Narbal-Mujgund -D	700	573	Sumo/Taxi	X
14	Tangmarg	O-Narbal-Kanihama-Magam-Kunzer-D	560	430	Sumo/Taxi	X
15	Magam	O-Narbal-Kanihama-D	600	466	Sumo/Taxi	X

Source: Site Visit



**Figure 5-55 Passenger Movement Route Mapping to and from Qamarwari**

The figure above shows the routes originating from Qamarwari to various destinations. Along with the routes, traffic moving from origin to each destination is also depicted in round dots, size of dots shows the volume of traffic.

**Table 5-40 Existing Public Transportation Route from Qamarwari to Banks of River**

Sr. No	Origin	Destination	Type of Service	No. of Vehicles	Trips/Bus	No. of Trips
1	Qamarwari	Dalgate	Bus	20	7	140
2		SMHS Hospital	Bus	7	9	63
3		Mandi	Bus	22	10	220
4		HMT	Bus	15	8	120
5		Shalteng	Bus	10	8	80
7		Mujgund Maloora	Bus	10	6	60

Source: Site Visit

**Table 5-41 Tariff for routes originating from Qamarwari**

Sr. No	Origin	Destination	Travel Purpose	Tariff (INR/Passenger)	Off Season
1	Qamarwari	Dalgate	Residential, Business	11	NA
2		SMHS Hospital	Residential, Hospital	7	NA
3		Mandi	Northern Bus Stand	6	NA
4		HMT	Residential, Official	7	NA
5		Shalteng	Residential, Bandipora Interconnection	6	NA
7		Mujgund Maloora	Residential	11	NA

Source: Site Visit

**Table 5-42 Volume count of Passengers on Public Transport from Qamarwari**

Sr. No	Origin	Destination	Daily Traffic (No.)		Non-Working Days
			Peak Hrs	Moderate Hrs	Moderate Hrs
1	Qamarwari	Dalgate	1,440	1,200	1,500
2		SMHS Hospital	240	540	512
3		Mandi	12,870	3,150	6,048
4		HMT	2,400	1,440	1,844
5		Shalteng	1,600	1,120	1,344
7		Mujgund Maloora	560	600	582

Source: Site Visit

- Route Survey – Athwajan (O-Origin)

All the destinations that originate from Qamarwari are listed down in table below. The table also shows route covered by each origin – Destination along with daily traffic moving on it.

**Table 5-43 Route Identification for proposed IWT, originating from Athwajan**

Sr. No	Destination (D)	Route (O-via-D)	Daily Traffic (No.)		Type of Service	Considerable for Proposed IWT
			Working Day	Non-Working Day		
1	Batamaloo	O-Nowgam-SanatNagar-Hyderpora-Tengpora-D	1730	1068	Bus	✓
2	Hyderpora	O-Nowgam-SanatNagar-D	1535	942	Bus	✓
3	Islamabad	O-Pampore-Galandar-Awantipora-Sangam-Bijbehara-D	960	388	Bus	✓
4	Awantipora	O-Pampore-Galandar-D	1260	704	Bus	✓
5	Shalteng	O-Nowgam-SanatNagar-Hyderpora-Tengpora-Bemina-Parimpore-D	460	356	Sumo/Taxi	✓
6	Hyderpora	O-Nowgam-SanatNagar-D	610	445	Sumo/Taxi	✓
7	Zewan	O-Zewan-D	940	687	Sumo/Taxi	✓

Source: Site Visit



**Figure 5-56 Passenger Movement Route to and from Athwajan (Pantha Chowk)**

All the destinations that originate from Athwajan, which is also known as Pantha Chowk, are listed down in table below. The table also shows route covered by each origin – Destination along with daily traffic moving on it.

**Table 5-44 Existing Public Transportation Route from Athwajan to Banks of River**

Sr. No	Origin	Destination	Type of Service	No. of Vehicles	Trips/Bus	No. of Trips
1	Athwanjan	Batamaloo	Bus	15	7	105
2		Hyderpora	Bus	10	8	80
3		Islamabad	Bus	15	3	45
4		Awantipora	Bus	15	4	60
5		Shalteng	Sumo/Taxi	20	7	140
6		Hyderpora	Sumo/Taxi	15	8	120
7		Zewan	Sumo/Taxi	15	7	105

Source: Site Visit

**Table 5-45 Tariff for routes originating from Athwajan**

Sr. No	Origin	Destination	Travel Purpose	Tariff (INR/Passenger)	Off Season
1	Athwanjan	Batamaloo	Business, Govt Offices	13	NA
2		Hyderpora	Private Offices, Residential, Private Tuition center	11	NA
3		Islamabad	Business, Govt Offices	45	NA

Sr. No	Origin	Destination	Travel Purpose	Tariff (INR/Passenger)	Off Season
4		Awantipora	Islamic University, Residential	17	NA
5		Shalteng	Residential, Bandipora intesection	30	NA
6		Hyderpora	Private Offices, Residential, Private Tuition centers	15	NA
7		Zewan	Residential, Police training center	20	NA

Source: Site Visit

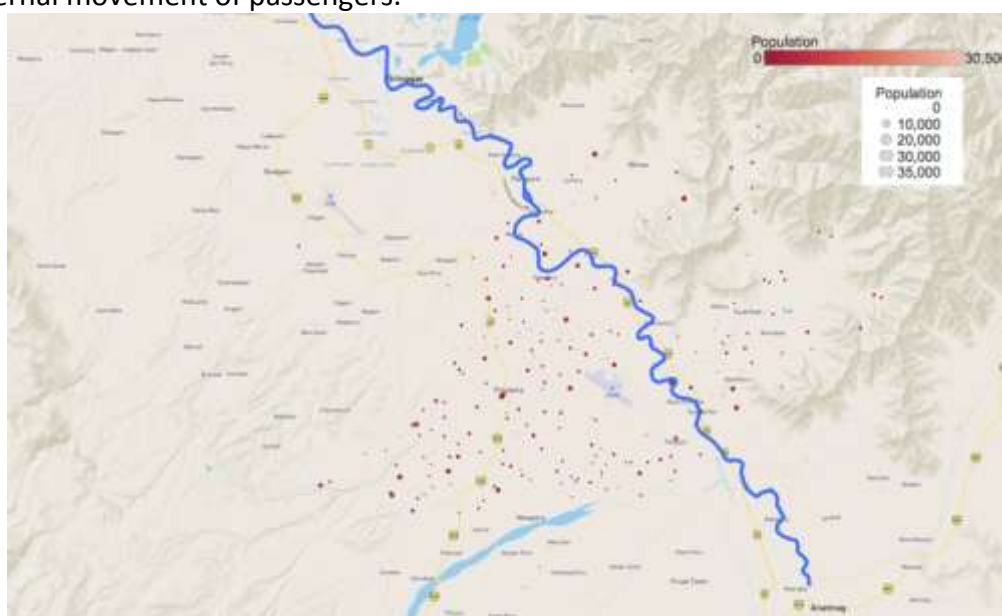
**Table 5-46 Volume count of Passengers on Public Transport from Athwajan**

Sr. No	Origin	Destination	Working Days Traffic (No.)		Non-Working Days
			Peak Hrs	Moderate Hrs	Moderate Hrs
1	Athwanjan	Batamaloo	770	960	1068
2		Hyderpora	735	800	942
3		Islamabad	660	300	388
4		Awantipora	660	600	704
5		Shalteng	140	320	356
6		Hyderpora	210	400	445
7		Zewan	220	720	687

Source: Site Visit

- Pulwama

Figure 5-57 shows population distribution of Pulwama district. Majority of the population is residing away from River Jhelum. They use internal roads for movement inside the district. Hence, there is no need for development of river transport for internal movement of passengers.



**Figure 5-57 Mapping of Population and Villages- Pulwama**

- Baramulla

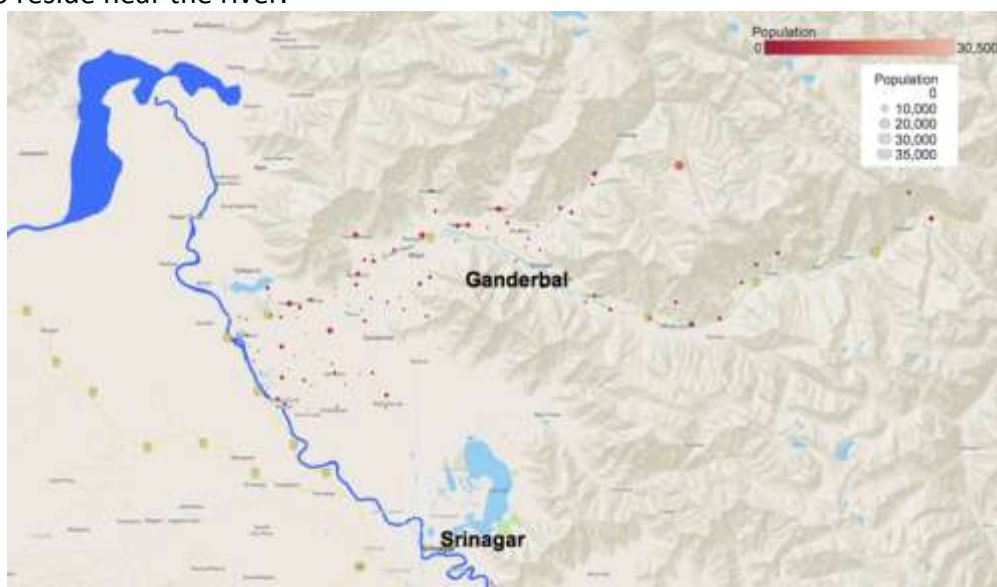
Figure 5-58 describes the distribution of village in Baramulla district. The population residing near village is negligible. There is no need for developing any type of water transport for intra district



**Figure 5-58 Mapping of Population and Villages- Baramulla**

- Ganderbal

Figure 5-59 describes the distribution of village in Ganderbal district. Central and Western part of Ganderbal is more developed than other parts of the district. Farther Western side of Ganderbal is covered in forests, which is least developed and has negligible population. Water transportation facility is required in Ganderbal for people who reside near the river.



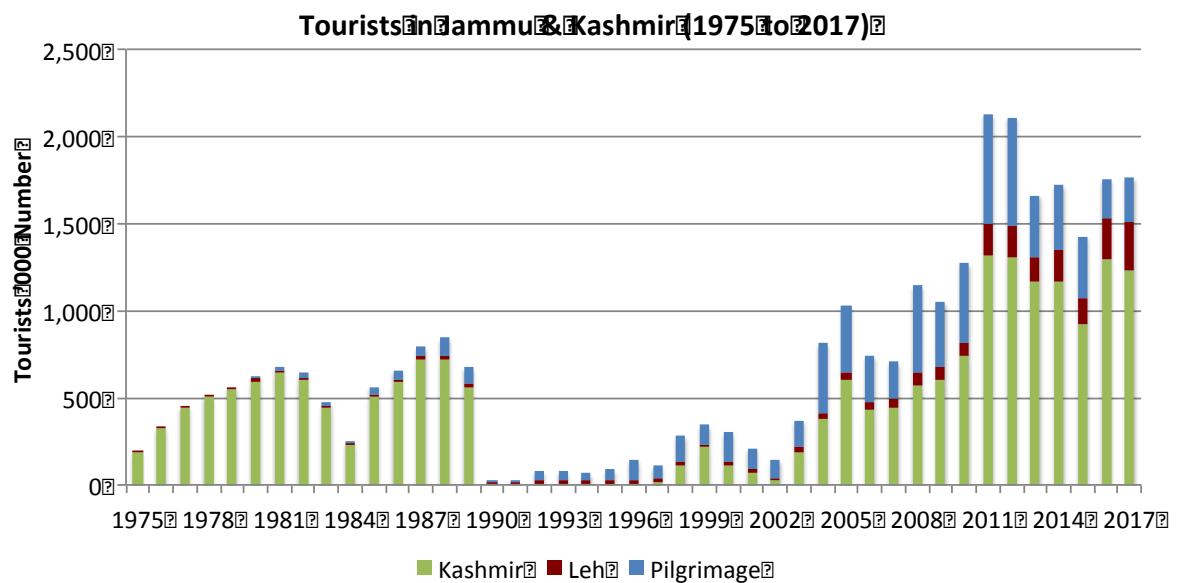
**Figure 5-59 Mapping of Population and Villages- Ganderbal**

### 5.14 Tourism Traffic

Tourism Industry acts as a backbone to the economy of Jammu and Kashmir. Majority of the tourists visit Kashmir Valley followed by Leh and Ladhak. The tourist visit to Jammu region is mostly for pilgrimage including Amarnath Yatra and Vaishno Devi Yatra. River Jhelum (NW-49) falls in Kashmir valley. It is connected with other water bodies acting as famous tourist spots in Kashmir. Hence, the scope for tourist engagement increases with development of River Jhelum from tourist perspective.

Tourism is predominantly service industry with very high influence of manpower associated with it. The natural scenic beauty is already available in the valley. Hence, development of additional avenues for tourists is likely to increase the number of tourist footfall along with increase in days of stay in Kashmir. This would increase overall revenue realization from tourists, economic growth, employment growth, etc. Increase in footfall of tourists or their duration of stay would create multiplier effect with job creation in allied industry. Large scale jobs would be created both in the organized as well as non organized sector.

Figure 5-60 shows annual historic footfall of tourist in the state of Jammu and Kashmir. The tourist traffic to the state has been highly erratic with several ups and downs. This has been observed to stagnate for last 5 years.

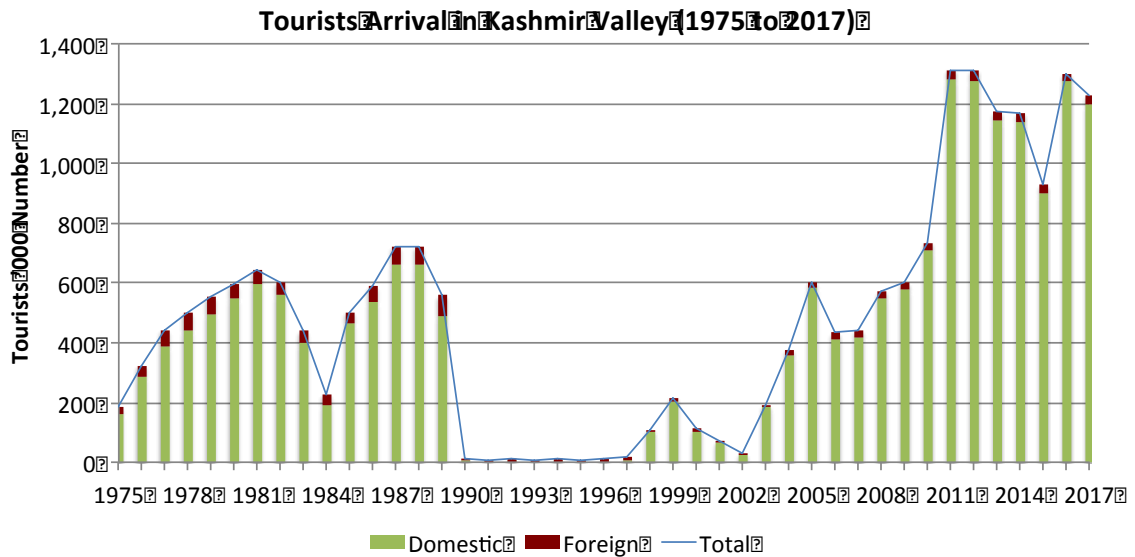


**Figure 5-60 Annual Tourism Arrival in Jammu & Kashmir ('000 Numbers)**

Jammu and Kashmir witness about 1.7 million tourists annually. This includes tourist arrival to all the 3 prominent locations of Jammu and Kashmir. The year 1990 to 2002 were very bad period for tourism industry in Jammu & Kashmir. The tourist footfall had vanished altogether for a decade. Tourist traffic began to rise again from the year 2002. It attained an all time peak in the year 2011. However, it began to fall in subsequent year. Presently, the annual tourist arrival has been stagnant in the range of 1.6 million to 1.8 million.

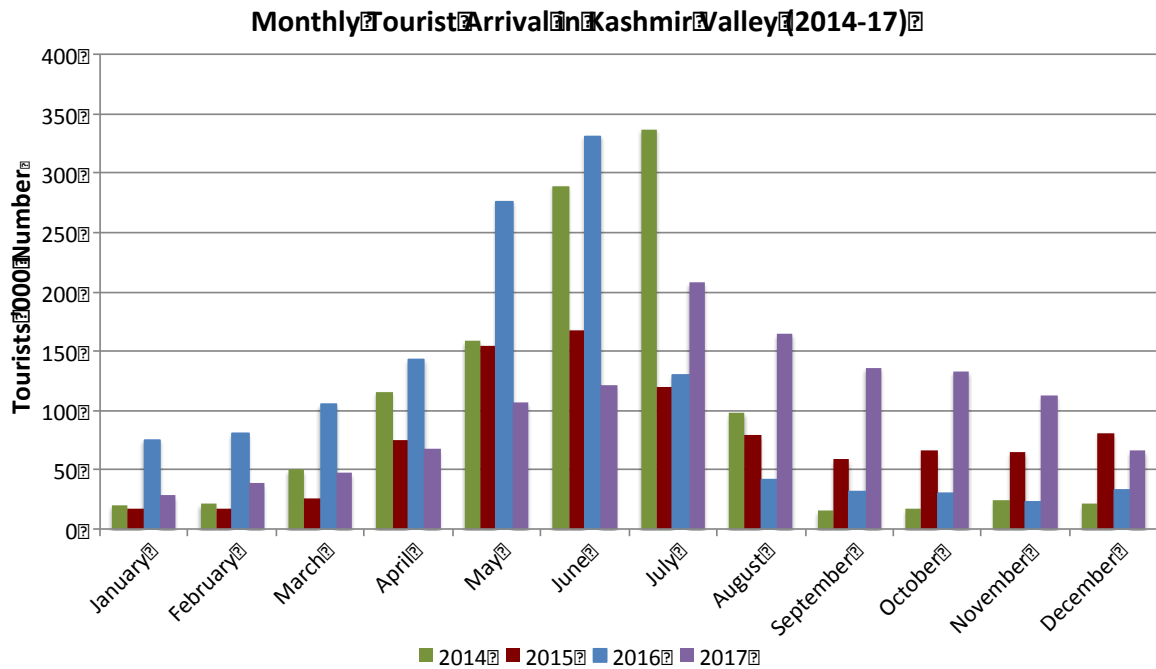
### 5.15 Kashmir Valley

Development of Jhelum River from the perspective of promoting tourism is likely to increase water -related tourism avenues for the tourists visiting Kashmir Valley. Figure 5-61 shows historic breakup of domestic and foreign tourists visiting Kashmir Valley.



**Figure 5-61 Domestic and Foreign Tourists in Kashmir Valley ('000 Numbers)**

The number of tourists visiting Kashmir Valley has increased about 7 times in last 40 years. There were years of disturbances in Kashmir Valley leading to fall in tourist footfall. The tourism industry was most affected during the 90s. There has been gradual rise of tourists calling to Kashmir Valley since 2002. The year 2014 witnessed maximum number of tourists calling to Kashmir. 2015 witnessed fall in tourism traffic on account of local disturbances. Excluding, small ups and downs, the last 6 years have seen an average annual tourist footfall of close to 1.0 million in Kashmir Valley. It is believed that every tourist coming to Kashmir Valley first visits Srinagar and then goes to other locations surrounding Srinagar. Hence developing tourism on Jhelum River is likely to increase tourism avenues for tourist visiting Kashmir Valley. The new avenues of tourism in Kashmir Valley would include boat ride on Jhelum River, visiting historic places and monuments using river, etc. The monthly tourists arrival in Kashmir Valley for last 4 years is shown in Figure 5-62



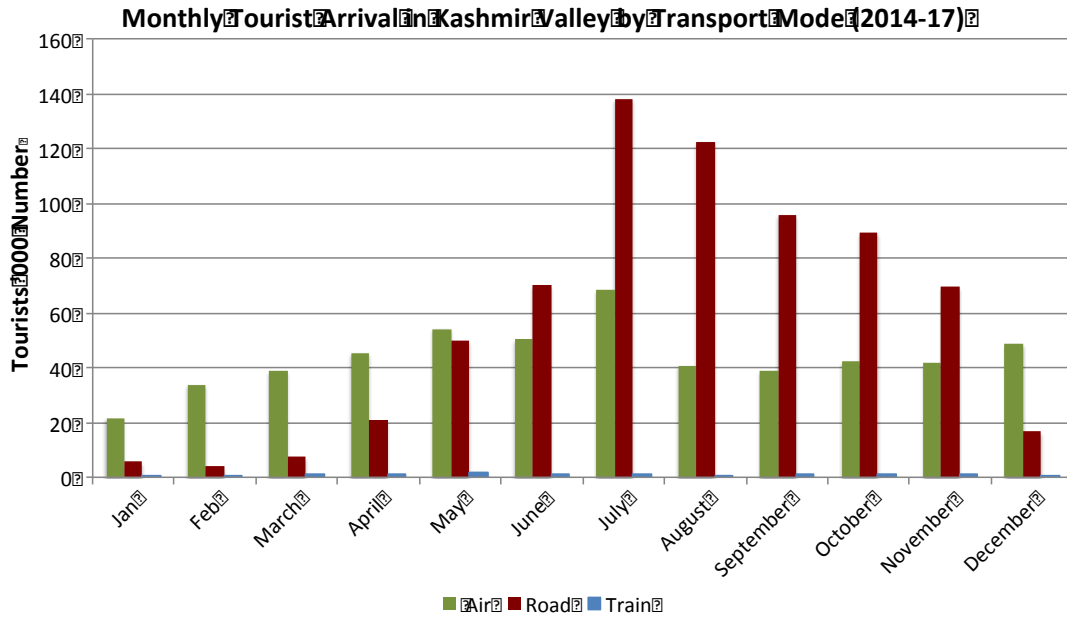
**Figure 5-62 Monthly Tourists Arrival in Kashmir (2013-2017) - '000 Numbers**

Last 4 year's monthly tourist arrival statistics in Kashmir Valley starting 2014 to 2017 is show in the following figure. It has been observe that May to July have witnessed maximum tourist arrival. The average monthly footfall of tourist arriving during these periods are 2,50,000.

Monthly tourist arrival from January to March is less than 100,000 people. Similarly, the average tourist arrival from August to December is on the lower side. The peak period tourism demand is about 3 times more than the lean period tourism demand.

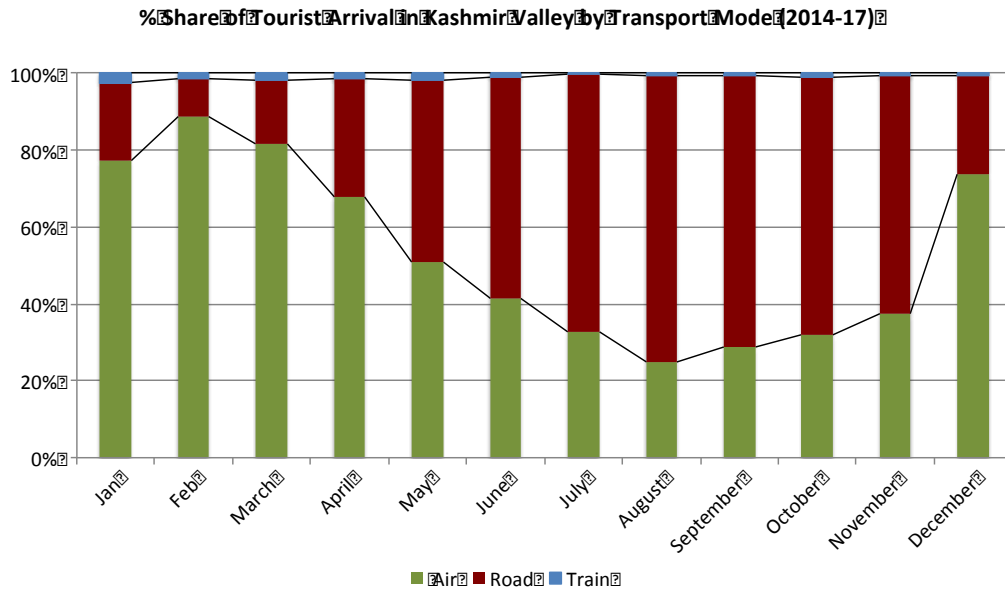
The planning of tourism infrastructure and facilities on the River Jhelum has to take into account the cyclicity involved in the tourism industry. There has to be a balance between peak demand as well as regular flow for tourists during initial years of implementation. This capacity of infrastructure could be increased gradually based on the acceptance of River Tourism of Jhelum among tourists. This would avoid idling of infrastructure, facilities and manpower resources during non peak period. Optimum capacity planning during initial years is also essential to reduce the average operating cost of operating tourism infrastructure including terminals, boats and other safety related facility.

Roads and Airways are the 2 popular modes of transportation used by tourists to reach Kashmir Valley from the rest of the India. The railways has not been found to be among popular transportation choice for tourists visiting Kashmir. One of the primary reason for same has been connectivity of railway upto Jammu Tavi or Udhampur. Tourists have to take road transportation beyond to reach Kashmir.



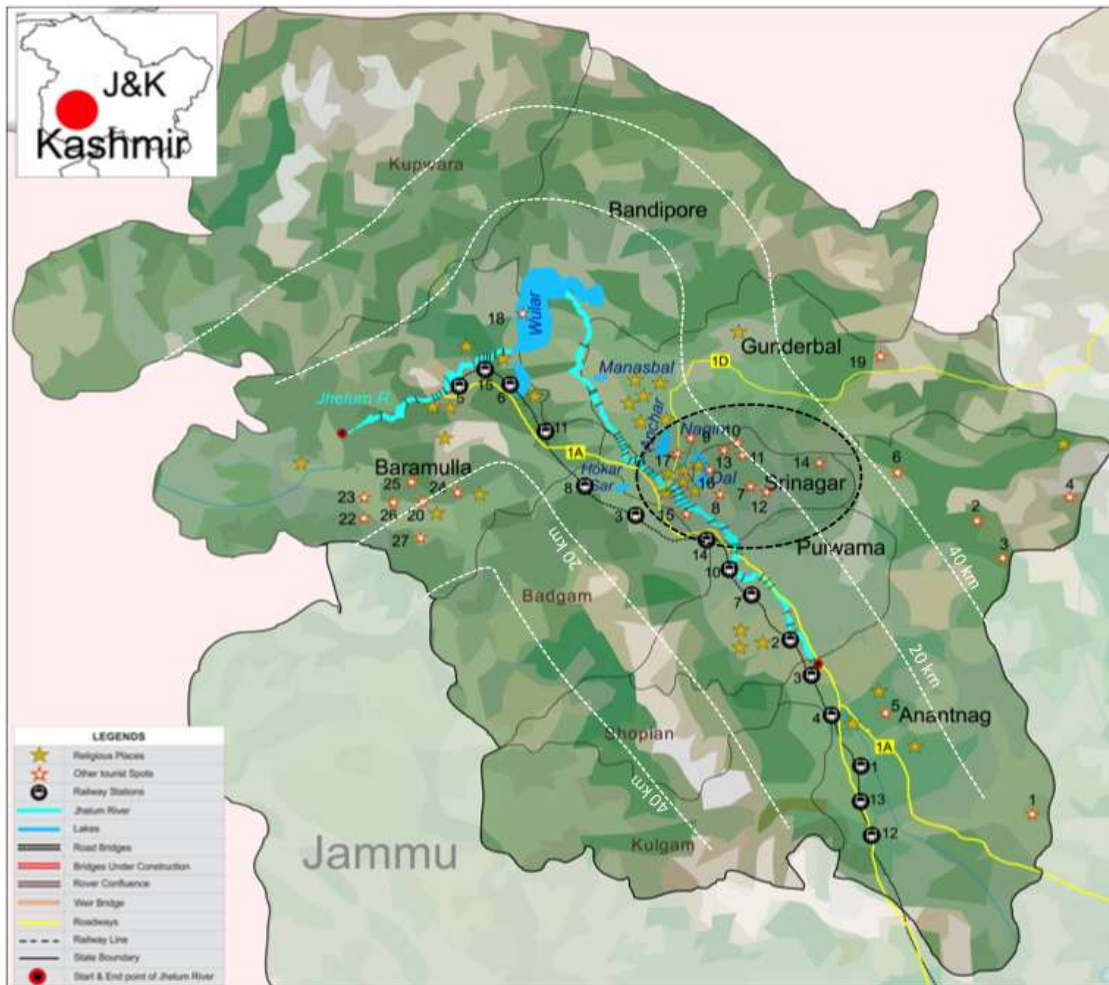
**Figure 5-63 Tourist Arrival by mode of transportation**

Less than 2% of the tourist arriving in the year 2017 used railways as their mode of transportation for reaching Kashmir and rest 98% used a combination of airways and roadways. Roadways were found to be the preferred choice for transportation during peak season that extends from May to November. Around 64% of passengers, on an average, arrived Kashmir in these months using roadways and around 35% arrived using airways. The average monthly arrival passengers to Srinagar during months of April to December using airways were 45,000 and during months of January to December using airways were 43,000 in the year 2017. The 1st 3 months of year including January to March witness lower %share of tourists arrival. Another reason for fall of air travellers during initial 3 months of year could be shifting of winter capital to Jammu. There was absence of methodology to differentiate arrival at Srinagar between tourists and passenger for work. Hence, the volume count as tourists arrival in Kashmir could also include regular passengers travelling to Kashmir for their work or family visit related requirements. Month of January witnessed the least volume of tourists arrival and July witnessed the peak season for tourists arriving to Kashmir.



**Figure 5-64 Percentage Share of Tourists to Kashmir by Mode of Transportation**

However, the road transportation has a very wide variation for tourist reaching Kashmir. Around 5000 to 8,000 tourists were observed to arrive in Kashmir during the months of January, February and March in the year 2017. The peak tourism season of May to November witnessed 70,000 to 138,000 tourists arrive Kashmir using roadways in the year 2017. The peak season of July and August witness 2 to 2.5 times passenger arriving using a road compared to airways. This gives an indication that a substantially large share of tourist preferring Road transportation. The road transportation in Kashmir Valley is time taking and cumbersome as well due to changing weather and other disturbances. It indicates that a large share to tourists arriving in Kashmir provide weightage to economy of transportation compared to comfort and time. Hence, it is assumed that, given a choice of faster water transportation with relatively lesser time along with provision for sightseeing and view of surrounding could be an acceptable mode of transportation for tourist arriving in Srinagar. Hence the possibility of passenger transportation using ferry route using Srinagar to Anantnag and Srinagar to Wular Lake could be explored.



**Figure 5-65 Tourism around River Jhelum**

The figure above depicts the tourist places of the considered districts. Kashmir is blessed with lot many religious places like Temples, Mosques and Churches. Major tourist places are listed below in the table and their distance with the River Jhelum.

**Table 5-47 List of Tourist spots around River Jhelum**

S.no	Districts	Tourist places	Distance from Jhelum
1	Anantnag	Sinthan Top	91
2		Beetab Valley	86
3		Tulian Lake	47
4		Sheshnag Lake	64
5		Achbal Gardens	23
6		Tar Sar & Mar Sar Lake	44
7	Srinagar	Indira Gandhi Tulip Garden	9
8		Shankracharya Hills	9
9		Nigeen Lake	5
10		Badamwari	13
11		Shalimar Bagh	11

S.no	Districts	Tourist places	Distance from Jhelum
12		Pari Mahal	9
13		Hari Parbat	3
14		Dachigham National Park	14
15		Shri Pratap Sing Museum	0.5
16		Dal Lake	10
17		Dabyan Valley	12
18		Bandipora	Wular Lake
19	Ganderbal	Sonmarg	95
20	Baramulla	Children's park	35
21		Ningle nallag	40
22		Alpathar Lake	69
23		Apharwat Peak	79
24		Gulmarg Ski	47
25		Golf Course	45
26		Khilanmarg	48
27		Kongdori	50

Source: Secondary Sources

Most of the tourist places in districts other than Srinagar are located far away from the river. Traffic generation from such places won't be possible for proposed waterway route on Jhelum River. However, tourist places in Srinagar and Bandipora could be considered for diversion as these places are located very nearby i.e within 20 kms. Following section describes the nearby places in detail.

- **Srinagar**

Srinagar City is the most popular tourist spot of Kashmir Valley, it is also known as 'City of Lakes'. Main reason behind the heavy tourist inflow in this city is the lakes. Majority of lakes are filled with houseboats through out the year. Apart from tourism these lakes serve other purpose of villagers like drinking water and cultivation. Fruits and vegetables are heavily produced in this lakes. One will find lot many activities to do in lakes, like ice skiing in winter season when lake gets freezed, houseboat ride, shikaras, etc. Visitors here book Shikara for whole day for sightseeing. Amongst all lakes, Dal lake is mostly populated by visitors, apart from visitors one will also find shops selling handicraft all within the lake.

Nagin lakes, it is a part of Dal lake linked through a causeway, it only permits walkers and two wheelers to enter this place. Lake is connected to the eastern part of Srinagar City by a pipeline for watersupply. It is bounded by Shankaracharya hill on the south and Hari Parbhat on the west. Entire lake is surrounded by willow and poplar trees. Hari Parbhat is also known as Sharika Peeth, it is located at the border of Srinagar city. This place is one of the ancient and holiest spot of Kashmir. Mostly visited by locals which for religious purpose.

Indira Gandhi Memorial Tulip Garden is the Asia's largest tulip garden. It was opened in 2007. One can reach at this location by taking a smooth cruising drive from Srinagar

along the Dal lake covering distance of 9 kms. This garden is surrounded by lush green course in the north and beautiful Dal lake in the west. Garden is filled with colourful tulips and multi-coloured hybrid flowers. This place has been created out of seven terraces on gentle sloping ground.

Badamwari Garden is the place full of Almond trees. Mostly visited by local people. Visitors from outside Kashmir will be seen very less. Shalimar Garden, another one in the Srinagar city is also as known 'garden of love'. It gives amazing combined view of Gardens, Lakes and shallow terraces. Apart from this, other attractions of this place are fountains, shaded trees and variety of flowers on spring and autumn. Authority of this garden organises Sound and Light show in the garden every evening during May to October. This is the time period when footfall increases for this place.

Pari Mahal is one of the most attractive destinations in Srinagar city. It is located on the top of Zabarwan mountain range just close to Dal Lake. State government of J&K owns and manages this garden. Best place to visit this garden is in summer season, as it faces freezing winters.

Apart from Gardens and Lakes, National Parks and Museums are also the most visited places in Srinagar city by outsiders.

- **Bandipora**

Wular lake lies in the Kashmir Valley, is the largest freshwater lake of India, and one of the largest lakes in Asia. Lake has very beautiful view and attracts large number of tourists throughout the year. It is the most visited picnic spots amongst local crowd. Jhelum river passes through this lake. Boat ride and Shikaras in the lake give very good experience of being in Kashmir. The figure below shows the view of Wular lake.



**Figure 5-66 Wular Lake View**

Apart from attracting tourism, Wular lake is used for cultivation, local residents around the lake produces fruits and vegetables in the lake. A certain part of the lake is especially used for cultivation purpose.

### 5.16 Cargo Traffic

Baramulla constitutes about 35% of the horticulture production followed by Anantnag 14% and Pulwama 10%. The other districts of Kashmir falling in the hinterland of river Jhelum produces around 2% of the total horticulture production. These districts include Bandipora, Ganderbal and Srinagar.

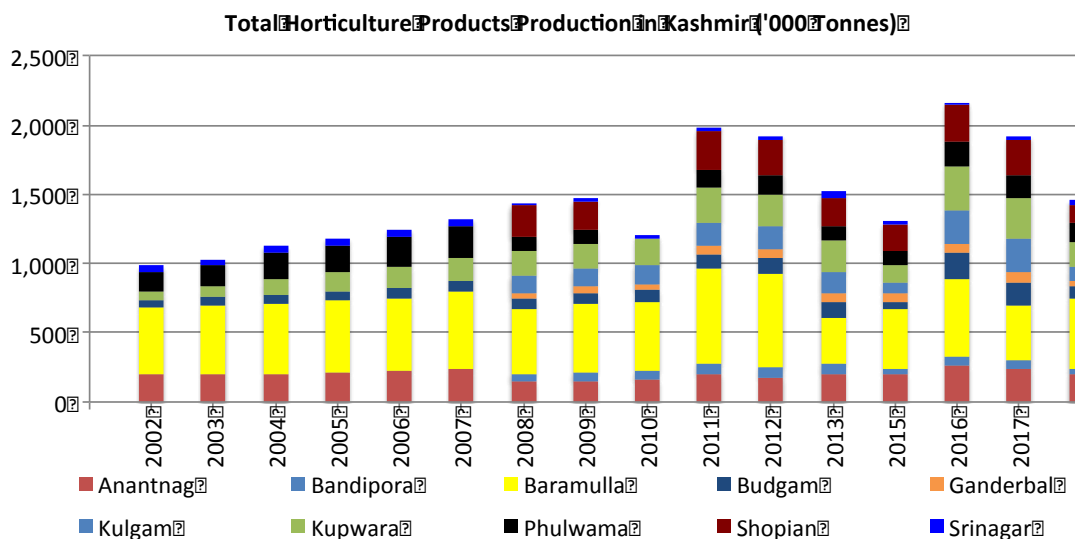


Figure 5-67 Horticulture Production in Kashmir Valley

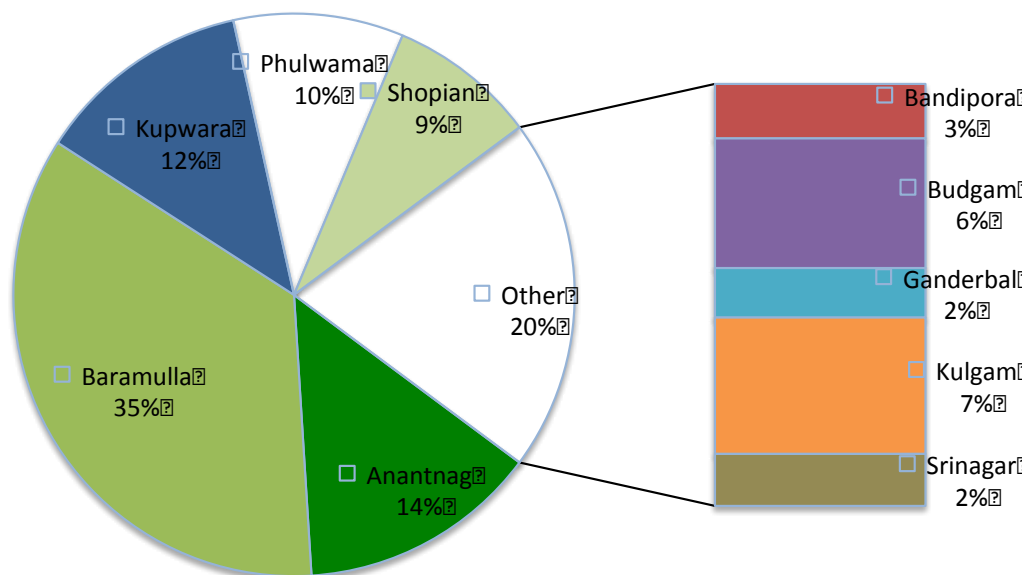
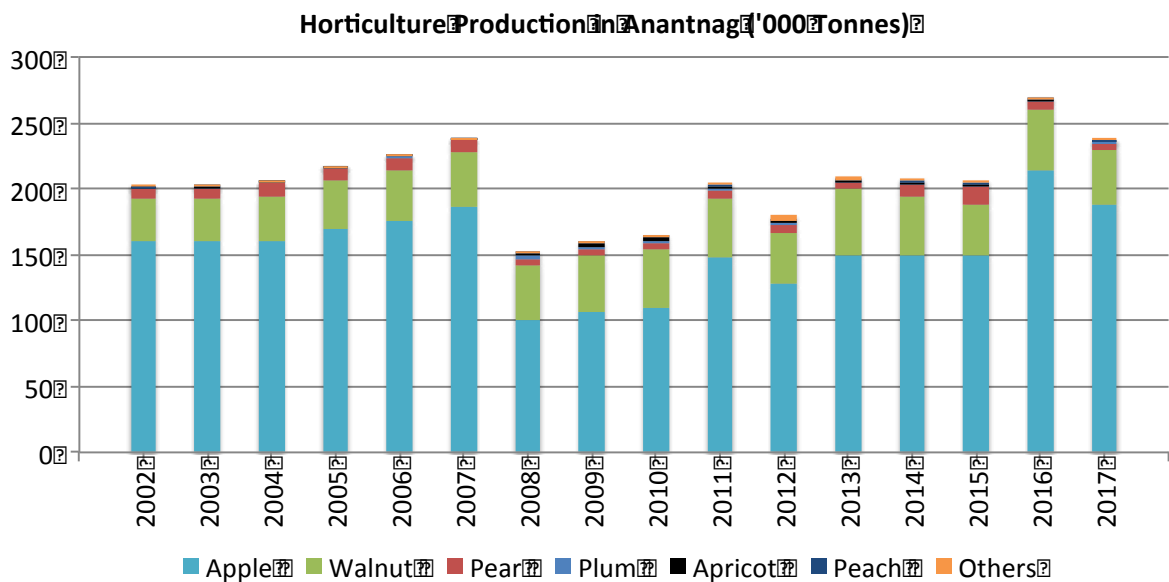


Figure 5-68 % Share Contribution of each district in Horticulture production

- Anantnag

Anantnag is one of the largest producer of Horticulture in Kashmir. The district has larger Area and produces about 10% of the total horticulture produced in Kashmir. It constitutes around 20% of Horticulture produced in among the districts falling in the hinterland of Jhelum. The horticulture produced in Anantnag includes Apple, Walnut and Pears. Other types of Horticulture produced in Anantnag includes peach, apricot, etc. They have not been considered due to smaller quantities. The figure below depicts the historic production of various types of Fresh Fruits and Dry Fruits in the district.



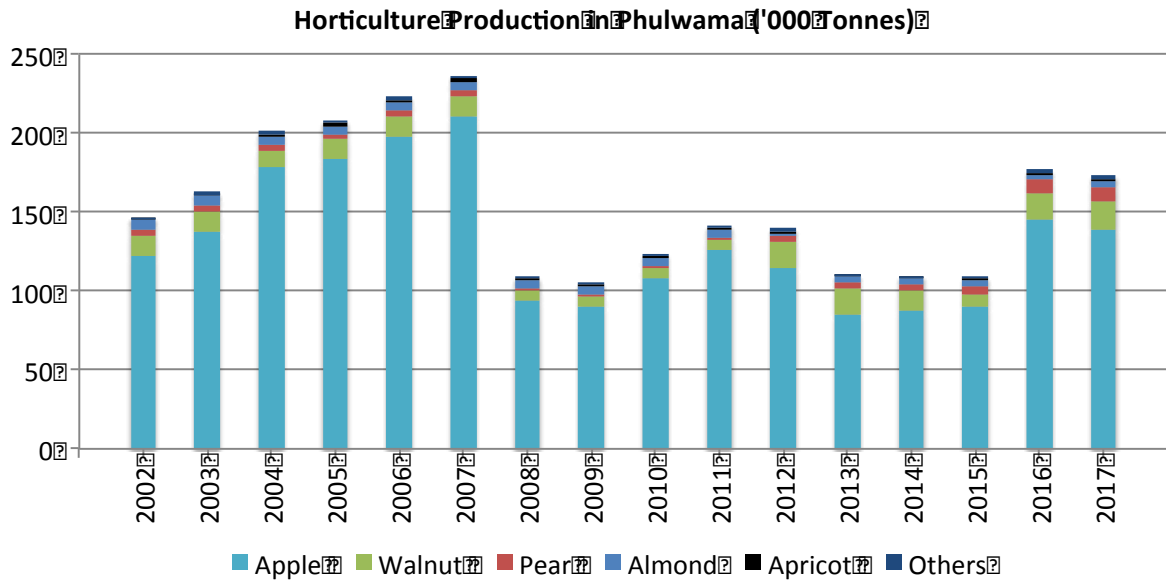
**Figure 5-69 Horticulture Production in Anantnag in last 15 Years ('000 Tonnes)**

Source: Directorate of Horticulture, J&K

However, above depicted commodities are not considered for any prospects of water transport. Horticulture produced from Anantnag is transported directly to other states of India using roadways. River Jhelum is located on the northern side of Anantnag and market for horticulture produced in Anantnag is located on the southern side. Hence, there is no prospect of horticulture trade of Anantnag going to other states using River Jhelum. Small volumes of trade by smaller farmers going to Srinagar for trade could use River Jhelum for transportation.

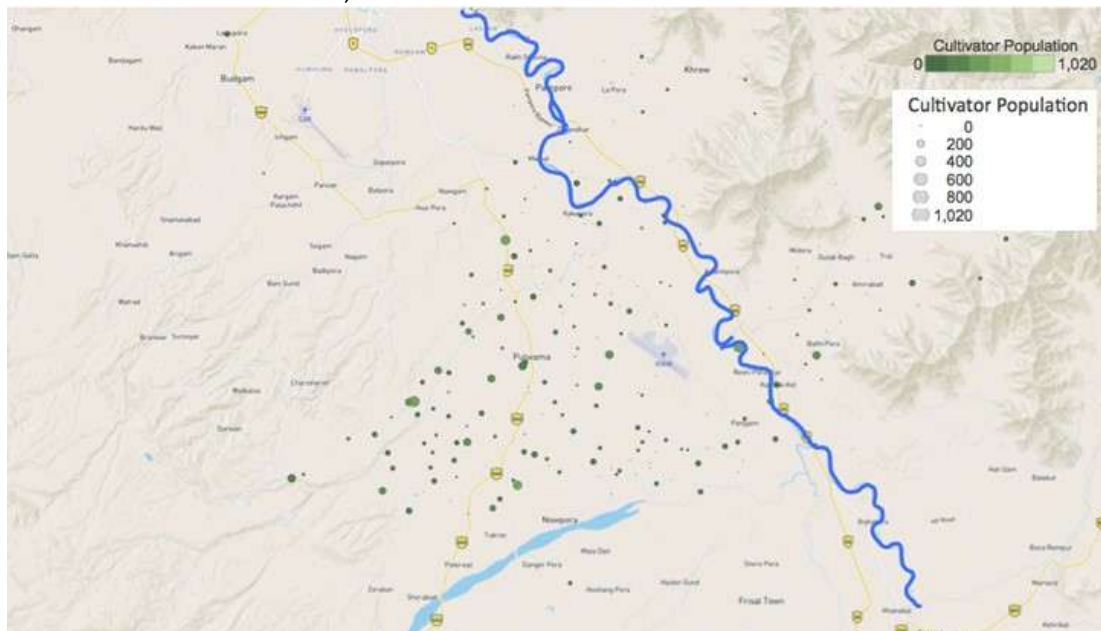
- Pulwama

Pulwama is the 2nd largest horticulture storage centre after Baramulla. A new cold storage is being constructed to meet the rising demand for horticulture products. The cold storage would also be used to store procurement of food products from other parts of India during lean season.



**Figure 5-70 Horticulture Production in Pulwama in last 15 Years ('000 Tonnes)**

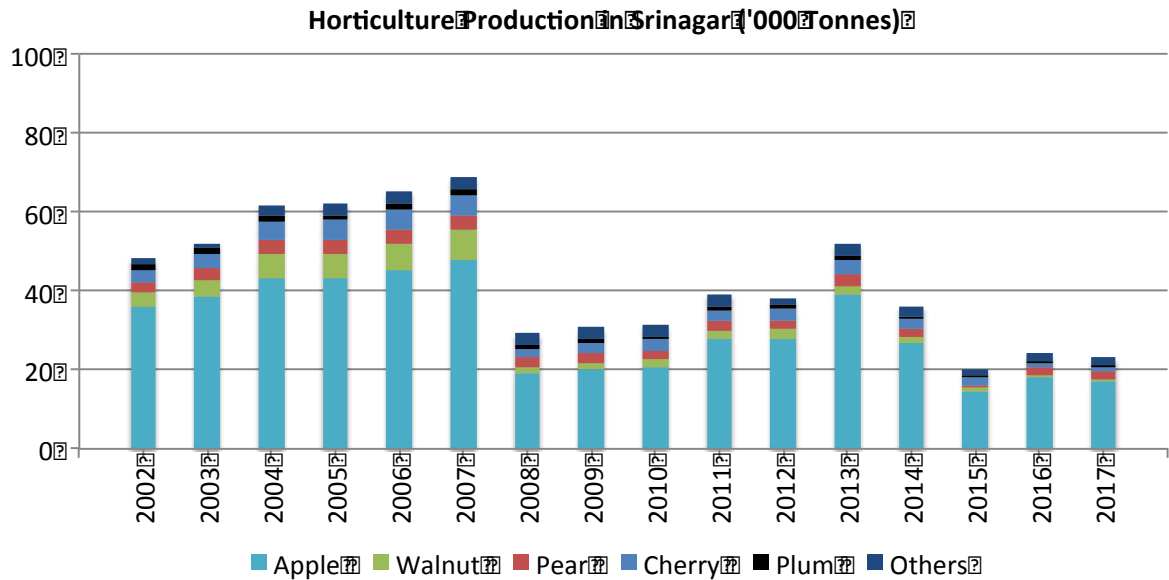
Source: Directorate of Horticulture, J&K



**Figure 5-71 Mapping of Villages with Horticulture Production – Pulwama District**

- Srinagar

The horticulture produce from Srinagar has been falling over years. It has reduced from more than 60,000 tonnes in the year 2007 to about 20,000 tonnes in the year 2017. The produce is brought to local mandis and mostly consumed locally. The production of Horticulture takes place on the outskirts of Srinagar. Hence, there is no scope for water transport on River Jhelum.



**Figure 5-72 Horticulture Production in Srinagar in last 15 Years ('000 Tonnes)**

Source: Directorate of Horticulture, J&K

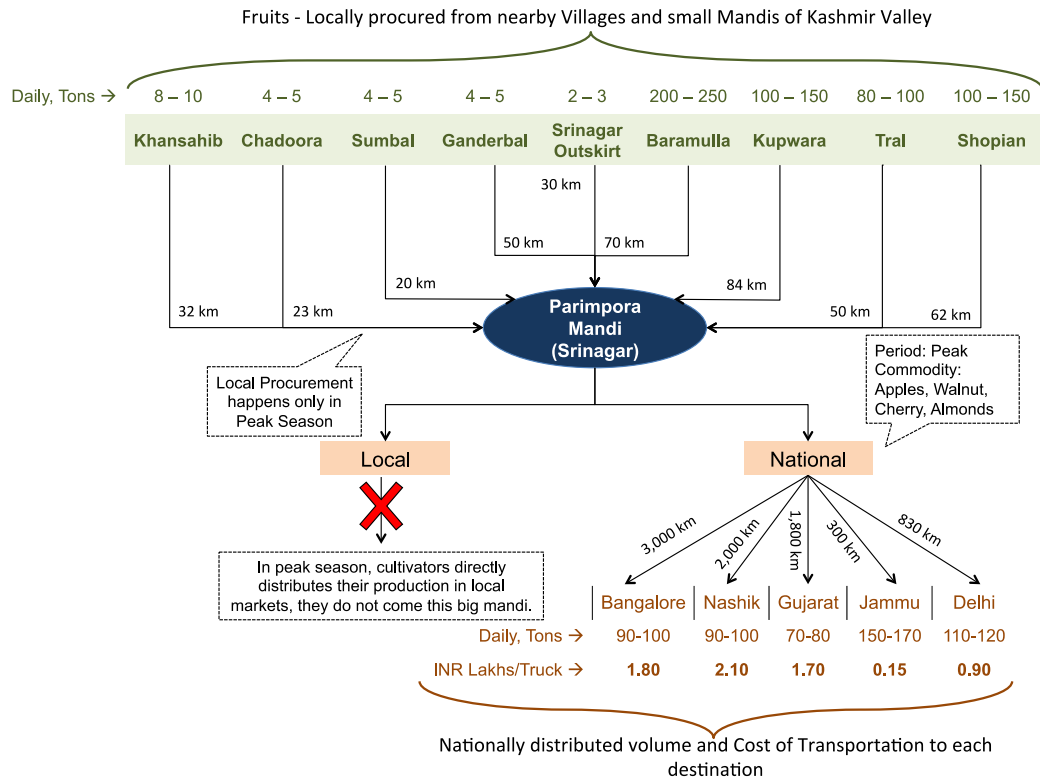


**Figure 5-73 Mapping of Villages with Horticulture Production – Srinagar District**

#### Trade of Horticulture – Srinagar Mandis

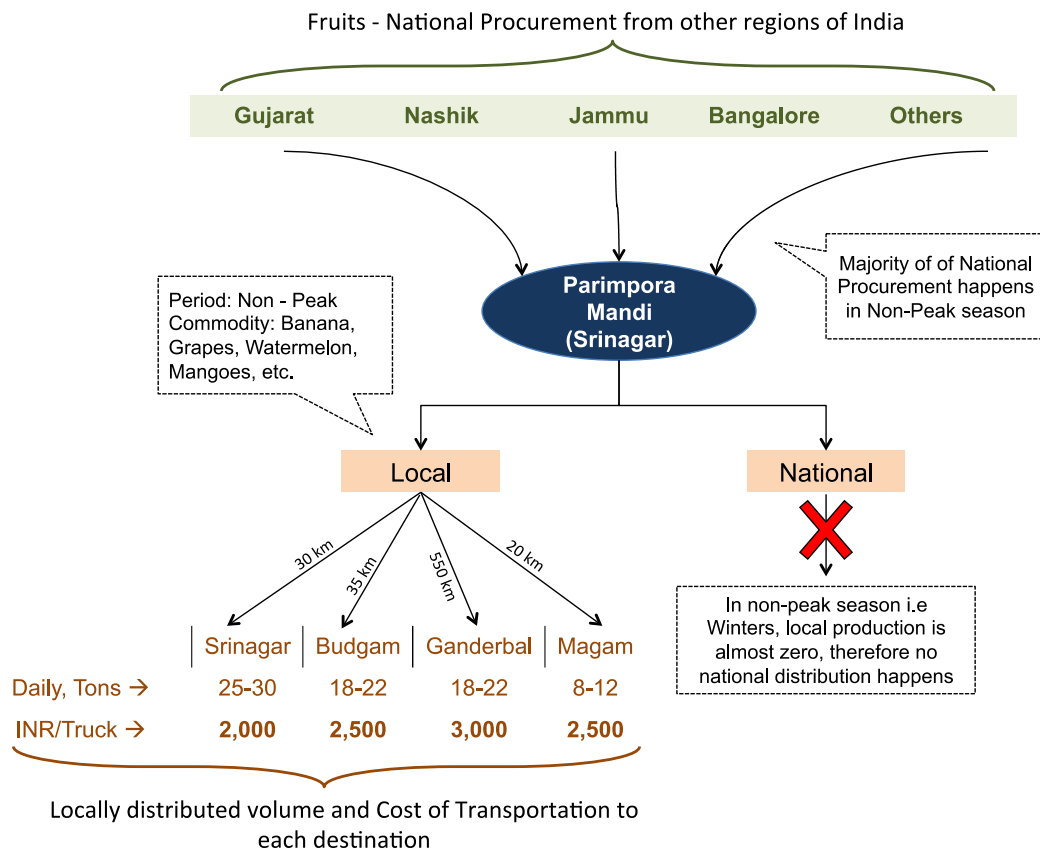
Srinagar is one of the trading Hubs for trade of Horticulture products locally and also out side states. This section draws flow charts and figures to describe the morement of horticulture prodcue to and from Srinagar Mandis.

- Fruits Trade – Peak Season



**Figure 5-74 Transportation Pattern of Fruits During Peak Season - Srinagar**

• Fruits Trade - Non-Peak Season



**Figure 5-75 Transportation Pattern of Fruits During Non Peak Season - Srinagar**

**Table 5-48 Type of Vehicle used for Transportation to/from Mandi**

Sr. No	Name of Mandi	Inward		Outward	
		Type	No.	Type	No.
1	Pampore	Piaggio	28	10 WL	15
		Tata 207	2	Piaggio & Tata 207	72
		6 Wheelers	5	12WL	21
		10 Wheelers	150		
2	Chattabal	Piaggio & Tata 207	208	6 WL	10
				10 WL	4
				Piaggio & Tata 207	50

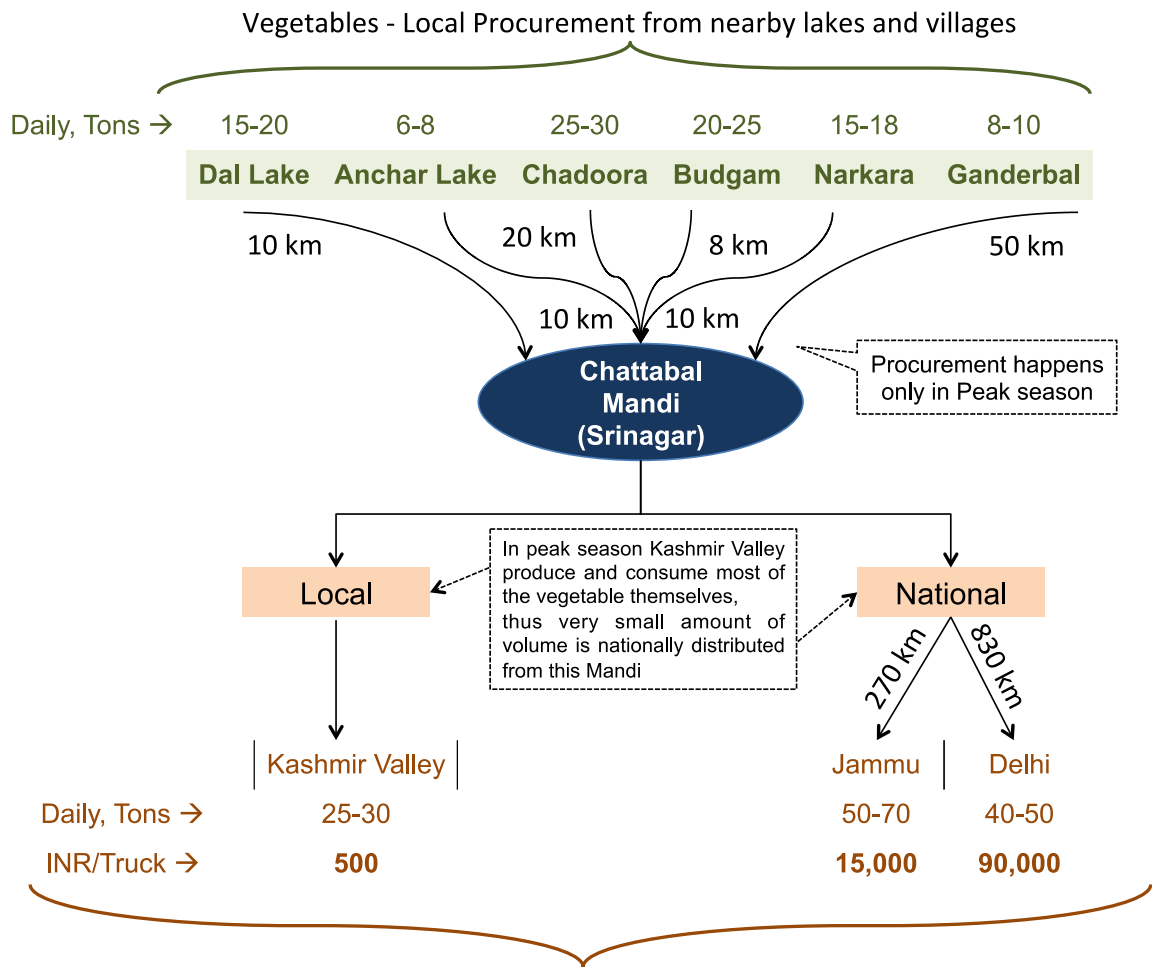
**Table 5-49 Total Volume Procured at Pampore Mandi, Srinagar**

Procured From	Annual Volume (T)	Type	Commodity
Khansahib	1,680	Local	Apples, Pears, Almonds
Chadoora	600		Apples, Almonds
Sumbal	600		Apples, Cherry
Ganderbal	600		Apples, Cherry
Outskirts of Srinagar	360		Almonds, Apples
Baramulla	30,000		Apple
Kupwara	18,000		Apple, DryFruits
Tral	12,000		Apple, Cherries
Shopian	18,000		Apple
Outside Kashmir	16,512	National	Banana, Grapes, Watermelon, Melons, Jamun, Mangoes

**Table 5-50 Total Volume Distributed from Pampore Mandi, Srinagar**

Distributed to	Annual Volume (T)	Type	Commodity
Bangalore	12,000	National	Apples
Nashik	12,000		
Gujarat	9,600		Apples, walnut, cherry, Almonds
Jammu	20,400		
Delhi	14,400		
Srinagar	7,200	Local	Apples, Banana, grapes, watermelon, melons, jamun, mangoes
Budgam	5,280		
Ganderbal	5,280		
Magam	2,880		

- Vegetables Trade



**Figure 5-76 Transportation Pattern of Vegetables - Srinagar**

**Table 5-51 Total Volume Procured at Chattabal Mandi, Srinagar**

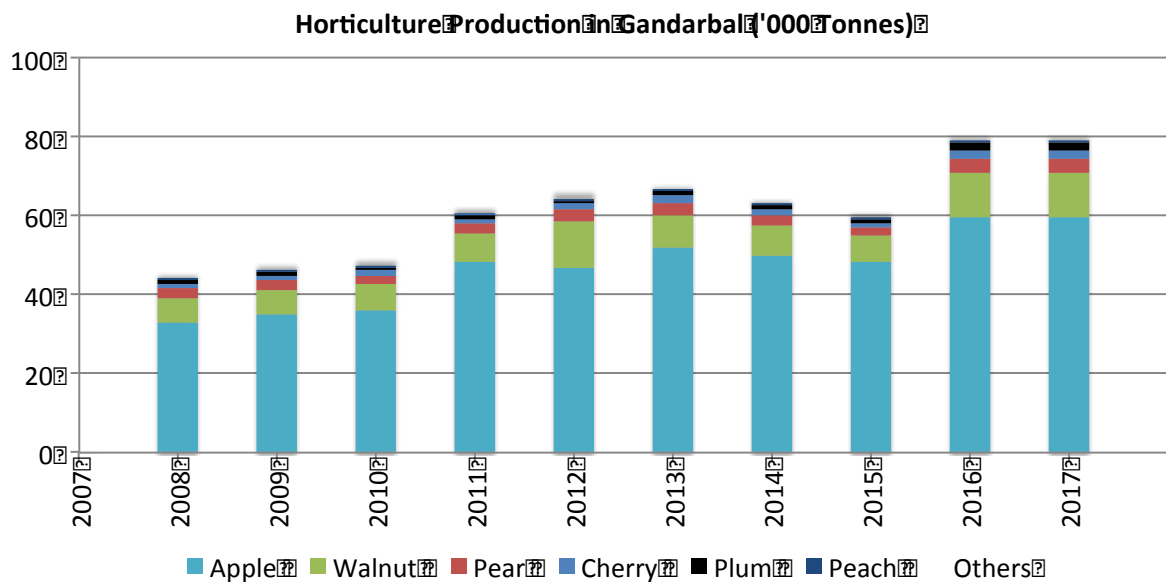
Procured From	Annual Volume (T)	Type	Commodity
Dal lake	9,600	Local	Lotus stem(Nadru), Green Leafy Vegetables, Tomatoes, Beans, Fenugreek, Raddish, Carrot
Aanchar lake	3,600		Lotus stem(Nadru), Green Leafy Vegetables, Tomatoes, Beans
Chadoora	13,200		Lotus stem(Nadru), Green Leafy Vegetables, Tomatoes, Beans, Cauliflower, Cababage, Carrots, Raddish, Gourd, Pumpkin
Budgam	9,600		Lotus stem(Nadru), Green Leafy Vegetables, Tomatoes, Beans, Cauliflower, Cababage, Garlic, carrots, Raddish, Gourd, Pumpkin
Naarkara	9,600		Lotus stem(Nadru), Green Leafy Vegetables, Tomatoes, Beans, Cauliflower, Cababage
Ganderbal	4,320		Lotus stem(Nadru), Green Leafy Vegetables, Tomatoes, Beans, Cauliflower, Cababage

**Table 5-52 Total Volume Distributed from Chattabal Mandi, Srinagar**

Distributed to	Annual Volume (T)	Type	Commodity
Kashmir Valley	21,600	Local	Lotus stem(Nadru), Green Leafy Vegetables, Tomatoes, Beans, Cauliflower, Cababage, Garlic, Carrots, Raddish, Gourd, Pumpkin
Jammu	11,040	National	Lotus stem(Nadru), Green Leafy Vegetables, Tomatoes, Beans, Cauliflower, Cababage, Garlic, Carrots, Raddish, Gourd, Pumpkin
Delhi	12,000		Tomato, Potatoes, Cabbage, Cauliflower, Onion, Spinach

- Ganderbal

The horticulture production has been rising in Ganderbal. The annual production has increased from about 60,000 tonnes in the year 2015 to 80,000 tonnes in the year 2017. This constitutes around 5% of annual horticultural produce of Kashmir valley and around 8% of annual horticulture produce in the hinterland of River Jhelum. A share of local produce gets consumed locally and in the regions, rest is trade outside Kashmir using roadways.



**Figure 5-77 Horticulture Production in Ganderbal in last 15 Years ('000 Tonnes)**

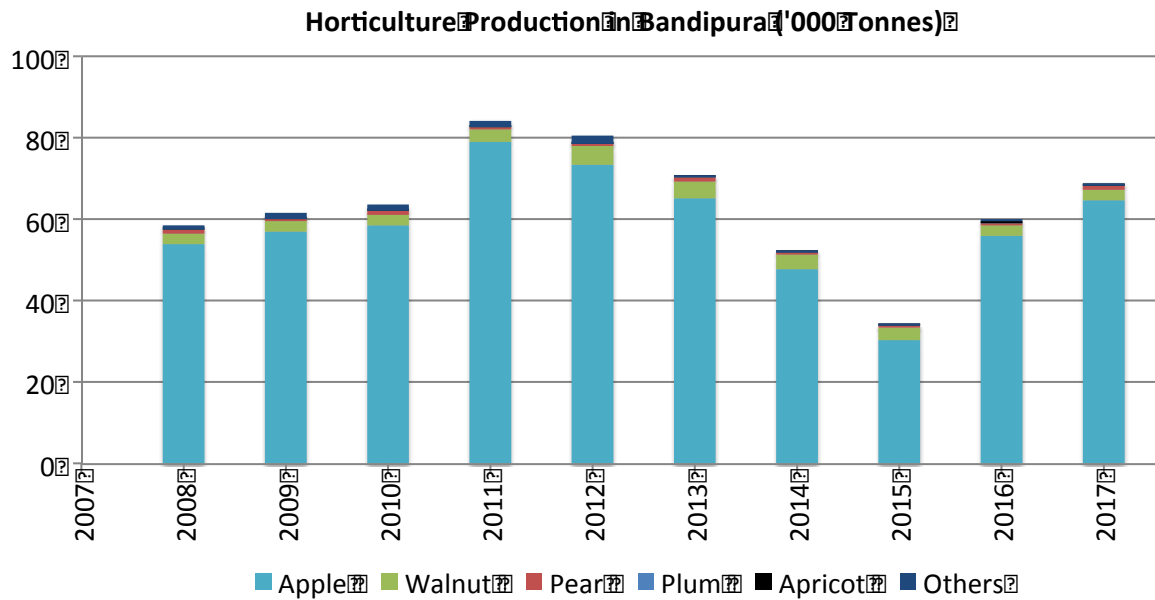
Source: Directorate of Horticulture, J&K



**Figure 5-78 Mapping of Villages with Horticulture Production – Ganderbal District**

- Bandipora

The average annual Horticulture production in Bandipora is about 60,000 tonnes . This constitutes less than 4% of annual horticultural produce of Kashmir valley and around 7% to 8% of annual horticulture produce in the hinterland of River Jhelum. A share of local produce gets consumed locally and in the regions, rest is trade outside Kashmir using roadways.

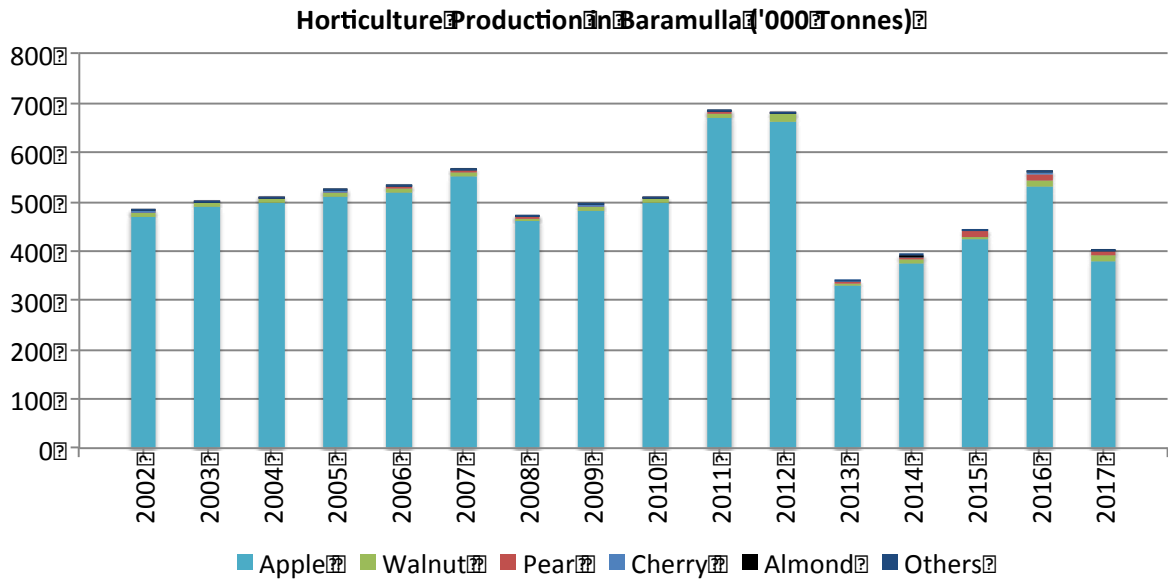


**Figure 5-79 Horticulture Production in Ganderbal in last 15 Years ('000 Tonnes)**

Source: Directorate of Horticulture, J&K

- Baramulla

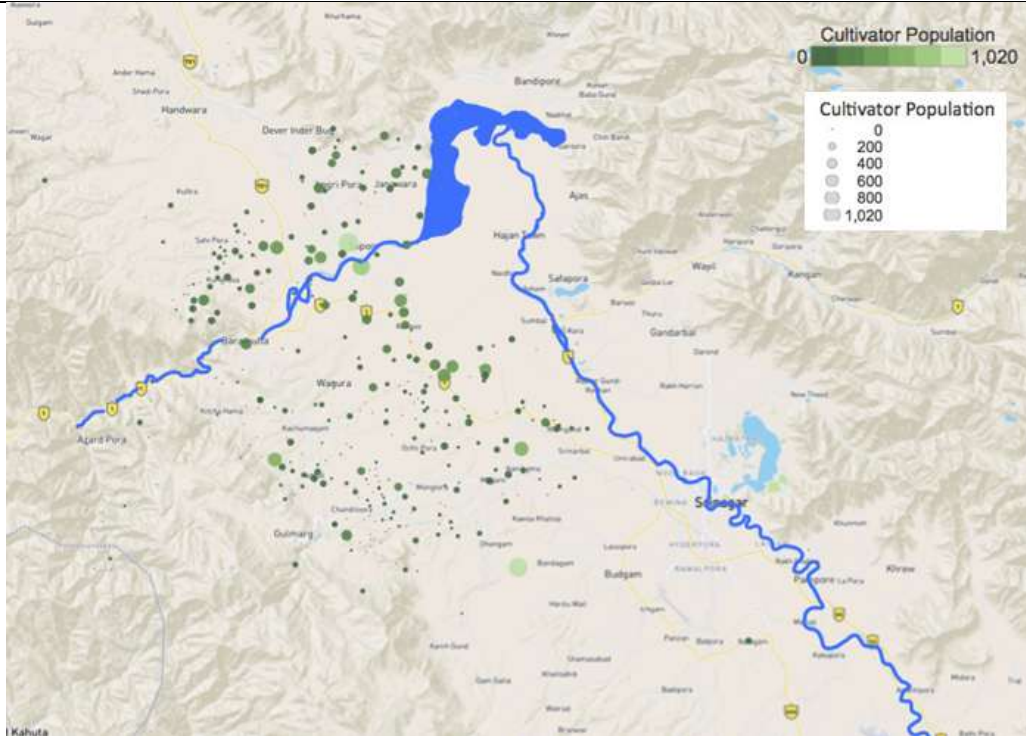
Baramulla is the largest producer of horticulture products. Its annual horticulture production is about 0.5 million. It has been contributing close to 35% of total horticulture produce in Kashmir for the last 15 years and 50% of total horticulture produce in the hinterland of River Jhelum during the same period.



**Figure 5-80 Horticulture Production in Baramulla in last 15 Years ('000 Tonnes)**

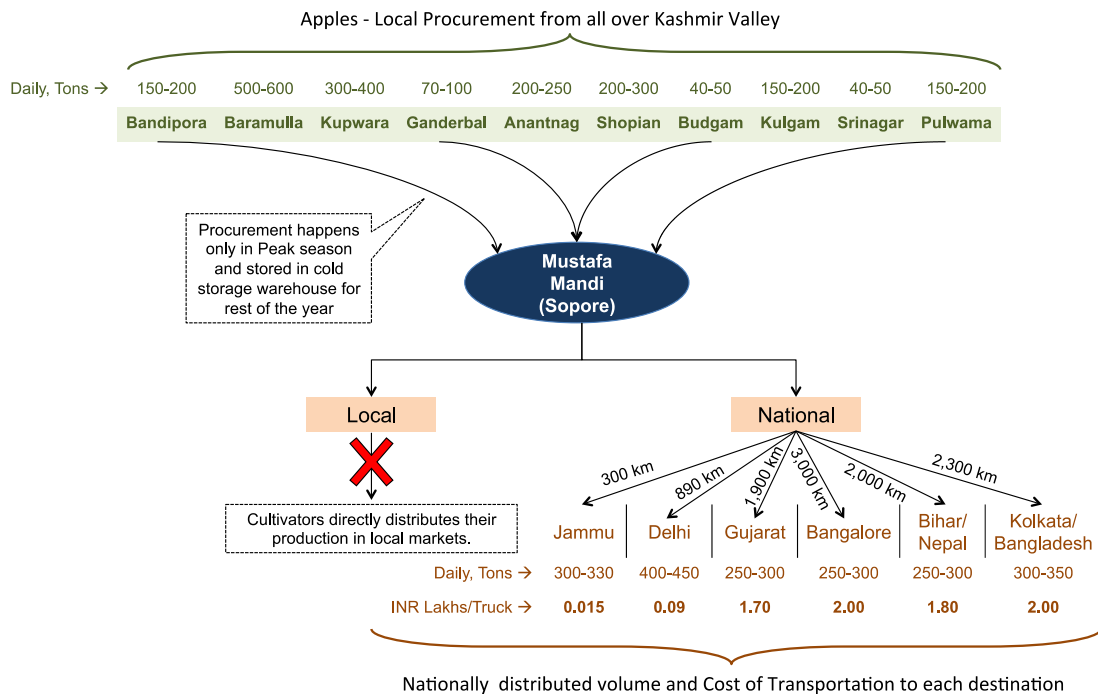
Source: Directorate of Horticulture, J&K

Baramulla is also the largest district in hinterland of River Jhelum spread over up to line of control in the west. The villages are spread out in Baramulla over a larger area. The district has highest number of Mandis and other storage infrastructure for horticulture produce. The cold storage has been developed in supore, Baramula. This area has densely populated village and are located closer to the River Jhelum. The produce of horticulture is accumulated and stored in local mandis before traded to other states of India using roadways. The waterways stretch of River Jhelum is limited till Anantnag. Hence there is no scope for shifting trade which is going to other states of India from Baramulla district to Jhelum. The waterway becomes redundant for trades to other states of India.



**Figure 5-81 Mapping of Villages with Horticulture Production – Baramulla District**

A small component of produce from Baramulla comes to Srinagar mandi for local consumption. Some of it is aggregated along with produce from other parts of Kashmir before being dispatched to other states of India. The volume of such trade constitute a small volume. The possibility of shifting such small quantities could be evaluated subject to development of River and mechanism to negotiate bad terrain connecting Baramulla with using Jhelum to Wular lake



**Figure 5-82 Transportation Pattern of Apples – Mustafa Memorial Fruit Mandi**

The above figure shows that apples are procured from mandis of Bandipora, Baramulla, Kupwara, Ganderbal, Anantnag, Shopian, Budgam, Kulgam, Srinagar and Pulwama for national distribution. These mandis send their apple production to Mustafa Memorial Fruit Mandi in Sopore for national distribution, in states like Jammu, Delhi, Gujarat, Bangalore, Bihar and Kolkata. Apples from Mustafa Mandi are also exported to Nepal and Bangladesh. Mustafa Mandi is not used for local consumption of apples. Mandis from Bandipora, Baramulla, Kupwara, Ganderbal, Anantnag, Shopian, Budgam, Kulgam, Srinagar and Pulwama sell apples in local markets also.

**Table 5-53 Type of Vehicle used for Transportation to/from Mandi**

Sr. No	Name of Mandi	Inward		Outward	
		Type	No.	Type	No.
1	Sopore	6 WL, Piaggio & Tata 207	490	10 WL & 12 WL	120

**Table 5-54 Total Volume Procured at Mustafa Memorial Fruit Mandi, Sopore**

Procured From	Annual Volume (T)	Type	Commodity
Bandipora	54,000	Local	Apples
Baramula	1,29,600		
Kupwara	86,400		
Ganderbal	21,600		
Anantnag	64,800		
Shopian	64,800		
Budgam	32,400		
Kulgam	32,400		
Srinagar	10,800		
Pulwama	32,400		

The above table shows total volume of apples procured by Mustafa Memorial Fruit Mandi from mandis of Bandipora, Baramulla, Kupwara, Ganderbal, Anantnag, Shopian, Budgam, Kulgam, Srinagar and Pulwama. These volumes of apple is sent for national distribution from Mustafa Memorial Fruit Mandi in Sopore. Baramulla sends the highest volume of apples, i.e. 1,29,600 T to Mustafa Mandi.

**Table 5-55 Total Volume Distributed from Mustafa Memorial Fruit Mandi, Sopore**

Distributed to	Annual Volume (T)	Type	Commodity
Jammu	75,600	National	Apple
Delhi	1,13,400		
Gujrat	56,700		
Banglore	56,700		
Bihar/Nepal	75,600		
Kolkata/Bangladesh	75,600		

Table 5-56 shows volumes of apples distributed and exported from Mustafa Memorial Fruit Mandi to states like Jammu, Delhi, Gujarat, Bangalore, Bihar and Kolkata. A portion of total volume of apples sent to Bihar and Kolkata is exported to Nepal and Bangladesh.

**Table 5-56 Total Traffic Handled at Major Mandis of Kashmir Valley**

Volume Handled (MTPA)		Pampore	Chattabal	Sopore
Procurement	Local	81,840	49,920	5,29,200
	National	16,512	-	-
	<b>Total</b>	<b>98,352</b>	<b>49,920</b>	<b>5,29,200</b>
Distribution	Local	20,640	12,000	-
	National	68,400	32,640	4,53,600
	<b>Total</b>	<b>89,040</b>	<b>44,640</b>	<b>4,53,600</b>

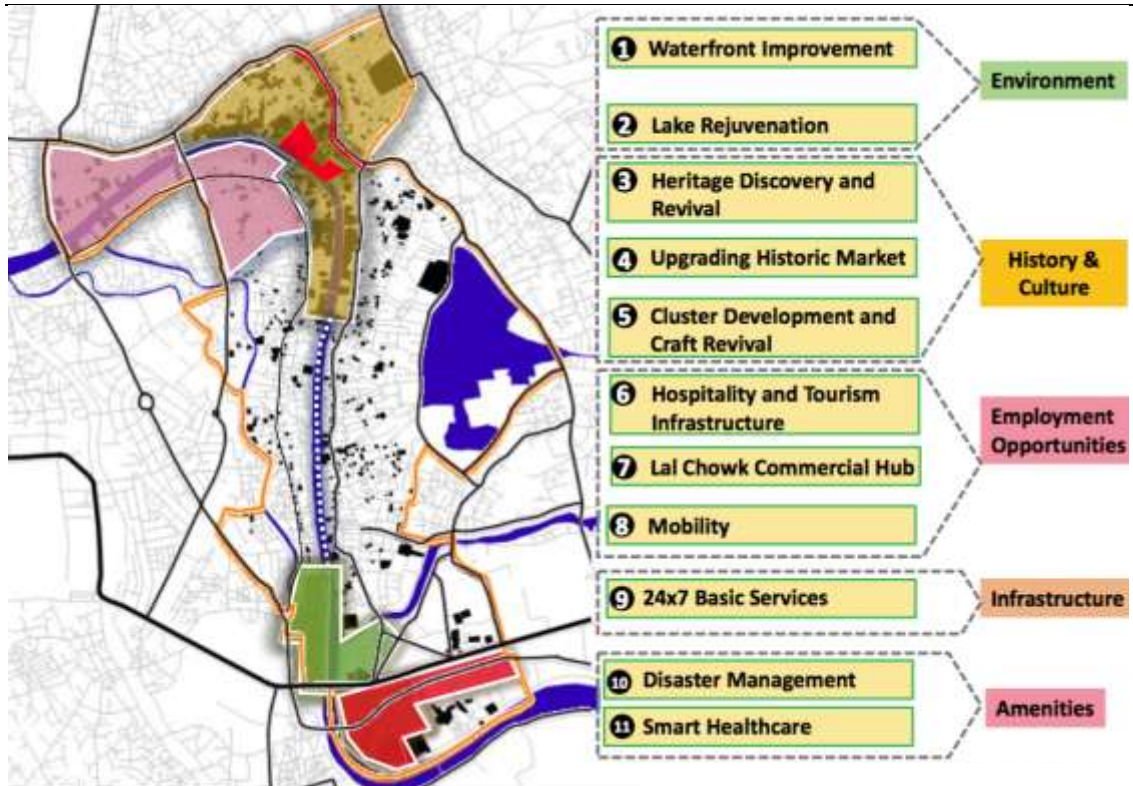
## 5.17 Growth Trends - Development Plans by J&K Government

### Srinagar Smart City Project

The Government of India (GoI) included Jammu and Srinagar for creation of smart cities in June 2017. The planning activities for the same is understood to have started in Srinagar. Smart city development would include extending planning of the transport network and mobility solutions for residents of Srinagar.

A Special Purpose Vehicle (SPV) for the smart city project has been created and named it as Srinagar Smart City Limited (SSCL). Some of the prominent tasks included in the Smart City Project of Srinagar includes

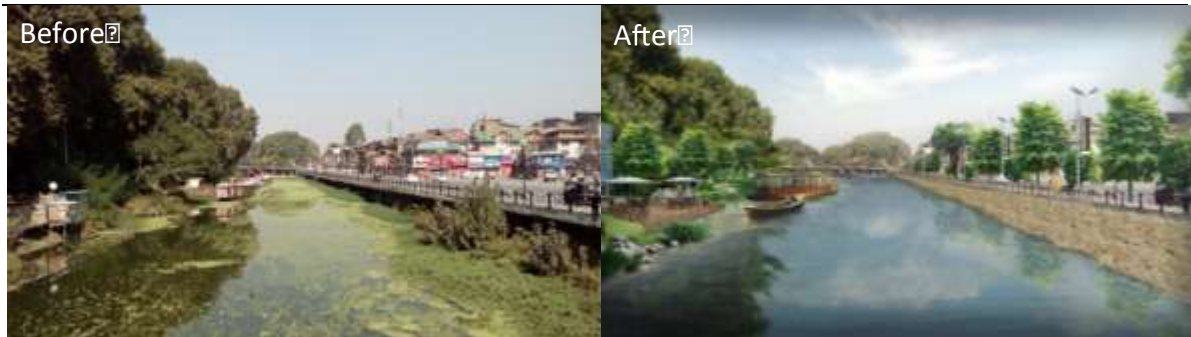
- Development of Metro Rail Network in City
- Restoration of heritage buildings
- Beautification of the Jhelum waterfront
- Dredging the river and removing silt
- Improvement of the Jhelum ghats
- Embankments and area illumination along riverbanks
- Creation of pathways and cycle tracks along Bund Road
- Water transport terminal for boats and shikaras
- Installation of biodigestors/interceptors for managing waste water
- Eco-Sewage Treatment Plant.



Source: Srinagar Municipal Corporation, Smart City Project  
 Figure 5-83 Area Based Development in Srinagar – Type of Development



Source: Srinagar Municipal Corporation, Smart City Project  
 Figure 5-84 Area Based Development of Srinagar City



Source: Srinagar Municipal Corporation, Smart City Project  
Figure 5-85 Jhelum River Development Plan



Source: Srinagar Municipal Corporation, Smart City Project  
Figure 5-86 Jhelum River Front Improvement Plan

### Master Plan of Srinagar 2035

Srinagar Development Authority has commissioned development of Master Plan for the city of Srinagar. The authorities have undertaken intensive planning for transportation infrastructure of Srinagar in the Master Plan. This includes development of Smart transportation including waterways using Jhelum River. Most of the commercial installation, government offices, private installations, schools, colleges, hospitals, etc are located on the banks of the River Jhelum. Some of the most densely populated regions of Srinagar are also located on the banks of the River Jhelum. Narrow roads with rising population and vehicles have led to large scale congestion on the roads of Srinagar. It is difficult to expand these roads due to existence of buildings, offices and historic structures. Hence, water transport as an alternative mode of commuting is being evaluated in the Srinagar. Approaching the installations of basic

needs and tourism importance could be easily accessed using waterways facing less congestion.

### Wular Lake Development Plans

The Government of Jammu & Kashmir has assigned the job of preparing a Comprehensive Management Action Plan (CMAP) in order to conserve Wular Lake to M/S Wetlands International- South Asia in 2006-07.

The action plan on Wular Lake emphasizes on development of effective institutional mechanism for conservation and management of the Lake within Jhelum Basin. The action plan also emphasizes the requirement of removal of Ningli (willow) plantations spread over an area of 27.30sq. km. This will enhance water holding capacity and improvement of overall water regimes of Wular. The action plan envisages dredging of an area of 27.72 Sq.Kms for enhancement of water holding capacity of the lake. To develop tourism, it is proposed to beautify Wular Lake with an "eco-friendly" Boulevard along its periphery at a cost of INR 276.474 Crores in Phase-III. The CMAP proposes development of a comprehensive ecotourism plan with a detailed zoning plan of Wular Lake, surrounding marshes and catchment areas. The proposed tourist activities are for bird watching, water sports, fish angling etc. It is also proposed to develop tourist infrastructure near the lake. Some of the prominent components included in Wular Lake Development Plan include

- Land and Water Management
- Catchment Conservation
- Water Management
- Bio-diversity Conservation
- Eco-tourism Development

With allocations for implementation of the project getting restricted for the time being to INR 120.00 Crores, work components under CMAP were revised and Management Action Plan was drawn as shown in the table below

**Table 5-57 Revised Plan for Implementation of CMAP**

Component	As Per Comprehensive Management Action Plan (Rs in Crores)	As Per Revised Plan Under 13th FCA (Rs in Crores)
Land and Water Management		
- Survey & Demarcation	2.25	2.25
- Catchment Conservation	37.32	24
- Water Management	279.96	91.8
Bio-diversity Conservation	13.72	0
Eco-tourism Development	11.45	0
Sustainable Resource Dev. & Livelihood Improvement	25.79	0
Institutional Development	15.9	1.95
<b>Total</b>	<b>386.39</b>	<b>120</b>

Source: Revised Management Action Plan (RMAP) (Wular Lake)

## 5.18 Forecasting and Potential IWT Assumptions

This chapter summaries and quantifies market opportunity in river transportation. It contains future projection of traffic for transportation of passengers, tourists and cargo for year 2022, 2027, 2037 and 2047.

### Terminal Locations

The terminal locations have been described in the map shown in Figure 5-87 and Table 5-. These terminals have been identified based on the market survey and analysis of the needs of local economy and population. There is an urgent need for developing passenger terminals for promoting passengers and tourists on river Jhelum. 3 terminals have been identified for cargo as well. However, not enough cargo was found during market analysis and survey to justify these 3 cargo terminals. These proposed cargo terminals could be finalised after stakeholder discussion and feed back from them. 8 terminals at judicious locations have been identified and proposed. Volume of passengers and tourists are available to use these terminals. However, the water transport would have to match the transportation price offered road and railways to shift passengers. Tourists are quite keen to use the river transportation during their visit to Srinagar and Kashmir.

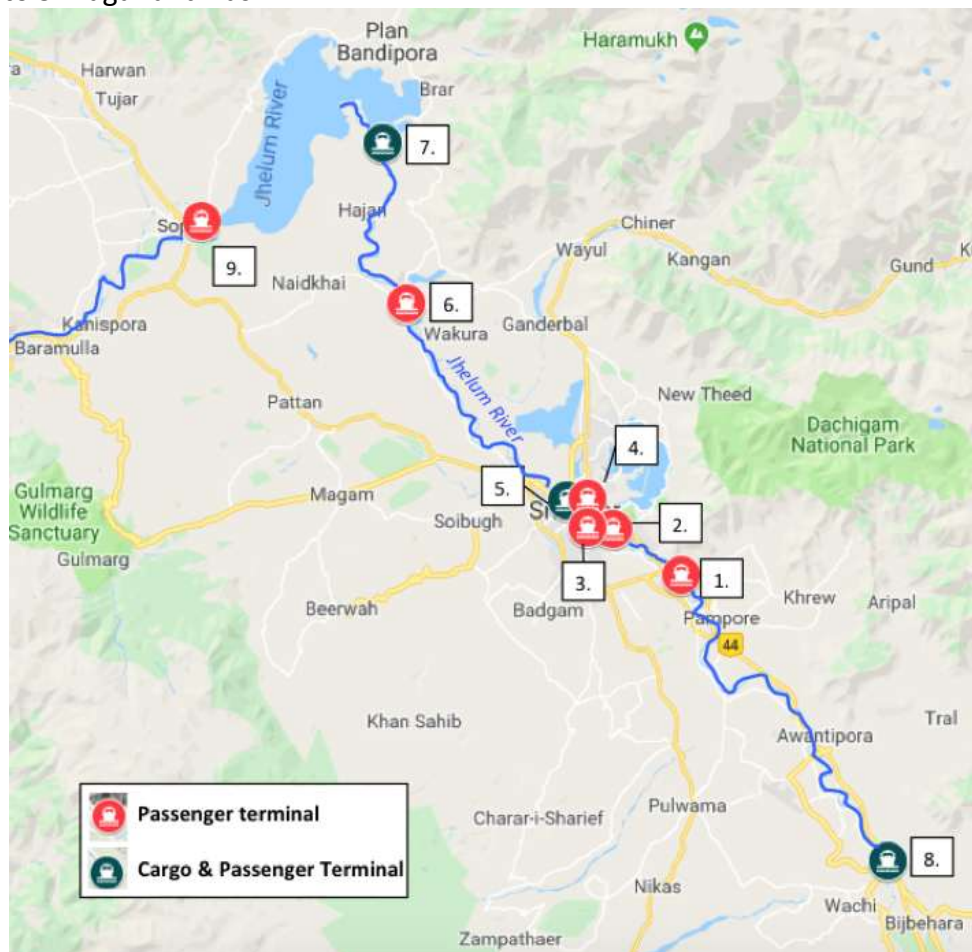


Figure 5-87 Tentative Terminal Locations on River Jhelum for Passenger and Cargo

**Table 5-58 List of Tentative Terminal locations**

Terminal No.	Tentative Location	Districts	Chainage (km)	Purpose
1	Pantha Chowk	Srinagar	62.00	Passenger
2	Zero Bridge	Srinagar	51.76	Passenger
3	Amira Kadal	Srinagar	49.39	Passenger
4	Shah-e-Hambam bridge	Srinagar	46.50	Passenger
5	Safa Kadal / Chattabal Shrine	Srinagar	44.00	Cargo, Passenger
6	Sumbal Bridge	Ganderbal	88.3	Passenger
7	Gund Prang	Bandipora	20.80	Cargo, Passenger
8	Sangam Bridge	Anantanag	2.09	Cargo, Passenger
9	Sopore Bridge	Baramulla	38.5	Passenger

Source: Consultant

Following is the description of all the terminals and reasons for selecting them.

#### 1. Pantha Chowk

Pantha Chowk is located on the outskirts of Srinagar. It is the famous place for tourism, many artisans are found exhibition and selling their work on the banks of river. Also it is very nearby to the most of busiest railway station i.e Nawgon (Srinagar) Railway station. Visitors of Kashmir valley passes by this location, that creates huge footfalls on the location. Pantha Chowk also has a large bus depot. Hence, developing a terminal at Pantha chowk provides opportunities for people entering into Srinagar either through road or railways use river transport for local last mile connectivity. It has been surveyed and concluded by Government of J&K that 80% of the population uses public transport. Hence, development of passenger terminal at Pantha chowk would provide local population one more medium and choice of transportation.

#### 2. Zero Bridge

Zero bridge is the most ancient bridge in Srinagar. Building terminal here will experience heavy traffic because lot many tourist spots are situated nearby. It was constructed by wood around 65 years back. It is still maintained in same way. Tourist flow at this location is high due to this bridge and other attracting facilities located nearby like restaurants, herigate places, gardens and parks, etc. Government started water transport service a few years back from this location. It was a great success and boats were running with 100% utilisation. It stopped during low water season. Reviving this would be a great success.

#### 3. Amira Kadal

Amira Kadal is located next to one of the most busiest location i.e Lal Chowk. Lal chowk is the oldest retail and wholesale market with numerous shops and stores. This market being connected to the heritage places, markets, schools and university accomodates heavy traffic. It is not not only the commercial hub of srinagar but also holds the historical significance of srinagar. This location witnesses maximum number of foot fall during working as well as non working hours. This is also closer to one of the busiest

city buss stop called Jahangir chowk. Several government establishment including high courts are located in this region. Developing terminal here would cater every type of passengers like working class people, residents, students and business people.

#### 4. Shah-e-Hambam Bridge

This terminal is proposed between new Zaina Kadal bridge and old Fateh Kadal bridge. This place is known for old residential buildings. There is already a big and established terminal there. Heavy population resides on both the side of the river. People travelling to northern and southern region of Jhelum river using roadways can be diverted to this terminal. This terminal could handle passengers as well as tourists. The existing terminal can be seen in the fig.5.88.



**Figure 5-88 Existing Passenger Terminal at Shah-e-Hambam**

#### 5. Safa Kadal / Chattabal Shrine (Weir)

Safa Kadal bridge is located in between the two major mandis of Srinagar i.e Pampore and Chattabal. These are the mandi where local cultivators come with their produce (Fruits and vegetables) for distribution in and outside Kashmir. Peak season witness heavy footfalls at this location because of huge rush in these mandis. Workers of nearby markets comes to these mandi every morning to load their vehicle for trade. Passenger movement to and from this location is also high.

#### 6. Sumbal Bridge

It is the only proposed terminal in Ganderbal district. Working class and school/college going people from Ganderbal travel daily to Srinagar. Srinagar is the nearest commercial hub and well developed city. They could also visit Wular Lake using water

transportation. Residents of Ganderbal district would use this terminal to travel to both way i.e Srinagar and Wular.

#### 7. Gund Prang

Last terminal is proposed near Wular lake for cargo and passenger both. Wular lake has heavy vegetation in and around. Development of cargo terminal would enable transportation of vegetables to hinterland of Jhelum river using waterway. Srinagar city would be the maximum beneficiary of this mode of transportation. This terminal would enable connecting tourism industry with waterway. A large population of tourists visit Wular lake using roadways. This terminal would enable additional mode of transportation for them. The people residing nearby Wular lake and Bandipore could also use this terminal to reach Srinagar.

#### 8. Sangam Bridge

This location falls in Anantnag district, it is one of the most populated place in Kashmir valley. People residing in and around this location travels to Srinagar on daily basis. Also small markets located nearby to this location are connected to Major mandis of Srinagar. This cargo traffic, which is presently moving on roads, could be shifted to proposed waterways in future. Apart from cargo, local residents of this location working in Srinagar city also generates future traffic for proposed route. There exist potential for tourism as well using this terminals.

#### 9. Sopore Bridge

The proposed Terminal 9 is located in Baramulla district on the downstream of Wular Lake, adjacent to Sopore Bridge. This district is blessed with scenic beauty, with round the year tourist visits. In winters, snow sports are very popular that attracts huge number of tourists. Gulmarg and Khadniyar are the most well-known tourist place that are located within 40 kms of the proposed terminal in Sopore. Visitors of Srinagar and Wular lake, continues their trip towards Baramulla. This traffic, which is presently moving on roads and railways, could be shifted to river Jhelum in future once terminal 9 gets operational. Proposed terminal in Sopore would connect Baramulla with other districts like Bandipore, Ganderbal, Srinagar and Anantnag by River Jhelum and enable linking the tourism industry with waterways.

**Table 5-59 Location identification for terminal development – Reasoning**

T. No.	Tentative Location	Type	Purpose of Selection
1	Pantha Chowk	Passenger	<ul style="list-style-type: none"> <li>• Busiest railway station i.e. Nawgon (Srinagar) and bus depot i.e. Pantha Chowk are located very nearby creating huge footfalls at the location.</li> <li>• River transportation would be opted as last mile connectivity by the arrivals at this location.</li> <li>• This location is selected for terminal development also on the basis of User's preference survey.</li> </ul>
2	Zero Bridge	Passenger, Tourism	<ul style="list-style-type: none"> <li>• Zero Bridge is one the most attractive place in the hinterland and surrounded by lot many tourist spots.</li> </ul>

T. No.	Tentative Location	Type	Purpose of Selection
			<ul style="list-style-type: none"> <li>Water transportation service started in 2014 was a great success and boats were running with 100% utilisation. It stopped later on, however reviving this would be a great success.</li> </ul>
3	Amira Kadal	Passenger, Tourism	<ul style="list-style-type: none"> <li>Amira Kadal is located next to Lal Chowk (cluster of markets, shops and stores) and Jahangir Chowk (busiest bus depot).</li> <li>Location witnesses huge number of foot falls (passenger and tourism) throughout the day</li> </ul>
4	Shah-e-Hambam	Passenger, Tourism	<ul style="list-style-type: none"> <li>There already exists a big and established terminal, so IWAI just need to start service over here.</li> </ul>
5	Safa Kadal / Chattabal Shrine	Cargo, Passenger, Tourism	<ul style="list-style-type: none"> <li>Location is in between the two major mandis of Srinagar. Peak season witness the huge footfalls of traders for procurement and distribution.</li> <li>Passenger movement to and from this location is also high.</li> </ul>
6	Sumbal Bridge	Passenger	<ul style="list-style-type: none"> <li>Residents travel to Srinagar on daily basis for work and education, because Srinagar is the nearest commercial hub.</li> <li>Commuters of Ganderbal would use this terminal to travel to both way i.e. Srinagar and Wular.</li> </ul>
7	Gund Prang	Cargo, Passenger, Tourism	<ul style="list-style-type: none"> <li>Wular Lake has heavy vegetation in and around, and this production gets transported to mandis of Srinagar for further distribution by roadways at present.</li> <li>Wular Lake is also the biggest tourist spot in the entire Kashmir, attracting huge tourists.</li> <li>Proposed Wular – Srinagar route would connect tourism industry with waterway.</li> <li>Nearby local residents would get additional mode of transportation to reach Srinagar. Could also use this terminal to reach Srinagar.</li> </ul>
8	Sangam Bridge	Cargo, Passenger, Tourism	<ul style="list-style-type: none"> <li>Nearby residents (South Pulwama and north Anantnag) travel to Srinagar on daily basis.</li> <li>Daily cargo movement between nearby small markets and Major Mandis of Srinagar.</li> <li>Tourist flow between Srinagar and Anantnag has been observed during field visit</li> </ul>
9	Sopore Bridge	Passenger, Tourism	<ul style="list-style-type: none"> <li>One of the most famous place of kashmir i.e Gulmarg is located within 40kms of proposed terminal. Round the year tourist inflow is observed here.</li> <li>Visitors of Srinagar and Wular could reach tourist places of Baramulla by using waterway till Sopore.</li> </ul>

### 5.19 Passenger Traffic

Srinagar is an important city and attract large population from nearby areas. Local passengers would use waterways for along the river movement, mostly for residential, business, work and education purpose. Local people and university students travel to/from Srinagar on a daily basis. 2 hours in each morning and evening are considered as Peak Hours. Movement would be more in peak hours, compared to other times of the day.

People who reside near Wular Lake, Ganderbal, Pulwama and Anantnag also visit Srinagar on a regular basis. Students and working class people also visit Srinagar. Apart

from people who go to school, offices and commercial areas of Srinagar, rural people also go to major mandis located in Srinagar and Pulwama.

Srinagar is the Summer capital of Kashmir. During winter season (Nov- March), offices shift to Jammu. This reduces work based movement in Srinagar. Considering the present passenger movement, we can assume that once waterway is developed, these passengers could be shifted to waterway.

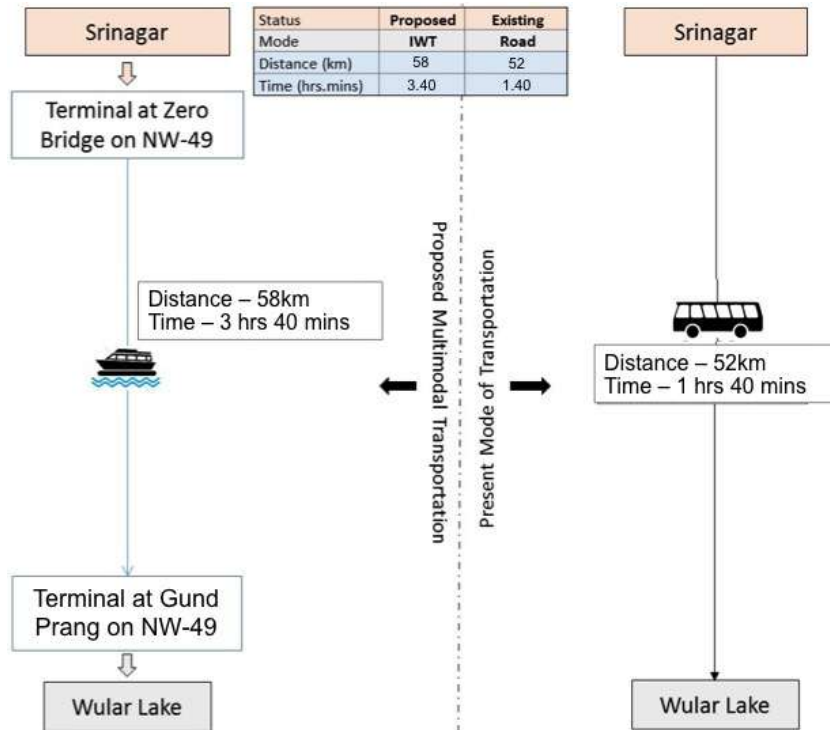


Figure 5-89 Time-Distance Comparison for Srinagar – Wular Route: Passenger

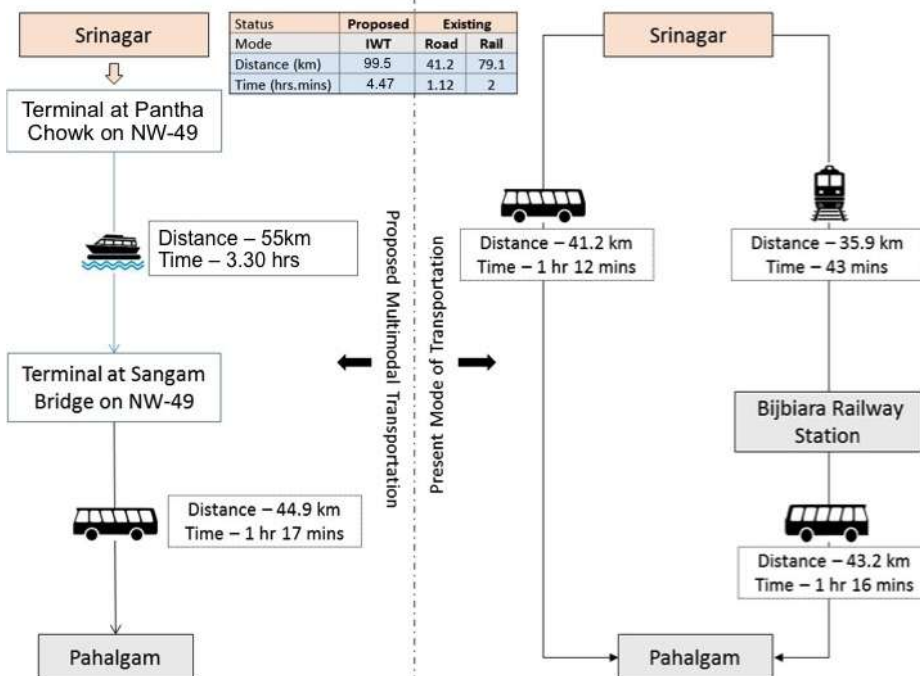
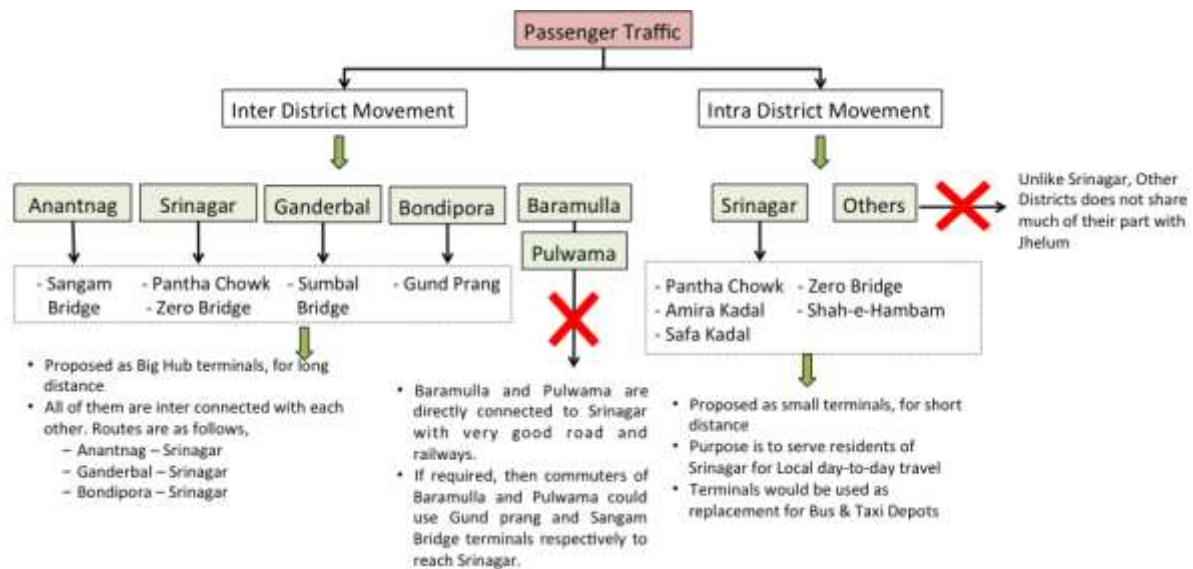


Figure 5-90 Time-Distance Comparison for Srinagar – Pahalgam Route: Passenger

- Assumptions

The figure below depicts the methodology behind selecting the route and terminal for passenger movement on River Jhelum. Total 9 terminals are proposed for passenger movement, out of which, 5 terminals would be developed as hub terminals. These hub terminals would handle passengers travelling to long distance. Capacity, size and engine power of the vessel would be designed according to the estimated traffic, targeted to be handled at the terminals and travel distance on the waterway. The main users of the proposed service would be commuters travelling from Anantnag, Pulwana, Ganderbal and Bondipora to Srinagar on daily basis for work or education purpose.



**Figure 5-91 Methodology for terminal selection and passenger traffic forecast**

At present, local residents use government/ private buses and Taxi/Sumo to travel from one place to another within Srinagar city. Srinagar, being the center, has all the utilities and infrastructure, like schools and colleges, commercial centers, industries, trade centers, Government offices. The city is highly populated and there is high demand of public transportation. There is huge congestion on roadways in Srinagar. Shifting the traffic to waterways on River Jhelum would solve the problem of congestion on roadways. For this local transportation, 5 terminals as mentioned above (2 hub terminals and 3 other terminals) are proposed. Local residents would be the main users of this service.

Schools/colleges, mandis/markets, Government offices/departments, etc. are fully functional during Peak and Moderate season (April to October). Traffic flow would be same in both the seasons, i.e. for 7 months. But in non-peak season, i.e. from November to March, the entire capital of Kashmir, along with all government departments, gets shifted to Jammu for 5 months. This non-peak season is winter season and due to extreme cold weather, roads freeze and residents face trouble. Roadways are not operational in winters. Schools/colleges, market places also remain

closed for some time during winter. Passenger movement decreases in the non-peak season.

**Table 5-16 % Share of Traffic Diversion from Existing mode to IWT**

% share of diversion from tourist traffic in the hinterland	
Tourism Traffic (as per FY17)	Local Traveller
Local Sailing - Srinagar	3%
Wular Lake - Srinagar	5%
Srinagar - Sangam Bridge	2%

Source: Consultants analysis

**Table 5-61 % Growth in Traffic under different Scenarios**

Scenarios	2022	2027	2037	2047
Optimistic Scenario	3%	3%	3%	3%
Realistic Scenario	3%	2%	2%	2%
Pessimistic Scenario	3%	1%	1%	1%

Source: Consultants analysis

The table above shows the share of existing passenger traffic likely to be diverted to the proposed waterway. Traffic for proposed route and terminals are generated by applying these % share on the existing traffic generated by field study. Projection of Passenger traffic is done for next 30 years, under three different scenarios - Optimistic, Base growth & Pessimistic. In traffic projections, various factors are taken into consideration like profiling of population, analysis of hinterland, need for infrastructure to improve connectivity in the region, analysis of pilot case of IWT on Jhelum River in 2014. The major growth drivers of the proposed IWT in River Jhelum are population growth in the hinterland, growth in economy of the region, increase in transportation demand for along and across the river movement. These growth drivers are also considered for projecting traffic growth in future.

- **Optimist Scenario**

In Optimistic scenario, Srinagar and surrounding region has developed, this has increased local population and passenger traffic. Increased population and congested roadways and railways. It is assumed that waterways would be convenient and cheaper. More people would be willing to shift from their existing mode of road transportation to waterways.

In future, political stability in the region would also positively impact the traffic. Waterway would be considered a safer and cheaper mode of transportation. This would attract more passengers in future. Large volume of tourists would visit Srinagar on a sustainable basis leading to higher foot fall of tourist. The tourists would like to use waterways and enjoy natural beauty of Jhelum and Surrounding areas.

- Traffic Projections for Hub Terminals

**Table 5-62 Terminal wise traffic for inter-district Travel: Optimistic**

Optimist Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)				
Sumbal Bridge	12	16	28	69
Pantha Chowk	182	244	393	816
Zero Bridge	110	147	234	476
Sangam Bridge	186	250	372	674
Gund Prang	116	156	282	686
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)				
Sumbal Bridge	12	16	28	69
Pantha Chowk	182	244	393	816
Zero Bridge	110	147	234	476
Sangam Bridge	186	250	372	674
Gund Prang	116	156	282	686
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)				
Sumbal Bridge	5	7	12	29
Pantha Chowk	58	80	132	285
Zero Bridge	34	47	76	161
Sangam Bridge	48	66	100	182
Gund Prang	48	66	120	292
Total Annual Traffic ( Passengers)				
Sumbal Bridge	2,604	3,546	6,426	15,642
Pantha Chowk	36,756	49,932	81,468	171,684
Zero Bridge	21,900	29,742	47,886	98,814
Sangam Bridge	35,220	47,760	71,520	129,720
Gund Prang	26,040	35,460	64,260	156,420
<b>Total Annual Passengers</b>	<b>122,520</b>	<b>166,440</b>	<b>271,560</b>	<b>572,280</b>

- Traffic Projections for Small Terminals

**Table 5-63 Terminal wise traffic for intra-district Travel: Optimistic**

Optimist Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)				
Pantha Chowk	52	84	183	444
Zero Bridge	70	113	247	600
Amira Kadal	64	105	229	555
Shah-e-Hambam	34	55	119	289
Safa Kadal / Chattabal Shrine	39	63	138	333
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)				

Optimist Scenario	2022	2027	2037	2047
Pantha Chowk	52	84	183	444
Zero Bridge	70	113	247	600
Amira Kadal	64	105	229	555
Shah-e-Hambam	34	55	119	289
Safa Kadal / Chattabal Shrine	39	63	138	333
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)				
Pantha Chowk	13	21	47	113
Zero Bridge	18	29	63	152
Amira Kadal	16	27	58	141
Shah-e-Hambam	9	14	31	73
Safa Kadal / Chattabal Shrine	10	16	35	85
Total Annual Traffic ( Passengers)				
Pantha Chowk	12,672	20,664	45,318	110,028
Zero Bridge	17,108	27,897	61,180	148,538
Amira Kadal	15,840	25,830	56,648	137,535
Shah-e-Hambam	8,237	13,432	29,457	71,519
Safa Kadal / Chattabal Shrine	9,504	15,498	33,989	82,521
<b>Total Annual Passengers</b>	<b>63,361</b>	<b>103,321</b>	<b>226,592</b>	<b>550,141</b>

- Route wise Traffic Projections

**Table 5-64 Route wise traffic projections for passengers: Optimistic**

Optimist Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)				
Local Travel Srinagar	256	417	914	2,219
Srinagar to Wular Lake	58	78	141	343
Srinagar to Sangam Bridge	93	125	186	337
Wular Lake to Srinagar	58	78	141	343
Sangam Bridge to Srinagar	93	125	186	337
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)				
Local Travel Srinagar	256	417	914	2,219
Srinagar to Wular Lake	58	78	141	343
Srinagar to Sangam Bridge	93	125	186	337
Wular Lake to Srinagar	58	78	141	343
Sangam Bridge to Srinagar	93	125	186	337
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)				
Local Travel Srinagar	64	105	231	561
Srinagar to Wular Lake	24	33	60	146
Srinagar to Sangam Bridge	24	33	50	91
Wular Lake to Srinagar	24	33	60	146
Sangam Bridge to Srinagar	24	33	50	91
Total Annual Traffic ( Passengers)				

Optimist Scenario	2022	2027	2037	2047
Local Travel Srinagar	63,360	103,320	226,590	550,140
Srinagar to Wular Lake	13,020	17,730	32,130	78,210
Srinagar to Sangam Bridge	17,610	23,880	35,760	64,860
Wular Lake to Srinagar	13,020	17,730	32,130	78,210
Sangam Bridge to Srinagar	17,610	23,880	35,760	64,860
<b>Total Annual Passengers</b>	<b>124,620</b>	<b>186,540</b>	<b>362,370</b>	<b>836,280</b>

- Realistic Scenario

Realistic scenario is based on current development plans and present trend of passenger traffic on roadways and railways. We assume that shifting roadway traffic to waterways would increase traffic in waterways on a moderate level. The growth would be moderate. The base volume has been escalated in proportion of passenger travel during previous water taxi project of government.

- Traffic Projections for Hub Terminals

**Table 5-65 Terminal wise traffic for inter-district Travel: Realistics**

Realistic Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)				
Sumbal Bridge	12	14	21	39
Pantha Chowk	182	222	332	602
Zero Bridge	110	134	200	363
Sangam Bridge	186	228	340	616
Gund Prang	116	142	212	386
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)				
Sumbal Bridge	12	14	21	39
Pantha Chowk	182	222	332	602
Zero Bridge	110	134	200	363
Sangam Bridge	186	228	340	616
Gund Prang	116	142	212	386
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)				
Sumbal Bridge	5	6	9	16
Pantha Chowk	58	72	108	197
Zero Bridge	34	42	63	115
Sangam Bridge	48	60	90	164
Gund Prang	48	60	90	164
Total Annual Traffic ( Passengers)				
Sumbal Bridge	3,156	3,882	5,802	10,566
Pantha Chowk	46,692	57,420	85,752	155,772
Zero Bridge	27,972	34,398	51,366	93,282
Sangam Bridge	46,260	56,880	84,900	153,960
Gund Prang	31,560	38,820	58,020	105,660
<b>Total Annual Passengers</b>	<b>155,640</b>	<b>191,400</b>	<b>285,840</b>	<b>519,240</b>

- Traffic Projections for Small Terminals

**Table 5-66 Terminal wise traffic for intra-district Travel: Realistics**

Realistic Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)				
Pantha Chowk	52	76	137	249
Zero Bridge	70	113	247	600
Amira Kadal	64	105	229	555
Shah-e-Hambam	34	55	119	289
Safa Kadal / Chattabal Shrine	39	63	138	333
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)				
Pantha Chowk	52	84	183	444
Zero Bridge	70	113	247	600
Amira Kadal	64	105	229	555
Shah-e-Hambam	34	55	119	289
Safa Kadal / Chattabal Shrine	39	63	138	333
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)				
Pantha Chowk	13	21	47	113
Zero Bridge	18	29	63	152
Amira Kadal	16	27	58	141
Shah-e-Hambam	9	14	31	73
Safa Kadal / Chattabal Shrine	10	16	35	85
Total Annual Traffic ( Passengers)				
Pantha Chowk	12,672	20,664	45,318	110,028
Zero Bridge	17,108	27,897	61,180	148,538
Amira Kadal	15,840	25,830	56,648	137,535
Shah-e-Hambam	8,237	13,432	29,457	71,519
Safa Kadal / Chattabal Shrine	9,504	15,498	33,989	82,521
<b>Total Annual Passengers</b>	<b>63,361</b>	<b>103,321</b>	<b>226,592</b>	<b>550,141</b>

- Route wise Traffic Projections

**Table 5-67 Route wise traffic projections for passengers: Realistics**

Realistic Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)				
Local Travel Srinagar	256	379	685	1,241
Srinagar to Wular Lake	58	71	106	193
Srinagar to Sangam Bridge	93	114	170	308
Wular Lake to Srinagar	58	71	106	193
Sangam Bridge to Srinagar	93	114	170	308

Realistic Scenario	2022	2027	2037	2047
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)				
Local Travel Srinagar	256	379	685	1,241
Srinagar to Wular Lake	58	71	106	193
Srinagar to Sangam Bridge	93	114	170	308
Wular Lake to Srinagar	58	71	106	193
Sangam Bridge to Srinagar	93	114	170	308
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)				
Local Travel Srinagar	64	95	172	312
Srinagar to Wular Lake	24	30	45	82
Srinagar to Sangam Bridge	24	30	45	82
Wular Lake to Srinagar	24	30	45	82
Sangam Bridge to Srinagar	24	30	45	82
Total Annual Traffic ( Passengers)				
Local Travel Srinagar	63,360	93,840	169,650	307,410
Srinagar to Wular Lake	15,780	19,410	29,010	52,830
Srinagar to Sangam Bridge	23,130	28,440	42,450	76,980
Wular Lake to Srinagar	15,780	19,410	29,010	52,830
Sangam Bridge to Srinagar	23,130	28,440	42,450	76,980
<b>Total Annual Passengers</b>	<b>141,180</b>	<b>189,540</b>	<b>312,570</b>	<b>567,030</b>

- Pessimistic Scenario

In Pessimistic scenario, passenger traffic would witness very less growth. After development of Waterway, it could be assumed that time and distance of transportation not be attractive enough to encourage large volume of personnels shifting to waterways. Passengers might be discouraged to use waterways, as they need to travel to the nearby terminal and then from there they would travel further by waterway. Such negative factors would be deterrant for higher growth.

- Traffic Projections for Hub Terminals

**Table 5-68 Terminal wise traffic for inter-district Travel: Pessimistic**

Pessimistic Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)				
Sumbal Bridge	12	13	16	22
Pantha Chowk	182	209	256	345
Zero Bridge	110	126	155	209
Sangam Bridge	186	217	266	359
Gund Prang	116	130	160	216
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)				
Sumbal Bridge	12	13	16	22
Pantha Chowk	182	209	256	345
Zero Bridge	110	126	155	209

Pessimistic Scenario	2022	2027	2037	2047
Sangam Bridge	186	217	266	359
Gund Prang	116	130	160	216
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)				
Sumbal Bridge	5	5	7	9
Pantha Chowk	58	67	82	111
Zero Bridge	34	39	48	65
Sangam Bridge	48	57	70	95
Gund Prang	48	54	66	90
Total Annual Traffic ( Passengers)				
Sumbal Bridge	3,156	4,266	7,722	18,786
Pantha Chowk	46,692	63,036	102,204	214,020
Zero Bridge	27,972	37,758	60,414	123,894
Sangam Bridge	46,260	62,400	93,120	168,840
Gund Prang	31,560	42,660	77,220	187,860
<b>Total Annual Passengers</b>	<b>155,640</b>	<b>210,120</b>	<b>340,680</b>	<b>713,400</b>

- Traffic Projections for Small Terminals

**Table 5-69 Terminal wise traffic for intra district Travel: Pessimistic**

Pessimistic Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)				
Pantha Chowk	52	69	103	139
Zero Bridge	70	113	247	600
Amira Kadal	64	105	229	555
Shah-e-Hambam	34	55	119	289
Safa Kadal / Chattabal Shrine	39	63	138	333
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)				
Pantha Chowk	52	84	183	444
Zero Bridge	70	113	247	600
Amira Kadal	64	105	229	555
Shah-e-Hambam	34	55	119	289
Safa Kadal / Chattabal Shrine	39	63	138	333
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)				
Pantha Chowk	13	21	47	113
Zero Bridge	18	29	63	152
Amira Kadal	16	27	58	141
Shah-e-Hambam	9	14	31	73
Safa Kadal / Chattabal Shrine	10	16	35	85
Total Annual Traffic ( Passengers)				
Pantha Chowk	12,672	20,664	45,318	110,028
Zero Bridge	17,108	27,897	61,180	148,538

Pessimistic Scenario	2022	2027	2037	2047
Amira Kadal	15,840	25,830	56,648	137,535
Shah-e-Hambam	8,237	13,432	29,457	71,519
Safa Kadal / Chattabal Shrine	9,504	15,498	33,989	82,521
<b>Total Annual Passengers</b>	<b>63,361</b>	<b>103,321</b>	<b>226,592</b>	<b>550,141</b>

- Route wise Traffic Projections

**Table 5-70 Route wise traffic projections for passengers: Pessimistic**

Pessimistic Scenario	2022	2027	2037	2047
<b>Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)</b>				
Local Travel Srinagar	256	345	513	692
Srinagar to Wular Lake	58	65	80	108
Srinagar to Sangam Bridge	93	114	140	189
Wular Lake to Srinagar	58	65	80	108
Sangam Bridge to Srinagar	93	103	126	170
<b>Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)</b>				
Local Travel Srinagar	256	345	513	692
Srinagar to Wular Lake	58	65	80	108
Srinagar to Sangam Bridge	93	114	140	189
Wular Lake to Srinagar	58	65	80	108
Sangam Bridge to Srinagar	93	103	126	170
<b>Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)</b>				
Local Travel Srinagar	64	87	130	176
Srinagar to Wular Lake	24	27	33	45
Srinagar to Sangam Bridge	24	30	37	50
Wular Lake to Srinagar	24	27	33	45
Sangam Bridge to Srinagar	24	27	33	45
<b>Total Annual Traffic ( Passengers)</b>				
Local Travel Srinagar	63,360	103,320	226,590	550,140
Srinagar to Wular Lake	15,780	21,330	38,610	93,930
Srinagar to Sangam Bridge	23,130	31,200	46,560	84,420
Wular Lake to Srinagar	15,780	21,330	38,610	93,930
Sangam Bridge to Srinagar	23,130	31,200	46,560	84,420
<b>Total Annual Passengers</b>	<b>141,180</b>	<b>208,380</b>	<b>396,930</b>	<b>906,840</b>

- Tourists

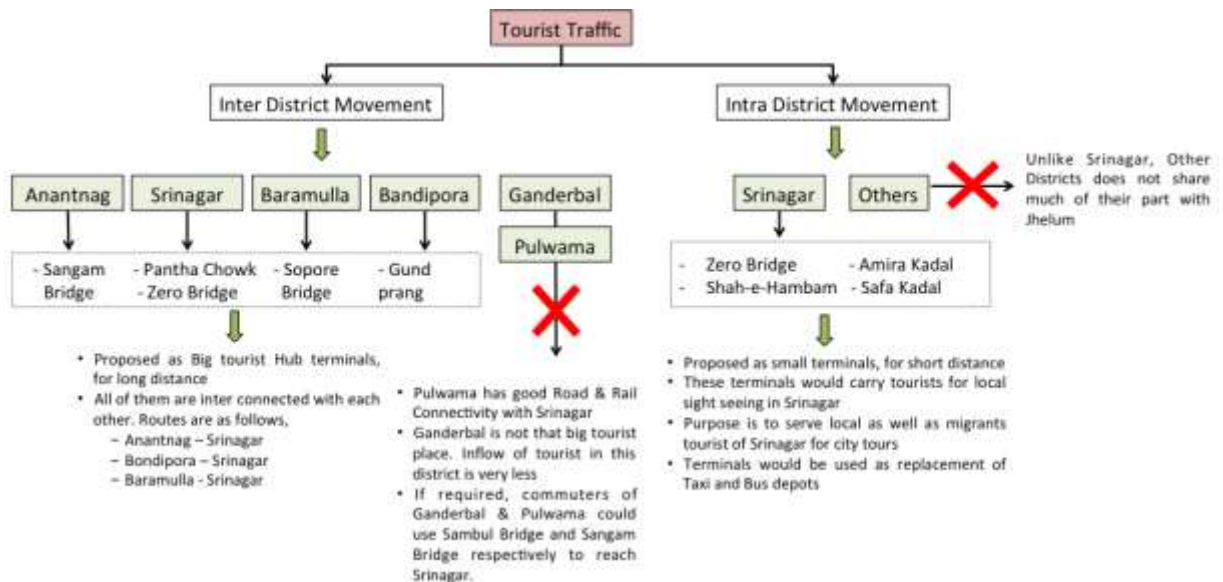
Peak season in Srinagar is Summer season (May to July) and non- peak season is Winter (Nov. to March) when there is heavy snow fall and rain.

Srinagar is an important city and the Summer capital of Kashmir. It attracts maximum number of tourists. Most of the famous tourist spots are located around Srinagar. There

are several Lakes, Gardens and Heritage sites in and around Srinagar. Tourists who visit Kashmir Valley definitely visit Srinagar and further to Wular Lake. Wular Lake is a prominent lake of Kashmir and is rich in scenic beauty, which attracts many tourists. Tourists would enjoy Shikara and boat rides in the lake and the river stretch. Considering the advantage of location, it can be assumed that Srinagar- Wular and Srinagar- Anantnag routes would witness heavy traffic.

- Assumptions

The figure below shows methodology behind selecting the terminals for handling tourist arrivals in the hinterland. Total 6 terminals are proposed for handling tourism traffic. Out of which, 4 terminals would be developed as hub terminals for handling tourists travelling for long distance. For these hub terminals, tourists moving between Baramulla, Anantnag and Bondipora – Srinagar would be the main users. To handle local tourists, 1 hub terminal and 3 small terminals are proposed in Srinagar. Tourists arriving to take a tour of Srinagar would be the main users of these 3 small terminals. Tourists could also take ferry from Anantnag and alight at each terminal, spend some time there and again board other ferry to next stop till Wular. Tourists could explore the other side of the river while returning. This way, tourists could explore the scenic beauty around the river.



**Figure 5-92 Methodology for terminal location selection and tourist traffic forecast**

Presently, tourists travel by public transportation or hire private vehicles to roam around in the hinterland. As mentioned above, Srinagar, being the Capital of Kashmir, is very congested and populated. Diverting the congestion from roadways to waterways would generate traffic for the proposed terminal for tourism.

Traffic projection for tourism is done for 3 different seasons, i.e. Peak, Moderate and Non-Peak. Peak season runs for 3 months, i.e. May to July. It is the best season for tourists to visit Srinagar because of pleasant climatic condition. As per the historic data, maximum footfalls are been observed during peak season. Moderate season is the month of April and August to October. During moderate season, tourist inflow in Kashmir is less

compared to peak season. Non-peak season is the months of winter, i.e. November to March. Kashmir receives negligible tourist in this season. Generally, local tourist arrivals are observed in this season.

**Table 5-71 % Share of Traffic Diversion from Existing mode to IWT**

% share of diversion from tourist traffic in the hinterland		
Tourism Traffic (as per FY17)	National	Local
Local Sailing - Srinagar	2%	2%
Wular Lake - Srinagar	2%	1%
Srinagar - Sangam Bridge	1%	-
Sopore - Srinagar	5%	-

Source: Consultants analysis

**Table 5-72 % Growth in Traffic under different Scenarios**

Scenarios	2022	2027	2037	2047
Optimistic Scenario	3%	3%	2%	2%
Realistic Scenario	3%	2%	2%	2%
Pessimistic Scenario	3%	1%	1%	1%

Source: Consultants analysis

The table above shows the share of existing tourist traffic likely to get diverted to the proposed waterway. Traffic for proposed route and terminals are generated by applying these % share on tourist traffic of FY17 of Kashmir Valley. Further, traffic projection for the is done for next 30 years, under three different scenarios - Optimistic, Base growth & Pessimistic. Under optimistic scenario, 5% growth rate is considered on 5 yearly basis for next 10 years and further 10 years on 4% and 3% for last 10 years

In traffic projections, various factors are taken into consideration, like profiling of tourists arriving, analysis of hinterland with regards to tourism, tourism development plans of the Government, need for infrastructure to improve connectivity in the region, support and plan to enhance the existing historic places, etc. The major growth drivers of the proposed waterway in River Jhelum are footfalls of tourists in the hinterland, growth in economy due to tourism of the region, increase in transportation demand for along and across the river movement. These growth drivers are also considered for projecting traffic growth in future.

- **Optimist Scenario**

In Optimistic scenario, we assume that in future, Srinagar and surrounding region would be more developed, which would increase tourist traffic. Tourists would use waterway as a leisure activity and boats and shikaras could be used for sightseeing. In future, political stability in the region would attract more tourist traffic in the region. Waterway would be considered a safer and cheaper mode of transportation and would be preferred by tourists in future.

- Traffic Projections for Hub Terminals

**Table 5-73 Terminal wise traffic for inter-district Travel:Optimistic**

Optimist Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)				
Zero Bridge	532	718	1,232	2,802
Sangam Bridge	154	208	310	562
Gund Prang	378	510	922	2,240
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)				
Zero Bridge	232	314	544	1,246
Sangam Bridge	62	84	126	230
Gund Prang	170	230	418	1,016
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)				
Zero Bridge	134	184	318	728
Sangam Bridge	38	52	78	142
Gund Prang	96	132	240	586
Total Annual Traffic ( Passengers)				
Zero Bridge	95,820	129,900	223,860	510,900
Sangam Bridge	27,000	36,600	54,720	99,480
Gund Prang	68,820	93,300	169,140	411,420
Sopore Bridge	23,476	25,355	27,384	30,123
<b>Total Annual Passengers</b>	<b>215,116</b>	<b>285,155</b>	<b>475,104</b>	<b>1,051,923</b>

- Traffic Projections for Small Terminals

**Table 5-74 Terminal wise traffic for intra-district Travel:Optimistic**

Optimist Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)				
Zero Bridge	223	364	798	1,936
Amira Kadal	238	388	851	2,065
Shah-e-Hambam	194	316	691	1,678
Safa Kadal / Chattabal Shrine	208	340	745	1,807
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)				
Zero Bridge	90	147	322	782
Amira Kadal	96	156	344	834
Shah-e-Hambam	78	127	279	678
Safa Kadal / Chattabal Shrine	84	137	301	730

Optimist Scenario	2022	2027	2037	2047
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)				
Zero Bridge	50	82	180	438
Amira Kadal	53	88	192	467
Shah-e-Hambam	43	71	156	379
Safa Kadal / Chattabal Shrine	47	77	168	409
Total Annual Traffic ( Passengers)				
Zero Bridge	38,183	62,550	137,363	333,585
Amira Kadal	40,728	66,720	146,520	355,824
Shah-e-Hambam	33,092	54,210	119,048	289,107
Safa Kadal / Chattabal Shrine	35,637	58,380	128,205	311,346
<b>Total Annual Passengers</b>	<b>147,640</b>	<b>241,860</b>	<b>531,136</b>	<b>1,289,862</b>

- Route wise Traffic Projections

**Table 5-75 Route wise traffic projections for tourists: Optimistic**

Optimist Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Tourists)				
Local Travel Srinagar	297	485	1063	2581
Srinagar to Wular Lake	189	255	461	1120
Srinagar to Sangam Bridge	77	104	155	281
Wular Lake to Srinagar	189	255	461	1120
Sangam Bridge to Srinagar	77	104	155	281
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Tourists)				
Local Travel Srinagar	119	195	429	1042
Srinagar to Wular Lake	85	115	209	508
Srinagar to Sangam Bridge	31	42	63	115
Wular Lake to Srinagar	85	115	209	508
Sangam Bridge to Srinagar	31	42	63	115
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Tourists)				
Local Travel Srinagar	66	109	240	583
Srinagar to Wular Lake	48	66	120	293
Srinagar to Sangam Bridge	19	26	39	71
Wular Lake to Srinagar	48	66	120	293
Sangam Bridge to Srinagar	19	26	39	71
Total Annual Traffic ( Tourists)				
Local Travel Srinagar	50,910	83,400	1,83,150	4,44,780
Srinagar to Wular Lake	34,410	46,650	84,570	2,05,710
Srinagar to Sangam Bridge	13,500	18,300	27,360	49,740
Wular Lake to Srinagar	34,410	46,650	84,570	2,05,710
Sangam Bridge to Srinagar	13,500	18,300	27,360	49,740
Srinagar – Sopore - Srinagar	23,476	25,355	27,384	30,123
<b>Total Annual Tourists</b>	<b>170,206</b>	<b>238,655</b>	<b>434,394</b>	<b>985,803</b>

- **Realistic Scenario**  
Realistic scenario is based on current development plans and present trend of tourist traffic on roadways and railways. Shifting roadway movement to waterway would impact the tourist traffic.
- **Traffic Projections for Hub Terminals**

**Table 5-76 Terminal wise traffic for inter-district Travel: Optimistic**

Realistic Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)				
Zero Bridge	532	650	968	1,756
Sangam Bridge	154	188	280	508
Gund Prang	378	462	688	1,248
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)				
Zero Bridge	232	286	428	778
Sangam Bridge	62	76	114	208
Gund Prang	170	210	314	570
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)				
Zero Bridge	134	166	250	456
Sangam Bridge	38	48	72	132
Gund Prang	96	118	178	324
Total Annual Traffic ( Passengers)				
Zero Bridge	95,820	117,720	175,980	319,800
Sangam Bridge	27,000	33,240	49,680	90,480
Gund Prang	68,820	84,480	126,300	229,320
<b>Sopore Bridge</b>	23,476	24,651	26,377	28,224
<b>Total Annual Passengers</b>	<b>215,116</b>	<b>260,091</b>	<b>378,337</b>	<b>667,824</b>

- **Traffic Projections for Small Terminals**

Small terminals located in Srinagar for intra district movement would accommodate passenger and tourism traffic. These would have moderately lower footfalls. The following table describes daily passenger traffic in smaller terminals for intra district travel in Srinagar

**Table 5-77 Terminal wise traffic for intra-district Travel: Optimistic**

Realistic Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)				
Zero Bridge	223	331	599	1,086

Realistic Scenario	2022	2027	2037	2047
Amira Kadal	238	353	639	1,158
Shah-e-Hambam	194	287	519	941
Safa Kadal / Chattabal Shrine	208	309	559	1,013
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)				
Zero Bridge	90	133	241	437
Amira Kadal	96	142	257	466
Shah-e-Hambam	78	116	209	379
Safa Kadal / Chattabal Shrine	84	124	225	408
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)				
Zero Bridge	50	75	135	246
Amira Kadal	53	80	144	262
Shah-e-Hambam	43	65	117	213
Safa Kadal / Chattabal Shrine	47	70	126	229
Total Annual Traffic ( Passengers)				
Zero Bridge	38,183	56,835	103,005	186,840
Amira Kadal	40,728	60,624	109,872	199,296
Shah-e-Hambam	33,092	49,257	89,271	161,928
Safa Kadal / Chattabal Shrine	35,637	53,046	96,138	174,384
<b>Total Annual Passengers</b>	<b>147,640</b>	<b>219,762</b>	<b>398,286</b>	<b>722,448</b>

- Route wise Traffic Projections

Route wise traffic projection quantifies opportunities for ferry boat operators in various routes. It's the cumulative traffic that would be sailing on the river during the day. The following table summarises total tourist traffic moving on the river in the identified routes.

**Table 5-78 Route wise traffic projections for passengers: Realistic**

Realistic Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Tourists)				
Local Travel Srinagar	297	441	798	1,447
Srinagar to Wular Lake	189	231	344	624
Srinagar to Sangam Bridge	77	94	140	254
Wular Lake to Srinagar	189	231	344	624
Sangam Bridge to Srinagar	77	94	140	254
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Tourists)				
Local Travel Srinagar	119	177	321	582
Srinagar to Wular Lake	85	105	157	285
Srinagar to Sangam Bridge	31	38	57	104
Wular Lake to Srinagar	85	105	157	285
Sangam Bridge to Srinagar	31	38	57	104
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Tourists)				

Realistic Scenario	2022	2027	2037	2047
Local Travel Srinagar	66	99	180	327
Srinagar to Wular Lake	48	59	89	162
Srinagar to Sangam Bridge	19	24	36	66
Wular Lake to Srinagar	48	59	89	162
Sangam Bridge to Srinagar	19	24	36	66
Total Annual Traffic ( Tourists)				
Local Travel Srinagar	50,910	75,780	1,37,340	2,49,120
Srinagar to Wular Lake	34,410	42,240	63,150	1,14,660
Srinagar to Sangam Bridge	13,500	16,620	24,840	45,240
Wular Lake to Srinagar	34,410	42,240	63,150	1,14,660
Sangam Bridge to Srinagar	13,500	16,620	24,840	45,240
Srinagar – Sopore - Srinagar	23,476	24,651	26,377	28,224
<b>Total Annual Tourists</b>	<b>170,206</b>	<b>218,151</b>	<b>339,697</b>	<b>597,144</b>

- Pessimistic Scenario

In Pessimistic scenario, tourist traffic would not increase much. After development of Waterway, it could be assumed that time and distance of transportation could be higher than the existing transportation through roadways.

- Traffic Projections for Hub Terminals

3 Hub terminals are proposed for tourist handling for long distance movement. These terminal would connect Bandipora – Srinagar and Anantnag i.e tourist travelling from Bandipora and Anantnag to Srinagar could use these terminals and vis-a-versa. The table below shows the daily and annual traffic projected at each terminals.

**Table 5-79 Terminal wise traffic for inter-district Travel: Pessimistic**

Pessimistic Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)				
Zero Bridge	532	600	734	992
Sangam Bridge	154	180	220	298
Gund Prang	378	420	514	694
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)				
Zero Bridge	232	263	322	436
Sangam Bridge	62	73	90	122
Gund Prang	170	190	232	314
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)				
Zero Bridge	134	153	190	261
Sangam Bridge	38	45	56	77
Gund Prang	96	108	134	184
Total Annual Traffic ( Passengers)				

Zero Bridge	95,820	108,510	133,200	180,750
Sangam Bridge	27,000	31,710	39,000	53,010
Gund Prang	68,820	76,800	94,200	127,740
Sopore Bridge	23,476	23,946	24,425	25,402
<b>Total Annual Passengers</b>	<b>215,116</b>	<b>240,966</b>	<b>290,825</b>	<b>386,902</b>

- Traffic Projections for Small Terminals

Tourist travelling within Srinagar could use these terminals for short distance movement. These terminals connect the prominent locations of Srinagar city. The table below shows the daily and annual tourist traffic projected for each terminals.

**Table 5-80 Terminal wise traffic for intra-district Travel: Pessimistic**

Pessimistic Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)				
Zero Bridge	223	301	448	604
Amira Kadal	238	321	478	644
Shah-e-Hambam	194	261	389	524
Safa Kadal / Chattabal Shrine	208	281	418	564
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)				
Zero Bridge	90	121	181	245
Amira Kadal	96	129	193	261
Shah-e-Hambam	78	105	157	212
Safa Kadal / Chattabal Shrine	84	113	169	229
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)				
Zero Bridge	50	67	101	137
Amira Kadal	53	72	108	146
Shah-e-Hambam	43	58	88	119
Safa Kadal / Chattabal Shrine	47	63	94	128
Total Annual Traffic ( Passengers)				
Zero Bridge	38,183	51,570	77,063	104,153
Amira Kadal	40,728	55,008	82,200	111,096
Shah-e-Hambam	33,092	44,694	66,788	90,266
Safa Kadal / Chattabal Shrine	35,637	48,132	71,925	97,209
<b>Total Annual Passengers</b>	<b>147,640</b>	<b>199,404</b>	<b>297,976</b>	<b>402,724</b>

- Route wise Traffic Projections

Route wise traffic projection quantifies opportunities for ferry boat operators in various routes. It's the cumulative traffic that would be sailing on the river during the day. The following table summaries total tourist traffic moving on the river in the identified routes.

**Table 5-81 Route wise traffic projections for passengers: Pessimistic**

Pessimistic Scenario	2022	2027	2037	2047
<b>Daily Traffic in Peak Season (May to July) - 3 Months (Tourists)</b>				
Local Travel Srinagar	297	401	597	805
Srinagar to Wular Lake	189	210	257	347
Srinagar to Sangam Bridge	77	94	115	156
Wular Lake to Srinagar	189	210	257	347
Sangam Bridge to Srinagar	77	86	105	142
<b>Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Tourists)</b>				
Local Travel Srinagar	119	161	241	326
Srinagar to Wular Lake	85	95	116	157
Srinagar to Sangam Bridge	31	38	47	64
Wular Lake to Srinagar	85	95	116	157
Sangam Bridge to Srinagar	31	35	43	58
<b>Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Tourists)</b>				
Local Travel Srinagar	66	89	134	182
Srinagar to Wular Lake	48	54	67	92
Srinagar to Sangam Bridge	19	24	30	41
Wular Lake to Srinagar	48	54	67	92
Sangam Bridge to Srinagar	19	21	26	36
<b>Total Annual Traffic ( Tourists)</b>				
Local Travel Srinagar	50,910	68,760	1,02,750	1,38,870
Srinagar to Wular Lake	34,410	38,400	47,100	63,870
Srinagar to Sangam Bridge	13,500	16,620	20,490	27,870
Wular Lake to Srinagar	34,410	38,400	47,100	63,870
Sangam Bridge to Srinagar	13,500	15,090	18,510	25,140
<b>Srinagar – Sopore - Srinagar</b>	<b>23,476</b>	<b>23,946</b>	<b>24,425</b>	<b>25,402</b>
<b>Total Annual Tourists</b>	<b>170,206</b>	<b>201,216</b>	<b>260,375</b>	<b>345,022</b>

- **Total Passengers and Tourists**

This section summaries the total passengers and tourists likely to use waterways on River Jhelum in future. The infrastructure and facilities used by passengers and tourists are same. Hence, the projections of both the previous section has been merged to arrive at cumulative demand for future.

- **Optimistic Scenario**

It is assumed that in optimistic scenario, Srinagar and surrounding region would be more developed that would led to increase in local movement and attract more tourist traffic. Increase in population would create congestion and roadways and railways. In order to de-congest the roads and railways and for free of movement, IWT would come in demand which is more convenient and cheaper mode of transportation. Tourists would use

waterway as a leisure activity and boats / shikaras could be used for sightseeing. In future, political stability in the region would attract more tourist traffic. Tourists could find water transport on the River Jhelum amusing. They would prefer to witness the beauty of the Srinagar from river. These developments would provide explosive growth of passenger and tourist in the region.

### Traffic Projections for Hub Terminals

**Table 5-82 Terminal wise traffic for inter-district Travel: Optimistic**

Optimist Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)				
Sumbal Bridge	12	16	28	69
Pantha Chowk	182	244	393	816
Zero Bridge	642	865	1,466	3,278
Sangam Bridge	340	458	682	1,236
Gund Prang	494	666	1,204	2,926
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)				
Sumbal Bridge	12	16	28	69
Pantha Chowk	182	244	393	816
Zero Bridge	342	461	778	1,722
Sangam Bridge	248	334	498	904
Gund Prang	286	386	700	1,702
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)				
Sumbal Bridge	5	7	12	29
Pantha Chowk	58	80	132	285
Zero Bridge	168	231	394	889
Sangam Bridge	86	118	178	324
Gund Prang	144	198	360	878
Total Annual Traffic ( Passengers)				
Sumbal Bridge	3,156	4,266	7,722	18,786
Pantha Chowk	46,692	63,036	102,204	214,020
Zero Bridge	123,792	167,658	284,274	634,794
Sangam Bridge	73,260	99,000	147,840	268,320
Gund Prang	100,380	135,960	246,360	599,280
Sopore Bridge	23,476	23,946	24,425	25,402
<b>Total Annual Passengers</b>	<b>370,756</b>	<b>493,866</b>	<b>812,825</b>	<b>1,760,602</b>

- Traffic Projections for Small Terminals

**Table 5-83 Terminal wise traffic for intra-district Travel: Optimistic**

Optimist Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)				

Optimist Scenario	2022	2027	2037	2047
Pantha Chowk	52	84	183	444
Zero Bridge	293	477	1,045	2,536
Amira Kadal	302	493	1,080	2,620
Shah-e-Hambam	228	371	810	1,967
Safa Kadal / Chattabal Shrine	247	403	883	2,140
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)				
Pantha Chowk	52	84	183	444
Zero Bridge	160	260	569	1,382
Amira Kadal	160	261	573	1,389
Shah-e-Hambam	112	182	398	967
Safa Kadal / Chattabal Shrine	123	200	439	1,063
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)				
Pantha Chowk	13	21	47	113
Zero Bridge	68	111	243	590
Amira Kadal	69	115	250	608
Shah-e-Hambam	52	85	187	452
Safa Kadal / Chattabal Shrine	57	93	203	494
Total Annual Traffic ( Passengers)				
Pantha Chowk	12,672	20,664	45,318	110,028
Zero Bridge	55,291	90,447	198,543	482,123
Amira Kadal	56,568	92,550	203,168	493,359
Shah-e-Hambam	41,329	67,642	148,505	360,626
Safa Kadal / Chattabal Shrine	45,141	73,878	162,194	393,867
<b>Total Annual Passengers</b>	<b>211,001</b>	<b>345,181</b>	<b>757,728</b>	<b>1,840,003</b>

- Route wise Traffic Projections

**Table 5-84 Projections for Total Passengers Travel under Optimistic Scenario**

Optimist Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)				
Local Travel Srinagar	553	902	1,977	4,800
Srinagar to Wular Lake	247	333	602	1,463
Srinagar to Sangam Bridge	170	229	341	618
Wular Lake to Srinagar	247	333	602	1,463
Sangam Bridge to Srinagar	170	229	341	618
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)				
Local Travel Srinagar	375	612	1,343	3,261
Srinagar to Wular Lake	143	193	350	851
Srinagar to Sangam Bridge	124	167	249	452
Wular Lake to Srinagar	143	193	350	851
Sangam Bridge to Srinagar	124	167	249	452
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)				

Local Travel Srinagar	130	214	471	1,144
Srinagar to Wular Lake	72	99	180	439
Srinagar to Sangam Bridge	43	59	89	162
Wular Lake to Srinagar	72	99	180	439
Sangam Bridge to Srinagar	43	59	89	162
<b>Total Annual Traffic ( Passengers)</b>				
Local Travel Srinagar	114,270	186,720	409,740	994,920
Srinagar to Wular Lake	50,190	67,980	123,180	299,640
Srinagar to Sangam Bridge	36,630	49,500	73,920	134,160
Wular Lake to Srinagar	50,190	67,980	123,180	299,640
Sangam Bridge to Srinagar	36,630	49,500	73,920	134,160
Srinagar – Sopore - Srinagar	23,476	23,946	24,425	25,402
<b>Total Annual Passengers</b>	<b>311,386</b>	<b>445,626</b>	<b>828,365</b>	<b>1,887,922</b>

- Realistic Scenario
- Traffic Projections for Hub Terminals

**Table 5-85 Terminal wise traffic for inter district Travel: Realistic**

Realistic Scenario	2022	2027	2037	2047
<b>Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)</b>				
Sumbal Bridge	12	14	21	39
Pantha Chowk	182	222	332	602
Zero Bridge	642	784	1,168	2,119
Sangam Bridge	340	416	620	1,124
Gund Prang	494	604	900	1,634
<b>Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)</b>				
Sumbal Bridge	12	14	21	39
Pantha Chowk	182	222	332	602
Zero Bridge	342	420	628	1,141
Sangam Bridge	248	304	454	824
Gund Prang	286	352	526	956
<b>Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)</b>				
Sumbal Bridge	5	6	9	16
Pantha Chowk	58	72	108	197
Zero Bridge	168	208	313	571
Sangam Bridge	86	108	162	296
Gund Prang	144	178	268	488
<b>Total Annual Traffic ( Passengers)</b>				
Sumbal Bridge	3,156	3,882	5,802	10,566
Pantha Chowk	46,692	57,420	85,752	155,772
Zero Bridge	123,792	152,118	227,346	413,082
Sangam Bridge	73,260	90,120	134,580	244,440

Realistic Scenario	2022	2027	2037	2047
Gund Prang	100,380	123,300	184,320	334,980
Sopore Bridge	23,476	24,651	26,377	28,224
<b>Total Annual Passengers</b>	<b>370,756</b>	<b>451,491</b>	<b>664,177</b>	<b>1,187,064</b>

- Traffic Projections for Small Terminals

**Table 5-86 Terminal wise traffic for intra district Travel: Realistic**

Realistic Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)				
Pantha Chowk	52	76	137	249
Zero Bridge	293	444	846	1,686
Amira Kadal	302	458	868	1,713
Shah-e-Hambam	228	342	638	1,230
Safa Kadal / Chattabal Shrine	247	372	697	1,346
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)				
Pantha Chowk	52	84	183	444
Zero Bridge	160	246	488	1,037
Amira Kadal	160	247	486	1,021
Shah-e-Hambam	112	171	328	668
Safa Kadal / Chattabal Shrine	123	187	363	741
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)				
Pantha Chowk	13	21	47	113
Zero Bridge	68	104	198	398
Amira Kadal	69	107	202	403
Shah-e-Hambam	52	79	148	286
Safa Kadal / Chattabal Shrine	57	86	161	314
Total Annual Traffic ( Passengers)				
Pantha Chowk	12,672	20,664	45,318	110,028
Zero Bridge	55,291	84,732	164,185	335,378
Amira Kadal	56,568	86,454	166,520	336,831
Shah-e-Hambam	41,329	62,689	118,728	233,447
Safa Kadal / Chattabal Shrine	45,141	68,544	130,127	256,905
<b>Total Annual Passengers</b>	<b>211,001</b>	<b>323,083</b>	<b>624,878</b>	<b>1,272,589</b>

- Route wise Traffic Projections

**Table 5-87 Route wise traffic projections for passengers: Realistic**

Realistic Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)				
Local Travel Srinagar	553	820	1,483	2,688

Realistic Scenario	2022	2027	2037	2047
Srinagar to Wular Lake	247	302	450	817
Srinagar to Sangam Bridge	170	208	310	562
Wular Lake to Srinagar	247	302	450	817
Sangam Bridge to Srinagar	170	208	310	562
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)				
Local Travel Srinagar	375	556	1,006	1,823
Srinagar to Wular Lake	143	176	263	478
Srinagar to Sangam Bridge	124	152	227	412
Wular Lake to Srinagar	143	176	263	478
Sangam Bridge to Srinagar	124	152	227	412
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)				
Local Travel Srinagar	130	194	352	639
Srinagar to Wular Lake	72	89	134	244
Srinagar to Sangam Bridge	43	54	81	148
Wular Lake to Srinagar	72	89	134	244
Sangam Bridge to Srinagar	43	54	81	148
Total Annual Traffic ( Passengers)				
Local Travel Srinagar	114,270	169,620	306,990	556,530
Srinagar to Wular Lake	50,190	61,650	92,160	167,490
Srinagar to Sangam Bridge	36,630	45,060	67,290	122,220
Wular Lake to Srinagar	50,190	61,650	92,160	167,490
Sangam Bridge to Srinagar	36,630	45,060	67,290	122,220
Srinagar – Sopore - Srinagar	23,476	24,651	26,377	28,224
<b>Total Annual Passengers</b>	<b>311,386</b>	<b>407,691</b>	<b>652,267</b>	<b>1,164,174</b>

Pessimistic Scenario

- Traffic Projections for Hub Terminals

**Table 5-88 Terminal wise traffic for inter-district Travel: Pessimistic**

Pessimistic Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)				
Sumbal Bridge	12	13	16	22
Pantha Chowk	182	209	256	345
Zero Bridge	642	726	889	1,201
Sangam Bridge	340	397	486	657
Gund Prang	494	550	674	910
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)				
Sumbal Bridge	12	13	16	22
Pantha Chowk	182	209	256	345
Zero Bridge	342	389	477	645
Sangam Bridge	248	290	356	481

Gund Prang	286	320	392	530
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)				
Sumbal Bridge	5	5	7	9
Pantha Chowk	58	67	82	111
Zero Bridge	168	192	238	326
Sangam Bridge	86	102	126	172
Gund Prang	144	162	200	274
Total Annual Traffic ( Passengers)				
Sumbal Bridge	3,156	3,540	4,350	5,886
Pantha Chowk	46,692	53,712	65,916	89,100
Zero Bridge	123,792	140,778	172,794	234,264
Sangam Bridge	73,260	85,830	105,360	142,650
Gund Prang	100,380	112,200	137,700	186,600
Sopore Bridge	23,476	25,355	27,384	30,123
<b>Total Annual Passengers</b>	<b>370,756</b>	<b>421,415</b>	<b>513,504</b>	<b>688,623</b>

- Traffic Projections for Small Terminals

**Table 5-89 Terminal wise traffic for intra-district Travel: Pessimistic**

Pessimistic Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)				
Pantha Chowk	52	69	103	139
Zero Bridge	293	414	695	1,204
Amira Kadal	302	426	707	1,199
Shah-e-Hambam	228	316	508	813
Safa Kadal / Chattabal Shrine	247	344	556	897
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)				
Pantha Chowk	52	84	183	444
Zero Bridge	160	234	428	845
Amira Kadal	160	234	422	816
Shah-e-Hambam	112	160	276	501
Safa Kadal / Chattabal Shrine	123	176	307	562
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)				
Pantha Chowk	13	21	47	113
Zero Bridge	68	96	164	289
Amira Kadal	69	99	166	287
Shah-e-Hambam	52	72	119	192
Safa Kadal / Chattabal Shrine	57	79	129	213
Total Annual Traffic ( Passengers)				
Pantha Chowk	12,672	20,664	45,318	110,028
Zero Bridge	55,291	79,467	138,243	252,691
Amira Kadal	56,568	80,838	138,848	248,631

Pessimistic Scenario	2022	2027	2037	2047
Shah-e-Hambam	41,329	58,126	96,245	161,785
Safa Kadal / Chattabal Shrine	45,141	63,630	105,914	179,730
<b>Total Annual Passengers</b>	<b>211,001</b>	<b>302,725</b>	<b>524,568</b>	<b>952,865</b>

- Route wise Traffic Projections

**Table 5-90 Route wise traffic projections for passengers: Pessimistic**

Pessimistic Scenario	2022	2027	2037	2047
Daily Traffic in Peak Season (May to July) - 3 Months (Passengers)				
Local Travel Srinagar	553	746	1,110	1,497
Srinagar to Wular Lake	247	275	337	455
Srinagar to Sangam Bridge	170	208	255	345
Wular Lake to Srinagar	247	275	337	455
Sangam Bridge to Srinagar	170	189	231	312
Daily Traffic in Moderate Season (April, Aug to October) - 4 Months (Passengers)				
Local Travel Srinagar	375	506	754	1,018
Srinagar to Wular Lake	143	160	196	265
Srinagar to Sangam Bridge	124	152	187	253
Wular Lake to Srinagar	143	160	196	265
Sangam Bridge to Srinagar	124	138	169	228
Daily Traffic in Non-Peak Season (Nov to March) - 5 Months (Passengers)				
Local Travel Srinagar	130	176	264	358
Srinagar to Wular Lake	72	81	100	137
Srinagar to Sangam Bridge	43	54	67	91
Wular Lake to Srinagar	72	81	100	137
Sangam Bridge to Srinagar	43	48	59	81
Total Annual Traffic ( Passengers)				
Local Travel Srinagar	114,270	154,260	229,980	310,590
Srinagar to Wular Lake	50,190	56,100	68,850	93,300
Srinagar to Sangam Bridge	36,630	45,060	55,440	75,060
Wular Lake to Srinagar	50,190	56,100	68,850	93,300
Sangam Bridge to Srinagar	36,630	40,770	49,920	67,590
Srinagar – Sopore - Srinagar	23,476	25,355	27,384	30,123
<b>Total Annual Passengers</b>	<b>311,386</b>	<b>377,645</b>	<b>500,424</b>	<b>669,963</b>

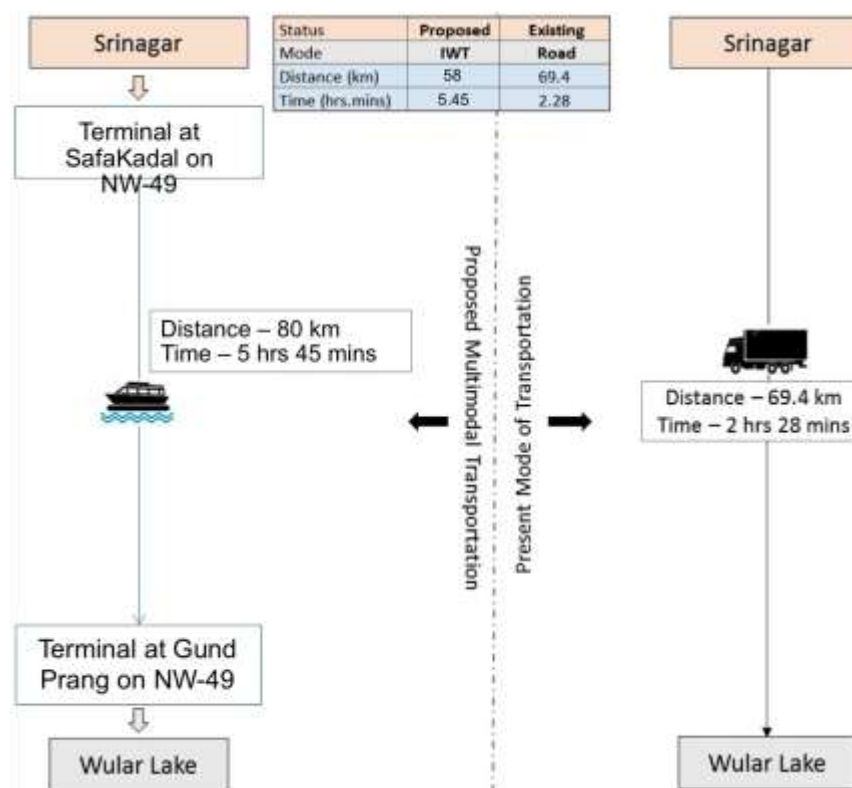
## 5.20 Cargo Traffic

There exist two major mandis in Srinagar, Parimpora and Chattabal mandi. Parimpora is for selling fruits and Chattabal is for selling vegetables. There are also other small mandis in Srinagar. The major mandis are used to procure fruits and vegetables locally in peak season for national distribution. Local distribution of fruits and

vegetables is done by local cultivators in other small mandis. In Wular, vegetables grow in abundance; these are sent to Srinagar mandis for mostly local consumption.

During non- peak season, other fruits, like mango, grapes, melon, orange etc. are procured from other states in Parimpora and Chattabal mandis. These fruits are locally distributed in entire Kashmir Valley. Considering the present cargo movement, we can assume that once waterway is developed, these cargoes could be shifted to waterway.

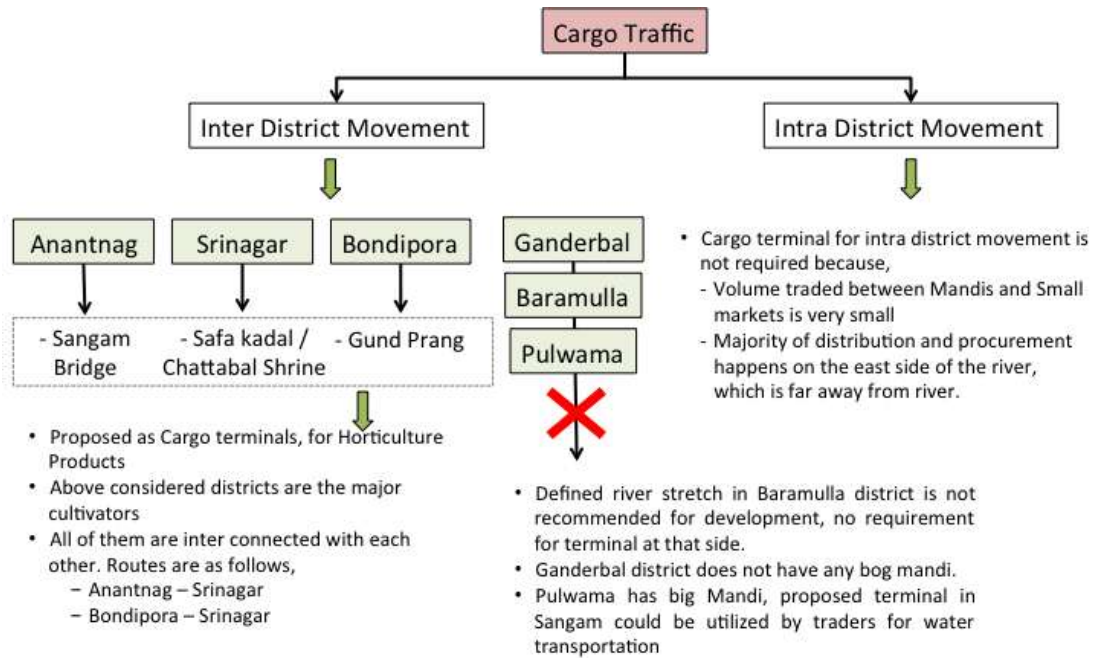
The volume of prospective cargo to be moved on waterway was found to be less to create an economy of scale. The local logistic dynamics and type of cargo is a big deterrent for shift. The trade of horticulture products requires prompt delivery due to lower shelf life. Their volumes are also low. The trade of horticulture product is seasonal. There is no scope for transporting industrial cargo due to unavailability of major industries around. The terminals have been suggested on the preliminary findings. Further planning and implementation of cargo terminals could be revised based on stakeholders view during stakeholders consultation on market assessment report.



**Figure 5-93 Time-Distance Comparison for Srinagar- Wular Route: Cargo**

- Assumptions  
The figure below depicts methodology behind selecting the terminals for cargo handling. Total 3 terminals are proposed for cargo handling, each in Anantnag,

Srinagar and Bondipora. Traders of other districts could load their cargo at Sangam or Gund Prang and reach Srinagar through proposed IWT route in River Jhelum.



**Figure 5-94 Methodology for terminal location selection and cargo traffic forecast**

At present, Cargo is transported via roadways in trucks and small tempos on a daily basis. This transportation could be shifted to proposed waterway route. Traffic projection for cargo terminal is done according to the production and consumption behavior of the region. 3 different seasons are considered for the traffic flow, i.e. Peak, Moderate and Non-Peak. During Peak season, i.e. between May to July, production is high and cargo is transported to Mandis for national distribution. In peak season, only national distribution happens on larger scale, while local distribution to end-users is done by cultivators and small traders. In moderate season, volume of cargo movement within hinterland decreases. In non-peak season, only local distribution takes place and there is no national distribution. In non-peak season, Kashmir procures fruits from other states and distributes locally in nearby markets. This yearly trade of horticulture could be shifted to waterways in future.

**Table 5-91 % Share of Traffic Diversion from Existing mode to IWT**

% share of diversion from existing cargo (Fruits and Vegetables) movement	
Cargo Traffic (Field Survey)	Local Trade
Wular Lake - Srinagar	4%
Sangam Bridge - Srinagar	2%

Source: Consultants analysis

**Table 5-92 % Growth in Traffic under different Scenarios**

Scenarios	2022	2027	2037	2047
Optimistic Scenario	2%	3%	2%	1%
Realistic Scenario	2%	2%	1%	1%
Pessimistic Scenario	2%	0%	0%	0%

Source: Consultants analysis

The table above shows the share of existing cargo movement likely to be diverted to the proposed waterway. Traffic for proposed route and terminals are generated by applying these % share on the existing traffic generated by field study. Traffic projections for cargo terminal is done for next 30 years, under three different scenarios - Optimistic, Base growth & Pessimistic. In traffic projections, various factors are taken into consideration, like profiling of mandis and markets, existing trade movement in the region, analysis of trade centers in the hinterland, need for infrastructure to improve connectivity in the region, support to villagers for selling their produce in market, etc. The major growth drivers of the proposed IWT in River Jhelum are production and consumption growth in the hinterland, growth in economy and trade of the region, increase in transportation demand for river movement. These growth drivers are also considered for projecting traffic growth in future.

### 5.21 Optimistic Scenario

In Optimistic scenario, we assume that development in Srinagar and other parts would result in increased population. More mandis would be developed and the existing mandis would increase in size. This would increase their handling capacity and more cargo (fruits and vegetables) would move for national distribution. Also, volume of cargo which would be procured from other states would increase. It can be assumed that waterway would witness high growth in cargo handling.

- Terminal wise Traffic Projection

Along with passenger and tourist traffic, below mentioned terminals are also proposed to handle cargo traffic (horticulture) in future. Safa Kadal in Srinagar would cater the cargo traffic originating from Gund Prangine near Wular Lake and Sangam Bridge i.e Anantnag. Horticulture cultivation and trade happens only in peak season i.e Fruits for 4 months and Vegetables for 8 Months. Therefore terminal would handle cargo only from April to November. The table below shows the daily and annual cargo traffic projections for each terminal.

**Table 5-93 Terminal wise Cargo Projections: Optimistic**

Optimist Scenario	2022	2027	2037	2047
Daily Traffic of Fruits in Peak Season (Aug to Nov) - 4 Months (Cargo - Tonnes)				
Gund Prang	56	76	113	153
Safa Kadal / Chattabal Shrine	62	85	127	172
Sangam Bridge	6	9	14	19
Daily Traffic of Vegetables in Peak Season (April to Nov) - 8 Months (Cargo - Tonnes)				
Gund Prang	0	0	0	0
Safa Kadal / Chattabal Shrine	12	17	26	36
Sangam Bridge	12	17	26	36
Daily Traffic in Non-Peak Season (Cargo - Tonnes)				

Gund Prang	0	0	0	0
Safa Kadal / Chattabal Shrine	0	0	0	0
Sangam Bridge	0	0	0	0
Total Annual Traffic ( Cargo - Tonnes)				
Gund Prang	6720	9120	13560	18360
Safa Kadal / Chattabal Shrine	10320	14280	21480	29280
Sangam Bridge	3600	5160	7920	10920
<b>Total Annual Cargo - Tonnes</b>	<b>20,640</b>	<b>28,560</b>	<b>42,960</b>	<b>58,560</b>

- Route wise Traffic Projection

In Wular and Anantnag, vegetables grow in abundance, which are sent to Srinagar mandis mostly for local distribution. Fruits and Vegetables procured from Wular and Alanatnag are also distributed in entire Kashmir Valley. The table below shows the season wise daily and annual cargo traffic projected for Wular to Srinagar and Sangam Bridge to Srinagar route.

**Table 5-94 Route wise traffic projections for Cargo :Optimistic**

Optimist Scenario	2022	2027	2037	2047
Daily Traffic of Fruits in Peak Season (Aug to Nov) - 4 Months (Cargo - Tonnes)				
Wular Lake to Srinagar	56	76	113	153
Sangam Bridge to Srinagar	6	9	14	19
Daily Traffic of Vegetages in Peak Season (April to Nov) - 8 Months (Cargo - Tonnes)				
Wular Lake to Srinagar	0	0	0	0
Sangam Bridge to Srinagar	12	17	26	36
Daily Traffic in Non-Peak Season (Cargo - Tonnes)				
Wular Lake to Srinagar	0	0	0	0
Sangam Bridge to Srinagar	0	0	0	0
Total Annual Traffic ( Cargo - Tonnes)				
Wular Lake to Srinagar	6,720	9,120	13,560	18,360
Sangam Bridge to Srinagar	3,600	5,160	7,920	10,920
<b>Total Annual Cargo - Tonnes</b>	<b>10,320</b>	<b>14,280</b>	<b>21,480</b>	<b>29,280</b>

### Realistic Scenario

Realistic scenario is based on current development plans and present trend of cargo traffic on roadways. We assume that shifting roadway traffic to waterways would increase traffic in waterways in future.

- Terminal wise Traffic Projection

3 terminals mentioned in below table are proposed to handle cargo traffic as well in future. There are 2 major mandis in Srinagar, these mandis procure vegetables and fruits from Wular and Anantnag and distributes locally. Horticulture trade between Wular – Srinagar and Anantnag – Srinagar is presently done using roadways. April to November are the peak season for horticulture cultivation and trade, rest of the months i.e December to March no trade happens. It is assumed that a certain share of this trade could be shifted to waterway, this diversion would happen only in future. The table below shows the daily and annual cargo traffic projections for each terminal.

**Table 5-95 Terminal wise Cargo Projections: Realistics**

Realistic Scenario	2022	2027	2037	2047
Daily Traffic of Fruits in Peak Season (Aug to Nov) - 4 Months (Cargo - Tonnes)				
Gund Prang	56	69	85	115
Safa Kadal / Chattabal Shrine	62	77	95	129
Sangam Bridge	6	8	10	14
Daily Traffic of Vegetables in Peak Season (April to Nov) - 8 Months (Cargo - Tonnes)				
Gund Prang	0	0	0	0
Safa Kadal / Chattabal Shrine	12	15	19	26
Sangam Bridge	12	15	19	26
Daily Traffic in Non-Peak Season (Cargo - Tonnes)				
Gund Prang	0	0	0	0
Safa Kadal / Chattabal Shrine	0	0	0	0
Sangam Bridge	0	0	0	0
Total Annual Traffic ( Cargo - Tonnes)				
Gund Prang	6720	8280	10200	13800
Safa Kadal / Chattabal Shrine	10320	12840	15960	21720
Sangam Bridge	3600	4560	5760	7920
<b>Total Annual Cargo - Tonnes</b>	<b>20,640</b>	<b>25,680</b>	<b>31,920</b>	<b>43,440</b>

- Route wise Traffic Projection

Mandis in Srinagar procures vegetables and fruits from Wular and Anantnag and distributes them locally. The table below shows the season wise daily and annual cargo traffic projected for Wular to Srinagar and Sangam Bridge to Srinagar route.

**Table 5-96 Projections for Cargo Transportation: Realistics**

Realistic Scenario	2022	2027	2037	2047
Daily Traffic of Fruits in Peak Season (Aug to Nov) - 4 Months (Cargo - Tonnes)				
Wular Lake to Srinagar	56	69	85	115
Sangam Bridge to Srinagar	6	8	10	14
Daily Traffic of Vegetables in Peak Season (April to Nov) - 8 Months (Cargo - Tonnes)				

Realistic Scenario	2022	2027	2037	2047
Wular Lake to Srinagar	0	0	0	0
Sangam Bridge to Srinagar	12	15	19	26
Daily Traffic in Non-Peak Season (Cargo - Tonnes)				
Wular Lake to Srinagar	0	0	0	0
Sangam Bridge to Srinagar	0	0	0	0
Total Annual Traffic ( Cargo - Tonnes)				
Wular Lake to Srinagar	6,720	8,280	10,200	13,800
Sangam Bridge to Srinagar	3,600	4,560	5,760	7,920
<b>Total Annual Cargo - Tonnes</b>	<b>10,320</b>	<b>12,840</b>	<b>15,960</b>	<b>21,720</b>

## 5.22 Pessimistic Scenario

Pessimistic scenario is considered if there would be moderate growth in cargo traffic in future. After development of Waterway, cargo would be moved to the nearby terminal and then further by waterway. It would increase time and distance of transportation, which would be higher than present mode of transportation, i.e. roadways. It can be assumed that increase in time and distance through waterway would decrease cargo traffic in future.

- Terminal wise Traffic Projection

Along with passenger and tourist traffic, below mentioned terminals are also proposed to handle cargo traffic (horticulture) in future. Safa Kadal in Srinagar would cater the cargo traffic originating from Gund Prang near Wular Lake and Sangam Bridge i.e Anantnag. Horticulture cultivation and trade happens only in peak season i.e **Fruits for 4 months and Vegetables for 8 Months**. Therefore terminal would handle cargo only from April to November. The table below shows the daily and annual cargo traffic projections for each terminal.

**Table 5-97 Terminal wise Cargo Projections: Pessimistic**

Pessimistic Scenario	2022	2027	2037	2047
Daily Traffic of Fruits in Peak Season (Aug to Nov) - 4 Months (Cargo - Tonnes)				
Gund Prang	56	56	56	56
Safa Kadal / Chattabal Shrine	62	62	62	62
Sangam Bridge	6	6	6	6
Daily Traffic of Vegetables in Peak Season (April to Nov) - 8 Months (Cargo - Tonnes)				
Gund Prang	0	0	0	0
Safa Kadal / Chattabal Shrine	12	12	12	12
Sangam Bridge	12	12	12	12
Daily Traffic in Non-Peak Season (Cargo - Tonnes)				
Gund Prang	0	0	0	0
Safa Kadal / Chattabal Shrine	0	0	0	0

Sangam Bridge	0	0	0	0
Total Annual Traffic ( Cargo - Tonnes)				
Gund Prang	6720	6720	6720	6720
Safa Kadal / Chattabal Shrine	10320	10320	10320	10320
Sangam Bridge	3600	3600	3600	3600
<b>Total Annual Cargo - Tonnes</b>	<b>20,640</b>	<b>20,640</b>	<b>20,640</b>	<b>20,640</b>

- Route wise Traffic Projection

In Wular and Anantnag, vegetables grow in abundance, which are sent to Srinagar mandis mostly for local distribution. Fruits and Vegetables procured from Wular and Alanatnag are also distributed in entire Kashmir Valley. The table below shows the season wise daily and annual cargo traffic projected for Wular to Srinagar and Sangam Bridge to Srinagar route.

**Table 5-98 Route wise traffic projections for Cargo: Pessimistic**

Pessimistic Scenario	2022	2027	2037	2047
Daily Traffic of Fruits in Peak Season (Aug to Nov) - 4 Months (Cargo - Tonnes)				
Wular Lake to Srinagar	56	56	56	56
Sangam Bridge to Srinagar	6	6	6	6
Daily Traffic of Vegetages in Peak Season (April to Nov) - 8 Months (Cargo - Tonnes)				
Wular Lake to Srinagar	0	0	0	0
Sangam Bridge to Srinagar	12	12	12	12
Daily Traffic in Non-Peak Season (Cargo - Tonnes)				
Wular Lake to Srinagar	0	0	0	0
Sangam Bridge to Srinagar	0	0	0	0
Total Annual Traffic ( Cargo - Tonnes)				
Wular Lake to Srinagar	6,720	6,720	6,720	6,720
Sangam Bridge to Srinagar	3,600	3,600	3,600	3,600
<b>Total Annual Cargo - Tonnes</b>	<b>10,320</b>	<b>10,320</b>	<b>10,320</b>	<b>10,320</b>

### 5.23 Conclusion and Recommendation

Development of IWT on river Jhelum would provide tourists and local passengers an alternative mode of transportation to travel to/from Srinagar and also undertake local travel within Srinagar. They would use waterways for along the river movement, majorly from tourism point of view. After development of NW 49, tourists would enjoy shikaras and boat rides in the lake and river Jhelum. Considering the advantage of location, it is assumed that Srinagar- Wular and Srinagar- Anantnag routes would witness heavy tourist traffic. Apart from tourist, local residents would also use river Jhelum for transportation. However, water transportation in River Jhelum would attract tourist more as compared to local passengers, because local passenger would

always opt for fastest mode to travel around. But, to shift passengers to waterway, IWT cost must match the transportation cost offered by roadway and railways along with time associated with travel.

Total 9 terminals are proposed for tourist and passenger movement, out of which, 6 terminals, i.e. Pantha Chowk (Terminal 1), Zero Bridge (Terminal 2), Sambul Bridge (Terminal 6), Gund Prang (Terminal 7), Sangam Bridge (Terminal 8) and Sopore Bridge (Terminal 9) would be developed as hub terminals for tourist and passenger movement. These hub terminals would be developed on large scale and would handle tourist and passenger for long distance route. The main users of these terminals would be tourist and passenger moving between Baramulla – Bandipora – Srinagar – Anantnag. To handle local traffic, 2 hub terminal, i.e. Pantha Chowk (Terminal 1) & Zero Bridge (Terminal 2) and 3 small terminals, i.e. Amira Kadal (Terminal 3), Shah-e-Hamdan (Terminal 4) and Safa Kala / Chattabal Shrine (Terminal 5) would be developed in Srinagar. The main users of these three terminals would be tourist and passenger who are travelling within Srinagar.

Horticulture is the only commodity traded in the hinterland of NW49. Other than this, no opportunity from industrial cargo exists due to unavailability of major industries in the hinterland. Total 3 terminals, i.e. Safa Kadal/ Chattabal Shrine (Terminal 5), Gund Parang (Terminal 7) and Sangam Bridge (Terminal 8) are proposed for cargo handling, located in Srinagar, Bandipora and Anantnag respectively. The trade of horticulture products is seasonal and requires prompt delivery due to lower shelf life. The volume of horticulture products for NW 49 is less **i.e 10,320 tons** annual and would not create an economy of scale. The local logistic dynamics and perishable nature of cargo is a big deterrent for shifting to IWT. Also, after interacting with the traders it is found that none of them are presently ready to shift their cargo to IWT. Main reason behind this is longer distance and time delay, also the negligible volume. **Hence, cargo movement on NW49 is discarded.** However, it is assumed that the success of passenger movement may encourage cargo traders to shift their trade on waterway in future.

## CHAPTER – 6

### MARKET DEVELOPMENT PLAN

#### 6.1 Market Development Plan

IWT on river Jhelum would be effective and can play a crucial role when waterway connections are available in combination with high transport demand and tourism activities. It is necessary to establish connecting transport networks, along with a well-developed waterway infrastructure on NW 49. The market development study of river Jhelum would focus to highlight advantages of IWT; identify challenges of IWT in the region, suggestive methods, and strategic areas to promote IWT at river Jhelum. The section would also study Government policies, subsidies and incentives for IWT promotion.

##### 6.1.1 Objective

The objective of the market development study is to foster the development of the inland waterway transport on River Jhelum (NW 49) in a manner that will lead to realization of an efficient, sustainable and safe waterway transportation system. The specific objectives related to the development of IWT in river Jhelum are following:

- Identify obstacles that hinder the intensive use of the waterway transport mode and develop strategies and policies to overcome them
- Create infrastructure and policies to facilitate possibility of shifting passenger traffic from existing modes to NW 49
- Prepare guidelines for the integration of the waterway transport on River Jhelum into transportation system
- Elaborate the concepts and strategies for the future actions to make inland waterway transport on NW 49 sustainable
- Work for Environmental conservation of the river and surrounding areas

##### 6.1.2 Benefits of using Inland Waterway Transportation

Despite the benefits for using IWT, the mode has not been utilized majorly in India. India is estimated to have nearly 14,500 km of navigable inland waterways, but the exploitation of this sector has remained neglected and underutilized. Compared to other countries like Europe and China, inland waterway in India is used so far for only miniscule trade. Recently, with the initiative of the Shipping Ministry of India, IWT is seriously considered as an alternate mode of transportation in every part of the country. Transport by inland waterways should be preferred in order to relieve heavily congested transport corridors. Inland waterway in River Jhelum (NW 49), which passes through the Capital city, Srinagar would be used for passenger and tourist movement.

River Jhelum was used as a means of transportation previously; hence many residential, commercial hubs are developed near the bank of River Jhelum. Development of NW 49 would revive the transportation system of river Jhelum.

Transport by NW 49 could be preferred in order to relieve heavily congested transport corridors. Development of NW 49 would open new avenues for tourism. Tourists would be attracted to the waterway to enjoy long route boat ride on the river. Apart from exploring the river stretch in and around Srinagar, tourists could also take a boat from Srinagar and travel all the way to Bandipore, which is popular for Wular Lake and natural beauty. There is potential for development of tourism related other activities on the bank of river Jhelum, like shops of handicraft, dry fruits and other local products.

By creating favorable conditions for further development of inland waterways, the Government could encourage more people to use this mode of transport. The government could promote IWT on river Jhelum by implementing green policies, changing budgetary priorities and achieving efficiency throughout all transport systems, gaining economies of scale and scope.

### **6.1.3 Strategic Areas for promoting IWT on river Jhelum**

This section comprises numerous actions and measures to boost transport on inland waterways. The development of river Jhelum as IWT and supportive infrastructure would help to attract passengers and tourists to the waterway. Following strategic areas could be considered for the development of IWT at river Jhelum.

#### **6.1.3.1 Economic Sector**

- Enhance Infrastructure  
With the development of NW 49, it is necessary to develop supporting infrastructure, approach road, parking facility etc. Facilities like café, restaurant etc. would boost the appeal of the terminals and would attract more passengers/ tourists.
- Public- Private Partnership  
Involve private players for development, maintenance and operation of inland waterway on river Jhelum.
- Improve market condition  
Expand reliable IWT services by integrating Inland Navigation within the transport chain. If travel costs would be low on NW 49, then passengers would be attracted and market for NW 49 would gradually expand. For tourists, cost would not be a deterrent, as they would use IWT as leisure activity. Development of NW 49 would provide tourists an opportunity to enjoy the long boat ride on the river and enjoy the scenic beauty of the surrounding area.

#### **6.1.3.2 Environmental Sector**

- Adaptation of inland navigation infrastructure

Adaptation of inland navigation infrastructure is vital to conserve environment. With rapid climate change, utilization of waterway should be encouraged.

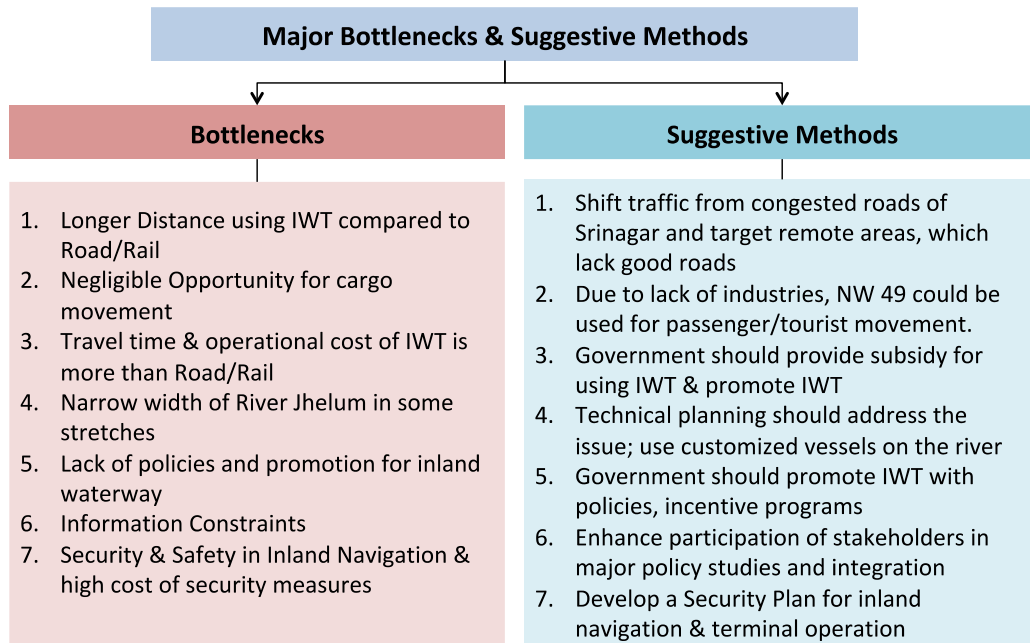
- Evaluate the environmental impacts related to dredging, bandalling, construction etc. on river Jhelum.  
Activities, like dredging, construction on the river can have significant impacts on the environment and ecological value of the river, especially on aquatic flora and fauna. All these effects should be examined and with proper planning, dredging and other related activities should be undertaken.
- Evaluate the environmental impacts of the different modes of transportation  
IWT is the most fuel-efficient mode of transportation for moving cargo and passengers. It is the least energy intensive method of transportation and consumes less energy than alternative modes per ton-kilometer.

#### **6.1.3.3 Socio- economic Sector**

- Raise image and awareness  
Inland navigation could be promoted as a successful partner in business. There is a need to establish promotion centers for IWT. Government should raise public awareness of the benefits of using waterway on NW 49 for a wide range of activities, from commercial use, like leisure boat rides and other recreational uses to passenger movement for daily commute.
- Develop human resources  
To promote IWT, it is important to enhance labor mobility, attract workforce and invest in human capital.

#### **6.1.4 Major Bottlenecks & Suggestive Methods**

Major challenges are identified, which could threaten the viability of IWT at River Jhelum. These challenges and suggestive methods are listed below.



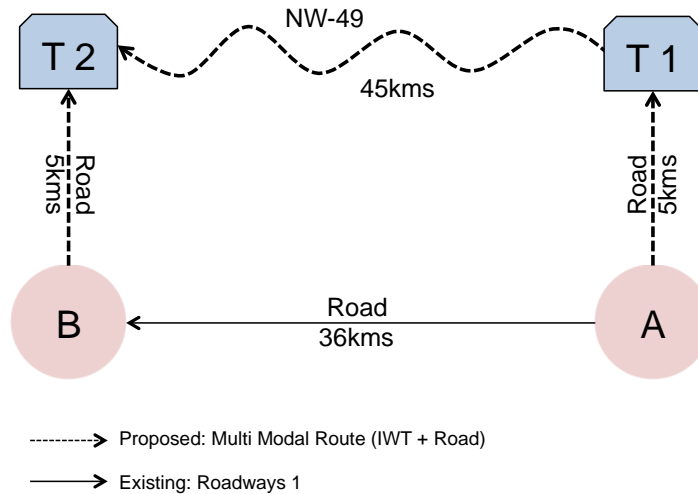
**Figure -6.1 Major Bottlenecks & Suggestive Methods**

The above mentioned bottlenecks and suggestive methods for each bottleneck are described in detail below.

#### **6.1.4.1 Longer distance using IWT compared to Road/Rail**

The major bottleneck for the viability of NW 49 is that using inland waterway in river Jhelum would take longer distance and more time as compared to roadway and railway. For instance, the river stretch between Lal Chowk to Pantha Chowk in Srinagar, is curvy and serpentine in nature. A national highway (Srinagar-Leh Highway) runs parallel to the river, which is straight and hence is shorter in distance compared to the waterway.

The below image depicts the comparison of IWT distance with existing mode of transportation, i.e. roadways.



**Figure -6.2 Comparison of Different Modes (IWT, Road & Rail)**

The above image shows that transportation through IWT takes longer distance and more time. Due to the curvy shape of the river, distance increases between origin and destination. Whereas, roadway takes shorter distance and less time. For instance, for movement from Point A to Point B, there is direct road connectivity and it takes 36 kms. In case of IWT, passengers/tourists need to travel from Point A to T 1 (Terminal 1) on the waterway for embarking the vessel.

Movement from Point A to Terminal 1 would be done by roadways, by covering a distance of approx. 5 kms. Further, from Terminal 1, passengers/tourists would travel to T 2 (Terminal 2), covering a stretch of 45 kms. From Terminal 2, after disembarking, passengers would further move to the destination Point B, by covering approx. 5 kms distance on roadways. Overall, by using IWT, the total distance covered by multi modal mode (roadways & waterways) is 85 kms. This distance is more than twice covered by roadways. Hence, IWT would take longer travel time. Due to this constraint, time sensitive passengers would not prefer IWT. Time is the key for daily commuters, who travel every day for work, education or business. However, this bottleneck would not deter tourists, as they would use inland waterways as a leisure activity. Due to more time involved with IWT, horticulture movement would not prefer NW 49, as horticulture is perishable commodity.

### **Suggestive Method**

Development of NW 49 with well-planned terminals and proper navigation would attract passengers to the waterway. Roads of Srinagar are often congested due to heavy traffic, which is a major problem for daily commuters. NW 49 has an edge over roadways, as Inland waterway does not suffer from congestion problem and it could provide uninterrupted transportation. If there is proper planning and timetable for ferry movement on NW 49, then passengers would consider using it as an alternate mode of transportation. Some remote regions, like Ganderbal and

Bandipore could be targeted, where there is lack of well-developed roads. People from these districts would be attracted to NW 49 for traveling to Srinagar.

#### **6.1.4.2 Negligible opportunity for cargo movement**

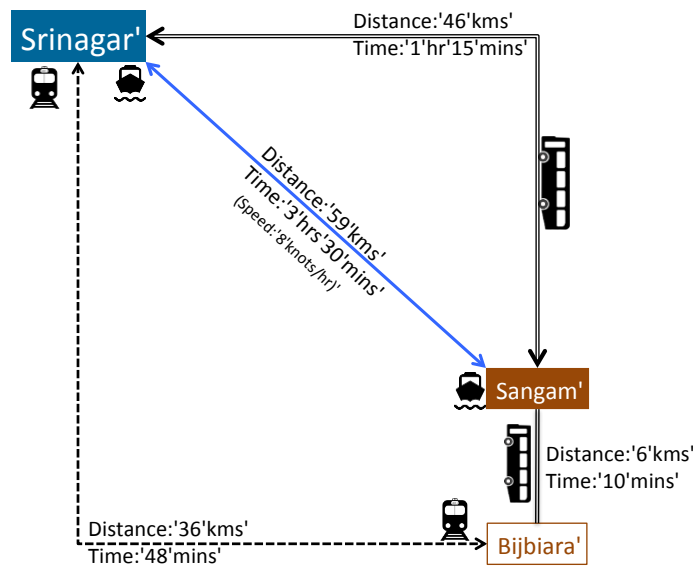
There is no major industry or industrial cluster in the hinterland of NW 49. Hence, there is no opportunity for industrial cargo movement in NW 49. Targeted commodity, horticulture would also not provide much opportunity. Horticulture is a perishable commodity and its transportation demands faster movement. During interaction with the stakeholders, it was observed that horticulture traders want even faster mode of transportation than existing mode, i.e. roadway. Hence, even if inland waterway on river Jhelum is developed, traders would not prefer it for horticulture movement. Lack of demand and need of users is a major bottleneck for the development and viability of NW 49.

#### **Suggestive Method**

Due to lack of industrial cargo and perishable nature of horticulture products, NW 49 should target passenger and tourist traffic. Tourist footfall in the region, growth in economy due to growing tourism, increase in transportation demand for passenger movement are indicators that NW 49 has potential to attract tourist and passenger traffic. Daily commuters would use waterway to avoid congestion on roads during peak hours. Tourists would opt for long route ferry ride on NW 49 for leisure activity and sightseeing. Considering the targeted traffic, NW 49 should be equipped with more facilities to address the comfort of tourists/passengers. It is also crucial that NW 49 maintains a proper timetable and has adequate number of ferry trips per day, so that daily commuters do not have to wait.

#### **6.1.4.3 Travel time and operational cost of IWT is more than Road/Rail**

Compared to existing modes of transportation, like roadways and railways, IWT is longer in distance due to the morphology of the river. River Jhelum has curves and bends, which increase the navigational distance. To understand the difference of distance through different modes of transportation, distance and travel time of all transit routes (Road, rail and IWT) is calculated between Srinagar to Sangam, which is depicted in the below image.



**Figure -6.3 Distance Comparison by IWT, Road & Rail**

Movement between Srinagar to Sangam (Anantnag) can be taken as an example to understand the difference in distance by different modes of transportation. As shown in the above figure, navigable river stretch from Srinagar to Sangam in NW 49 is 59 km long. Roadway would take shorter distance. There is direct road connectivity between Srinagar and Sangam via NH 44, which is 46 km long. There is no direct rail connectivity between Srinagar and Sangam, as there is no railway station in Sangam. For railway movement, passengers would take train from Srinagar and reach Bijbiara, which is the nearest station from Sangam. From Bijbiara to Sangam, there is roadway, which takes 6 km. Railway distance between Srinagar to Bijbiara is 36 km and last mile connectivity by road is 6 km, hence it takes total 42 km. It is evident that IWT takes longer distance as compared to roadway and railway.

The reason for difference in distance between IWT and railway/roadway is the curvy shape of the river. River Jhelum is not straight like roadway and railway, which run parallel to the navigable stretch of the river. Longer travel distance results in longer travel time. As shown in the above image, IWT movement between Srinagar to Sangam would take around 3 hrs. 30 min travel time, which is far higher than roadway travel time, i.e. 1 hr. 15 min. Travel time, combining railway and last mile travel by roadway is 58 min.

Longer travel distance and time would result in higher operational and transportation cost of IWT. The major bottleneck for the development of NW 49 is transportation cost by roadways and railways would be cheaper than IWT due to shorter distance via roadway and railway.

### **Suggestive Method**

To integrate IWT in the transportation system and to keep the cost of transportation similar to roadway and railway, it is necessary that IWT is subsidised by Government. Despite the constraint of long distance and more

travel time by IWT, passengers would prefer it if the fare is cheaper or at par with the existing mode. Moreover, IWT can leverage its uninterrupted route to solve the city's road congestion problem. IWT can overcome the shortcoming of longer distance by its unhindered navigation, as there is no congestion on NW 49.

Water transportation in River Jhelum would attract tourists more as compared to local passengers, because passengers would always opt for fastest mode to travel. Tourists would use NW 49 for leisure and they would not be discouraged by shortcomings of time and cost.

#### **6.1.4.4 Narrow width of River Jhelum in some stretches**

The width of River Jhelum is narrow in some places, which is a technical obstacle. Earlier, boats were moved on river Jhelum on a pilot basis. This boat movement ran for a period of more than a year. However, later the operation was stopped due to restriction in boat movement.

It was observed that several houseboats are berthed on the banks of River Jhelum. These houseboats are kept stationary for whole of year. The width of Jhelum is narrow. Hence, any motorised boat sailing at high speed creates ripple effects on the surface of the river. This adversely affects the houseboats stationed near the bank of the river, as with ripples on the water, there is strong chance of collision of moored boats. The owners of houseboats usually protest and advise the boat owners to sail at a slow speed so that there is no ripple effect on the water of the river. This issue should be considered while planning boating activity on river Jhelum.

#### **Suggestive Method**

Technical planning of inland waterway development of NW 49 should address the issue mentioned above. With proper planning, this problem could be resolved. Small size, customized vessels could be used on the river. In earlier times, boating activity on river Jhelum was undertaken with small boats. These boats did not have motors and hence there was negligible impact on the water of the river. Customized vessels could solve this problem.

#### **6.1.4.5 Lack of policies and promotion for inland waterway**

At present, integrated transport planning to minimize operational costs and promotion for inland waterways on river Jhelum is not adequate. The policy directives should encourage IWT development and focus on promotion of infrastructure, policy instruments, implementation arrangements and financial support etc.

#### **Suggestive Method**

The Government should act as an advocate to promote policies, which make waterways more attractive and easier to use. There is a need for proper

integration of public & private sector for the development and operation of NW 49. With favorable policies and subsidy, NW 49 would attract more users.

Government needs to generate public interest, encouragement and involvement in the prospects and potential inherent in the inland waterways in river Jhelum. Government needs to be determined to provide an investment friendly climate and generate policy and incentives that will encourage new investors and investments in NW 49.

People should be encouraged to use IWT. Inland waterways is a new concept in India and people are still dependent on existing modes of transportation due to cost, time and efficiency. To compete with road/rail, it is necessary that Government would make suitable investments on IWT infrastructure and policy to bring waterways at par with roadway/railways.

#### **6.1.4.6 Information Constraints**

Lack of institutionalized communication among IWT stakeholders is a hurdle. There is lack of awareness among people of the opportunities coming out of the IWT system on NW 49. There is a need of effective communication channels among locals, tourism department and government.

#### **Suggestive Method**

Enhance participation of stakeholders in major policy studies and integration. The Government should demonstrate the economic and environmental benefits of waterway transport to stakeholders through a coordinated, long-term approach. This would encourage stakeholders to increase their participation in IWT on river Jhelum. Regular communication with the stakeholders and addressing their needs and requirements is necessary for improving customer service.

#### **6.1.4.7 Security & Safety in Inland Navigation**

Safety and security of staffs, passengers, vessels, terminal infrastructure etc. is one of the major concerns. Like Ports, the areas of inland navigation are also threatened by terrorist attacks. Security measures would be required for safety in terminals and on vessels. High cost associated with the security measures would further hinder the viability of IWT on NW 49.

#### **Suggestive Method**

IWAI needs to develop a security plan for IWT infrastructure and other facilities on NW 49. The security plan must include measures to prevent unauthorized access in terminals, measures to prevent weapons or dangerous substance onboard of vessels or in terminals, procedures to respond to security threats, evacuation process during emergency, duties of personnel responsible for security etc.

## 6.2 Comparison of IWT, Railway & Roadway

Rail and road are traditional modes of transportation in India. At present, railway is widely used in the hinterland of river Jhelum. Roads are preferred for both short and long distance travel, whereas railway is mostly used for long distance travel.

With the development of IWT at river Jhelum, opportunities will open up when intermodal services are available at the terminals. Inland waterways unlike other modes of transport are considered to be the cheapest form of transport due to its capability of carrying larger volumes. SWOT Matrix of the three modes of transportation, IWT, Rail and Road is presented below.

### 6.2.1.1 SWOT of Inland Waterway Transportation

#### Strength

- Large transport capacity of passengers
- Small risk of accidents and breakdowns
- No congestion on waterways
- Environmentally friendly mode
- Easily accessible to both banks of river, while other modes are dependent on bridges on the rivers

#### Weakness

- Time to operation limited to daytime
- Limited area of operation, depending on sufficient depth of waterways
- Low transport speed, usually approx. 6-8 knots
- Less service flexibility than roadway

#### Opportunity

- Comparatively low investment costs for waterways (mostly naturally available) and low operations cost of IWT
- Very limited land requirement for developing passenger/tourism terminal
- Potential for simultaneous development of a river for power generation, flood control, navigation, irrigation, industrial uses and recreation
- Srinagar smart city project and Wular lake development plan includes beautification of NW 49 waterfront, dredging to remove siltation, improvement of Jhelum Ghats etc. This would compliment development of NW 49.

#### Threats

- IWT is not dependable and reliable mode. Operation is interrupted in some seasons due to weather condition, when water level is low or high.
- During winter season, when there is extreme low temperature in Kashmir, NW 49 might be under-utilized due to fall in traffic.

- Rivers may change course leading to navigation problem
- Traveling cost is more in IWT compared to Rail/Road.

### 6.2.1.2 SWOT of Railway

#### Strength

- High speed over long distance
- Large transport capacity
- Lower travel cost
- Fixed routes and schedules resulting in more uniformed and regular service than other modes
- Limited accidents and breakdowns

#### Weakness

- Large investment in construction, maintenance and overhead
- Inflexibility of routes and timings, which cannot be adjusted to individual requirements
- Transport is not economical for short distances and small number of passengers
- No service in rural areas because of high capital requirement

#### Opportunity

- Dependable and reliable mode of transport as being least affected by adverse weather conditions and time of day

#### Threats

- Lack of competition may lead to inefficiencies and higher costs
- Lack of railway stations in some region leads to multi modal transportation

### 6.2.1.3 SWOT of Roadway

#### Strength

- Road offers door-to-door service, which reduces travel cost and is more convenient
- Flexible service as routes and timings can be adjusted and changed to individual requirements

#### Weakness

- Higher risk of accidents and breakdown
- Heavy congestion on city roads
- Emits carbon and causes pollution
- Lack of organization, can be irregular and undependable

#### Opportunity

- Suitable for short distance
- Transport is more independent of schedules
- Cost of constructing, operating and maintaining roads is lower than railways

#### Threats

- Road congestion often leads to delays
- Road dimension in some regions is often inadequate
- Roads are often in bad condition and poorly maintained
- Less reliable during rainy season, when roads may be unfit and unsafe to use
- During winter, roads of Kashmir Valley are usually covered in snow, which restricts movement
- Heavy tax burden on motor transport in India

### 6.3 IWT Promotion & Incentives in Europe & China

Countries, like Europe and China have applied national IWT policies of their own. The economics of water transport are strongly tied up with the location of industrial activities in a country. European industry, which is mostly located close to waterways, has favored IWT, especially for bulk products. A comparative overview of European Union (EU) incentive and development programs to initiate IWT indicates the wide range of instruments for a mature EU transport industry, infrastructure and market driven forces. These market driven forces help in deciding which transport mode will be chosen to serve the market. The Netherlands and Germany remain the largest inland shipping nations in the EU, followed by Belgium and France. By modal share, the Netherlands, Romania and Bulgaria have most goods carried by inland shipping.

Another comparative overview of the Chinese incentive and development programs indicates government's initiative and support for inland waterway transport in the country. It also indicates the engagement of the national ministries and departments in implementation of rules and regulations. Compared to other countries, the Indian IWT transport market is currently in an immature stage. It could follow models of highly developed IWT markets, like Europe and China for policies, subsidies and regulations for the development and integration of IWT in multi modal supply chain.

#### 6.3.1.1 Policies & Subsidies in favour of IWT in Europe

In Europe, IWT is considered as a complementary mode of transportation. IWT plays an important role in Europe for transportation of goods from EU's major ports to the hinterland. In Europe, IWT is significant for the movement of freight than passengers. Passenger traffic in European IWT is less compared to freight traffic. IWT is extensively used for transporting commodities like metal ores, coke and refined petroleum, agricultural products etc. as well as containers. IWT has significant

contribution in multi modal transport and container movement. The Netherlands and Germany together account for a large share of container transportation through IWT. Other countries like Hungary, Romania, Austria and Slovakia also increased their share in container transportation through IWT.

Most of European industrial centers can be reached by inland navigation. The Rhine-Danube network, with a length of 14,360 km, alone represents nearly half of the inland waterways of international importance.

The European Union (EU) has implemented several successful programs to promote IWT and intermodal transport, and to take freight off roads since 2003. These programs are mentioned below

1. The Marco Polo program gives grants in the crucial start-up phase of direct modal-shift or traffic avoidance projects or projects providing supporting services that enable freight to switch from road to rail and waterborne systems efficiently and profitably.
2. The Trans- European Network for Transport (TEN-T) that aims to help connect industrial regions and urban areas; link them to ports and help establish an interoperable, intelligent traffic and transport system. Integration of good navigation status in TEN-T ensures the quality of existing infrastructure.
3. INTERREG IV-A Upper Rhine that intends to support development of the Upper Rhine into an internationally competitive cross-border knowledge and innovation region.
4. NAIADES that promotes inland waterway transport and focuses on five strategic areas for a comprehensive inland waterway transport policy: market, fleet, jobs and skills, image and infrastructure.
5. NAIADES 2, the EU inland waterway transport action plan is in implementation with harmonisation of technical requirements, education and greening of the fleet. It aims to improve the economic and environmental performance of IWT.
6. PLATINA that was designed to support implementation of the NAIADES European inland navigation program.
7. PLATINA 2 that was designed as a multi-disciplinary project to implement the European Action Program for the promotion of inland waterway transport (NAIADES 2).

The policy instruments that are applied for promoting IWT differ between European Union (EU)-level and the national and sub-national levels, because of different political competences.

### **6.3.1.2 EU-level policy instruments**

The most important instruments on European Union-level are listed below:

- Co-funding of infrastructure projects through a Fund for the development of the Trans – European Network for Transport (TEN-T). This fund is to encourage Member States to invest in infrastructure (including port infrastructure), which is of

international importance to Europe. The fund, renamed as Connecting-Europe-Facility, co-finances up to 20% of the infrastructure works and up to 50% of studies in the preparation phase like feasibility studies, design studies and environmental impact assessments. To some extent, it can also provide co-funding of infrastructure related facilities, like Liquefied Natural Gas (LNG)-bunkering facilities and port information systems. The remaining part of funding usually is provided by the relevant lower level authorities and sometimes by private sector.

- Co-funding of research and development studies. These studies are mainly of large scale and with good representation of the relevant market players and other stakeholders. The study addresses technological innovations, like cleaner engines, cargo handling systems, improved port operations, optimizing information flows between operators and authorities, information and communication systems for navigation, and supply chain optimization etc.
- Co-funding of pilots or other implementation steps for transport quality and efficiency improvements on similar topics as mentioned above, for example for pilots of implementing port information systems or for developing a network of LNG-bunkering and related training of port staff on security issues.
- Co-funding of modal shift actions. The instrument Marco Polo II opened for IWT companies in 2007. The instrument supports IWT-operators by taking a share of the risk in the start up phase of a new service. The EU-contribution is always below the operational losses in the first 3 years of operation and required is a business plan that demonstrates viability of the service at the latest after 3 years.

EU-funding program NAIADES is presented in detail below. The Government of India could follow this model for the development and implementation of inland waterway in River Jhelum.

### **6.3.1.3 The EU funding program NAIADES**

IWT plays an important role for the transport of goods in Europe. More than 37,000 kms. of waterways connect a large number of cities and industrial regions. Around 21 Member States out of 28 have inland waterways, 13 of which have an interconnected waterway networks.

The policy to promote inland waterway transport in Europe is encapsulated in the NAIADES Action Programme. This Programme comprises numerous actions and measures to boost transport on inland waterways. The programme would run until 2020 and is to be implemented by the European Commission, the Member States and the industry itself.

The European Commission aims to promote and strengthen the competitive position of inland waterways in the transport system, and to facilitate its integration into the intermodal logistics chain. The Commission is promoting inland waterway transport through various funding and financing programmes, such as the Connecting Europe Facility, Horizon 2020, the European Fund for Strategic Investments and through the Cohesion policy.

Apart from the above listed Policies & Subsidies to promote IWT in Europe, European Union has implemented following

- Introduction of low sulphur fuel for IWT vessels
- Development of digital river information services to facilitate logistics services and make inland waterway easy to use and reliable mode in multi-modal supply chain.
- Education and training of all involved staffs
- Providing electronic navigational charts for smooth operation
- Optimisation of lock and bridge schedules to reduce waiting times, the overall duration of the voyage and to optimise energy use.
- Proper berth management for booking of berth space

#### **6.3.1.4 Policies & Subsidies in favour of IWT in People's Republic of China**

China's inland waterway transport (IWT) network is well developed in terms of length and freight handling. There are a large number of inland port facilities with berths for large vessels. China has a tripartite system of IWT management. The Ministry of Transport (MOT) of China has the overall responsibility for policy and administration of inland waterways. Delivery of IWT infrastructure and enforcement of regulations on the two most important sub-systems, the Yangtze and Pearl Rivers, are delegated to specialized River Administrations that are responsible to MOT.

While China, like the USA, operates a policy of cabotage in IWT, it is trying to encourage international investment and participation in inland port and logistics industries. Traffic on the China IWT system has been increasing rapidly in recent years.

In 2007, the government's National Development and Reform Commission and MOT issued the National Plan for Inland Waterways and Ports, with a planning horizon from 2007 to 2020. The plan evaluated the country's system of inland waterways, ports, and transport; analysed the advantages and functions of IWT; and proposed comprehensive long-term inland waterways and ports development. The plan has details of intended improvements to each of the country's following main IWT systems in rivers

- Yangtze River
- Pearl River
- Grand Canal
- Huaihe-
- Heilongjiang
- Songliao,
- Minjiang

In each case, it is taking a network approach by designing interlinked routes that can accommodate large and modern vessels. These improvements include a combination of channel dredging, new or upgraded locks (many combined with hydropower generation facilities) and new and upgraded terminals for both bulk and container traffic.

After development, the high-class waterway (Class III and above) will be around 19,000 km in 2020 compared to less than 9,000 km in 2006. The high-class system will extend to 20 provinces, including 56 cities with populations greater than 500,000, and will serve a catchment area that contains approximately a quarter of the population of China.

Some of the Opinions, published by MOT for promoting IWT in China are listed below

- In February 2006, MOT published the “National Outline for the Development of Ship-Class Standardization on Inland Waterways”, which requires Provincial transport authorities develop the navigation industry by relying on technological innovations and progress.
- In January 2011, the State Council issued “Opinions on Accelerating the Development of Water Transport on the Yangtze River”, which requires governments at all levels shall be devoted to integrating water transport with other modes of transport involving highways, railways, aviation, and pipelines, developing multimodal transport; and strengthening comparative advantages and combination efficiency of various transportation means.
- In May 2013, MOT issued the “Guiding Opinions on Promoting the Development of Green, Recycling-Oriented, and Low-Carbon Transportation.” The Opinions mandated provincial transport authorities to (a) strengthen technological research and development on green, recycling-oriented, and low-carbon transportation; (b) promote scientific and technological breakthroughs including R&D and application of key technology for intelligent transportation, and the research and demonstration of the key technology for emergency response to transportation pollution and pollution control.
- In August 2013, MOT issued the “Notice on Issuing the Action Programs (Year 2013–2020) on Accelerating the Development of Water Transport on the Yangtze River and Other Inland Waters,” in which Governments were required to strengthen planning and construction of inland waterways, which connect with coastal ports. Furthermore, governments at all levels shall make efforts to (a) speed up development of large-scale port areas for special purpose at major ports and part of the key ports along inland rivers, especially terminals for handling containers, automobile Ro-Ro handling, and bulk commodities; and (b) develop multimodal transport and port logistics.
- In April 2014, the Ministry of Finance and the MOT promulgated the “Management Measures for Subsidy on Ship-Class Standardization on Inland Waters.” The policy encourages cargo vessel replacement by providing subsidies. It also provides subsidies for vessels to install sewage cabin.
- For the development and promotion of inland waterways, there are several regulations issued in China, such as Regulations for Strengthening Safety Management of IWT Enterprises, Regulations for Renewal and Renovation of Ships

of Local Shipping Enterprises, Regulation for Management of Water Transportation and Regulations for Navigation Channels.

China introduced foreign capital for the construction of ports and waterways. Loans from the World Bank, the Asian Development Bank, the Overseas Joint Foundation and foreign governments are used, and foreign traders are encouraged to invest in the construction and operation of ports and waterways. For the latter, the State Council issued in 1985 "Provisional Regulations of the People's Republic of China on Preferential Treatment of Joint Investment of China and Foreign Countries in Construction of Ports and Waterways". Later, the Ministry of Communications formulated some policies. The Regulations and Policies include the following contents.

- Joint investment is encouraged in the construction and operation of public wharves. Joint-venture enterprises are allowed to conduct such businesses as loading and unloading, freight storage, dismantling and installation, packing, and domestic transportation.
- The time limit of operation for the joint-venture enterprise can exceed 30 years. The specific time limit for a joint-venture enterprise is defined by the parties involved, but it cannot exceed 50 years according to related laws. If a longer period is needed, an application must be made and submitted to the State Council for approval.
- Joint-venture enterprises managing loading and unloading can fix the rate of charge themselves and report to the Ministry of Communications or the local department of communications and the pricing department for the record.
- Besides their main business, joint venture enterprises are allowed to be engaged in other port-related projects whose period of construction is short, which need a comparatively small investment, and whose profit is high.
- Joint-venture enterprises are allowed to rent wharves and run loading and unloading.
- Foreign traders are allowed to construct freight owners' wharves and special waterways with their own capital.
- When foreign traders develop and manage large stretches of land, they are allowed to construct and manage special ports and wharves.
- Domestic freight owners and shipping enterprises are allowed to construct and manage special wharves, to rent wharves for the shipping of their own freight, and to invest in the excavation of special waterways. Special wharf owners are allowed to open their surplus berths to other vessels and run loading and unloading.

#### **6.3.1.5 Suggestions for IWT Promotion & Incentives in India**

Compared to IWT in Europe and China, IWT market in India is in an early stage and needs lots of support through policies and incentives from the Government. Prior to that huge investment is required for inland waterways and associated infrastructure. Adequate infrastructure is required for the success of IWT.

Crucial tasks related to IWT development, such as terminal construction, operation and maintenance would involve private investors. The private sector has the capability and willingness to invest in barge ownership, operation and supporting

services such as barge building, maintenance and repair. The Government should provide grant of 100% tax exemption to investors for five years.

Availability of vessels/boats should be considered during development phase. It is necessary that number of vessels/boats, which would be deployed in NW 49, is adequate to handle the passenger/tourist traffic. With increase in traffic volume, the number of vessels/boats should increase in future.

Tourism and related activities in inland waterway in NW 49 offer good potential. Government should encourage local and private parties with appropriate local investments and operational control, wherever relevant.

To encourage IWT in river Jhelum, Government of India should incorporate best policies and incentives by referring examples of European and Chinese governmental policies and subsidies. In initial phase, the waterway in Jhelum would need Government support and favorable policies. The government should provide subsidy in operational cost to encourage private sector participation in the sector. The subsidy would at least make the operations viable. This would also help in reducing fare price for passengers.

In order to further exploit the potential of inland waterway transport in river Jhelum, the strengthening of its market position, its integration into co-modal or multi-modal transport chains, the deployment of new technologies including River Information Services (RIS) would be important steps.

Government should make policies to shift road movement to inland waterways. The objective of the policy would be to reduce congestion on over burdened roadways and encourage people to use inland waterways. This would also curb issues like accidents due to congestion and collision on roadways.

## CHAPTER – 7 MORPHOLOGICAL STUDY

### 7.1 General Review

The morphology of a river channel is a function of a number of processes and environmental conditions, including the composition and erodibility of the bed and banks (e.g., sand, clay, bedrock); erosion comes from the power and consistency of the current, and can affect the formation of the river's path. The Morphological Studies, therefore, play an important role in planning, designing and maintaining river engineering structures. In order to assist the engineers of the concerned departments and other agencies, morphological study reports with broad guidelines are prepared.

### 7.2 Project Area

The morphology of various channels of the Jhelum River from Sangam to Lower Jhelum Hydroelectric Project across the outfall Channel (OFC) was analyzed using the available Landsat images (USGS site), Google earth images and taking note of the reach while visiting the actual site during the tour in the month of March 2018 & May 2018.

### 7.3 Data

Landsat05, Landsat07 and Landsat08 imageries are of 30m spatial resolution provide very good details entire course of Jhelum River. Route of Jhelum River from Bhagpora to Gantmulla Payeen has been analyzed using Landsat satellite imagery for a period of 10 years from 2009 to 2018. Satellite imagery of two seasons April to June and September to October has been analyzed for each of the years.

The details of Landsat imagery used for river course analysis for a period of 10 years are as follows:

**Table 7.1 Details of Landsat imagery name**

Year	Landsat imagery Name	Date of Acquisition
2009- April to June	LT05_L1TP_149036_20090523_20161026_01_T1	20090523
2009- September to October	LT05_L1TP_149036_20091014_20161019_01_T1	20091014
2010- April to June	LT05_L1TP_149036_20100526_20161015_01_T1	20100526
2010- September to October	LT05_L1TP_149036_20101017_20161012_01_T1	20101017
2011- April to June	LT05_L1TP_149036_20110513_20161009_01_T1	20110513
2011- September to October	LE07_L1TP_149036_20110926_20161206_01_T1	20110926
2012- April to June	LE07_L1TP_149036_20120710_20161130_01_T1	20120710

Year	Landsat imagery Name	Date of Acquisition
2012- September to October	LE07_L1TP_149036_20120928_20161128_01_T1	20120928
2013- April to June	LC81490362013138LGN01_18052013	20130518
2013- September to October	LC81490362013298LGN00_25102013	20131025
2014- April to June	LC81490362014157LGN00_B3_06062014	20140606
2014- September to October	LC81490362015128LGN00_B3_12102014	20141012
2015- April to June	LC81490362015128LGN00_08052015	20150508
2015- September to October	LC81490362015256LGN00_13092015	20150913
2016- April to June	LC81490362016179LGN00_270620161	20160627
2016- September to October	LC81490362016259LGN00_15092016	20160915
2017- April to June	LC08_L1TP_149036_20170529_20170615_29052017	20170529
2017- September to October	LC08_L1TP_149036_20170918_20170929_18092017	20170918
2018- April to June	LC08_L1TP_149036_20180430_20180502_30042018	20180430
2018- September to October	LC08_L1TP_149036_20180921_20180928_21092018	20180921

#### 7.4 River's Trajectory Change Analysis

The basic idea of Jhelum river route analysis is to find the significant change of river's trajectory from Year 2009 to 2018. Landsat Satellite images for the year 2009 to 2018 have been used for mapping of the shift in the river bank lines along the Jhelum River.

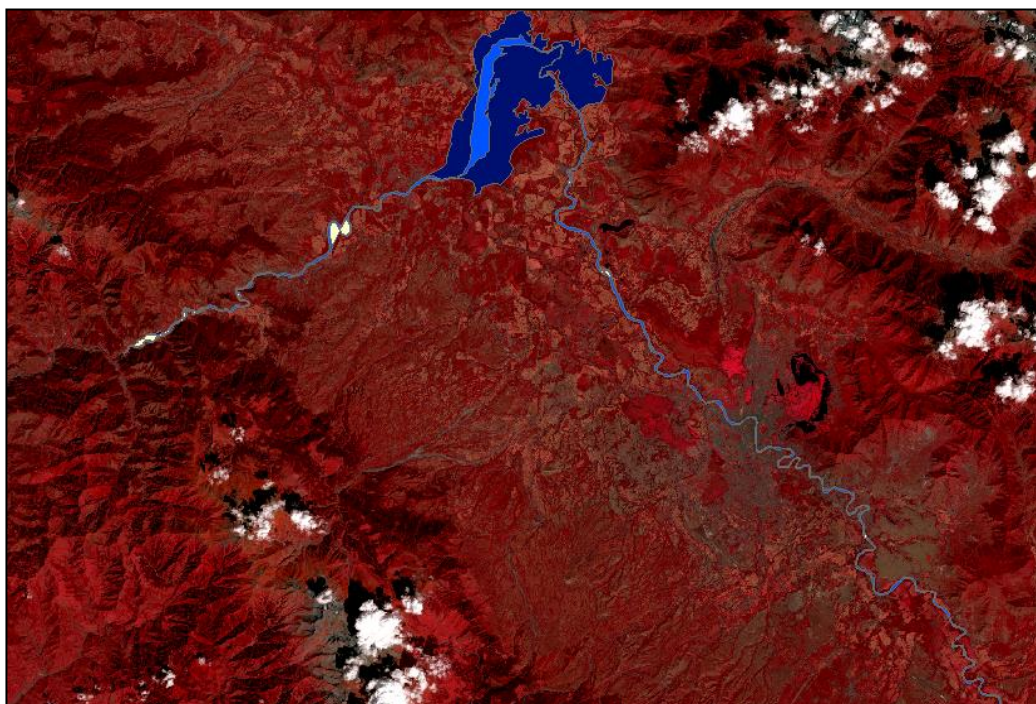
The river route of the entire stretch is extracted in 2D mode vector data digitization/ extraction from satellite imagery through image interpretation and analysis.

The spatial analysis of the extracted vector data has been done by overlay analysis of two seasons data within a year.

Spatial analysis of river's route within a year in two different seasons.

**Table 7.2 Spatial analysis observation of river's route within a year**

Year	Observations
2009- April to June 2009- September to October	No Change in course of the river observed.
2010- April to June 2010- September to October	No Change in course of the river observed.
2011- April to June 2011- September to October	No Change in course of the river observed.
2012- April to June 2012- September to October	No Change in course of the river observed.
2013- April to June 2013- September to October	No Change in course of the river observed.
2014- April to June 2014- September to October	No Change in course of the river observed.
2015- April to June 2015- September to October	No Change in course of the river observed.
2016- April to June 2016- September to October	No Change in course of the river observed.
2017- April to June 2017- September to October	No Change in course of the river observed.
2018- April to June 2018- September to October	No Change in course of the river observed.



**Fig. 7.1 Spatial route of river jhelum**

Spatial analysis of river's route in two different year :

**Table 7.2 Spatial analysis observation of river's route in two different year**

Year	Observations
2009- 2010	No Change in course of the river observed.
2010- 2011	No Change in course of the river observed.
2011- 2012	No Change in course of the river observed.
2012- 2013	No Change in course of the river observed.
2013- 2014	No Change in course of the river observed.
2014- 2015	No Change in course of the river observed.
2015- 2016	No Change in course of the river observed.
2016- 2017	No Change in course of the river observed.
2017- 2018	No Change in course of the river observed.

## 7.5 Analysis of Morphology of River Jhelum by CWPRS

The main channel of river Jhelum through Srinagar is found to be well incised and the banks are generally stable except at the downstream reach near Asham. The channel through the Srinagar and upstream portion is well maintained. At many places the channel is found to have been either dredged or probably sand has been mined from the river bed for a long period of time. The native vegetation/ trees have also been cut from the channel banks. The fresh shoals are rarely seen in this portion except at downstream reaches which leads to Wullar Lake. The area on the left side of river Jhelum downstream of Sangam and upstream of Padshahi bagh is having lower contour levels compared to the right side.

The main Jhelum channel is found to be heavily constricted in the reach upstream of Chattabal weir or when it traverses through the old city of Srinagar. Further the Channel experiences congestion as it approaches the Wullar Lake near Banyari. The main channel divides into smaller distributory channels. These distributaries further extend into the deeper portion of the Wullar Lake due to embankments that are either artificial or natural.

The images of the Wullar Lake show spread of water in this portion only when the water level in the Lake increases beyond RL 1577 m or so. Hence, it is estimated that the water enters in to Wullar Lake with ease only when the water level in the Channel at these places is beyond RL 1577 m. The flow from these channels distributes and seeps through the channels which cause the back water effect in the upstream reach. It is felt that the area in this reach should be properly dredged and connected to deep channels of the Lake.

The main Jhelum Channel beyond the Asham Gauging site traverses north and joins the Wullar Lake beyond Banyari. The Wullar Lake turns south and flows towards the outfall channel. The outfall channel starts from the Ninglee. The total length of the channel from Asham to Ninglee through the main Jhelum channel is about 45 to 50 km depending on the distributory channel selected. The straight line distance between the Asham to Ninglee outfall channel is about 10 km only. It is felt that the Wullar Lake may have been extending up to Asham in the early period and later might have got silted up. The channel may have extended to present day alignment slowly due to siltation

River feature vector data has been analyzed through overlay analysis of the vector data of two years and It is observed that **the course of the river didn't change in two consecutive years.**



Image of Wullar Lake as on 03.03.2000  
RL. 1574.23 m



Image of Wullar Lake as on 17.10.2010  
RL. 1574.25 m

**Fig. 7.2 Wullar Lake Imagery at RL 1574.23m & 1574.25m**

Satellite images & Jhelum Route analysis is enclosed in drawing folder of this report.



Image of Wullar Lake as on 07.04.2001  
RL. 1574.52 m

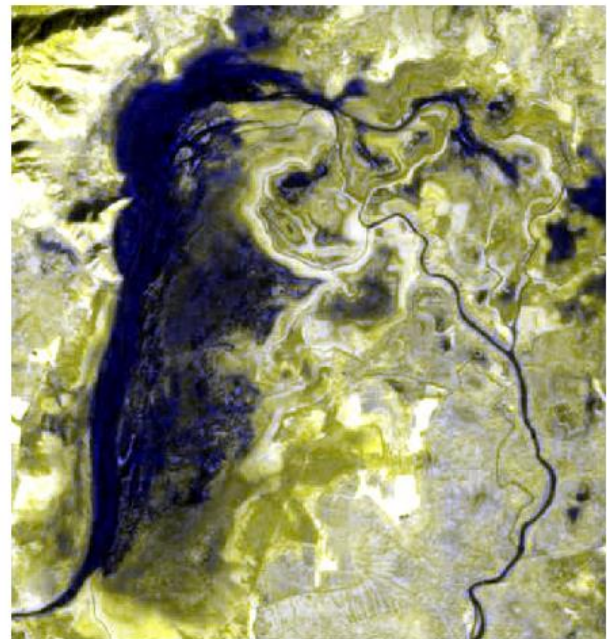


Image of Wullar Lake as on 20.12.2010  
RL. 1574.51 m

**Fig. 7.3 Wullar Lake Imagery at 1574.52m & 1574.51**



Image of Wullar Lake as on 31.05.2003  
RL. 1577.24 m

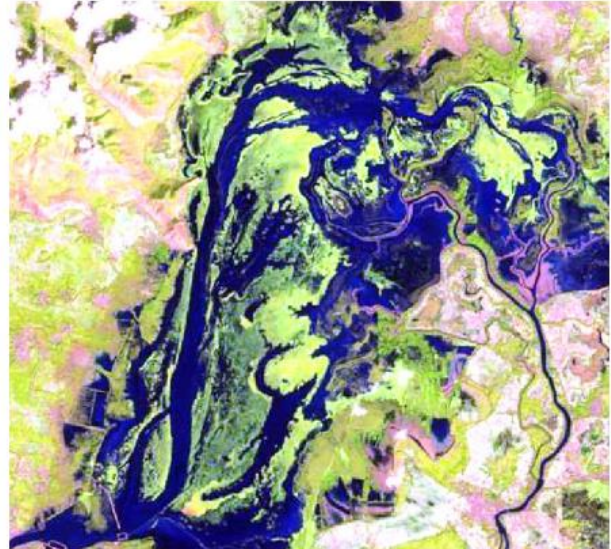


Image of Wullar Lake as on 26.09.2014  
RL. 1577.35 m

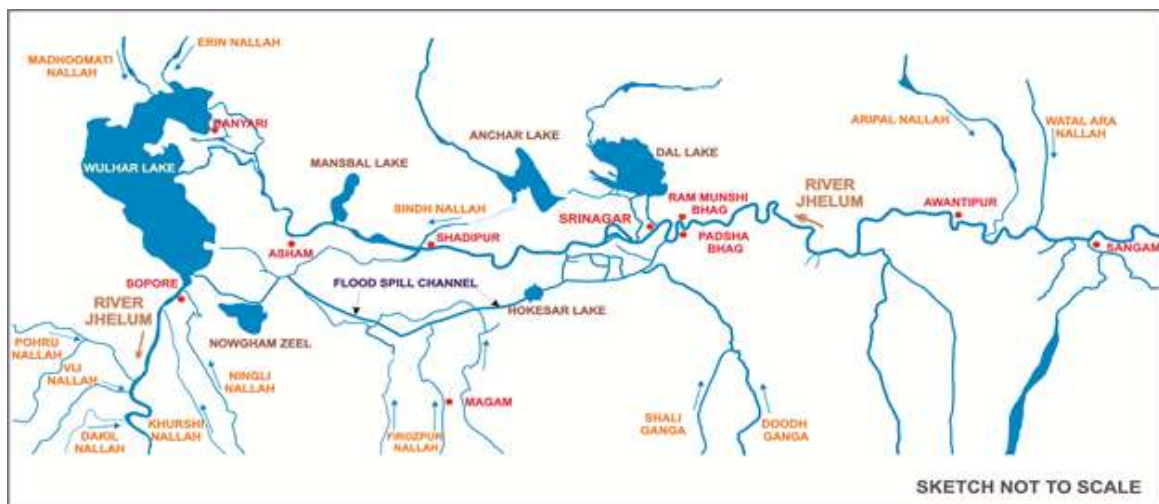
**Fig. 7.4 Wullar Lake Imagery at 1577.24m & 1577.35**

## CHAPTER – 8 MODEL STUDIES

### 8.1 MATHEMATICAL MODEL STUDIES FOR ASSESSING FLOW PARAMETERS IN JHELMUM RIVER REACH FROM SANGAM TO LOWER JHELMUM HE PROJECT

#### Preamble

M/s WAPCOS Limited, Pune vide their letter dated 04.04.2018 had requested CWPRS to conduct the mathematical model studies for assessment of feasibility of round the year navigation, improvement of navigability for proposed development of water transport facilities from Sangam bridge to Lower Jhelum power project in river Jhelum in NW 49 (Figure 8.1).



**Fig 8.1 - Jhelum River and tributaries in the reach under consideration for NW49**

### 8.2 OBJECTIVES OF STUDY

Following were broad objectives of these model studies.

- Prediction of flow depths/water levels for lean season flows and high flood discharges.
- Suggest measures for improvement of navigability during low flow periods.
- Suggest safe grade elevation for terminal locations and bank protection measures at vulnerable locations.

### 8.3 MATHEMATICAL MODEL STUDIES

These 1-D mathematical model studies for predicting water levels along Jhelum river reach under consideration were carried out on HEC-RAS model developed by Hydrologic Engineering Centre (HEC) of U. S. Army Corps of Engineers . HEC-RAS

### 8.3.1 HEC- RAS Model

HEC-RAS model was developed by Hydrologic Engineering Centre (HEC) of U. S. Army Corps of Engineers. HEC RAS is a software for River System analysis and is capable of simulating one dimensional steady and unsteady flows and mobile bed changes in river channel network with different types of boundary conditions. The basic computational procedure is based on the solution of Energy equation and momentum equations. This model is used worldwide to study flood plain management, to evaluate effects of encroachments in flood plain, to assess changes in water surface profiles due to channel modifications and construction of levees etc. The model is also capable of simulating various hydraulic structures along river reach such as bridges, culverts, dams, weirs. Model needs appropriate topographical data of river channels and flood plains for topography simulation in the model and hydrological and hydraulic data for model calibration and for generating boundary conditions required to simulate upstream and downstream boundary conditions for the model runs.

### 8.3.2 Gauge Discharge data for calibrating mathematical model

The water levels in Jhelum River are measured at gauging stations located near Sangam, Ram Munshi Baug (RMB), Asham and Wular exit point. These data were made available for model calibration. The gauge–discharge curve developed from the data for the Sangam, RMB and Asham sites are presented in Figures 8.2 to 8.4. The Gauge discharge curve for the lean season period for these three station combined together is shown in Figure 8.5.

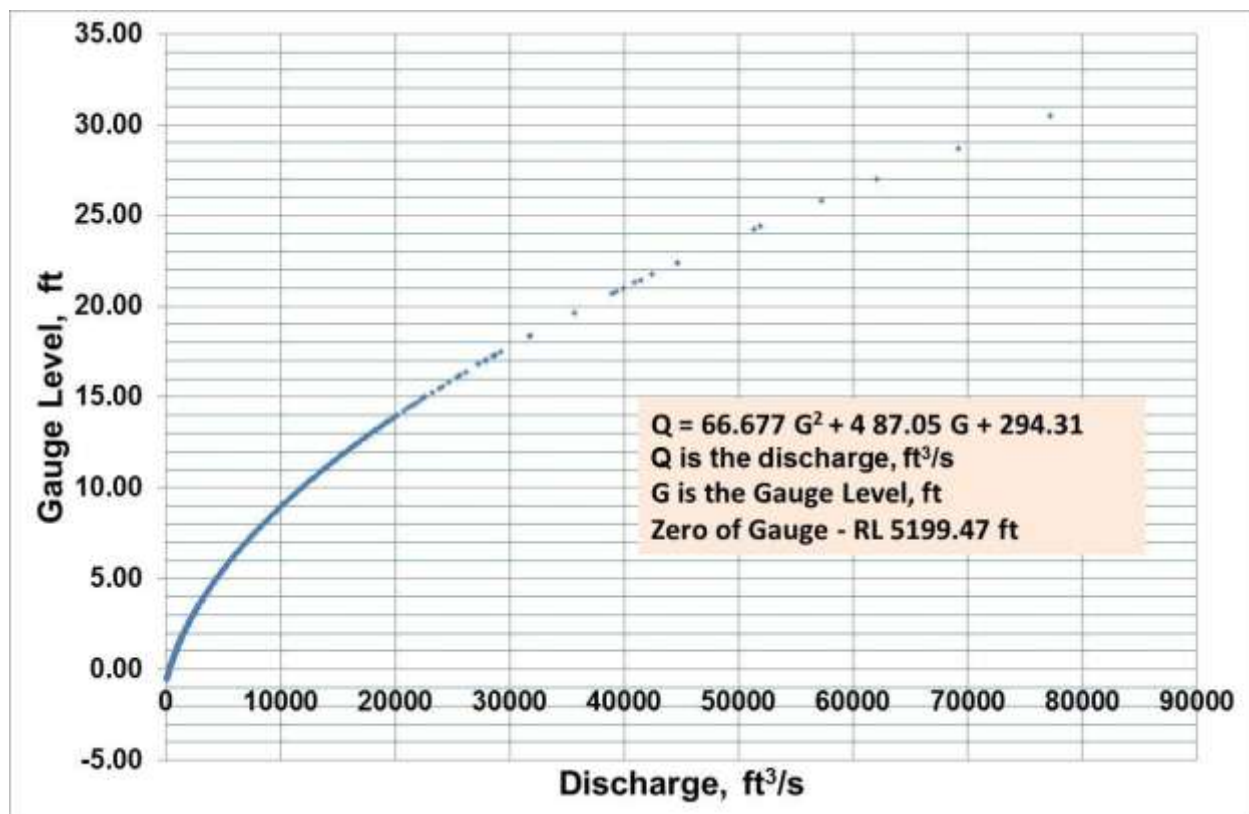


Figure 8.2: Gauge Discharge curve for Sangam Gauge site

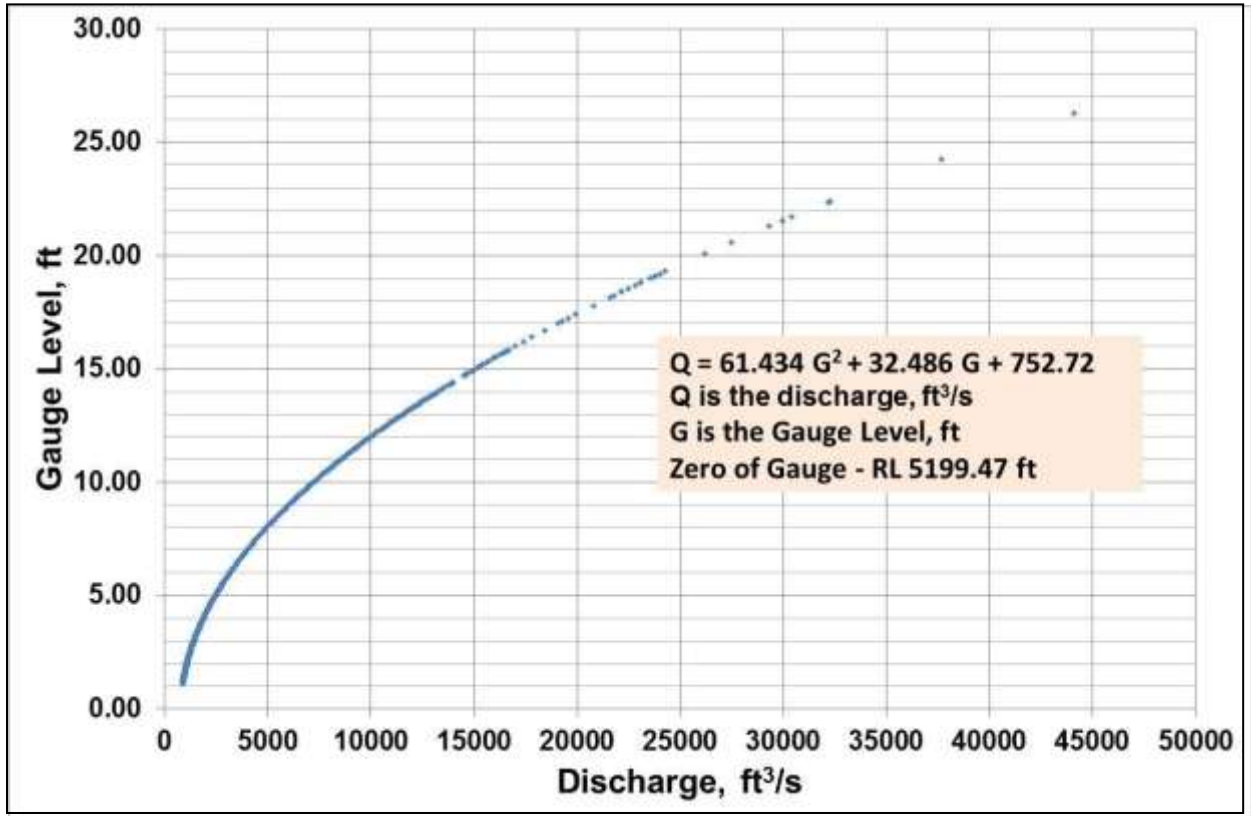


Figure 8.3: Gauge Discharge curve for Ram Munshi Bagh (RMB) gauge site.

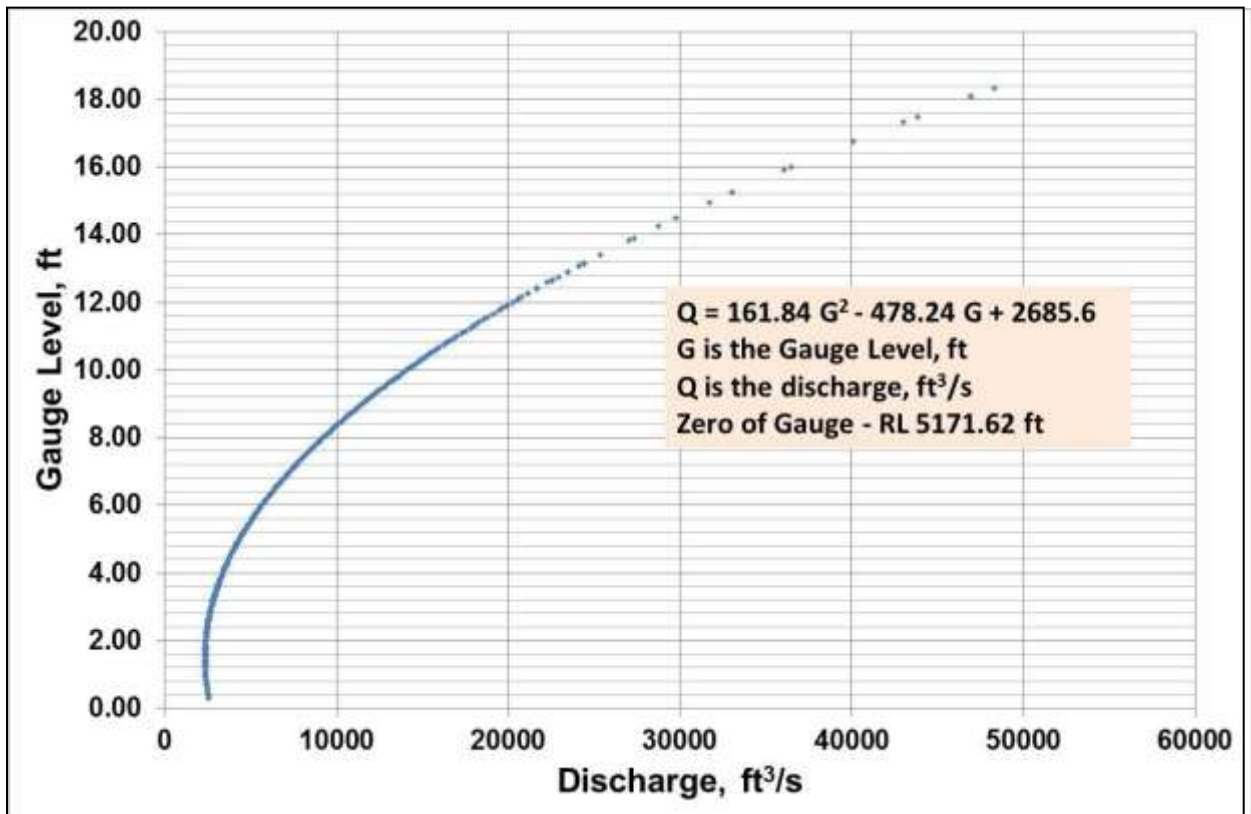
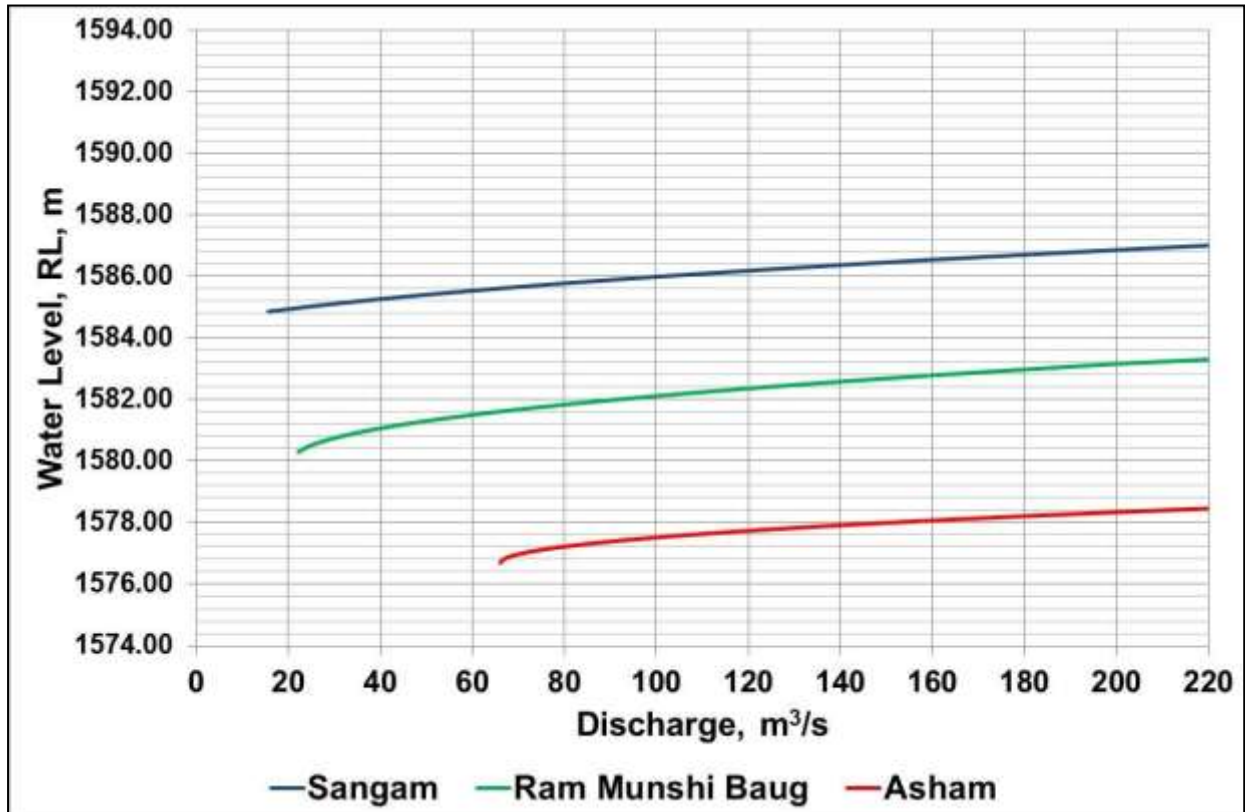


Figure 8.4: Gauge Discharge curve for Asham gauge site.



**Figure 8.5: Low flow Gauge Discharge curves for different gauge sites used for calibration of model**

### 8.3.2 Development of 1 D model for river Jhelum

The CWPRS, Pune had conducted mathematical model study for routing the flood in river Jhelum and based on the studies, a Technical report No. 5593 was submitted to Project authorities in April 2018 to the Government of J& K. The survey data provided by IWAI was used in the said studies. The model was set up with inclusion of lakes, bridges, weir, barrage, etc. For the present study for NW-49, the M/s WAPCOS Limited supplied/verified the survey conducted earlier by the IWAI and requested CWPRS to use these data to conduct the mathematical model study for assessing the hydraulic parameters for navigability in river Jhelum.

The 1-D mathematical model covering the reach starting from upstream boundary point of Jhelum at Sangam to downstream boundary at Lower Jhelum HE project was developed. The discharge Vs. head data available for the spillway of LJHEP was utilized as the downstream boundary condition. Since complete bathymetry data of Wular lake was not available to prepare cross sections, the river reach was split in to 2 stretches as below.

- 1) From Sangam to Jhelum outfall in Wular lake near Baniyari (about 107 km)
- 2) From Wular lake outfall near Ningli to lower Jhelum HE project reservoir( about 28 km)

The Wular lake reach of about 40 km (from Jhelum outfall at Baniyari to Wular outfall at Ningli) was not simulated in model. Minimum water levels 1572 m, 1573 m and 1574 m were assumed in Wular lake for these runs with low flows during lean season.

Water level in the Wular Lake was assumed as downstream boundary for stretch 1 and as upstream boundary condition for stretch 2.

The spillway rating curve of LJHEP was taken as downstream boundary condition for stretch 2.

### 8.3.3 Model calibration

Calibration of model for the steady case was done with the gauge discharge data available at three sites namely Sangam, Ram munshi bagh and Asham gauging stations. **Manning's n value** was of the order of **0.033** which was appropriate considering nature of river bed and banks. Figure 8.5 shows gauge discharge relationship at three gauging stations for flows up to about 220 m<sup>3</sup>/s.

## 8.4 LOW FLOW STUDIES FOR EXISTING CONDITION

It is understood from daily gauge-discharge and 10 daily flow data analysis presented in chapter 4 that the lean season (November to February) average minimum flows in Jhelum will be varying between 20 to 50 m<sup>3</sup>/s. This period will be more critical for navigation due to reduced depths along the reaches of NW 49. Therefore, after model calibration, the model runs for low flows were carried out. For these runs, discharges in the range of 20 to 220 m<sup>3</sup>/s were considered as upstream boundary at Sangam. The water levels in Wular lake reduced during lean season, during draught and subsequent withdrawal of water from lake for various purposes. Analysis of water levels in Wular lake for past 6 years indicate minimum water level of 1573.83 m. The minimum water level in the Wular Lake keep varying around RL 1573 m. The downstream boundary considered for the reach from Sangam to Baniyari was the water level in the Wular Lake. The Wular lake water level was also considered as upstream boundary for model runs for reach from Wular outfall to LJHEP. Hence, the studies for lean season flows were conducted with Wular lake water levels of RL 1572 m, RL 1573 m and RL 1574 m Mean Sea Level (MSL) to understand the effect of varying water levels in the lake during lean season. Typical output of some model runs (for discharges 100 and 220 m<sup>3</sup>/s) on HECRAS model showing longitudinal water surface profiles for two reaches i.e., from Sangam to Wular lake entry and Wular Lake exit to Lower Jhelum Hydro Electric Project (LJHEP) barrage are shown in Figures 6 to 9. The graph of chainage versus the depth of flow for various discharges when the Wular lake level is kept at RL 1574 m is presented in Figures 10 to 19. The water level and depth of flow for Jhelum river reach from Sangam to LJHEP for various discharges with different water levels of Wular Lake is given in **Annexure IV**.

Water surface profile generated from *Hec-Ras* model at different discharges is shown below in fig.8.6 to fig.8.13

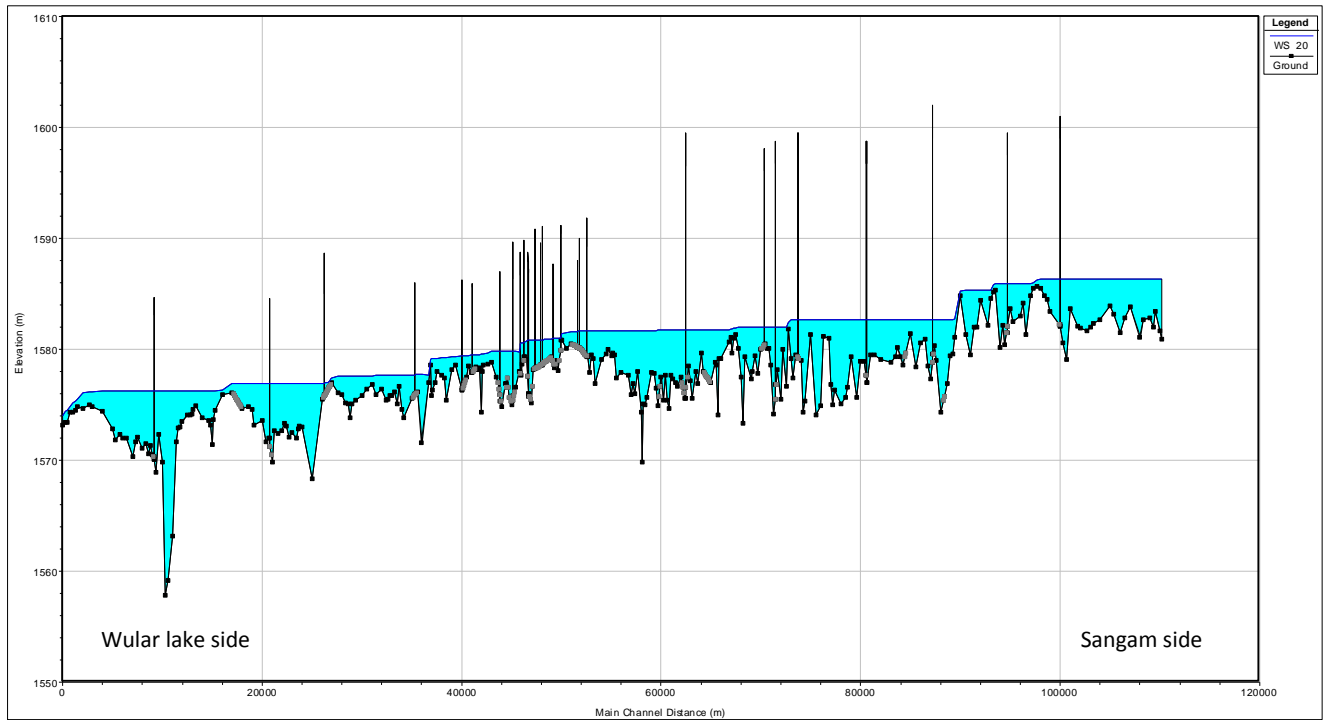


Figure 8.6 : Water Surface profile under existing condition for discharge of  $20 \text{ m}^3/\text{s}$  when Wular lake level is at RL 1574 m

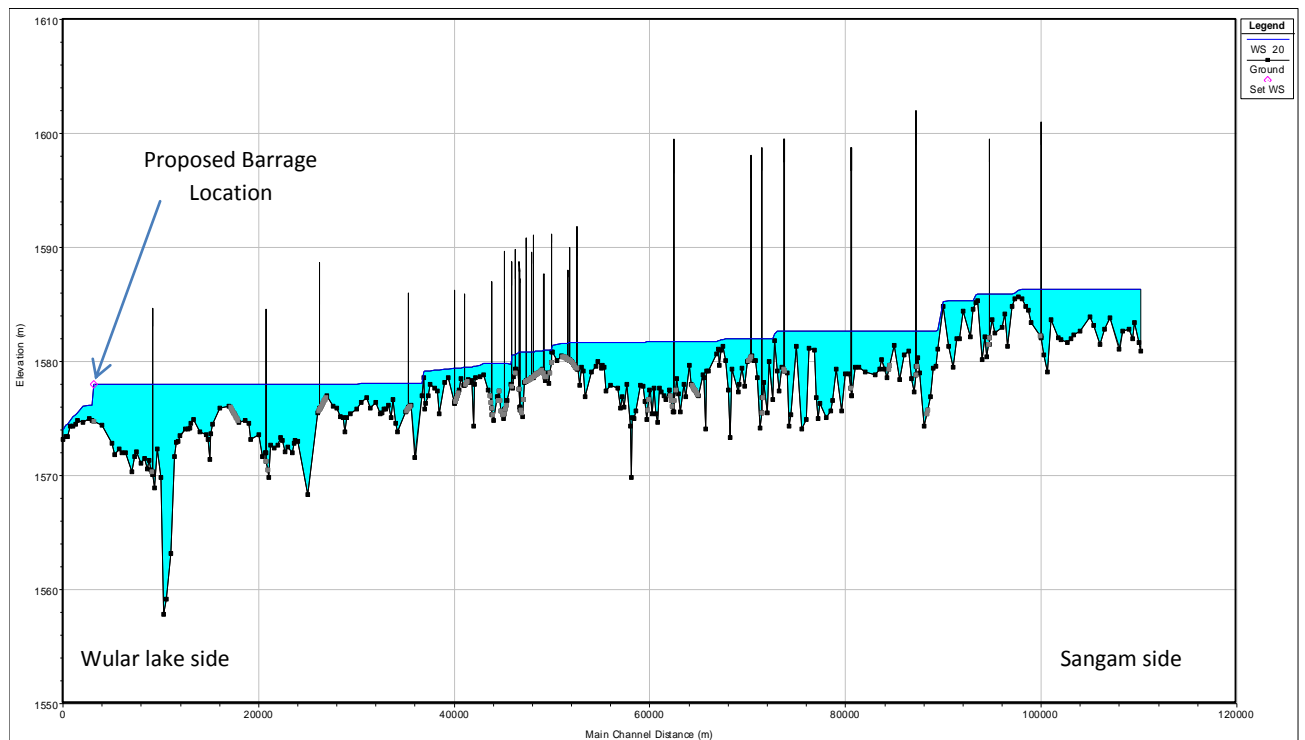


Figure 8.7 : Water Surface profile with proposed barrage at RD 115.42 km for discharge of  $20 \text{ m}^3/\text{s}$  when Wular lake level is at RL 1574 m

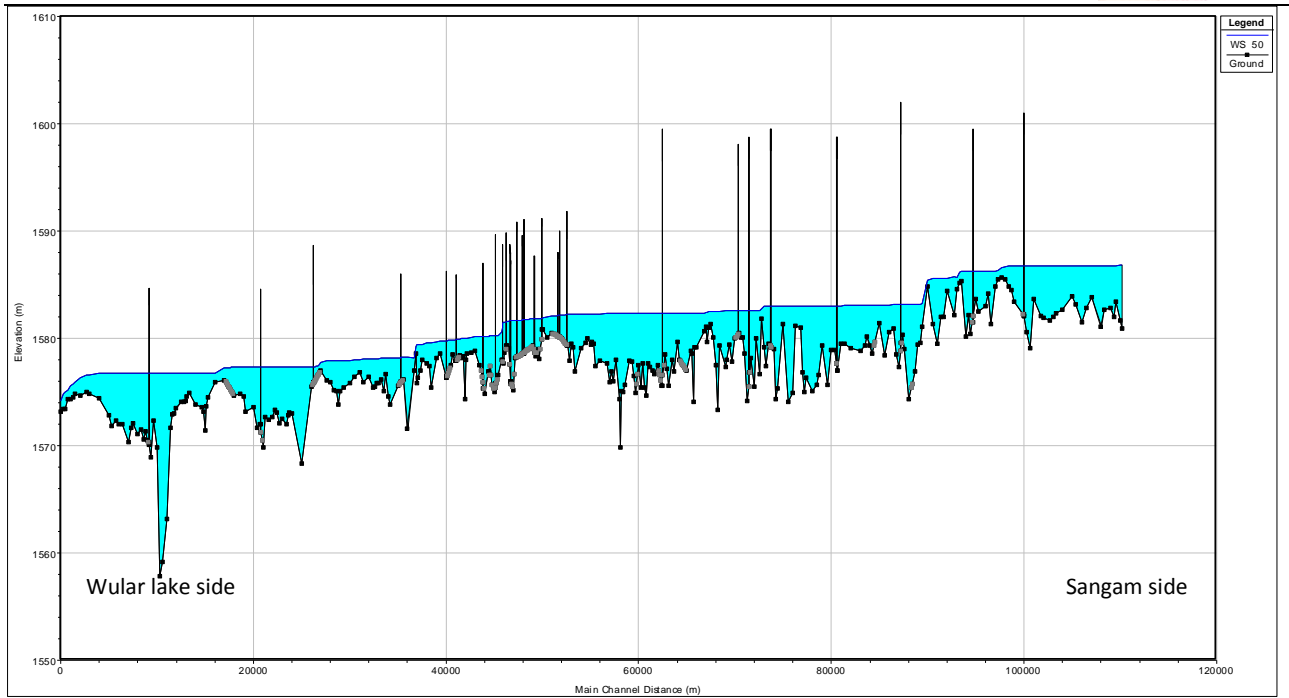


Figure 8.8 : Water Surface profile under existing condition for discharge of  $50 \text{ m}^3/\text{s}$  when Wular lake level is at RL 1574 m

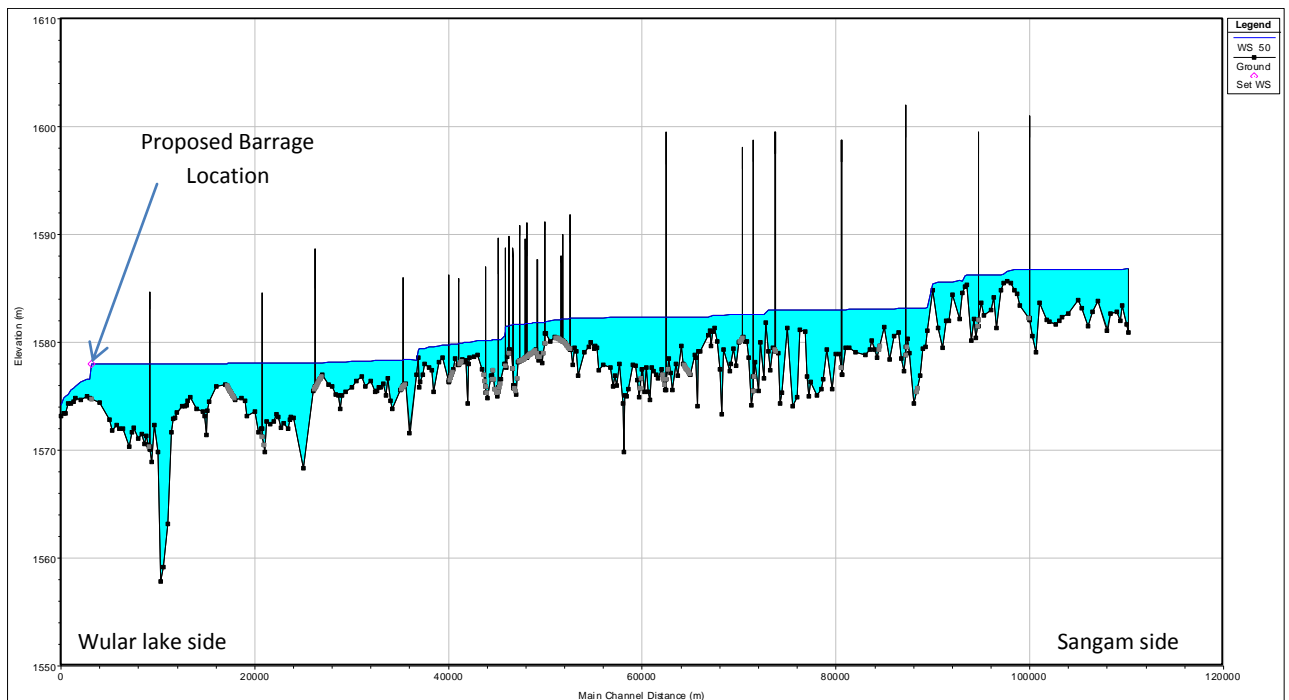


Figure 8.9 : Water Surface profile with proposed barrage at RD 115.42 km for discharge of  $50 \text{ m}^3/\text{s}$  when Wular lake level is at RL 1574 m

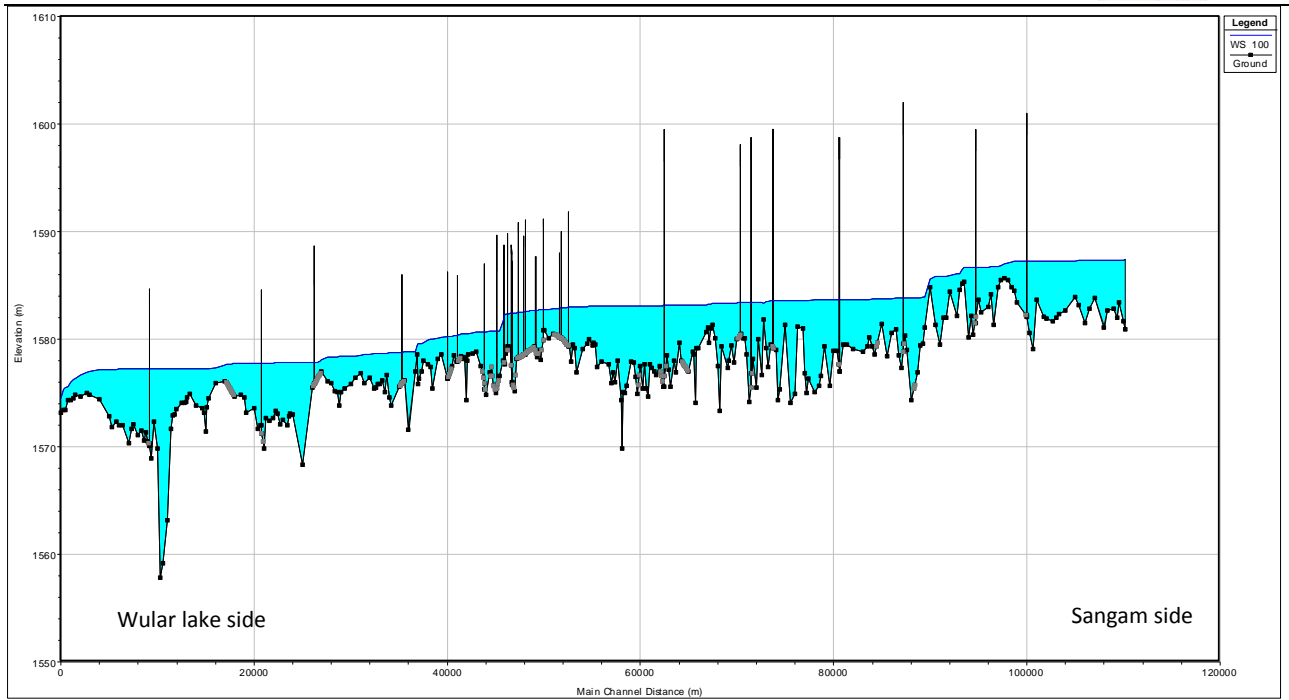


Figure 8.10 : Water Surface profile under existing condition for discharge of  $100 \text{ m}^3/\text{s}$  when Wular lake level is at RL 1574 m

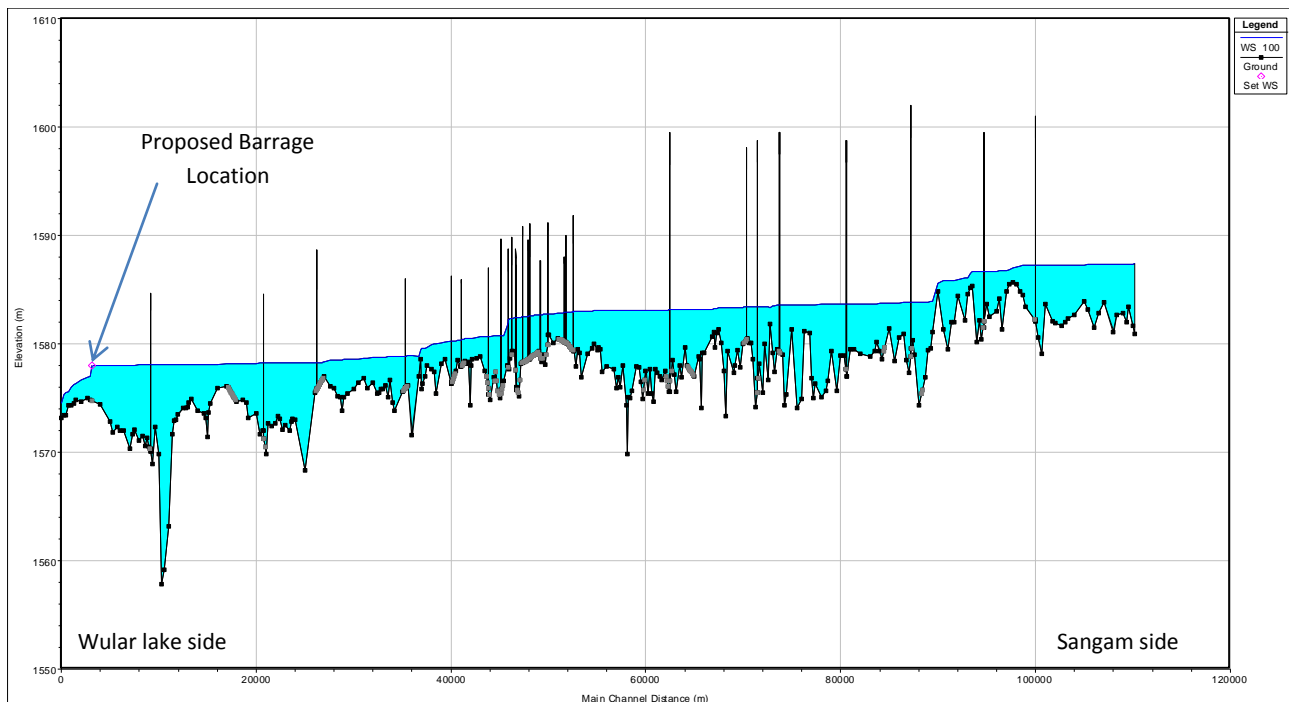


Figure 8.11 : Water Surface profile with proposed barrage at RD 115.42 km for discharge of  $100 \text{ m}^3/\text{s}$  when Wular lake level is at RL 1574 m

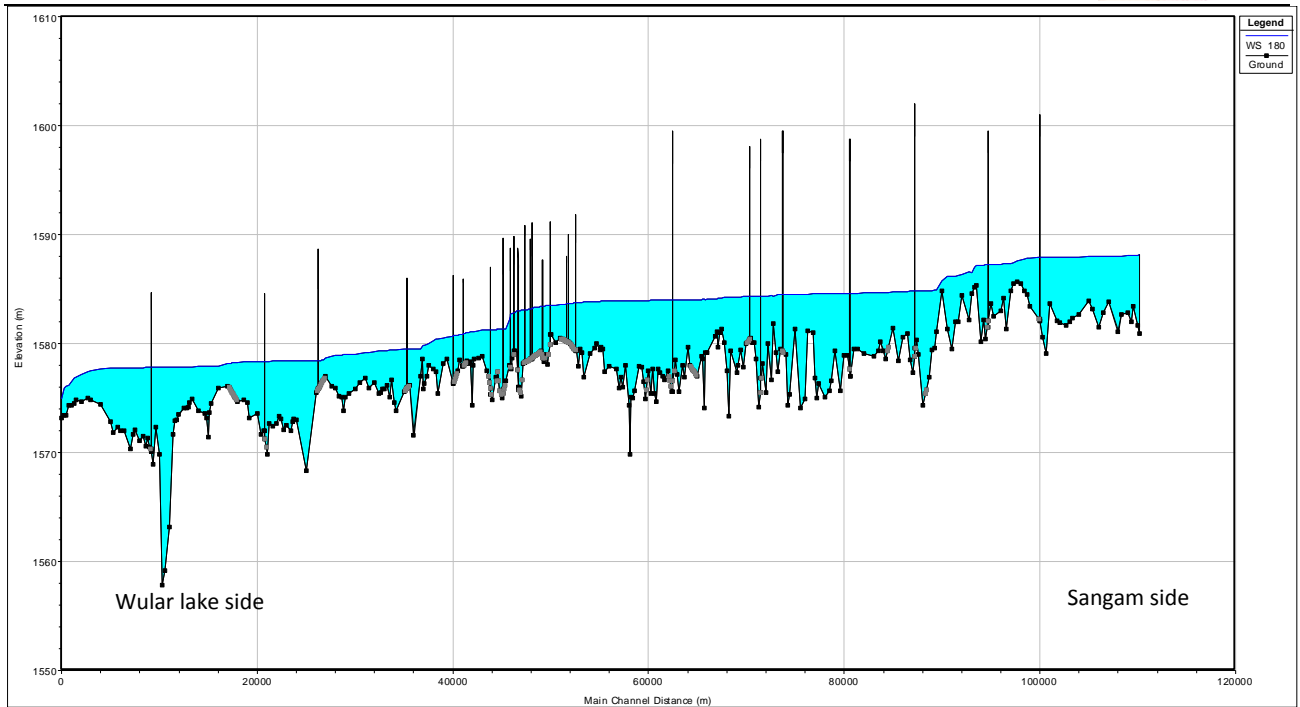


Figure 8.12 : Water Surface profile under existing condition for discharge of  $180 \text{ m}^3/\text{s}$  when Wular lake level is at RL 1574 m

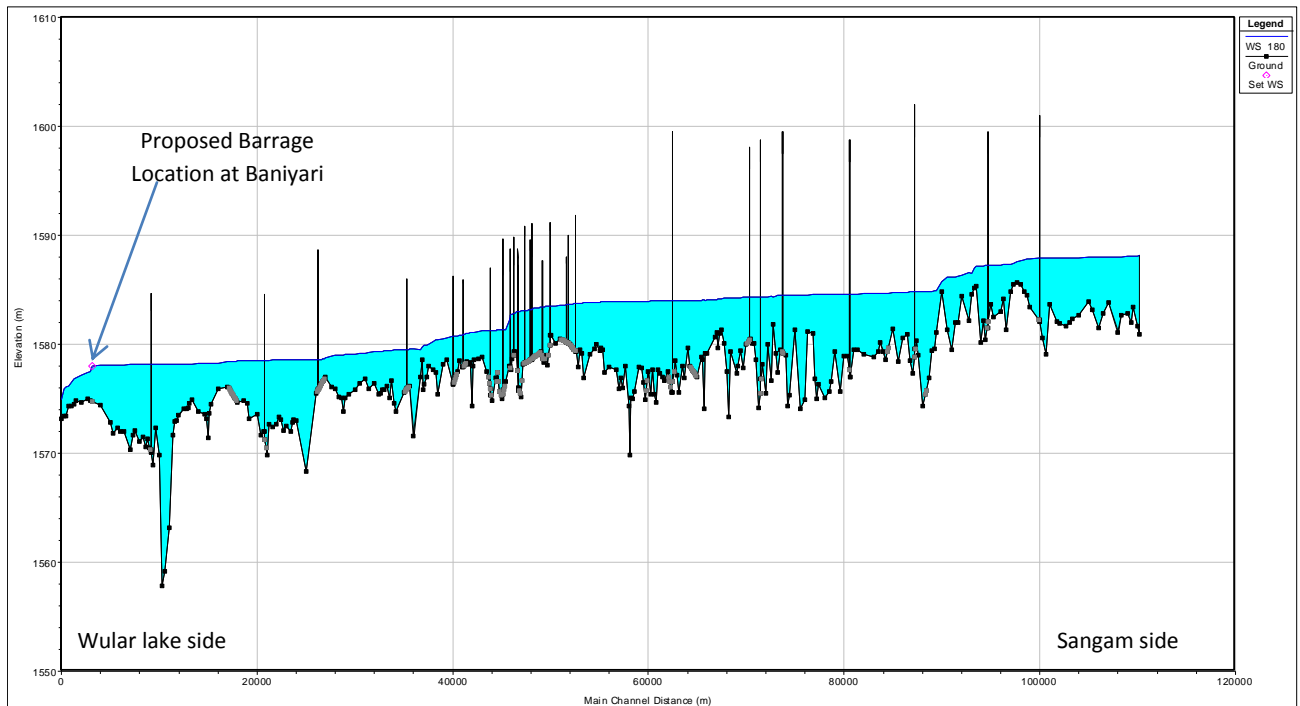


Figure 8.13: Water Surface profile with proposed barrage at RD 115.42 km for discharge of  $180 \text{ m}^3/\text{s}$  when Wular lake level is at RL 1574 m

The analysis of results of model runs for lean season low flows presented above vide fig 8.6 to Fig 8.13 and also tabulated vide Annexure-IV & V indicate following conclusions for the two reaches studied.

### **Reach 1 – Sangam (Chainage 181.20 km ) to Baniyari (Chainage 71km) i.e Jhelum outfall in Wular lake**

- The average bed slope in the reach is 1/5350
- Except for few small stretches in most of the reach from Sangam to Chattabal weir water depths of about 2 m will be available even for lean season minimum flow of 20 m<sup>3</sup>/s to 30 m<sup>3</sup>/s and Wular lake level 1574 m MSL. **Class I and II type waterways** will be feasible in this reach with marginal dredging at few isolated places as indicated in Annexure –IV  
Depths of 2 to 4 m will be available in most of reach.
- In the reach from Chattabal weir ( CH-115.42 Km) to Baniyari (Ch 71 km) depths in range 0.5 m to 1.6 m will prevail in some stretches for discharge of 20 to 30 m<sup>3</sup>/s for Wular lake level of 1574 m MSL as indicated in Annexure-IV. The total length of the reach with depths less than 2 m will be about 12 km. Depths of 2 to 4 m will be available in remaining reach. With dredging of the order of 0.5 m to 1.5 m in shallow reaches entire reach from Sangam to Baniyari will be suitable for class I & II.
- Dredging requirement decreases with increase in flow beyond 50 m<sup>3</sup>/s .
- Provision of a control structure at Baniyari to improve flow depths downstream of Chattabal weir could be a better option to avoid capital and maintenance dredging.

### **Reach 2 – From Wular Lake outfall ( Ch 71km /RD 146 km ) to LJHEP ( Ch 0 km /RD 178.8km)**

- The average bed slope in the reach is 1/1270. In reach 13-14 km upstream of LJHEP slope is very steep ( 1/450). River bed is undulating resulting in formation of chutes and pools.
- For lean season discharges of 20 to 50 m<sup>3</sup>/s depths are 0.5 m to 1 m in major portion of reach. Therefore navigation not feasible under existing conditions.
- Due to steep slopes high velocity flow with chutes and pools prevails therefore interventions such as control structures/barrages, Locks may be necessary to make navigation feasible round the year.

Based on above findings further studies were taken up with water level control structure for improvement of depths without resorting to dredging.

## **8.5.0 STUDIES WITH CONTROL STRUTURES TO IMPROVE DEPTHS**

### **8.5.1 Upstream of Wular lake**

The low flow studies for existing condition indicate that for lean season discharge range of 20

to 30 m<sup>3</sup>/s which is considered to be critical discharge stage in terms of navigability, the depths are insufficient at many of reaches to maneuver the vessels through the river. In such circumstances, construction of a control structures at identified suitable across river Jhelum would be helpful in improving the depth of flow. However, these control structures should be such that they will not obstruct the flood passage, otherwise they can cause congestion along the upstream side of the structure. The location of the proposed barrage is identified based on the following points

- The barrage will not be a impediment in the passage of flood
- The bank levels are sufficiently high to effectively achieve with ease the navigable depth.
- It will be easy to drain the upstream area in the event of oncoming flood wave from upstream.
- Length of barrage will be optimum

The location decided based on above points is near Baniyari at Chainage 74.15km /RD 120.277 Km. The studies were conducted by reproducing the pond level needed upstream so that the navigable depth is available on upstream side. In view of this the pond level upstream of this barrage is maintained at RL 1578 m. With all other parameters kept unchanged in the earlier setup of model, the model was run for lean season discharges i.e., 20, 30 and 50 m<sup>3</sup>/s. The results of the model run with these three discharge stages are compared with the existing conditions with Wular Level maintained at RL 1574 m and are shown in Annexure IV. The output results indicated that the depth of flow has drastically improved upstream of the control structure and the backwater extended till downstream of Chattabal weir. The existing Chattabal weir could be used to improve the depth of flow on upstream of the weir. If required provision for raising of weir crest level during lean season by inserting additional needles could be planned.

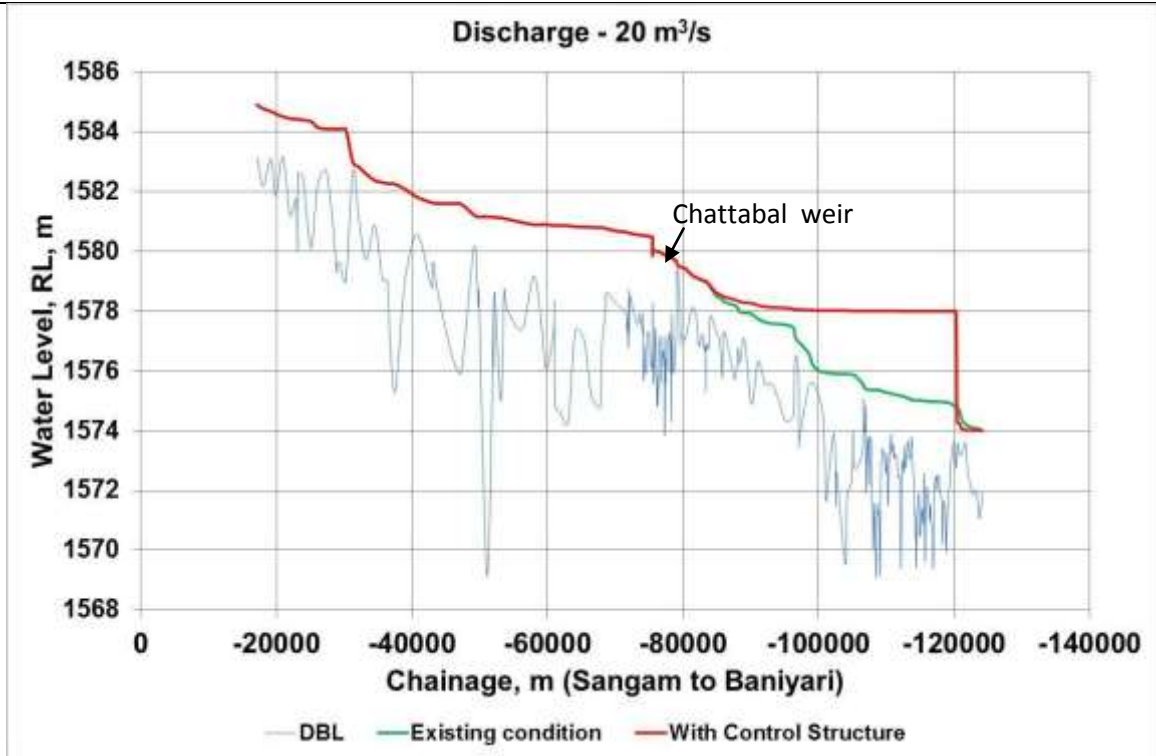


Figure 8.14: Comparison of Water Level for different conditions (Discharge 20 m<sup>3</sup>/s)

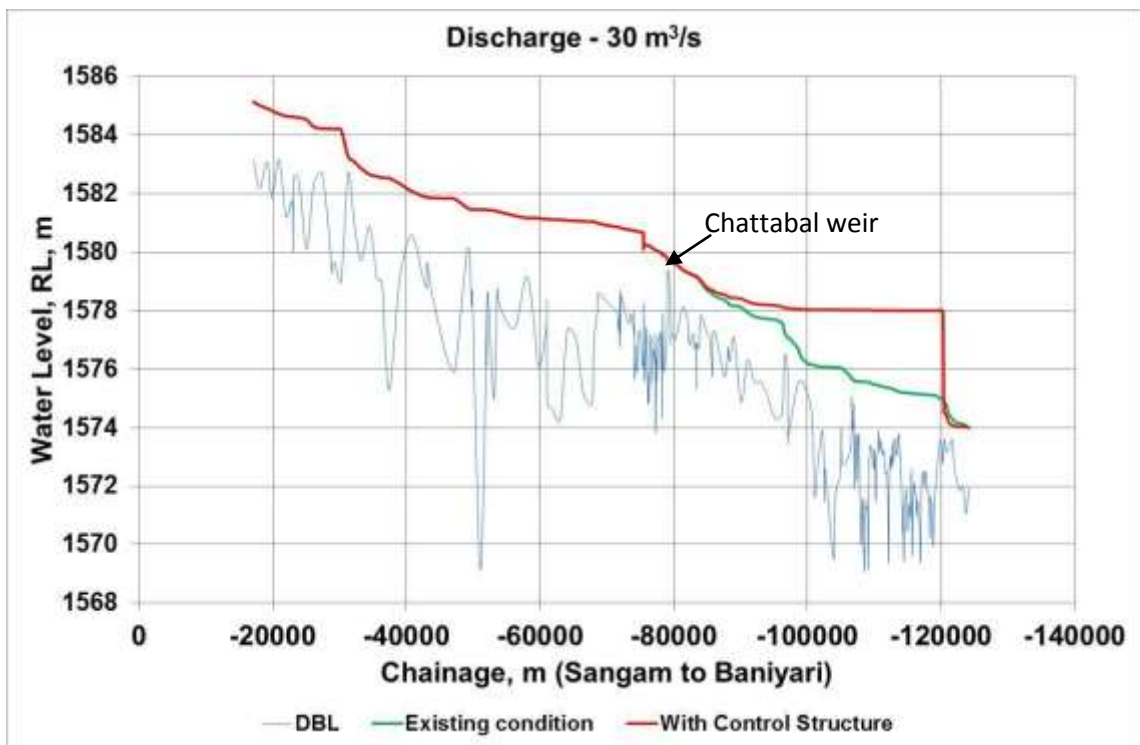


Figure 8.15 : Comparison of Water Level for different conditions (Discharge 30 m<sup>3</sup>/s)

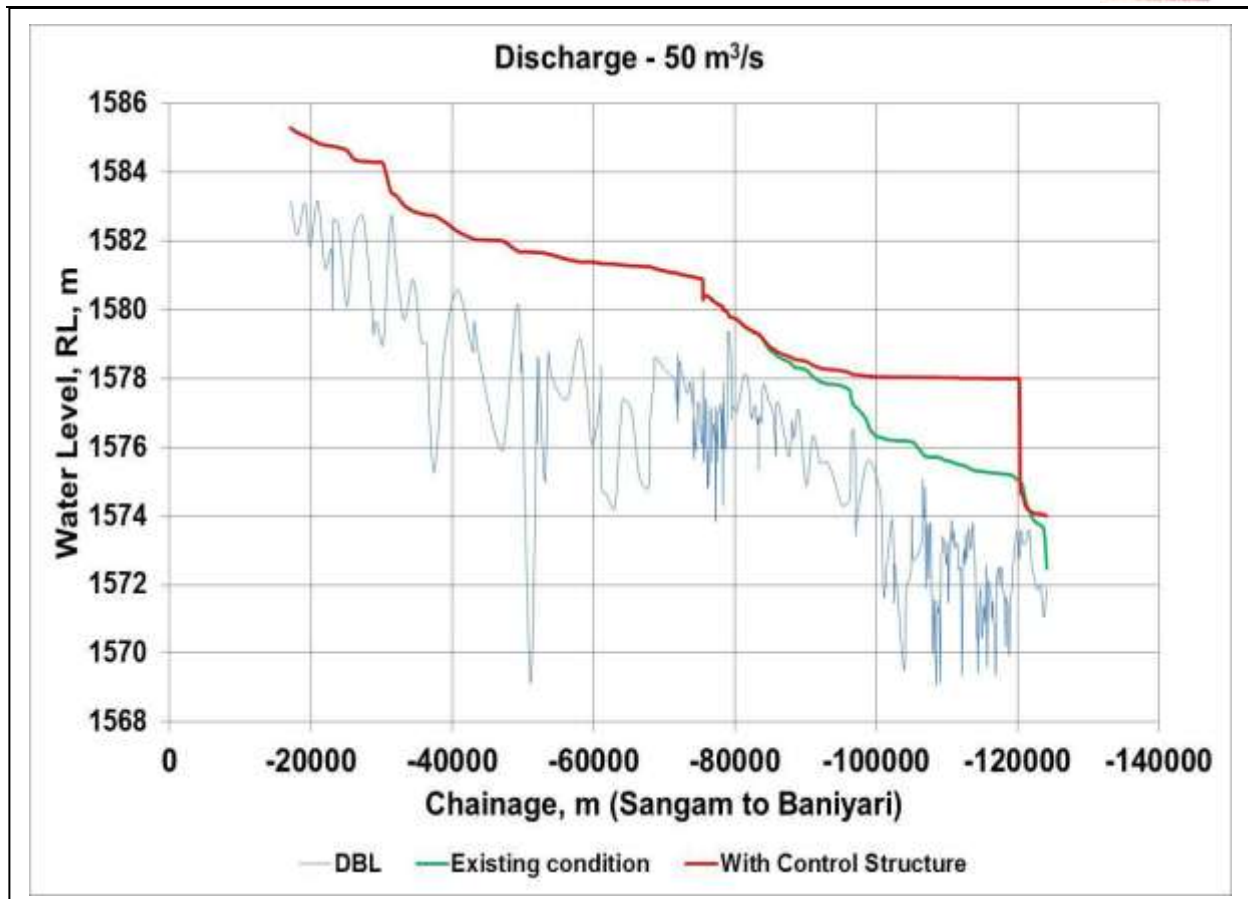


Figure 8.16: Comparison of Water Level for different conditions (Discharge 50 m<sup>3</sup>/s)

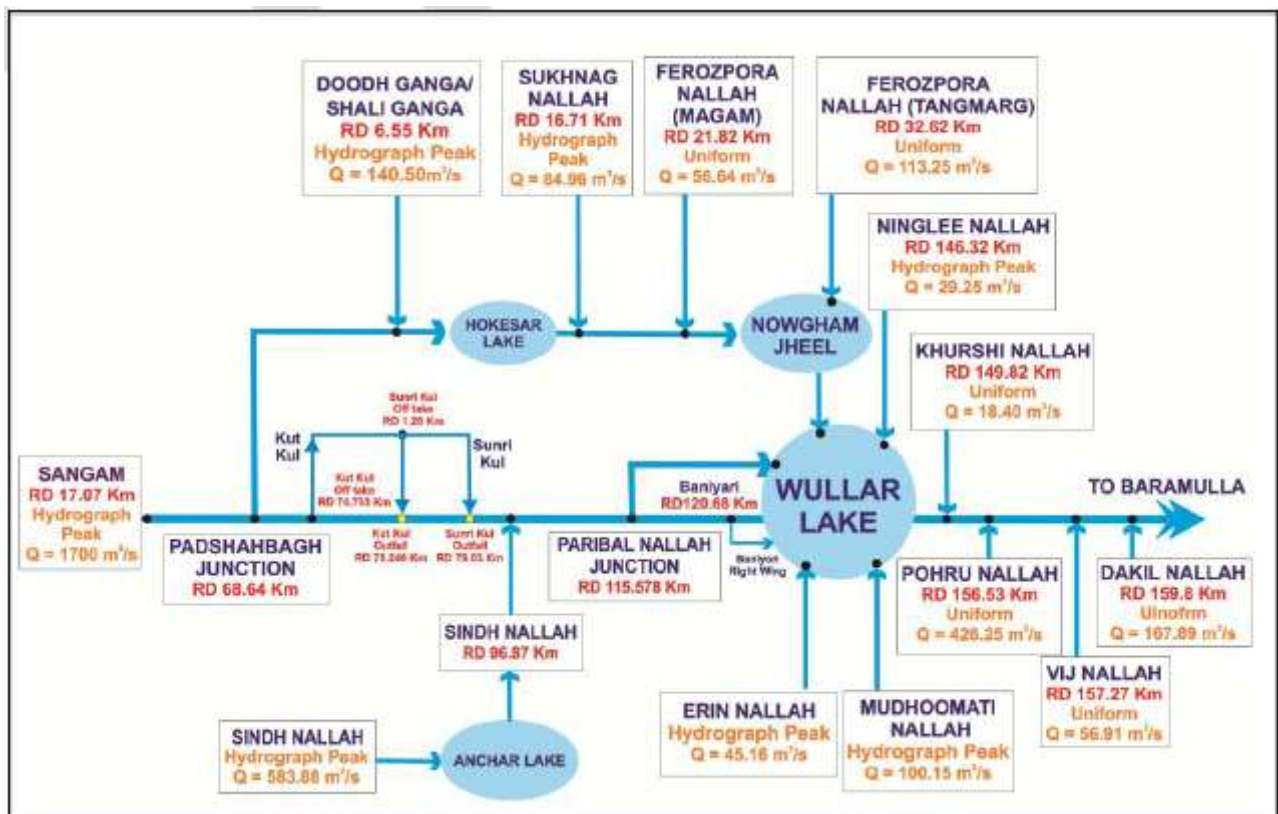
## 5.2 Downstream of Wular lake

It is understood that CWC has a proposal to construct a weir/barrage near Ninglee at the exit reach of Wular lake. If this structure comes up with gated control and low crest level, it will be of help in navigation as well as help assist in maintaining the wular lake wetland conservation efforts. Wular Lake generally termed as crude weir at the sopore village. This weir is old and acts as a flow controlling weir for the Wular lake. Any increase in crest level of this structure will affect the routing of flood in river Jhelum and may cause submergence in the Wular lake and its upstream. Another barrage structure across the Jhelum, LJHEP also contributes in retention of water to some extent in the Out Fall Channel (OFC). The slope of the OFC from Wular lake exit to downstream is steeper and thereby the flow experiences intermittent reduction in depth. Hence, to maintain a navigable depth in the reach of OFC up to LJHEP, more number of control structure would be necessary which act against easy passage of flood. Hence, no specific studies with control structure were carried out for the OFC. Moreover, local dredging for navigation purpose could be taken up in OFC.

## 8.6.0 SENARIO DURING THE FLOODS

The unsteady 1-D mathematical model was set up with the latest data in respect of Jhelum

main channel, parallel channels and various lakes like Hokarsar, Nowgham, Anchar and Wular. The reach starting from upstream boundary point of Jhelum at Sangam to downstream boundary point at Lower Jhelum HE project was reproduced in the mathematical model. As the discharge vs. head data for the spillway of LJHEP was given, the same was utilized as the downstream boundary condition. The flow through lakes, though compartmentalized by the embankments constructed by the human interventions and having siltation to a great extent, is not accounted as the data for the same is not available. The various lakes are simulated as a single body of water reflected by their area-elevation and volume-elevation curves without accounting for their spatial extent or their lengths. The schematic diagram showing the configuration of model including lakes submitted by WRD J & K for river Jhelum and its tributaries is shown in Figure 8.23.

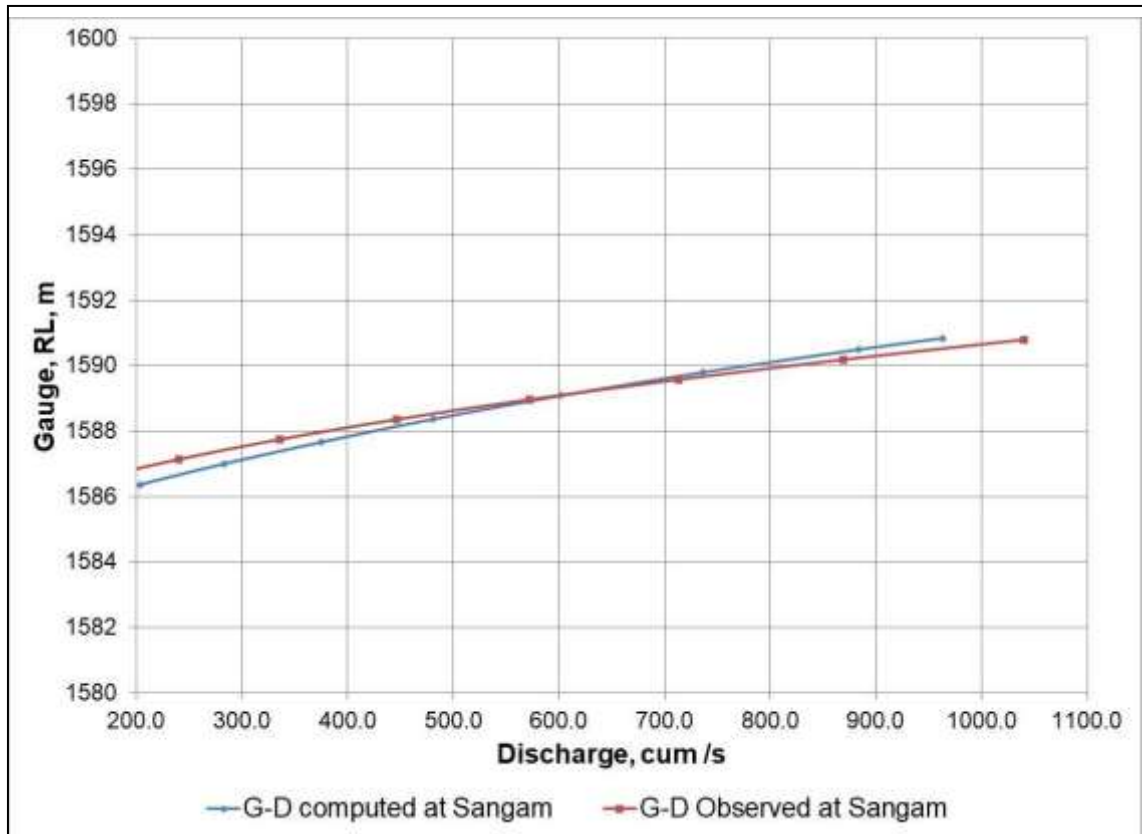


**Figure 8.17. Schematic Diagram of Jhelum Channels including Existing Lakes**

### 8.6.1 Proving of model

The system has multiple parallel channels, lakes and many Nallahs which contribute varying discharge at differing time. The gauge discharge data is available at four gauging stations. However, for the available gauge discharge data, input discharges for all the Nallahs are not known. Hence, to prove the mathematical model, simple channel reach which has minimum incoming tributaries and without lakes was selected. The reach selected is from Sangam to Ram Munshi Bagh. Though it has FSC taking off at Padshahi Bagh, the same is neglected by selecting the discharge range such that FSC does not draw water.

The gauge discharge curve is available for Sangam as well as Ram Munshi Bagh. The available G-D data for RMB is given as internal boundary condition while a range of discharges were given as upstream boundary condition at Sangam. The extracted water levels for various discharges at Sangam from mathematical model are compared with the available G-D data for the Sangam. The comparison of the same is presented in Figure 8.24. It is seen that the comparison is satisfactory for Manning's 'n' value of 0.025. The 'n' value which was utilized for proving the flow conditions in this limited range of discharges has also been used for extrapolated discharges and along other reaches of the Jhelum parallel channels.



**Figure 8.18. Proving of Mathematical Model for higher discharges**

### 8.6.2 Model Simulations

The model simulations were conducted with cross sections of all channels from Sangam to Baramulla through spillway of Lower Jhelum HE project, main Jhelum channel, through FSC and other parallel channels, bridges, four lakes, namely Hokarsar, Nowgham, Anchar and Wular.

The flood hydrograph including the peak discharge of 1700 m<sup>3</sup>/s submitted by project authorities were considered as the upstream boundary condition. The normal depth with a channel slope of 1:156 at the end reach near Baramulla is considered as downstream boundary condition, while the gauge discharge data available for the LJHEP barrage spillway was adopted as interim boundary condition for the flow upstream of it. Thus, the studies were conducted for the existing condition. The water levels obtained with this condition at some of the key locations of the reach under consideration is given in **Annexure – V**. An average

velocity of 1.55 m/s and average depth of 9.22 m in the Jhelum river from Sangam to Baniyari and an average velocity of 2.07 m/s, average depth of 10.41 m in out fall channel from Wular lake exit to LJHEP were computed based on the model runs. Similarly, Maximum velocity of 3.5 m/s and maximum depth of 20.25 m in the Jhelum river from Sangam to Baniyari.

The tentative locations of Navigational Terminals to assess the safe grade elevation for their construction. The present study considered the hydrograph including the maximum discharge of 1700 m<sup>3</sup>/s. The details of the High Flood Elevation are given in **Table 8.1 for deciding the safe grade elevation at those locations.**

**Table 8.1: Details of High Flood Elevation near Navigational terminals**

Terminals	Location	Geographical Coordinates	High Flood, Elevation and velocity
Terminal 1	Pantha chowk	340 2' 16.30" N 740 52' 22.02" E	RL 1588.01 m
Terminal 2	Near Zero Bridge, Srinagar	340 04' 09.90" N 740 49' 46.80" E	RL 1586.94 m
Terminal 3	Near Amir Kadal Bridge, Srinagar	340 04' 14.20" N 740 48' 25.90" E	RL 1586.60 m
Terminal 4	Near Fateh Kadal Bridge, Shah-e-Hamdan, Srinagar	340 05' 29.00" N 740 48' 26.80" E	RL 1585.77 m
Terminal 5	Near Safa Kadal/Chattabal Shrine, Srinagar	340 05' 25.40" N 740 47' 19.50" E	RL 1585.06 m
Terminal 6	Near Sumbal Bridge, Bandipora, Sonawari	340 13' 41.40" N 740 39' 05.00" E	RL 1581.97 m
Terminal 7	Near Gund Prang,	340 20' 44.00" N 740 37' 47.90" E	RL 1580.71 m
Terminal 8	Near Sangam Bridge,	330 49' 47.00" N 750 04' 13.20" E	RL 1592.84 m
Terminal 9	Near Sopore Bridge,	340 16' 56.50" N 740 28' 20.60" E	RL 1580.18 m

### 8.7.0 BANK PROTECTION WORKS

The bank protection works are required near the structures and near the jetties provided for navigation purposes. The protection works can be designed based on the velocities and discharge intensities in the near field. The velocity and discharge intensities are the function of the various parameters including the proposed structures across river to raise the water level for navigational purposes. The bank protection work can only be finalized after firming up of the various structures as proposed above along with assessment of the site conditions near these structures. Hence, this part will be covered later. However, for DPR purpose bank protection works near terminals can be designed with velocities of the order of 2.5 to 3 m/s as indicated in Table-I

### 8.8.0 CONCLUSION

Following conclusions are derived based on the preliminary studies conducted.

1. The longitudinal slope of the river from Sangam to Wular lake is comparatively uniform and thereby navigability can be achieved with ease. However, the bed elevations for the reach from Wular exit to lower Jhelum HE project is comparatively varying and steeper. Hence, achieving navigability is difficult.
2. The water depths along the Jhelum main channels from Sangam to Chattabal weir are already controlled by the channel slope itself and the chattabal weir. However, the reach from Chattabal weir to entry of Jhelum near baniyari are affected by the water levels existing in the Wular Lake. The wular lake water levels are controlled by the flow conditions over the crude weir at sopore. The available depths in the upstream channels during lean season flows can be boosted by either providing a barrage at the exit of wular lake (Ninglee) or at the entry of the lake near Baniyari.
3. The provision of Barrage or some structure near Baniyari that can raise water depth upstream up to chattabal weir is an easy option when compared with the barrage at the exit of wular lake. The site location needs to investigate from other angles before proceeding. However, the investigated Tulbul barrage site location exists at the Wular Lake exit.
4. The proposed structure at Baniyari shall be designed such that the water level upstream raises upto about RL 1578 m which is below the flood level and hence, there will not be any additional submergence or need of constructing additional embankments along the Jhelum channels. However, the existing embankments have

to strengthened and repaired.

5. The back water effect with raised water level of RL 1578 at baniyari will extend upto chattabal weir thereby the depths in the channel up to chattabal weir and from chattabal weir to Sangam will become navigable with selective dredging at few identified locations for low flows.
6. The barrage or some form of structure at Baniyari will be such that its crest shall be at the bed of the river and depth of water upto RL 1578 m is stored against movable gates that can be completely opened during floods.
7. The barrage or some structure at Baniyari will also have navigational lock. There will be necessity of dredging downstream of the structure upto the varying water levels of the Wular Lake.
8. The safe grade elevations for the proposed jetties may be decided based on the HFL's given in the Table 8.1.
9. The final design of bank protection necessary near the proposed structures will be fine-tuned after the finalization of the structures and assessing the site conditions. For DPR the tentative designs could be based on velocities near terminal sites as mentioned in Table –I.
10. Impact of Dredging:

The flood is arriving at faster rate from the Sangam to RMB. This may have been caused by the channel improvement in the form of de-silting/dredging/sand mining undertaken earlier or being undertaken, at present, in this reach. This rate of flood wave propagation may also be possible because of construction of embankments. The effect of embankment construction will be more prominent if the embankments disconnect the low lying areas or avoid the flood water to spread into the flood plain.

Hence, unplanned dredging and de-silting or sand mining of channels should be avoided. The channels attain the regime on their own and human intervention should be minimized and; if at all necessary, should be based on sound reasoning not only including local effects, but also effects on upstream and downstream. It is strongly advised that the dredging of Jhelum main channel from Sangam to Asham must be avoided in future.

11. Impact of channelization & Bank protection work:

The present proposal of Irrigation & Flood control department for “Priority Works- Comprehensive Plan for Flood Management Works on Jhelum- Phase-I” had been framed & executed at many places. This includes channelization & Bank protection work. Hence, As of now there is no need to channelize the flow again in order to avoid duplication.

**Table 8.2. Advantages and Disadvantages of alternative barrage locations**

S.No.	Details	Barrage near	
		Baniyari	Wular lake exit
a)	Ease of flood passage	Easy	Difficult
b)	Sediment management	Creating riverine flow conditions and flushing possible	Difficult to create riverine flow conditions in the channels as large quantum of water in the Wular lake has to be emptied.
c)	Irrigation benefits	Raised water levels in Jhelum channels will provide water for irrigation by gravity to the fertile land between jhelum channel and wular lake water line during lean season.	No irrigation benefits. The area between lean season water line of wular lake and jhelum channel adjacent to it are being used for various purposes including agriculture. Raising water level of wular lake to help navigation will lead to additional submergence of this area which may be resisted by locals.
d)	Requirement additional embankments	No new embankments are necessary as the water level to be raised is below the flood water level requirement.	May be required at places to protect them against submergence.
e)	Availability of investigated site	This needs investigation.	Already investigated Tul Bul project site exists.
f)	Out flanking of river flows	There is a rare chance of outflanking of flow as short circuiting of river flow is possible between Jhelum channel and Wular Lake.	Natural barriers exist and hence outflanking is comparatively a rare possibility.

**Table 8.3. Results of analysis based on the given data for routing about 1700 m<sup>3</sup>/s of flood in river Jhelum under existing setup (with constriction at Wular Lake outlet**

Sl. No.	Location	Discharge routed through the Channel for Max WL, m <sup>3</sup> /s	Input Discharge/ Discharge Distribution, m <sup>3</sup> /s	Maximum Water Level as per analysis, RL, m	Maximum Discharge routed through the Channel, m <sup>3</sup> /s	WL for the maximum Discharge routed through the Channel, RL, m
1	Sangam - RD 17.11 Km	1683.70(Maximum of Flood Hydrograph)		1592.84	1700	1592.83
2	Near Watal Ara – RD 23.177 Km (Tributary)	1620.14	--	1592.12	1677.75	1592.05
3	Near Aaripal Nallah – RD 26.10 Km (Tributary)	1607.55	--	1591.67	1669.82	1591.53
4	Near Awantipora – RD 33.25 Km	1600.39	--	1591.06	1648.11	1590.89
5	Near Romshi Nallah – RD 43.05 Km	1597.67	--	1590.23	1597.67	1590.19
6	Near Pampore – RD 52.165 Km	1597.56	--	1589.26	1597.97	1589.26
7	Downstream of Padshahi bagh Junction – RD 68.708	1263.08	-343.05 ( river Jhelum to Flood Spill Canal)	1587.18	1263.343	1587.18
8	Near Ram Munshi bagh - RD 71.758 Km	1262.81	--	1586.94	1262.18	1586.94
9	Kut Khul (off take from Jhelum at RD 74.753 Km	1012.27	-250.48 (to City channel)	1586.36	1012.58	1586.36
10	Sunri Khul (off take from Kut Khul at RD 1.28 Km)	--	- 92.46 (to City channel)	1585.64 (in Kut Khul)	92.48	1585.64
11	Kut Khul outfall RD 78.246 Km in Jhelum	1168.88	157.79 (to Jhelum)	1585.15	1170.43	1585.14
12	Downstream of Sunri Khul outfall RD 79.03 Km in Jhelum	1260.83	92.35 (to Jhelum)	1585.06	1262.86	1585.06

Sl. No.	Location	Discharge routed through the Channel for Max WL, m <sup>3</sup> /s	Input Discharge/ Discharge Distribution, m <sup>3</sup> /s	Maximum Water Level as per analysis, RL, m	Maximum Discharge routed through the Channel, m <sup>3</sup> /s	WL for the maximum Discharge routed through the Channel, RL, m
13	Anchar Lake	331.65 (Out flow)	Inflow 100 Year Return Flood of 583.83 which was correlated from 1995 and 2014 floods.	1582.68	353.74	1582.49
14	Sindh Nallah – RD 96.98 Km (Tributary)	1582.84	323.68 – (After routing 100 Year Return Flood of	1582.59	1599.19	1582.56
15	Asham – RD 107.73	1507.42	--	1581.60	1589.93	1581.49
16	Paribal Nallah Junction – RD 115.955 Km	1076.03	-112.18 (to Paribal nallah)	1580.98	1441.69	1580.35
17	Paribal nallah exit to wular lake – RD 10.775 Km	--	103.96 (to Wular lake)	1580.67	137.18	1579.71
18	Banyari – (End section) RD 124.160 Km (Left wing)	318.85	--	1580.67	655.53	1576.41

Sl. No.	Location	Discharge routed through the Channel for Max WL, m <sup>3</sup> /s	Input Discharge/ Discharge Distribution, m <sup>3</sup> /s	Maximum Water Level as per analysis, RL, m	Maximum Discharge routed through the Channel, m <sup>3</sup> /s	WL for the maximum Discharge routed through the Channel, RL, m
	Banyari – (End section) RD 0.316 Km (Right wing)	681.49	--	1580.67	919.50	1579.53
19	Wular Lake	1756.91		1580.67	2201.22	1579.53
	i. Erin Nallah	--	92.64 Peak flood hydrograph considered (while 100 Year			
	ii. Madhoomati Nallah	--	147.32 Peak flood hydrograph considered (while 100			
	iii. Ninglee Nallah	--	67.95 Peak flood hydrograph			
			considered (while 100 Year Return Flood is 29.26)			
20	Just Downstream of Padshahi bagh Junction (FSC)	343.05 (from Flood Spill Canal to river	-1263.08 (to main Jhelum river)	1586.99	349.60	1586.98

Sl. No.	Location	Discharge routed through the Channel for Max WL, m <sup>3</sup> /s	Input Discharge/ Discharge Distribution, m <sup>3</sup> /s	Maximum Water Level as per analysis, RL, m	Maximum Discharge routed through the Channel, m <sup>3</sup> /s	WL for the maximum Discharge routed through the Channel, RL, m
21	Downstream of Doodh Ganga/Shali Ganga – RD 6.554 Km (Flood Spill Channel) Tributary	500.58	234.54 Peak flood hydrograph considered (while 100	1586.21	500.58	1586.21
22	Hokarsar Lake	396.26 (Outflow)	399.29 (Inflow)	1584.47	396.95 (o) 500.29 (l)	1584.47 (o) 1584.19 (l)
23	Downstream of Sukhnag Nallah – RD 16.972 Km (Flood Spill Channel) Tributary	581.12	221.40 Peak flood hydrograph considered (while 100 Year	1584.36	581.10	1584.36
24	Downstream of Ferozpora Nallah (Magam) – RD 21.937 Km (Flood Spill Channel) Tributary	637.67	56.64 (100 year return Flood – Uniform Lateral Inflow)	1583.21	637.67	1583.21
25	Nowgham Lake	545.50 (inflow)		1580.87	637.24	1580.39
	Ferozpora Nallah (Tangmarg)		113.26 (100 year return Flood – Uniform Lateral	1580.87		
26	Nowgham Lake	657.28 (Outflow)	545.50 (inflow)	1580.87	685.67 (o) 637.24 (l)	1580.66 (o) 1580.39 (l)

Sl. No.	Location	Discharge routed through the Channel for Max WL, m <sup>3</sup> /s	Input Discharge/ Discharge Distribution, m <sup>3</sup> /s	Maximum Water Level as per analysis, RL, m	Maximum Discharge routed through the Channel, m <sup>3</sup> /s	WL for the maximum Discharge routed through the Channel, RL, m
27	Exit of FSC in to Wular lake - RD 39.86 Km	651.61( Outflow to Wular lake )	--	1580.67	682.537	1580.44
28	Wular Lake	1820.40 (Outflow)	1756.91 (inflow)	1580.67	1820.40 (o) 2201.22 (l)	1580.67 (o) 1579.53 (l)
29	RD 146.026	1820.40	--	1580.68	1820.40	1580.68
30	Khurshi Nallah RD 149.82 Km	1847.34	18.40 (100 year return Flood –	1580.42	1847.34	1580.42
			Uniform Lateral Inflow)			
31	Crude Weir RD 150 25 Km	1847.34	--	1580.40	1847.34	1580.40
32	Pohru Nallah RD 156.523 Km	2273.59	426.25 (100 year return Flood – Uniform Lateral	1579.57	2273.59	1579.57

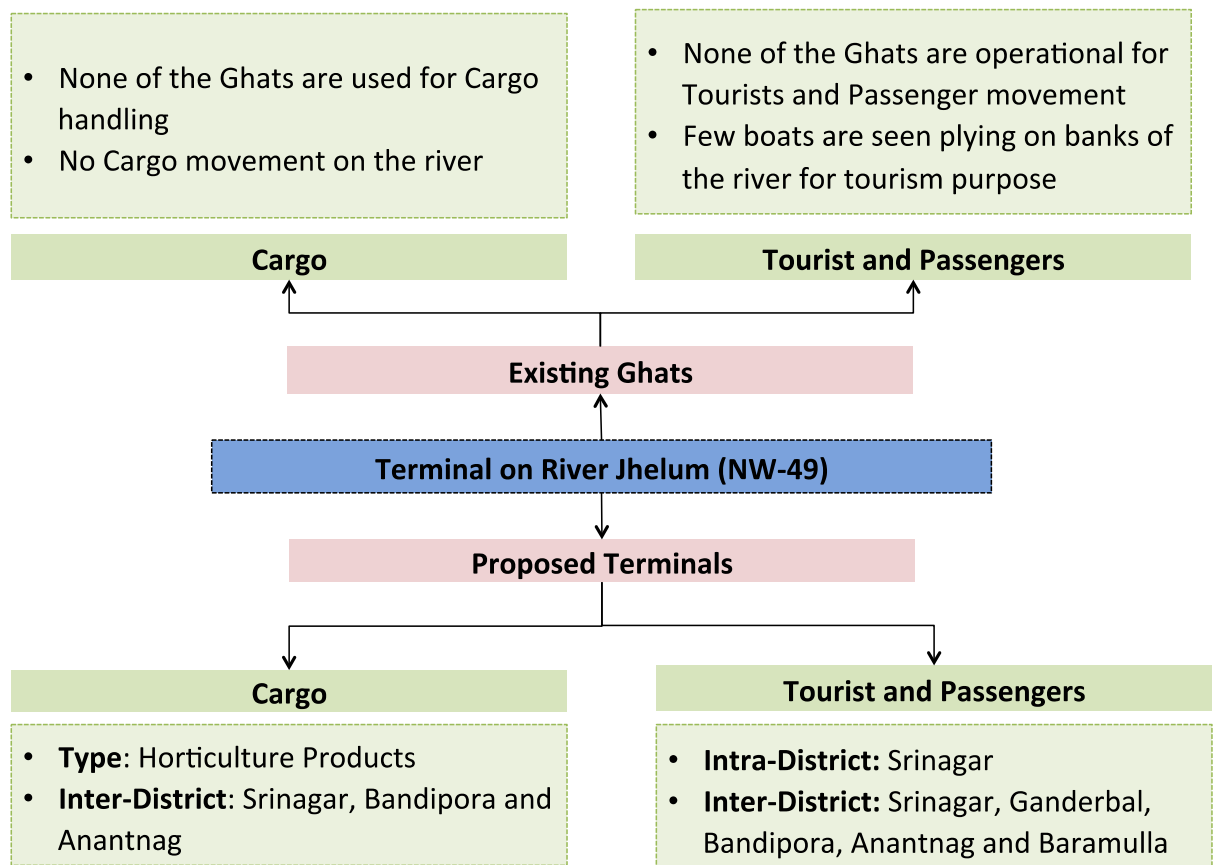
Sl. No.	Location	Discharge routed through the Channel for Max WL,m <sup>3</sup> /s	Input Discharge/ Discharge Distribution, m <sup>3</sup> /s	Maximum Water Level as per analysis, RL, m	Maximum Discharge routed through the Channel, m <sup>3</sup> /s	WL for the maximum Discharge routed through the Channel, RL, m
33	Vij Nallah RD 157.4 Km	2330.50	56.92 (100 year return Flood – Uniform Lateral Inflow)	1579.43	2330.50	1579.43
34	Dakil Nallah RD 159.8 Km	2498.39	167.89 (100 year return Flood – Uniform Lateral	1578.15	2498.39	1578.15
35	LJHEP Barrage RD 178.8 Km	2498.39	--	1564.45	2498.39	1564.45
36	RD 221.176 Km	2498.39	--	1087.52	2498.39	1087.52

## CHAPTER – 9: WATERWAY & INFRASTRUCTURE

### 9.1 General Review

Terminal acts as an interface between land and water for handling cargo and passenger. As per Traffic Study, River Jhelum was evaluated to be developed for passenger and cargo movement. However, after primary interaction with traders and further detailed evaluation, it has been found that no traders are willing to use IWT for cargo movement because of longer distance and time delay for the perishable nature of cargo. Hence, the passenger transportation has been given higher importance in infrastructure planning. Provision for development of cargo transportation has been created for future use. This has been done to provide holistic view over next 30 years in River Jhelum. The success of passenger terminal (passenger and tourist movement) on River Jhelum may encourage cargo trader shift their trade to waterway. The planned infrastructure and other facilities for cargo terminals could be implemented at that time

Terminals can be classified as general cargo terminal, bulk cargo terminal and passenger terminals. Inland water terminals are different from seaterminals in the sense that water levels during flood and dry season varies considerably. The figure below depicts the existing and proposed Ghats on River Jhelum.



**Figure 9-1 Existing & Proposed Ghats/Terminals on NW-49**

## 9.2 Identification of site location

Site selection is the most important factor as it dictates investments for establishing the terminal facilities. Therefore, utmost care is taken to select most reliable locations to minimize the capital and the recurring cost for the terminals.

The terminal locations have been described in the map shown in **Figure 9-2 Mapping of Proposed Terminals on NW-49**. These terminals have been identified based on the market survey and analysis of the needs of local economy and population. There is an urgent need for developing passenger terminals for promoting passengers and tourists on river Jhelum. 3 terminals have been identified for cargo as well. However, not enough cargo was found during market analysis and survey to justify these 3 cargo terminals. These proposed cargo terminals could be finalized after stakeholder discussion and feed back from them. 9 terminals at judicious locations have been identified and proposed. Volume of passengers and tourists are available to use these terminals. However, the water transport would have to match the transportation price offered road and railways to shift passengers. Tourists are quite keen to use the river transportation during their visit to Srinagar and Kashmir.

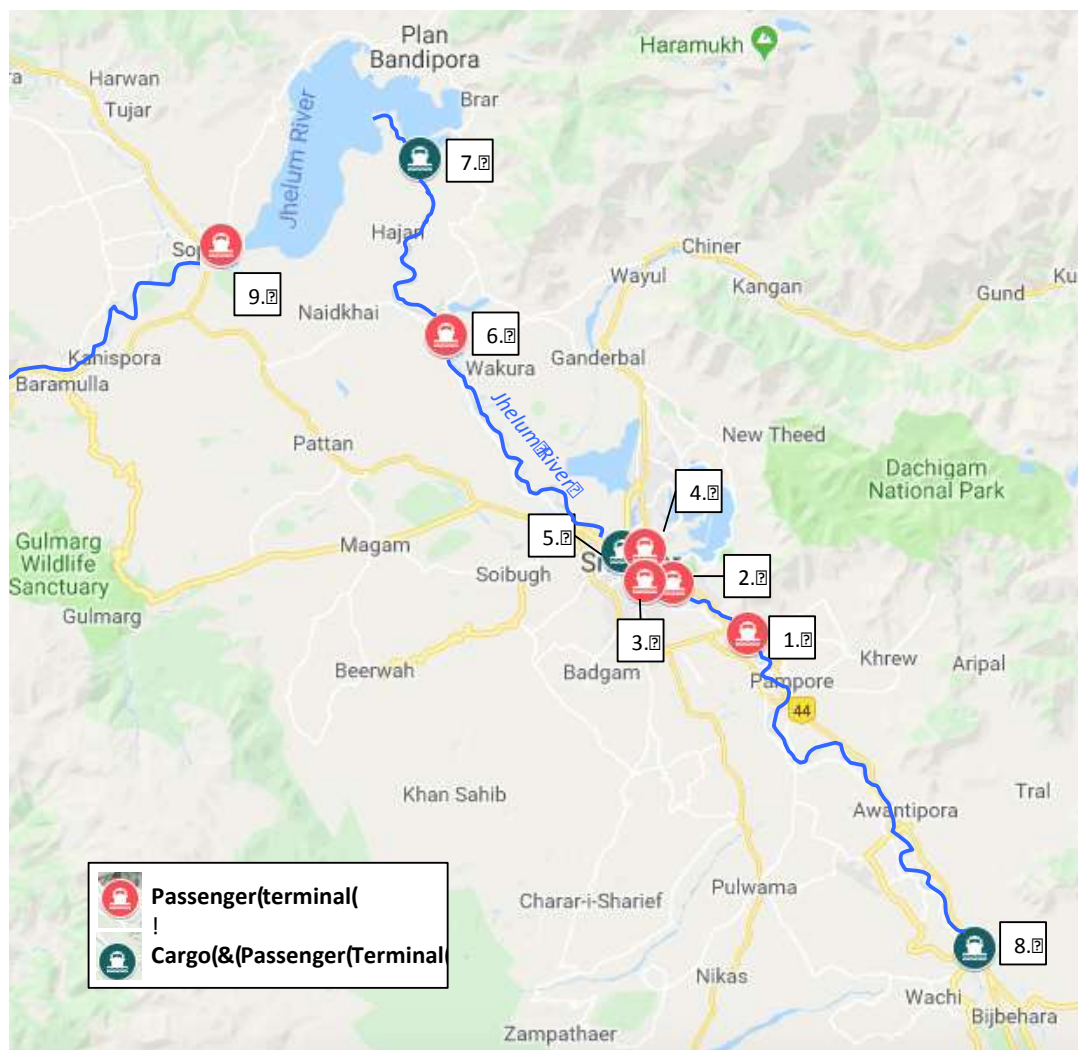


Figure 9-2 Mapping of Proposed Terminals on NW-49

**Table 9-1 Details of Proposed Terminals with projected Traffic on NW-49**

Locations	Districts	Lat/Long	Chainage (Km)	Type	Units	Projected Annual Traffic			
						Fy22	Fy 27	Fy 37	Fy 47
1. Pantha Chowk	Srinagar	34°02'33.3"N 74°52'21.2"E / 34° 2'16.30"N 74°52'21.93"E	133.2	Passenger	Numbers	59,364	78,084	131,070	265,800
2. Zero Bridge	Srinagar	34° 4'9.32"N 74°49'43.53"E	122.36	Passenger	Numbers	179,083	236,850	391,531	748,460
3. Amira Kadal	Srinagar	34° 4'15.83"N 74°48'25.74"E	121.07	Passenger	Numbers	56,568	86,454	166,520	336,831
4. Shah-e-Hamdan	Srinagar	34° 5'28.22"N 74°48'26.85"E	117.91	Passenger	Numbers	41,329	62,689	118,728	233,447
5. Safa Kadal/Chattabal Shrine	Srinagar	34°05'25.4"N 74°47'19.5"E	115.76	Cargo	Tonnes	10,320	12,840	15,960	21,720
				Passenger	Numbers	45,141	68,544	130,127	256,905
6. Sumbal Bridge	Ganderbal	34°13'41.4"N 74°39'05.0"E	91.9	Passenger	Numbers	3,156	3,882	5,802	10,566
7. Gund Prang	Bandipora	34°20'39.89"N 74°37'51.26"E	74.42	Cargo	Tonnes	6,720	8,280	10,200	13,800
				Passenger	Numbers	100380	123300	184320	334980
8. Sangam Bridge	Anantnag	33°49'47.54"N 75° 4'10.29"E	179.6	Cargo	Tonnes	3,600	4,560	5,760	7,920
				Passenger	Numbers	73,260	90,120	134,580	244,440
9. Sopore Bridge	Baramulla	34°16'56.09"N 74°28'20.83"E	39.55	Passenger	Numbers	23,476	24,651	26,377	28,224

As shown in the above table, terminal no. 1, 2, 3, 7, 8 & 9 are the hub terminals that are proposed to cater both inter and intra district movement of cargo and passengers. While, remaining terminals i.e 4, 5 & 6 are proposed for passenger movement within the Srinagar for short distance i.e intra district movement. Cargo terminals will be handling horticulture products only; no industrial traffic exists in the hinterland of river Jhelum. Both Cargo & Passenger transportation prospected were evaluated for waterway transportation. After the further interaction with traders, it has been found that they are not ready to shift on IWT for their cargo transportation because of time and distance issues. Therefore, cargo handling on River Jhelum has been discarded in immediate development stage.

**Table 9-2 Type of Terminals for Inter & Intra District Movement**

Passenger Terminals		Tourism Terminals		Cargo Terminals
Inter-District Movement	Intra-District Movement	Inter-District Movement	Intra-District Movement	Inter-District Movement
1. Pantha Chowk	1. Pantha Chowk	2. Zero Bridge	2. Zero Bridge	5. Safa Kadal/Chattabal Shrine
2. Zero Bridge	2. Zero Bridge	7. Gund Parang	3. Amira Kadal	7. Gund Parang
6. Sumbal Bridge	3. Amira Kadal	8. Sangam Bridge	4. Shah-e-Hamdan	8. Sangam Bridge

7. Gund Parang	4. Shah-e-Hamdan	9. Sopore Bridge	5. Safa Kadal/Chattabal Shrine	
9. Sopore Bridge	5. Safa Kadal/Chattabal Shrine			

**Table 9-3 Existing Connectivity and Infrastructure around each Proposed Terminals**

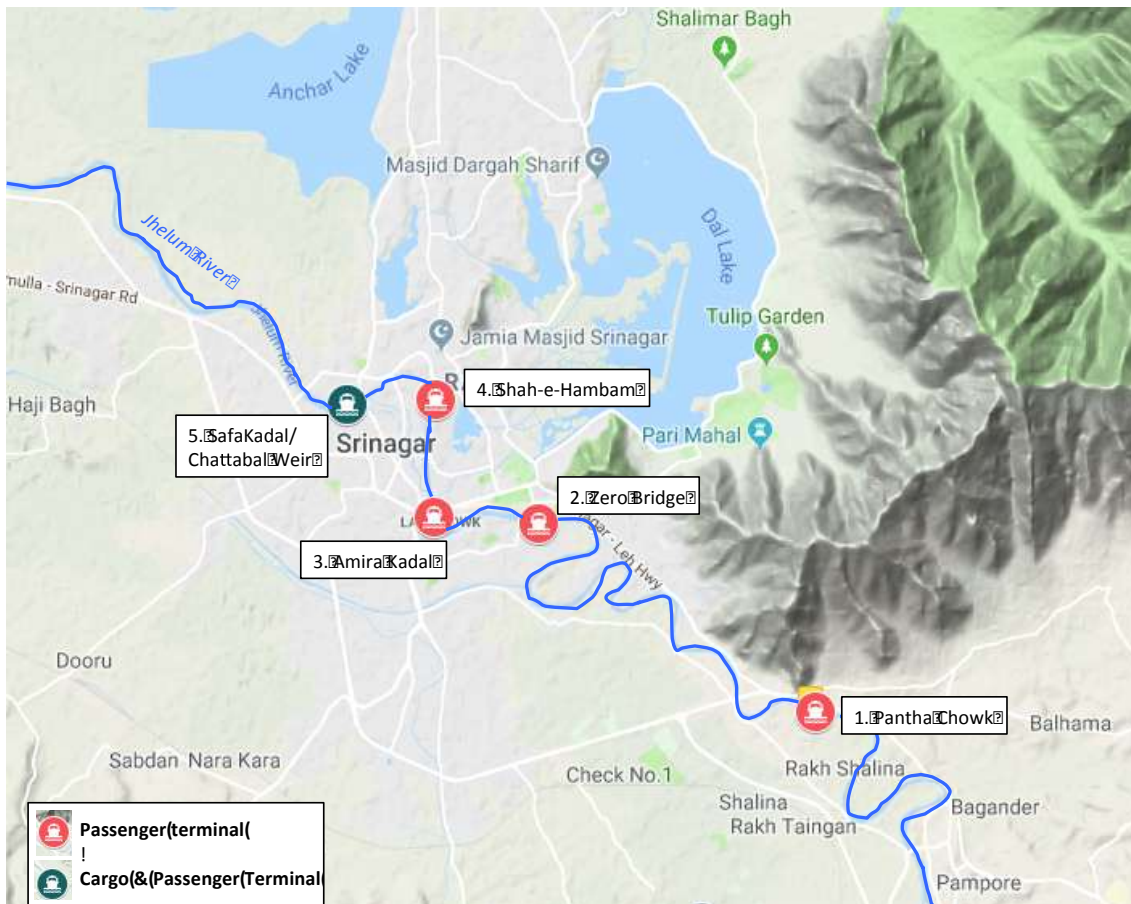
Terminal Location	Initial Capacity - FY'17 (Cargo in '000 T & Passengers in '000 No.)	Connectivity with other modes of Transportation (km)		Infrastructure around Terminals (Within 50-70 kms approx.)		
		Roadway	Railway	Bridges	Warehouses	Industrial Areas
1. Pantha Chowk	Passenger – 59.4	Local Road – 1km	Srinagar – 6 kms	Lasjan Bridge – 2kms	FCI Srinagar – 14 kms	Shalteng, Khanmoh I, II & III, Zakoora, Baghi Ali Mardan, Zainakote
2. Zero Bridge	Passenger – 179.1	Rajbagh-Modern Hospital Bund Rd – 200m	Srinagar – 9 kms	Zero Bridge	FCI Srinagar – 4kms	
3. Amira Kadal	Passenger – 56.6	Maulana Azad Rd – 150m	Srinagar – 12 kms	Amira Kadal	FCI Srinagar – 1.5kms	
4. Shah-e-Hamdan	Passenger – 41.3	Khan Kah-Babdem Rd - km	Srinagar – 14 kms	New Zaina Kadal Bridge	FCI Srinagar – 2kms	
5. Safa Kadal/Chattabal Shrine	Cargo – 10.3 Passenger – 45.1	Malik Sahib-Cement Kadal Rd. – 50m	Mazhom – 19kms	Safa Kadal Bridge	FCI Srinagar – 3kms	
6. Sumbal Bridge	Passenger – 3.2	BandiporaSumbal Rd – 500m	Hamre – 24kms	Sumbal Bridge	FCI Baramulla – 14kms	Simbal
7. Gund Prang	Cargo – 6.7 Passenger – 100.4	Local Road – 200m	Sopore – 29kms	-	FCI Baramulla – 36kms	Simbal
8. Sangam Bridge	Cargo – 3.6	DogriPora Rd. - 1 km	Bijbiara&Panzgo m – 5kms	Sangam Bridge – 400m	FCI Mirbazar- 17kms	Lassipora, Bijbiara, Anantnag, Anchidoora
9. Sopore Bridge	Passenger –	Tarzoos – Sopore Road	Sopore – 4kms	Sopore Bridge	FCI Baramulla – 12kms	Doabgah Food Park, Sopore& Baramulla

### 9.3 Phase wise Development of Proposed Terminals on River Jhelum

Terminals on River Jhelum are proposed to develop in three different phases. Phase 1 would cover all the terminals, which are for intra district movement i.e. within Srinagar, terminals located in other districts would be developed in Phase 2. While in Phase 3, one terminal in downstream of Wular Lake.

#### 9.3.1 Development of Phase 1

All the 5 terminals located in Srinagar for intra district movement would be developed in Phase 1. These terminals are proposed to handle traffic moving for short distance. The figure below depicts the location of terminals to develop in Phase 1.



**Figure 9-3 Development of Cargo & Passenger Terminals in Phase 1**

##### 9.3.1.1 Terminal 1 – Pantha Chowk

Terminal 1 at Pantha Chowk, located on the outskirts of Srinagar, is a hub terminal proposed for passenger & tourism movement. There are 2 locations identified for this terminal. One of it could be selected based on land availability, commercials. Etc. Proposed locations are located nearby to the busiest railway station i.e. Nawgon (Srinagar) Railway station. Visitors of Kashmir valley passes by this location, that creates huge footfalls on the location. Pantha Chowk also has a large

bus depot. Hence, developing a terminal at Pantha Chowk provides opportunities for people entering into Srinagar either through road or railways use river transport for local last mile connectivity. It has been surveyed and concluded by Government of J&K that 80% of the population uses public transport. Hence, development of passenger terminal at Pantha Chowk would provide local population one more medium and choice of transportation. The figure below depicts the 2 optional locations of proposed terminals near Pantha Chowk.



**Figure 9-4 Site Location of Terminal 1 – Pantha Chowk (Option 1)**



**Figure 9-5 Site Location of Terminal 1 – Pantha Chowk (Option 2)**

### 9.3.1.2 Terminal 2 – Near Zero Bridge

Terminal 2 just next to Zero Bridge would be handling local residents and tourism traffic. This bridge is the most ancient bridge in Srinagar, building terminal here will experience heavy traffic because lot many tourist spots are situated nearby. Tourist flow at this location is high due to this bridge and other attracting facilities located nearby like restaurants, heritage places, gardens and parks, etc. Government started water transport service a few years back from this location. It was a great success and boats were running with 100% utilization. It stopped during low water season. Reviving this would be a great success. Terminal location and nearby connectivity is shown in below figure.



**Figure 9-6 Site Location of Terminal 2 – Zero Bridge**

### 9.3.1.3 Terminal 3 – Near Amira Kadal

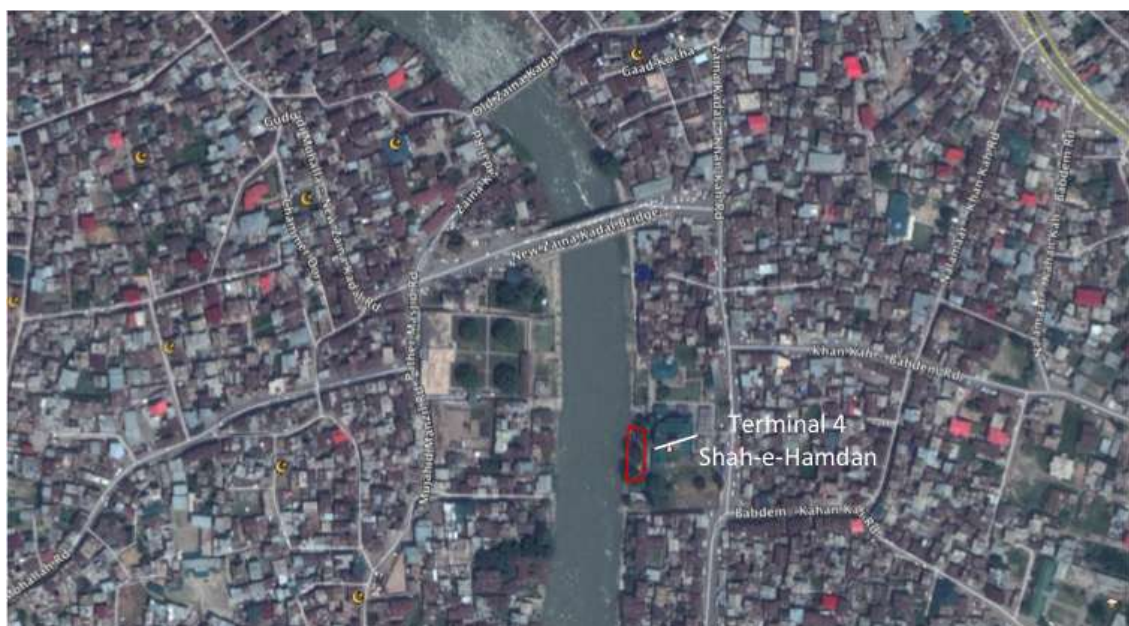
Terminal 3 is proposed near Amira Kadal Bridge for tourism & passenger traffic handling. Lal Chowk, one of the busiest places of the city is just next to the proposed location it is the oldest retail and wholesale market with numerous shops and stores. This market being connected to the heritage places, markets, schools and university accommodates heavy traffic. It is not only the commercial hub of Srinagar but also holds the historical significance of Srinagar. This location witnesses maximum number of footfall during working as well as non-working hours. This is also closer to one of the busiest city bus stop called Jahangir Chowk. Several government establishments including high courts are located in this region. Developing terminal here would cater every type of passengers like working class people, residents, students and business people. Location of terminal and its nearby connectivity is depicted in below figure.



**Figure 9-7 Site Location of Terminal 3 – Amira Kadal**

#### 9.3.1.4 Terminal 4 – Shah-e-Hamdan

Terminal 4 is proposed between new Zaina Kadal Bridge and old Fateh Kadal Bridge for passenger handling. This place is known for old residential buildings. There is already a big and established terminal there. Heavy population resides on both the side of the river. People travelling to northern and southern region of Jhelum River using roadways can be diverted to this terminal.



**Figure 9-8 Site Location of Terminal 4 – Near Shah-e-Hamdan**

#### 9.3.1.5 Terminal 5 – Near Safa Kadal

Terminal 5 is proposed next to Safa Kadal Bridge for cargo and passenger handling. It is located in between the two major mandis of Srinagar i.e. Pampore and

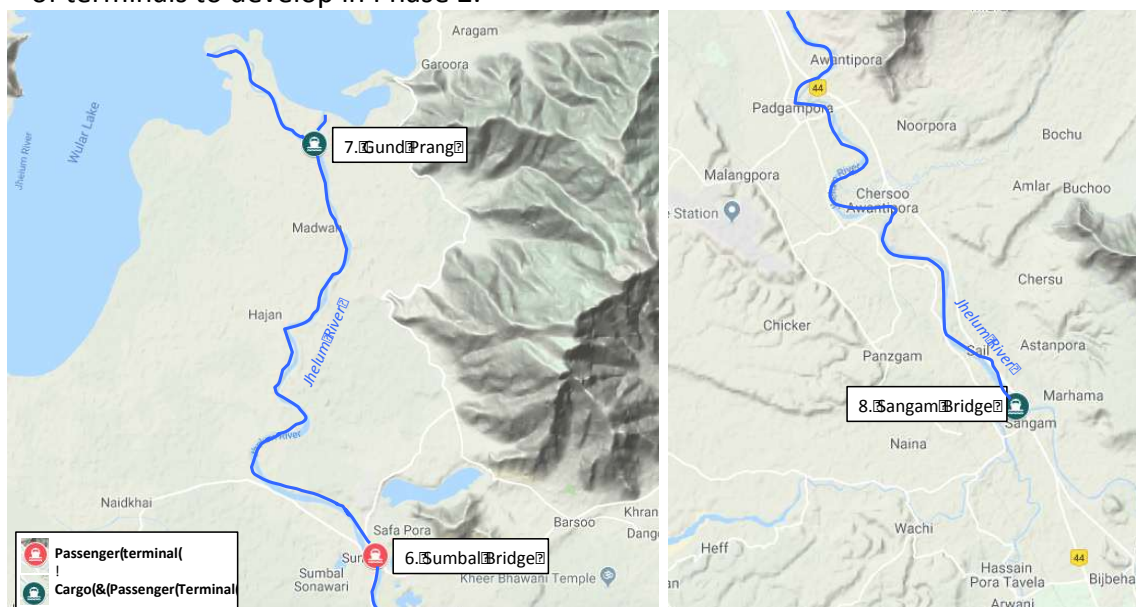
Chattabal. These are the Mandi where local cultivators come with their produce (Fruits and vegetables) for distribution in and outside Kashmir. Huge rush in peak season witness heavy footfalls at this location. Workers of nearby markets come to these Mandi every morning to load their vehicle for trade. Passenger movement to and from this location is also high. The figure below depicts location of terminal and its connectivity with nearby area.



**Figure 9-9 Site Location of Terminal 5 – Near Safa Kadal**

### 9.3.2 Development of Phase 2

Remaining 3 terminals, each in Ganderbal, Bandipora and Anantnag are proposed to develop in Phase 2. These terminals are for long distance movement of Cargo and Passenger movement. Traffic moving between above mentioned districts and Srinagar would be handled at these terminals. The figure below depicts the location of terminals to develop in Phase 2.



**Figure 9-10 Development of Cargo & Passenger Terminals in Phase 2**

### 9.3.2.1 Terminal 6 – Near Sumbal Bridge

Terminal 6 is proposed for passenger handling near Sumbal Bridge. It is the only proposed terminal in Ganderbal district. Working class and school/college going people from Ganderbal travel daily to Srinagar. Srinagar is the nearest commercial hub and well developed city. They could also visit Wular Lake using water transportation. Residents of Ganderbal district would use this terminal to travel to both ways i.e. Srinagar and Wular. Location of terminal is shown in below figure along with nearby roads and bridges.



**Figure 9-11 Site Location of Terminal 6 – Sumbal Bridge**

### 9.3.2.2 Terminal 7 – Gund Prang

Terminal 7 is proposed near Wular Lake for cargo and passenger both. Wular Lake has heavy vegetation in and around. Development of cargo terminal would enable transportation of vegetables to hinterland of Jhelum River using waterway. Srinagar city would be the maximum beneficiary of this mode of transportation. This terminal would enable connecting tourism industry with waterway. A large population of tourists visits Wular Lake using roadways. This terminal would enable additional mode of transportation for them. The people residing nearby Wular Lake and Bandipora could also use this terminal to reach Srinagar. Location of terminal is depicted in below figure.



**Figure 9-12 Site Location of Terminal 7– Gund Prang**

### 9.3.2.3 Terminal 8 – Near Sangam Bridge

Terminal 8 is proposed for Cargo and passenger movement from and to Srinagar city. This location falls in Anantnag district; it is one of the most populated places in Kashmir valley. Residents in and around of this location travels to Srinagar on daily basis. Also small markets located nearby to this location are connected to Major mandis of Srinagar. This traffic, which is presently moving on roads, could be shifted to proposed waterways in future. There exist potential for tourism as well using this terminals. The figure below depicts the location of proposed terminal and nearby connectivity.



**Figure 9-13 Site Location of Terminal 8 – Near Sangam Bridge**

### 9.3.3 Development of Phase 3

Terminal 9 is proposed to develop in Phase 3 of this project. This terminal would be handling tourist and passenger traffic moving between Baramulla and Srinagar. The figure below depicts the location of terminal to develop in Phase 3.



**Figure 9-14 Site Location of Terminal 9 – Near Sopore Bridge**

The proposed Terminal 9 is located in Baramulla district on the downstream of Wular Lake, adjacent to Sopore Bridge. This district is blessed with scenic beauty, with round the year tourist visits. In winters, snow sports are very popular that attracts huge number of tourists. Gulmarg and Khadniyar are the most well-known tourist place that are located within 40 kms of the proposed terminal in Sopore. Visitors of Srinagar and Wularlake, continues their trip towards Baramulla. This traffic, which is presently moving on roads and railways, could be shifted to river Jhelum in future once terminal 9 gets operational. Proposed terminal in Sopore would connect Baramulla with other districts like Bandipore, Ganderbal, Srinagar and Anantnag by River Jhelum and enable linking the tourism industry with waterways.

### 9.4 New Infrastructure & Facility Assessment

A total of 9 Terminals are proposed to be developed on the defined stretch of NW 49 on River Jhelum. Out of the total 9 terminals, 3 terminals would be developed as Multi Purpose Terminals for handling both cargo and passenger/tourists. Rest of the 6 terminals in NW 49 would be developed as Passenger terminals for handling passenger/tourist traffic. These 6 terminals would not handle cargo.

The identified locations for the proposed terminals lack infrastructure. None of the terminals are operational yet. However, with the development of full-fledged terminals on all the identified locations, it is necessary to develop other supporting infrastructure and facilities. There is a need to develop approach road in most the

terminals. Supporting infrastructure and facilities for cargo handling would be different from passenger/tourist terminals.

This section would study in detail the required facilities and infrastructure in each terminal. These facilities and infrastructure at terminal boarding point need to be developed to make them conducive and comfortable for tourists. It is essential to create services, which would help in creation of economic and tourism development atmosphere on NW 49. These additional facilities developed at the terminal could be translated in to additional source of revenue and would make the terminals self-sustainable. It will encourage visitors to explore the region and contribute to the local economy. The below tables depict infrastructure requirement at each cargo terminal and passenger terminal.

**Table 9-4 Requirement of Additional Infrastructure at each Passenger Terminal**

Sr. No.	Infrastructure	Requirement at each Terminal								
		1	2	3	4	5	6	7	8	9
1	Restroom	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	Waiting Hall	✓	✓	x	x	x	✓	✓	✓	✓
3	Souvenir Shop	✓	✓	✓	✓	x	x	✓	x	✓
4	Ticket Counter	✓	✓	✓	✓	✓	✓	✓	✓	✓
5	Admin Office	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	Fencing and Guard room	✓	✓	x	x	x	✓	✓	✓	✓

**Table 9-5 Requirement of Additional Infrastructure at each Cargo Terminal**

Sr. No.	Infrastructure	Requirement at each Terminal		
		5	7	8
1	Multimodal Logistics Hub	x	x	x
2	ICD	x	x	x
3	Cold Storage	✓	✓	✓
4	Storage area, Warehouses	✓	✓	✓
5	Rail Siding	x	x	x
6	Construction of Approach Road for terminal	✓	✓	✓
7	Admin Office	✓	✓	✓

#### 9.4.1 Passenger Terminal Planning-Immediate

All 9 proposed terminals on NW 49 would handle passenger and tourist traffic. These terminals have been identified based on the market survey and analysis of the needs of local economy, population and tourism sector. Passenger terminals are divided into two categories- (a) inter district terminal and (b) intra-district terminals. The proposed facilities, infrastructure and other development required on NW 49, river Jhelum could be evaluated for these two types of terminals.

##### 9.4.1.1 Inter District Passenger Terminals Infrastructure

6 terminals are proposed on NW 49 as inter district terminals for handling tourist traffic for long distance ride on NW 49. Inter district terminals would be developed in Pantha Chowk (Terminal 1), Zero Bridge (Terminal 2), Sumbal Bridge (Terminal 6), Gund Prang (Terminal 7), Sangam Bridge (Terminal 8) and Sopore Bridge (Terminal 9). These IWA terminals would be an integral part of the waterway development on river Jhelum. They would attract tourists to the waterway for leisure ride and sight seeing on the river. Inter district terminals are proposed to handle passenger/tourist movement in 3 routes,

- Anantnag (Sangam)- Srinagar (Pantha Chowk)
- Ganderbal (Sumbal Bridge), Bandipora (Gund Prang)- Srinagar (Zero Bridge)
- Baramulla (Sopore Bridge) – Srinagar

The above-mentioned three routes are busy and have good connectivity. Development of IWT on river Jhelum would provide passengers an alternate mode of transportation. Passengers usually choose any mode of transportation based on time, cost and reliability. IWT development on river Jhelum would provide tourists and opportunity to see the scenic beauty around the river, while enjoy boat ride on Jhelum. Tourists would very likely prefer waterway to travel the tourist places, which are located near Srinagar, Anantnag, Ganderbal and Bandipora.

This section would discuss in detail planning for supporting infrastructure required for handling passengers/tourists. Tourist activities generally demand a good and aesthetic environment congenial for relaxed spending. This requires a safe landing arrangement and a furnished waiting hall. The terminal facility should also include fencing and guardroom, toilet facilities, ticket counter, etc. No night stay accommodation is envisaged for the tourists as the tourists are meant to stay for shorter duration, not requiring any night stay.

Brief description of some of the proposed facilities is given in this section for terminal planning. Other infrastructural facilities like water supply, electrification, fire fighting with portable pumps, communication facilities, life saving equipment, security check areas, emergency service facilities etc. are also considered.

- ✓ Restroom  
Restroom would be located in a permanent structure in the terminal, within sight distance of the jetty. The structure could be stand alone or part of ticketing area or canteen. Restroom would be developed separately for men and women.

- ✓ Waiting Hall

Waiting Hall would be required in Inter District Terminals. These terminals would cater to large number of tourist and passenger traffic; hence it is advised that waiting hall should be developed at these terminals. The waiting hall would have sufficient seating arrangement for tourists/passengers. It should be sufficient enough to handle at least 25 no. of tourists. Separate toilet facility for ladies and gents would also be developed adjacent to the Waiting Hall. Sufficient number of electrical points shall be provided for phone/laptop charging purpose.

✓ Souvenir Shop

There would be a souvenir shop in the premise, which would sell objects, gifts and souvenirs. Earnings from sale of souvenirs would be a revenue source.

✓ Admin Office with ticket counter

In each of Inter district passenger terminal, Admin Office with ticket counter would be developed. The Administrative office would serve as the base for the terminal and would be required for administration of the terminal. Along with the Office, there would be a 2-window ticket counter. 2 window-ticketing booths would be sufficient to cater the peak passenger/ tourist traffic.

The in-charge officers and other personnel would use the Office as their work base. Administration work, like paperwork, documentation etc. would be done here. The Office would be used for administrative works to ensure effective, smooth and efficient functioning of the terminal.

✓ The Fencing and guard room

The area of landing facility shall be provided with 3-lined barbed wire system with RCC square pillars for supporting the fencing. The entrance to the terminal complex will be through a gate, which shall have aesthetic looks. A guardroom shall be developed along with the fencing for the security of the property at site.

✓ Other Facilities

- Outdoor Passenger Queuing Area: An outdoor deck area should be provided for visitors waiting to embark on a boat/ferry. The queuing area should be located in association with the shade/rain shelter feature in close proximity to the dock.
- Security System: CCTV security system would be installed in all the terminals as the safety and security measures.
- Garbage Collection: Waste collection bins would be installed inside and outside of the terminals for garbage disposal. This would ensure cleanliness in and around the terminals.
- Health & Safety Counter: Developing small dispensary with first aid could be beneficial. Health counter would serve both terminal staffs and passengers.
- Banking related Facilities: Developing ATM facility near terminal would be very useful for tourists and passengers.

#### 9.4.1.2 Intra District Passenger Terminals Infrastructure

Total 5 terminals would handle intra district passenger/tourist traffic within Srinagar. These 5 terminals would be developed at Pantha Chowk (Terminal 1), Zero Bridge (Terminal 2), Amira Kadal (Terminal 3), Shah-e-Hambam (Terminal 4) and Safa Kadal/Chattabal Shrine (Terminal 5).

Out of these 5 terminals, Pantha Chowk (Terminal 1), Zero Bridge (Terminal 2) would be developed in a bigger scale as they would be dedicated for handling both intra and inter district tourist/passenger traffic. As both these terminals would handle both types of traffic; hence it is necessary that these terminals would be developed in big scale and in large area. Supportive Infrastructure and amenities, which would be developed in these two terminals, are already discussed in previous section.

There are only 3 terminals, i.e. Amira Kadal (Terminal 3), Shah-e-Hambam (Terminal 4) and Safa Kadal/Chattabal Shrine (Terminal 5), which would handle only intra district. This section would discuss various amenities for tourists/passengers, planned for these three terminals. There would be ticket counter and rest room. This section would discuss in detail planning for these infrastructure.

✓ Restroom

Restroom would be located in a permanent structure in the terminal, within sight distance of the jetty. The structure could be stand alone or part of ticketing area or canteen. Small separate restroom for men and women would be developed in the Terminal.

✓ Ticket Counter

Ticket Counter area would be manned by ferry operators for the sale of boarding tickets. There would be a 2 window ticket counter in Terminal 3, 4 & 5. Two window ticketing booths would be sufficient to cater the passenger/ tourist traffic.

#### 9.4.2 Cargo Terminal Planning-later

Three terminals (Terminal 5, 7 & 8) are proposed on NW 49 as multi purpose terminals for handling cargo as well as passenger traffic. This section would discuss in detail planning for required infrastructure.

##### 9.4.2.1 Infrastructure for handling Cargo

Multi purpose terminals would handle Horticulture products, like fruits & vegetables. These Horticulture products originate in and around Wular Lake and Sangam and would be destined to Srinagar for distribution. As fruits and vegetables are perishable items; hence they require cold storage facilities in Warehouse for storage for short period.

- ✓ Warehouse  
Warehouse facility would be developed in all three multi purpose terminals. A manual warehouse is appropriate as the commodities, which would be handled are fruits and vegetables and their volume would be small. These products will be received and stored in cold storage. Products from trucks can be unloaded and moved around by hand or with the assistance of trolleys. Similar manner, products could be loaded in the vessel for further movement on NW 49.
  
- ✓ Cold Storage Facilities  
Considering the volume of Horticulture products, which would be transported using inland waterway in NW 49, it is advised that a medium size cold storage room would be developed in the warehouse. There is no need to develop a big cold storage facility, as it would be under utilized.  
  
Cold storage facility needs electricity requirements. Demand for electricity may increase as per the required cooling effect to maintain the freshness of fruits and vegetables. The proposed cold storage facility would be small; hence it would not consume much electricity.
  
- ✓ Admin Office with ticket counter  
In each of Inter district passenger terminal, Admin Office would be developed. It would serve as the base for the terminal and would be required for administration of the terminal. The in-charge officers and other personnel would use the Office as their work base. Administration work, like paperwork, documentation etc. would be done here. The Office would be used for administrative works to ensure effective, smooth and efficient functioning of the terminal.

#### 9.4.2.2 Infrastructure for Passengers/Tourists

- ✓ Ticket Counter  
Ticket Counter area would be manned by ferry operators for the sale of boarding tickets. There would be a 2 window ticket counter in/adjacent to Admin building. Two window ticketing booths would be sufficient to cater the passenger/ tourist traffic.
  
- ✓ Restroom  
Restroom would be located in a permanent structure in the terminal, within sight distance of the jetty. The structure could be stand alone or part of ticketing area. Restroom would be developed separately for men and women.
  
- ✓ Waiting Hall  
Waiting Hall would be required in Terminal 7 & 8. These terminals would cater to large tourist traffic; hence it is advised that waiting hall should be developed at

these terminals. Waiting hall should be sufficient enough to handle at least 25 no. of tourists. Separate toilet facility for ladies and gents could be developed adjacent to Waiting Hall. The waiting hall would have sufficient seating arrangement for tourists/passengers. Sufficient number of electrical points shall be provided for phone/laptop charging purpose.

✓ Souvenir Shop

Terminal 7, which would be located in Gund Parang is closer to Wular Lake; hence would attract many tourists. A souvenir shop in Terminal 7 is advised as tourists would very likely buy souvenirs, other antiques and local things. This souvenir shop would be a source of additional revenue for the terminal.

## 9.5 SWOT Analysis of Proposed Passenger Terminals

All 9 proposed terminals on NW 49 would handle passenger and tourist traffic. Six terminals would be dedicated exclusively for handling passenger/tourist movement. These terminals are 1, 2, 3, 4, 6 & 9.

Terminal 1,2,3,4 & 5 are located in Srinagar district. Terminal 6, 7, 8 & 9 are located in Ganderbal, Bandipora, Anantnag and Baramulla districts respectively. District wise SWOT of passenger terminals is discussed below.

### 9.5.1 Strength

#### Terminals located in Srinagar District

- All the terminals located in Srinagar have advantage of good connectivity. There are 4 National Highways that pass through Srinagar. Srinagar is connected with other cities of India through Railway and roadways. This would be an advantage as tourists from different parts could reach Srinagar easily. These tourists would contribute in tourist traffic of NW 49.
- Srinagar is a densely populated city and local passengers are mostly dependent on roadways for their daily commute. These passengers would contribute in passenger traffic of NW 49. For instance, a large number of passengers/tourists is observed near Pantha Chowk. Development of a terminal on Pantha Chowk would attract these passengers/tourists to use IWT on NW 49 for internal movement as well as long route travel till Anantnag or Baramulla.
- Internal roads are usually congested due to heavy traffic. Development of NW 49 would open an alternative for locals /tourists and they would opt for waterway transportation to avoid congestion on roadway.
- Srinagar is a famous tourist destination. There are many heritage buildings and sites, lakes, gardens and parks in the city, which witness major tourist footfall. These tourists would be attracted to the Terminals on NW 49 for leisure boat rides or traveling from Anantnag to Baramulla via Srinagar.

- There exist many educational institutes and government offices in Srinagar. Locals and people from nearby areas use roadways to travel to/from schools, colleges, universities, government offices etc. Existing mandis also attract workers/traders from in and around the city. These passengers could be targeted to the proposed terminals in Srinagar.
- Availability of adequate open land near the proposed terminals is an advantage. This parcel of land could be utilized for developing any supportive infrastructure along with the terminal.
- Some of the terminals, like Terminal 1, 3, 4, 6, 8 & 9 already have approach roads. These are mostly kaccha road, which could be developed as concrete roads. The additional investment on developing roads for these terminals would be less.
- Availability of bridges near some terminals, like Terminal 1, 3, 4 & 5 would be useful to attract passengers/tourists from other side of the terminal. These bridges would also help in faster evacuation of passengers from the terminals.

#### **Terminal located on Ganderbal District**

- Terminal 6 would be developed near Sumbal Bridge, Ganderbal. Terminal location is closer to Sumbal Bridge, so people from both sides of the river can access this terminal to reach Srinagar. An approach road exists behind this terminal; hence minimum investment is required to develop access road to the terminal.

#### **Terminal located in Bandipora District**

- Bandipora is located on the northern bank of Wular Lake. Wular Lake is a famous tourist spot. It is the second largest fresh water lake in Asia. Tourists from Srinagar could reach Bandipora using NW 49 and explore Wular Lake. Boat/ferry ride on river Jhelum from Srinagar to Bandipora would be a beautiful experience for tourists. Terminal 7 would target this tourists traffic. Apart from Wular Lake, Bandipora is rich in natural beauty and would attract nature lovers.
- Availability of large open land near the terminal is another strength, as it would facilitate development of supportive infrastructure along with the terminal.

#### **Terminal located in Anantnag District**

- The terminal has a kachha approach road, connecting it to NH44. Minimum investment would be required to develop it into a concrete road.
- There exists a Police Station on the opposite side of the Terminal, on the other side of the river. This would support the safety of the terminal.
- There exists a large parcel of open land near the terminal, which could be utilized for development of additional infrastructure.

### **Terminal located in Baramulla District**

- There are densely populated villages located in the hinterland of Terminal 9. There are many villages, which are located very close to the Terminal. This population would contribute in passenger traffic for the Terminal.
- Gulmarg in Baramulla is a famous tourist spot and attracts large number of tourists. It is located within 40 kms. from Terminal 9. Tourist traffic of this region could be shifted to IWT.
- There exist two bridges near Terminal 9 for across the river movement. These bridges would facilitate smooth evacuation of passengers as well as attract traffic from both the sides of the river.

## **9.5.2 Weakness**

### **Terminals located in Srinagar District**

- Traveling on NW 49 would be more time taking compared to the existing mode. Due to the curvy shape of river Jhelum, distance increases between origin and destination. Longer distance results in longer travel time. This factor might deter time sensitive passengers, who travel everyday for work, education or business.
- Srinagar is the summer capital and during winter (November to March), passenger and tourist volume in the city reduces dramatically. Due to extreme cold weather and snowfall, schools, colleges, offices etc. shut down for winter season. There is no cultivation of Horticulture products during winter; hence traders do not travel to Srinagar. Due to all these factors, it is very likely that all the IWT terminals in Srinagar would not be utilized during winter. This would affect the viability of NW 49.
- There is good road and rail connectivity in and around Srinagar. Tourists/ Passengers might prefer existing roadways and railways for travel instead of waterways.
- As internal city roads are already congested; hence evacuation from terminals would further increase congestion on these roads.
- There would be timetable for ferries/boats on each Terminal. Passengers would have to wait to board a ferry. Loading and unloading of passengers add on transportation time. This factor could discourage passengers to opt NW 49. Passengers can travel by their own car/public transport as per their convenience. Whereas, they have to follow a fixed schedule if they use IWT on river Jhelum.

### **Terminal located in Ganderbal District**

- Unlike other terminals in Srinagar, there are not places of tourist interest near Terminal 6 near Sumbal Bridge, Ganderbal. Hence, it is very unlikely that this terminal would attract tourist traffic. Population density is also not high in Ganderbal as compared to Srinagar. Traffic volume for this terminal would be less compared to other passenger terminals in Srinagar.

#### **Terminal located in Bandipora District**

- Bandipora district is a hilly and backward district. It has dense vegetation and forest areas. The district is less developed. Due to these factors, population density is less in the district. Hence, passenger traffic would be less on Terminal 7.

#### **Terminal located in Anantnag District**

- There is good road connectivity in Anantnag. NH 44 passes through Terminal 8. There are also internal roads near the terminal. Passengers might prefer roadways for transportation. This would adversely affect the passenger/ tourist traffic for Terminal 8.

#### **Terminal located in Baramulla District**

- There is good rail/road connectivity in Baramulla. These are faster modes of transportation; hence IWT would have to compete with them to attract traffic.

### **9.5.3 Opportunity**

#### **Terminals located in Srinagar District**

- Roadways in Srinagar often face congestion. Development of NW 49 would provide passengers/tourists an alternate mode of transportation.
- As per Government of J&K, 80% of the population use public transportation. Traffic & congestion on road. There is possibility to shift part of the existing traffic to waterway.
- The busiest railway station, i.e. Srinagar Kashmir Railway Station and bus depots are located near the Terminal. Both locals as well as tourists, visiting Kashmir Valley, use these existing modes of transportation. Development of IWT Terminals would provide passengers and tourists an alternate mode of transportation, which is scenic and beautiful.
- Continuous footfalls of passengers irrespective of peak or non-peak season. Terminals would attract all kinds of passengers, like working people, students, tourists, residents etc.
- Development of Terminal 4 in Shah-e-Hambam, Srinagar would help to attract passengers traveling from North Jhelum to South Jhelum. This location would require less capital investment due to existing platform.
- There are new projects for the development and beautification of Srinagar. Some of these upcoming projects are under Srinagar Municipal Corporation (SMC), Srinagar Development Authority (SDA) and INTACH. These projects would create more opportunity for all the terminals in Srinagar on NW 49. For instance, INTACH is involved in restoration of heritage buildings and sites in Srinagar. This would boost heritage tourism in the city and would result in increase in tourism traffic.

#### **Terminal located in Ganderbal District**

- People travel by local roads to reach Srinagar in the absence of national highway. Development of this terminal would create another option for traveling to Wular Lake and Srinagar. By using waterway transport residents of this district would have direct access to mandis of Srinagar without getting affected by city road congestion and traffic of Srinagar. This could eventually save their time.

#### **Terminal located in Bandipora District**

- There is no strong road connectivity between Bandipora and Srinagar. People use Bandipora- Srinagar road, which is a crucial road link between Bandipora and Srinagar. Development of Terminal 7 on river Jhelum would provide passengers/tourists an alternative mode of transportation.

#### **Terminal located in Anantnag District**

- There are many pilgrimage and tourist sites in Anantnag district. This would attract tourists in the district from Srinagar. Waterway would provide tourists an opportunity to enjoy the scenic beauty around the river while traveling to Anantnag. This would increase the passenger/tourist volume on Terminal 8.

#### **Terminal located in Baramulla District**

- Terminal 9 would get opportunity from tourists, who are destined to Gulmarg. Tourists from Srinagar or other terminals would reach Terminal 9 by waterway and then would further travel to Gulmarg by roadways. This multi modal route provides tourists opportunity to enjoy boat ride on river Jhelum along with the scenic beauty of the surrounding area.

### **9.5.4 Threat**

#### **Terminals located in Srinagar District**

- An upcoming Metro Rail Project in Srinagar would pose threat to the IWT terminals. This project would develop three corridors, with total length of 58 Kms. This Metro service would connect most of the important locations of the city. Metro service is faster, comfortable and economical for passenger, whereas inland waterway transport is time consuming. Passengers and tourists might opt Metro over IWT; which would negatively impact the traffic on each Terminal in the city.
- Five terminals are proposed to be developed in Srinagar. The distance between these terminals are very less. Due to close proximity of terminals on NW 49, passenger/tourist traffic would be scattered. The traffic for each of these terminals could vary. Some of these terminals could be under utilized.
- Passengers working in offices and students are time bound and if waterway transport is not at par with existing roadways then they would not prefer waterways. Close proximity of proposed dedicated passenger terminal 2 at Zero bridge further

weakens the opportunity to develop terminal 3 i.e. Amira Kadal. Strong road connectivity acts as faster & economical method of transportation.

- Closure of passenger boat service near Zero Bridge (Terminal 2), Srinagar in the past need to be taken into consideration. If the price of IWT transportation on river Jhelum is costlier than the existing modes, then passengers would not be attracted to the terminals for waterway transportation.
- River Jhelum is prone to flood, as water level rises due to heavy rainfall during monsoon. These kinds of calamities and natural factors would pose serious threat to the waterway movement in river Jhelum. Flood of 2014 witnessed massive destruction in the region. During monsoon, IWT transportation in river Jhelum would be dangerous; hence it is very unlikely that passengers would use NW 49 for transportation. If in future, Flood occurs then it would cause heavy damage to terminals and additional infrastructure.

#### **Terminal located in Bandipora District**

- Earlier, Bandipora- Srinagar Road was in bad condition. However, it was reconstructed in August, 2018. Reconstruction of Bandipora- Srinagar Road would provide a strong connectivity to Srinagar city. Hence people might prefer traveling by road.

#### **Terminal located in Baramulla District**

- The downstream stretch of Wular Lake, where Sopore Bridge is located, is difficult for vessel navigation. This would pose threat for vessel movement from Terminal 9 on river Jhelum. The surrounding region of this part of the river is politically disturbed, which might hinder administration of the Terminal and the waterway.
- Sopore to Srinagar has direct rail connectivity, whereas inland waterway would take a longer route. Boats have to pass through Wular Lake, which increase the distance of the route. This factor would pose threat to the development of Terminal in Baramulla on river Jhelum, as passenger/tourists would prefer existing modes than IWT.

### **9.6 SWOT Analysis of Proposed Cargo Terminals**

Three terminals, Terminal 5,7 & 8 would be developed as Multi Purpose Terminals. These terminals would handle both cargo and passengers. As cargo terminals, they would handle Horticulture products, like fruits & vegetables. SWOT of these three terminals is discussed below.

#### **9.6.1 Strength**

- Terminal 5 is strategically located between two big mandis of Srinagar, namely Pampore and Chattabal. Local cultivators sell fruits & vegetable in these mandis. From these mandis, Horticulture products are distributed in entire Kashmir.

- There is adequate open land near the proposed terminal locations, which would be used for developing additional infrastructure, like warehouse, cold storage etc. This open land would ease loading of cargo.
- Safa Kadal Bridge, which is located within 500 mtrs. from Terminal 5 would be useful in faster evacuation of cargo.

### 9.6.2 Weakness

- Horticulture products originate from Bondipora and Anantnag districts. It would be loaded on Terminal 7 & 8. Terminal 5 would be used for unloading in Srinagar. This cargo movement is one way and is destined to Srinagar. There is no return cargo and the vessels would return empty. This would increase logistics cost and would adversely impact the viability of cargo movement on NW 49.
- The proposed cargo on these terminals comprises of fruits and vegetables. These commodities are perishable in nature and are time sensitive. Multiple handling might adversely impact their shelf life. Transportation of fruits & vegetables by roadways would reduce time and cost; whereas transportation on waterway would require longer time for delivery. This is a major weakness of the cargo terminals.
- Safa Kadal Bridge is well developed and currently used for transportation of cargo. Internal roads are also well developed, which provide direct last mile connectivity. Well-developed roadways and good connectivity would reduce the appeal of Terminal 5 on NW 49. Traders would prefer roadways than IWT, as roadways would ensure faster movement of perishable commodities.
- There exist well-developed national highways, which pass through South Pulwama and north Anantnag districts in the hinterland of NW 49. Good road connectivity would lessen the opportunity for Terminal 8 on NW 49. Existing mode would be preferred as it would be time saving and cost effective, as compared to waterway.

### 9.6.3 Opportunity

- There exists movement of Horticulture products between Anantnag and Srinagar. This cargo movement could be partially shifted to NW 49. Terminal 8 could be used for loading cargo, which would be transported further to Srinagar.
- At present, Terminal 7 lacks strong road connectivity, like national highways. There is only one direct road, i.e. Bandipora- Srinagar Road, which provides direct connectivity between Bandipora and Srinagar. Development of NW 49 and Terminal 7 would open new avenues for local cultivators. It would provide an alternate mode of transportation of cargo from Bandipora to Srinagar.

### 9.6.4 Threat

- Perishable nature of the targeted commodities, i.e. fruits and vegetables require cold storage facilities in Warehouse for storage for short period. Development of warehouse and cold storage would increase capital investment.

- Volume of targeted cargo is very less, which would be transported by NW 49. Due to less volume and no return cargo on NW 49, it is very unlikely that the investment on these terminals would be recovered.
- Reconstruction of Bandipora- Srinagar Road completed on August 2018. This reconstruction has improved the efficiency of this roadway. This could pose threat to Terminal 7, as traders might prefer roadway to save time and cost.

## 9.7 Vessel Design

The length of River Jhelum (NW49) for development is 181.2 Km with 1.2m planned draft for navigation. As per the outcomes of traffic study, the river could be used for passenger transportation. A major opportunity rests with passenger movement within Srinagar (Intra District) and also to other districts like Anantnag, Bandipora and Baramulla (Inter District). River Jhelum could also be developed for Cargo transportation in future. Horticulture products are the primary traded commodities. This movement is seasonal with annual volume ranging between 3,000 Tonne to 10,000 tonne in the catchment area of River Jhelum. Hence, cargo traffichas been deferred to later stage. Total 9 terminals are proposed on River Jhelum for traffic handling. All 9 terminals will be used for handling passenger and tourist traffic, while 3 of them could also be further developed for cargo handling in future. Cargo transporters find roads to be the best and most convenient mode of transportation to reach Srinagar.

This Vessel Design section discusses in identifying vessels best suited to be deployed in River Jhelum for Passenger and tourism purpose. This section would help to recommend the type and number of vessels to be deployed at each terminal and on each route on River Jhelum to accommodate the proposed traffic for next 30 years.

### 9.7.1 Basis of Design

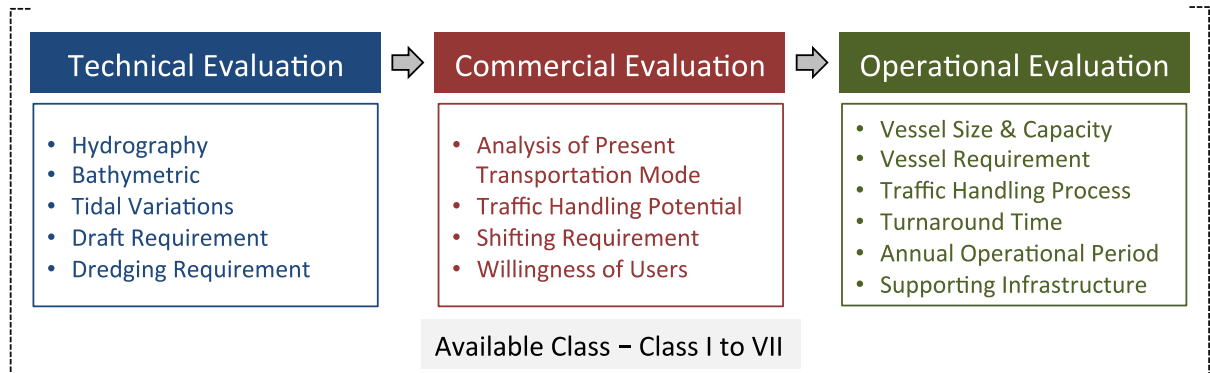
IWAI has classified National Waterways under 7 classes based on the physical parameters such as Water Depth, Channel Width, Bend Radius, Vertical & Horizontal Clearance and 330 days of water availability. According to the table below, waterway characteristics, River Jhelum falls under Class I category.

**Table 9-6 Classifications of River by IWAI**

Class of Waterway	Rivers				
	Minimum Depth	Bottom Width	Bend Radius	Vertical Clearance	Horizontal Clearance
I.	1.2 m	30 m	300 m	4 m	30 m
II.	1.4 m	40 m	500 m	5 m	40 m
III.	1.7 m	50 m	700 m	6 m	50 m
IV.	2.0 m	50 m	800 m	8 m	50 m
V.	2.0 m	80 m	800 m	8 m	80 m
VI.	2.75 m	80 m	900 m	10 m	80 m
VII.	2.75 m	100 m	900 m	10 m	100 m

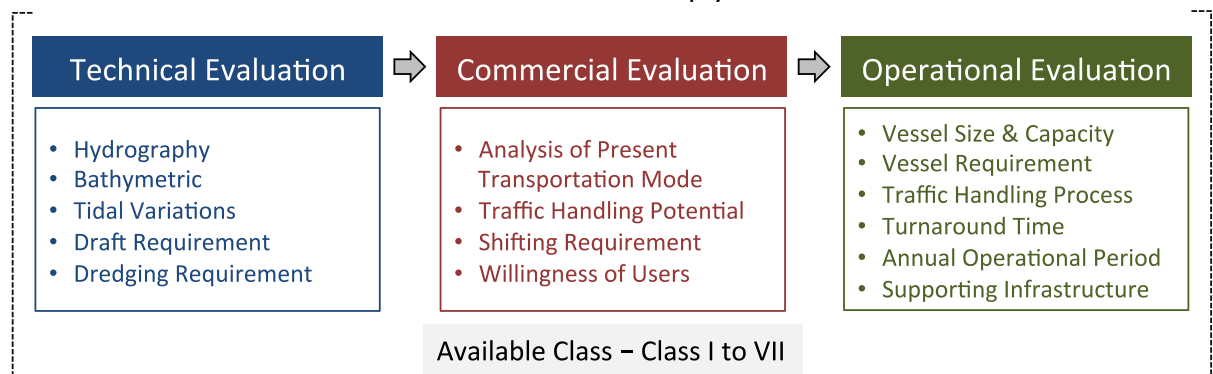
Source: IWAI

Waterway characteristics (already defined above), nature of cargo, vessel dimensions, physical constraints (bridges, weirs, navigations locks, etc) on the rivers, operational factors, etc. are the main aspects that influence the design parameters of vessels to be deployed on NW49 for passenger handling. The figure below shows the steps involved in decision making while selecting the suitable vessel type tfor NW49.



**Figure 9-15 Decision Making Process for vessel design**

**Technical Evaluation** – It acts as the ultimate framework, within which the vessel design selection has to be made. Hydrographic study, tidal study, draft available and physical constraints, together helps to evaluate technical conditions that the vessel needs to meet in order to ply on River Jhelum.



**Commercial Evaluation** - Projected traffic volume for all terminals and willingness of the users to shift to waterways helps to narrow down the type of vessels to be recommended.

**Traffic evaluation** - It makes way for the probable operational conditions under which vessel will be operating. This requires knowledge of sailing duration and distance, which will further dictate the turnaround time for vessels.

The vessel specifications mentioned in below table are the classifications defined by IWAI. Highlighted class is the recommended vessel size for deploymentment on River Jhelum to carry projected 30 years of passenger traffic.

**Table 9-7 Vessel's Specification of Special Class**

Ferry à	India-Bungy	Abra 36	Model Victory 10 Boat	Champ Tourist Boat 27ft	Tourism Powercat 14m	Catamaran Platform 13.2m	Passenger Cat 20m 100
Length (m)	5.6	11	7	8.2	14	13.2	20
Beam (m)	2.28	3.84	2	2.74	7.5	5.6	7
Draft (m)	0.6	0.6	0.4	0.6	0.6	0.8	0.8
Passenger Capacity (PAX)	18	20	10	26	45	64	100
Speed (Knots)	10	12	12	12	12	8	10
Engine Capacity (hp)	25	2X70	40	2X70	-	2 x 60	2 x 103
Type of Fuel	Diesel	Petrol	Diesel	Petrol	Diesel	Diesel	Diesel
Fuel Consumption (L/Hr)	4.5	20	6.8	20	-	20	35

The following images depict typical passenger carrying vessels that are used for passenger and tourist transportation. These images are for illustrative purposes only.



Source: Secondary Source

**Figure 9-16 Class I type Vessel - India Bungy**



Source: Secondary Source

**Figure 9-17 Abra-36**



Source: Secondary Source

**Figure 9-18 Model Victory 10 Boat**



Source: Secondary Source

**Figure 9-19 Champ Tourist Boat 27ft**



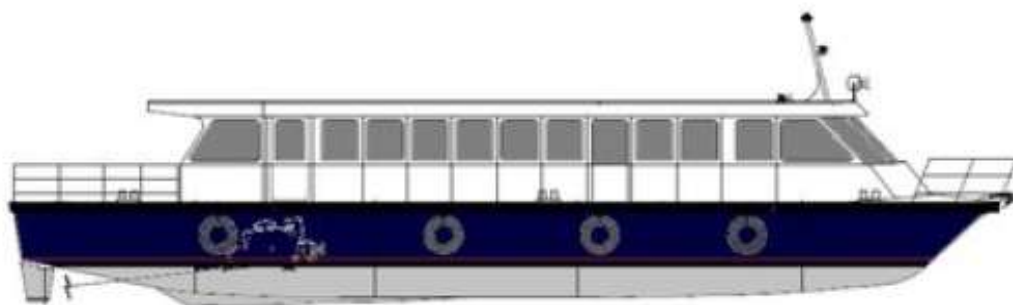
**Figure 9-20 Tourism Powercat14m**

Source: Secondary Source



**Figure 9-21 Catamaran Platform 13.2m**

Source: Secondary Source



Source: Secondary Source

**Figure 9-22 Passenger Vessel (20m 100Pax Capacity)**

### 9.7.2 Number of Vessels Required

Detailed Estimation of number of ferries required to deploy at all 9 terminals in order to accommodate projected passenger and tourism traffic is discussed in this section. For calculating number of shipcalls, turnaround time and vessels requirement, following are the considered assumptions.

- Operational daily Hours / Days: 12 Hrs / 300 Days
- Vessel capacity: Small Terminals – 20 Pax, Hub Terminals – 50 Pax
- Vessel Speed: Movement within Srinagar – 6 Knots, Inter-District Movement – 8 Knots
- Loading / Unloading Time: Small Terminals – 15 mins, Hub Terminals – 15 mins

The table below shows the total turnaround time taken recommended class of vessel i.e Class I in each route i.e Within Srinagar, Sangam – Gund Prang and Srinagar – Sopore for handling passengers.

**Table 9-8 Total Turnaround Time Calculations**

Route →	Unit	Within Srinagar	Sangam - Gund Prang	Sopore-Srinagar
Terminals in the route	No.	5	5	2
Handling at each Terminal	Hrs:Mins	0:15	0:15	0:15
Handling at all terminals	Hrs:Mins	1:15	1:15	0:30
Misc. Waiting	Hrs:Mins	-	0:30	0:30
Total Handling Time	Hrs:Mins	1:15	1:45	1:00
Sailing Speed	Knots	6	8	8
Sailing Time	Hrs:Mins	1:00	6:35	5:55
<b>Total Time (Hours)</b>	<b>Hrs:Mins</b>	<b>2:15</b>	<b>8:20</b>	<b>6:55</b>

**Table 9-9 Estimated Numbers of Vessels Required for Intra-District Traffic**

Terminals	Sr. No	FY22	FY27	FY37	FY47
1. Pantha Chowk	Passenger (Annual)	12,672	20,664	45,318	110,028
	Ship Calls (Annual)	634	1034	2266	5502
	No. of Trips (Daily)	3	4	8	19
	Total Vessels Required (No.)	1	1	1	2
	Additional Vessel Requirement (No.)		0	0	1
2. Zero Bridge	Passenger (Annual)	55,291	84,732	164,185	335,378
	Ship Calls (Annual)	2765	4237	8210	16769
	No. of Trips (Daily)	10	15	28	56
	Total Vessels Required (No.)	1	2	3	6

Terminals	Sr. No	FY22	FY27	FY37	FY47
	Additional Vessel Requirement (No.)		1	1	3
3. Amira Kadal	Passenger (Annual)	56,568	86,454	166,520	336,831
	Ship Calls (Annual)	2829	4323	8326	16842
	No. of Trips (Daily)	10	15	28	57
	Total Vessels Required (No.)	1	1	2	3
	Additional Vessel Requirement (No.)		0	1	1
4. Shah-e-Hamdan	Passenger (Annual)	41,329	62,689	118,728	233,447
	Ship Calls (Annual)	2067	3135	5937	11673
	No. of Trips (Daily)	7	11	20	39
	Total Vessels Required (No.)	1	1	1	2
	Additional Vessel Requirement (No.)		0	0	1
5. Safa Kadal / Chattabal Weir	Passenger (Annual)	45,141	68,544	130,127	256,905
	Ship Calls (Annual)	2258	3428	6507	12846
	No. of Trips (Daily)	8	12	22	43
	Total Vessels Required (No.)	1	1	1	2
	Additional Vessel Requirement (No.)		0	0	1

**Table 9-10 Estimated Numbers of Vessels Required for Inter-District Traffic**

Terminals	Sr. No	FY22	FY27	FY37	FY47
1. Pantha Chowk	Passenger (Annual)	46,692	57,420	85,752	155,772
	Ship Calls (Annual)	1,038	1,276	1,906	3,462
	No. of Trips (Daily)	4	5	7	12
	Total Vessels Required (No.)	2	2	3	4
	Additional Vessel Requirement (No.)	0	0	1	1
2. Zero Bridge	Passenger (Annual)	123,792	152,118	227,346	413,082
	Ship Calls (Annual)	2,751	3,381	5,053	9,180
	No. of Trips (Daily)	10	12	17	31
	Total Vessels Required (No.)	3	4	5	9
	Additional Vessel Requirement (No.)	0	1	1	4
6. Sumbal Bridge	Passenger (Annual)	3,156	3,882	5,802	10,566
	Ship Calls (Annual)	71	87	129	235
	No. of Trips (Daily)	1	1	1	1
	Total Vessels Required (No.)	1	1	1	1
	Additional Vessel Requirement (No.)	0	0	0	0

Terminals	Sr. No	FY22	FY27	FY37	FY47
7. Gund Prang	Passenger (Annual)	100,380	123,300	184,320	334,980
	Ship Calls (Annual)	2,231	2,740	4,096	7,444
	No. of Trips (Daily)	8	10	14	25
	Total Vessels Required (No.)	2	2	3	5
	Additional Vessel Requirement (No.)	0	0	1	2
8. Sangam Bridge	Passenger (Annual)	73,260	90,120	134,580	244,440
	Ship Calls (Annual)	1,628	2,003	2,991	5,432
	No. of Trips (Daily)	6	7	10	19
	Total Vessels Required (No.)	2	3	4	7
	Additional Vessel Requirement (No.)	0	1	1	3
9. Sopore Bridge	Passenger (Annual)	24,651	26,377	28,224	30,765
	Ship Calls (Annual)	548	587	628	684
	No. of Trips (Daily)	2	2	3	3
	Total Vessels Required (No.)	1	1	1	1
	Additional Vessel Requirement (No.)	0	0	0	0

### 9.7.3 Recommendation

As per the detailed study on Vessel Designing, it is recommend to deploy special class of Vessels for passenger handling at the terminals proposed on River Jhelum. Two different types of vessel would be deployed, vessel with 20 passenger capacity for small distance movement i.e within Srinagar and 50 passenger capacity vessel for long distance movement i.e between districts.

## CHAPTER – 10 IMPLICATIONS OF ONGOING PROJECTS

### 10.1 Flood Routing Studies by WAPCOS on River Jhelum for IFC

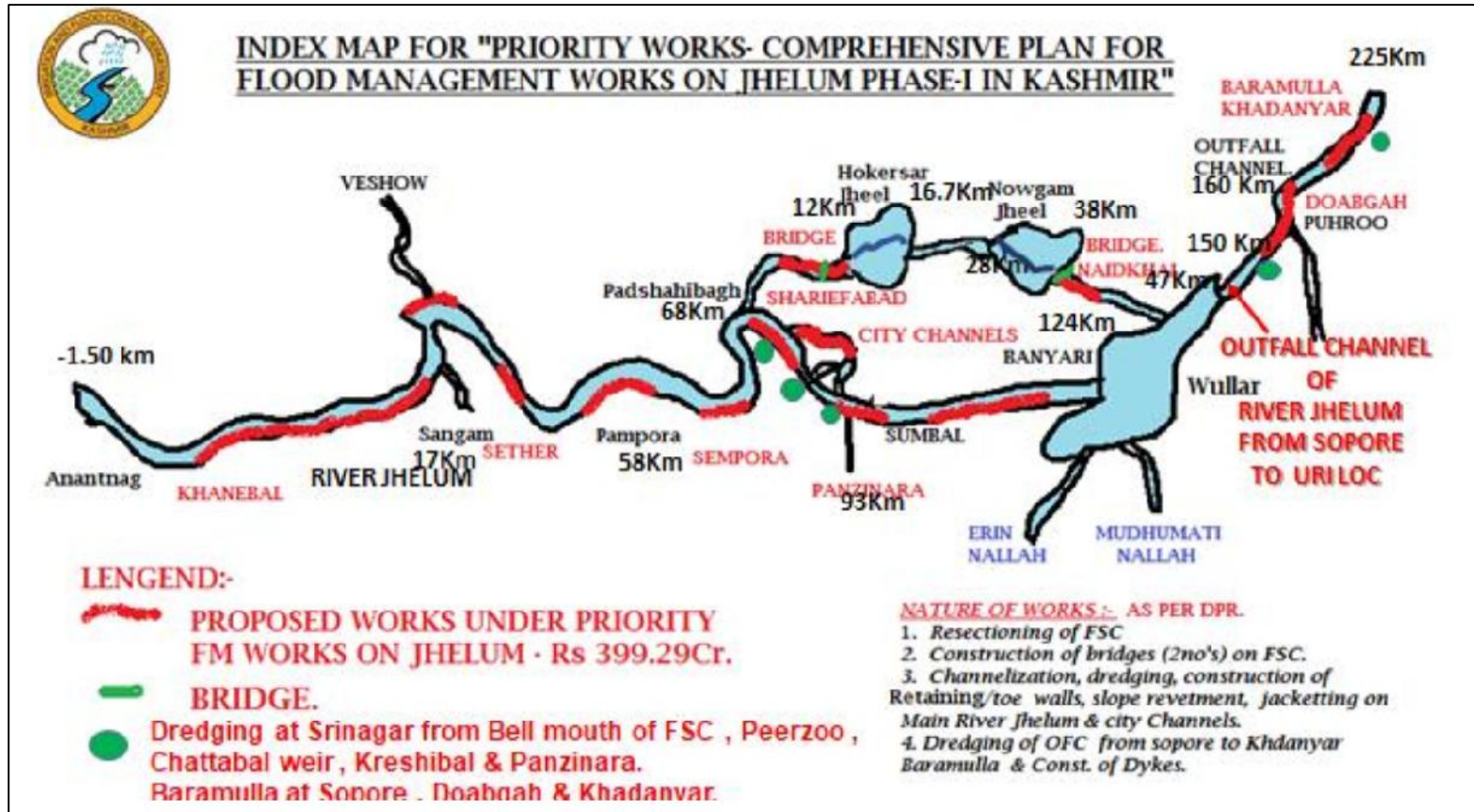
#### Proposal:

After the devastating floods of past year 2014 which resulted in colossal damage to human life and property, there is an urgent need to address the problem of floods in the valley on long term basis. The Government of J&K is formulating a comprehensive plan to manage the floods effectively covering entire reach of about 150 km from upstream of Sangam to downstream of Baramulla. It is proposed to manage the 1 in 100 years flood of **3260 cumec (1,15,000 cusec)** at Sangam in two phases. In Phase-I by implementing a comprehensive plan to manage floods of the order of **1700 cumec (60,000 cusec) at Padshahi Bagh**, which is about 50 km downstream of Sangam, by way of routing flood of 991 cumec (35000 cusec) through city reaches of Main Jhelum and 709 cumec (25000 cusec) existing flood spill channel. In Phase-II, it proposed to implement the works to handle the additional flood of 1558 cumec (55000 cusec) at Sangam by constructing about 81 km long supplementary flood spill channel taking off from Dogripora and draining in to Wullar lake or downstream; or taking up flood storage projects on the tributaries of Jhelum in upper reaches; or combination of both.

After detailed analysis, the **priority works** required for integrated flood and erosion management, have been proposed for sustainable flood management of the river system. The proposed management practices include the following aspects:

- Re sectioning/channel improvement of main Jhelum and flood spill channel
- Relocation/Renovation of bridges for re-sectioning of the flood spill channels ,
- Measures to check the erosion at some vulnerable reaches of the main Jhelum and flood spill channel.
- Dredging and shoal removal in outfall channel.

The present proposal for “**Priority Works- Comprehensive Plan for Flood Management Works on Jhelum- Phase-I**” has been framed at an estimated cost of Rs. 401 crores.



<b>(A) Direct Charges</b>			
I-Works	=	Rs.	397.64
II-Establishment	=	Rs.	0.00
III-Tools & Plant	=	Rs.	0.00
IV-Suspense	=	Rs.	0.00
V-Receipts & Recoveries	=	Rs.	-0.84
<b>Direct Charges( I+II+III+IV-V)</b>	=	Rs.	<b>396.80</b>
<b>(B) Indirect Charges</b>			
(a) Capitalized value of abatement of land revenue (5% of cost of culturable land or 20 times of annual revenue)	=	Rs.	0.00
(b) Audit & Account Charges(1% of I-Works)	=	Rs.	3.98
<b>Indirect Charges</b>	=	Rs.	<b>3.98</b>
<b>Total Cost</b>	=	Rs.	<b>400.78</b>
<b>say</b>			<b>401</b>

<b><u>Details of I-Works</u></b>			
A-Preliminary	=	Rs.	5.94
<b>B-Land</b>	=	<b>Rs.</b>	<b>142.33</b>
<b>C-Works</b>	=	<b>Rs.</b>	<b>245.15</b>
K-Building	=	Rs.	0.00

M-Plantation	=	Rs.	0.00
O-Miscellaneous	=	Rs.	0.00
P-Maintenance	=	Rs.	2.48
Q-Spl T&P	=	Rs.	1.13
R-Communication	=	Rs.	0.00
X-Environment &Ecology	=	Rs.	0.00
Y-Losses on Stock	=	Rs.	0.61
<b>Total (I-Works)</b>	=	<b>Rs.</b>	<b>397.64</b>

**Urgent works on Main Jhelum for removal of bottle necks for enhancing its carrying capacity in Srinagar City Reach**

- Channelization of River Jhelum/Removal of Garbage Dumps from RD 58 Km (Sempora) to Cement Bridge
- RCC Retaining walls of old houses located on river Jhelum (both banks)
- Construction of Toe walls and stone revetment on river Jhelum (Both Sides) left and right from Sempora to Shivpora RD 58km to RD 71km
- Construction of Retaining Walls and Stone pitching along RP Bund of river Jhelum (TypeI+TypeII+TypeIII) from Dubji Ghat to Parimpora RD 74.5km to RD 82 km
- Construction of Toe Wall and Stone pitching on B/S of River Jhelum from SafaKadal to Weir RD 78.80 Km To RD 80.2Km
- Construction of Parrapet walls on Both sides of River Jhelum
- Provision for removal of Electric lines/ water mains/ Drainage Diversions
- Removal of temporary sheds & rehabilitation of displaced owners on account of anticipated damaged during resectioning for increasing capacity.
- Channelization/ Removal of Garbage Dumps of Kut Khul from Div. Commissioners office upto Confluence of River Jhelum
- Channelization of Sunuri Khul/ Removal of Garbage Dumps from Syed Mansoor Bridge to upto Confluence of River Jhelum
- Construction of Cement conc. R/W, Toe wall /RCC jacketing on both sides of Kutkhul at critical reaches after resectioning.
- Construction of Counterfort Type Retaining Walls( RCC) on b/s of Sunuri Khul at Critical Spots
- Protection works on Jhelum from Panzinara to Wular

## Implication of Priority Works- “Comprehensive Plan for Flood Management Works on Jhelum- Phase-I”

- Bank protection work at proposed locations mentioned in chapter 3 of this report can be avoided as it is already in action plan of J&K Government.
- Presence of garbage dumps are main hindrance in navigation. This particular work is also under action plan of J&K Government.
- Provision for removal of Electric lines/ water mains/ Drainage Diversions is also proposed in this report in order to make waterway feasible. However, it is to be noted that this particular job is also listed in “Urgent works” of state government.

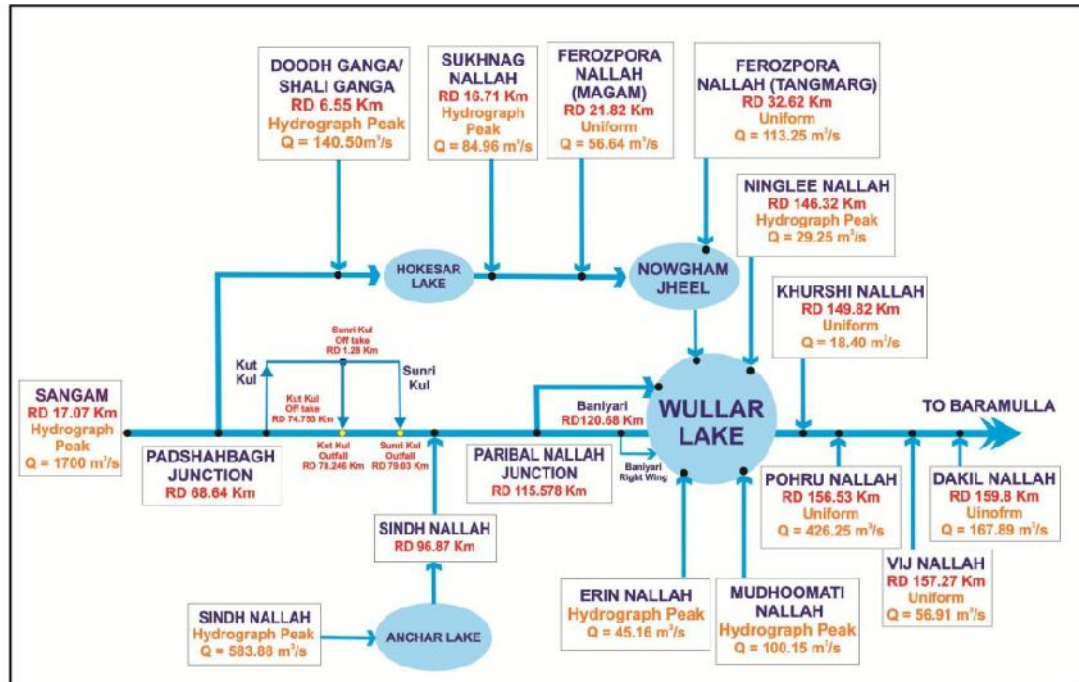
### **10.2 Flood Routing Studies by CWPRS under Phase-1 study**

There was a devastating flood in River Jhelum in September 2014 which resulted in heavy damages to human life and property. It was felt by the State Government that there is an urgent need to address the problem of floods in the valley on long term basis. In this regard the state Government is formulating a comprehensive plan to manage the floods in phases. In phase-I, as an interim measure the state Government has taken up dredging and other related works. In Phase-II, it proposes to implement a comprehensive plan to manage flood of the order of 1700 m<sup>3</sup>/s at Padshabagh. For this purpose, State Government is preparing a DPR for Comprehensive Plan phase-II. In this context **CWPRS has been entrusted with the mathematica lmodel studies for assessing the flood levels. The study to route the flood of 1700 m the existing Jhelum main and FSC has been undertaken with the latest data submitted by the State Government.** The studies were conducted using 1-D unsteady mathematical model for nineteen cases accounting various practically possible alternatives. Provisions such as introducing detention tanks, widening of out Fall Channel (OFC) by 40 m and modifications to FSC in isolation and in combination of cases. Following are the main conclusion drawn based on the studies:

- a) All the bridges across Main Jhelum channel, Flood Spill Channel (FSC) and OFC except bridges at RD 151.25, 167.5, 182 and 201.1 km are safely passing the flood discharge for the Case 11.
- b) For better flood management, it is recommended to target at FSC modification including inside lakes, connecting two detention basins and 40 m widening of OFC from downstream of crude weir to Rd 173.2 Km. The second alternative considered is existing condition with FSC modification as proposed by CWPRS and 40 m widening of OFC from d/s of crude weir to RD. 173.2 km. The third alternative is existing condition with FSC modification as proposed by Project

- Authorities and 40 m widening of OFC from d/s of crude weir to RD. 173.2 km (Optimized reach length of OFC) in order of preference.
- c) The provision of barrage is not recommended as there are no known major flood management benefits accruing due to the construction of the barrage at RD.68.62 km.
  - d) The maximum flood expected to pass through the LJHEP is of the order of 2731.89 m<sup>3</sup>/s for various discharge and channel configurations considered. The project authorities are advised to take note of this and pass the same safely downstream.
  - e) The existing structure at the exit of Wullar Lake is causing about 8 to 25 cm of afflux. Hence, it is recommended to modify the structure by increasing its width by at least another 40 m at the thalweg. If any structure is proposed at the site, the crest level of that structure shall be such that it can induce the head cut in the lake and reduce sedimentation. Water way of the structure should span entire width of the present day river width at the exit except the minimum pier width requirements to support the gates. Before finalizing the design of the structure the same should be tested in the physical model for the above listed requirements.
  - f) Dredging from Sangam to Asham should be prohibited in order to control flood
  - g) The existing embankments must be strengthened and refurbished so that breaches are avoided during the passage of flood.
  - h) The provision of barrage is not recommended as there are no known major flood management benefits accruing due to the construction of the barrage at RD. 68.62km.
  - i) The partly dismantled bridge piers shall be removed from the river till a level of 1.5 m below the lean season river bed. For any new bridges, it is advised to adopt longer span widths so that number of piers obstructing the river flow is minimized. The well/pile caps shall be terminated at lowest level that is practically possible to avoid constriction in the river water way. The afflux generated by any bridge shall not be more than 1% of the normal depth of flow

Schematic Diagram of Jhelum Channels including Existing Lakes and Two Detention Basins is mentioned below:



### Implication of Model Studies on Navigation Project

- Barrage requirement has been proposed in technical analysis report as dredging from sangam to Asham cannot be done in order to route flood safely. However, dredging requirement is mentioned in chapter 3. Keeping, recommendations of CWPRS in mind, Provision of Barrage is must in order to provide hassle free navigation without dredging.
- Dredging in upper reaches should be avoided.
- Modification of all bridges except four bridges after Wullar are proposed in the CWPRS report as none of them are passing flood safely. Also, for navigation purpose maximum bridges are not fulfilling vertical & horizontal clearance. Hence, modification of bridges can be discussed with state government.

### **10.3 Projects under Srinagar Municipal Corporation (SMC)**

The Government of India (GoI) included Jammu and Srinagar for creation of smart cities in June 2017. The planning activities for the same are understood to have started in Srinagar. Smart city development would include extended planning of the

transport network and mobility solutions for residents of Srinagar. Some of the prominent tasks included in the Smart City Project of Srinagar include

- ✓ Development of Metro Rail Network in City
- ✓ Restoration of heritage buildings
- ✓ Beautification of the Jhelum waterfront
- ✓ Dredging the river and removing silt
- ✓ Improvement of the Jhelum ghats
- ✓ Embankments and area illumination along riverbanks
- ✓ Creation of pathways and cycle tracks along Bund Road
- ✓ Water transport terminal for boats and Shikaras
- ✓ Installation of biodigestors/interceptors for managing waste water
- ✓ Eco-Sewage Treatment Plant

- **Impact of Project on NW 49**

The key objectives of the project would boost the tourist and passenger traffic on NW 49. Beautification of the waterfront, improvement of ghats, embankments, area illumination along riverbanks and restoration of heritage buildings would help in attracting large number of tourists around the river. This would eventually increase the tourist traffic on NW 49. Dredging of the river would improve water depth and navigability throughout the year. Under the project, plan of developing water transport terminal for boats and Shikaras would compliment IWAI's plan of developing Terminals on River Jhelum as NW 49.

Development of Metro Rail Network in City would be another advantage, as it would ease the travel experience of tourists and passengers. Tourists/passengers would use metro to reach the Terminal on NW 49. This would improve multi modal transportation in/around Srinagar.

#### **10.4 Projects under Srinagar Development Authority (SDA)**

Srinagar Development Authority has commissioned development of Master Plan for the city of Srinagar. The master plan focuses on smart transportation including development of waterways on River Jhelum and Dal Lake. The water transport is proposed to connect Dal Lake with River Jhelum and make an integrated transportation system for tourists as well as passengers. The interaction with Traffic Advisor, Government of J&K provided following critical inputs.

- ✓ Development of 42 terminals/ghats on the banks of River Jhelum between Pampore to Chattabal (17 kms)
- ✓ Development of 39 terminals/Ghats on Dal Lake
- ✓ The routes for passenger and tourism transportation have been selected based on following infrastructure
- ✓ Proximity of important destinations from River
- ✓ Efforts to connect School colleges, hospitals, offices etc.

The government was anticipating about 20% shift of passenger movement from Road to waterways with development of these infrastructure. They planned to start round the day boating services for passenger/tourist movement. These boats would have a capacity of 25 passengers. There would be 2 types of services, namely slow and express services. The express services would connect only the terminals (large ones). The slow service would connect all the small ghats/terminals. Slow service boats would stop at every alternate terminal and run every 10 mins. These boats would be electric operated.

Some of the most densely populated regions of Srinagar are also located on the banks of River Jhelum. Narrow roads with rising population and vehicles have led to large-scale congestion on the roads of Srinagar. It is difficult to expand these roads due to existence of buildings, offices and historic structures. Hence, water transport as an alternative mode of commuting is being evaluated in Srinagar by Srinagar Development Authority. Approaching the installations of basic needs and tourism importance could be easily accessed using waterways facing less congestion.

- **Impact of Project on NW 49**

This project is complimenting IWAI's development plan of river Jhelum as National Waterway 49. Under the Master Plan, the stretch of river Jhelum, which is identified for development, comes under the stretch of NW 49. Srinagar Development Authority might consult and involve IWAI for the development of waterways on River Jhelum and Dal Lake, as IWAI is undertaking development of inland waterways NW 49 on river Jhelum. Development of Dal Lake would attract more tourists to the region, who would also be interested in taking boat ride on NW 49.

Smart Transportation service would boost passenger traffic on NW 49. Development of waterway would reduce congestion from roads of populated areas of Srinagar, as people would get an alternative mode of transportation, i.e. IWT.

## **10.5 Wular Lake Development Plans**

The Government of Jammu & Kashmir has assigned the job of preparing a Comprehensive Management Action Plan (CMAP) in order to conserve Wular Lake to M/S Wetlands International- South Asia in 2006-07.

The action plan on Wular Lake emphasizes on development of effective institutional mechanism for conservation and management of the Lake within Jhelum Basin. The action plan also emphasizes the requirement of removal of Ningli (willow) plantations spread over an area of 27.30 sq. km. This will enhance water holding capacity and improvement of overall water regimes of Wular. The action plan envisages dredging of an area of 27.72 sq. km. for enhancement of water holding capacity of the lake. To develop tourism, it is proposed to beautify Wular Lake with an "eco-friendly" Boulevard along its periphery at a cost of INR 276.474 Crores in Phase-III. The CMAP proposes development of a comprehensive ecotourism plan with a detailed zoning plan of Wular Lake, surrounding marshes and catchment

areas. The proposed tourist activities are for bird watching, water sports, fish angling etc. It is also proposed to develop tourist infrastructure near the lake.

Some of the prominent components included in Wular Lake Development Plan include

- ✓ Land and Water Management
- ✓ Catchment Conservation
- ✓ Water Management
- ✓ Bio-diversity Conservation
- ✓ Eco-tourism Development
- ✓ Develop river/lake tourism on Wular Lake

- **Impact of Project on NW 49**

This project's positive impact on NW 49 is removal of willow plantations from the Lake, which would improve the inland waterway navigability. Dredging would also improve navigability. Beautification of the Lake and development of a Boulevard would increase tourist flow and would result in growth in tourism traffic on NW 49. However, the Bio-diversity Conservation plan of the Lake might discourage movement of vessels on the Lake.

## **10.6 INTACH Development Plans**

Indian National Trust for Art and Cultural Heritage (INTACH) has plans for restoration of neglected heritage buildings and sites in Srinagar on the bank of River Jhelum. INTACH has already identified heritage zones of Srinagar. Some of the heritage sites are already restored by them and other sites are listed on their future development plans. For instance, fire damaged Khanqah-e- Moula shrine (Shah Hamdan), which is on the bank of Jhelum in Srinagar. It is one of Kashmir's holiest Muslim shrines. INTACH had been charged with reconstruction of the damaged part of the shrine. The restoration of the shrine is complete and it looks beautiful now. Tourists visit the shrine and witness its glory and splendour.

- **Impact of Project on NW 49**

Srinagar is famous for its monuments and shrines. Heritage tourism would get a boost from INTACH's project. The project of restoration of heritage buildings and sites in Srinagar would make the waterfront of river Jhelum more beautiful. This would make the experience of tourists pleasant, as they would be able to enjoy the beauty of these heritages sites while traveling on shikaras/boats on NW 49. It would attract more tourists in and around the river.

## CHAPTER -11 PRELIMINARY ENGINEERING DESIGN

**11.0** This chapter covers the PRELIMINARY ENGINEERING DESIGN of the proposed structures in NW-49 i.e design of pitching & Terminals.

### 11.1 Design of Pitching for the protection of Terminal

Design Discharge Q = 3260 cumecs

Av. Width = 114 m

HFL = 1584.90

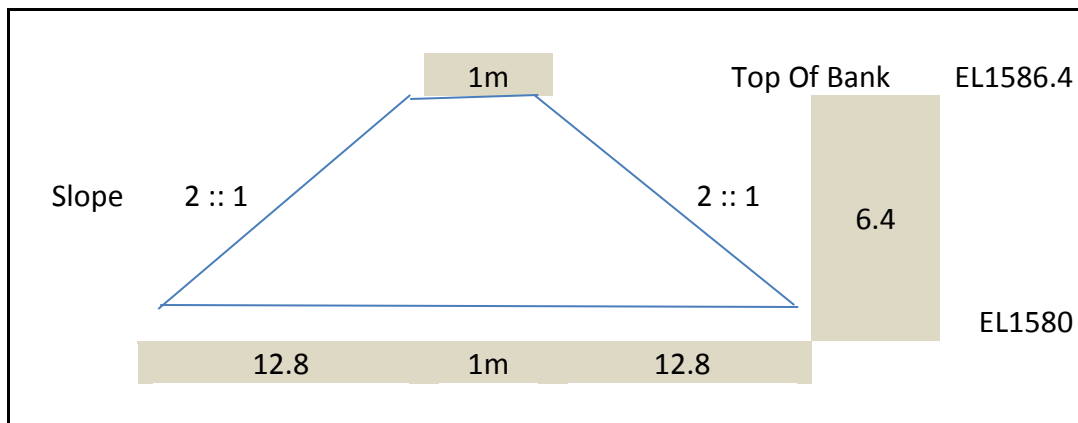
Bed Level = 1580.0

Tap of Bank = HFL + FB  
 = 1584.90 + 1.5 m  
 = 1586.40 m

Height of Bank = 1586.40 – 1580.0  
 = 6.4 m

Assume Bank width = 1 m

Side slope = 2:1



Thickness of Pitching =  $.06 Q^{1/3}$   
=  $.06 (3260)^{1/3}$   
= 0.89 m  
= Provided 1 m

Thickness of Apron = 1.9 T  
= 1.9 x 1m = 1.9 m

Length of Apron =  $R = 0.47 \left(\frac{Q}{f}\right)^{1/3}$

Assume to size of particle = 0.2 m

f =  $0.8 (f = 1.76 (\text{size of particle})^{1/2})$

R =  $0.47 \left(\frac{3260}{0.8}\right)^{1/3}$   
= 7.5 m  
= Say 8 m

D = 1.5 R – Y

Where Y = Depth of water  
= HFL – Bed Level  
= 1584.90 – 1580  
= 4.90 m  
= 1.25 x 8 - 4.9  
= 10 – 4.9  
= 5.1

Length of Apron = 1.5 D

$$\begin{aligned} &= 1.5 \times 5.1 \\ &= 7.55 \\ &= \text{say provided } 10 \text{ m} \end{aligned}$$

For Cost

$$\begin{aligned} \text{Slanting height} &= \sqrt{12.8^2 + 6.4^2} \\ &= 14.30 \text{ m} \\ \text{Quantity of stone} &= \text{on sloping surface} + \text{on apron} \\ \text{Length of Pitching} &= 100 \text{ m} \\ \text{Quantity of stones} &= 100 (14.3 \times 1 + 10 \times 1.9) \\ 100 \text{ m} &= 100 (14.3 + 19) \\ &= 3330 \text{ cum} \\ \text{Earth filling} &= \text{Av.B} = 1 + 26.6 = \frac{27.6}{2} \\ &= 13.8 \text{ m} \\ \text{Total volume} &= 13.8 \times 6.4 \times 100 \\ &= 88.32 \times 100 \\ \text{Compaction} &= 8832 \text{ cum} \end{aligned}$$

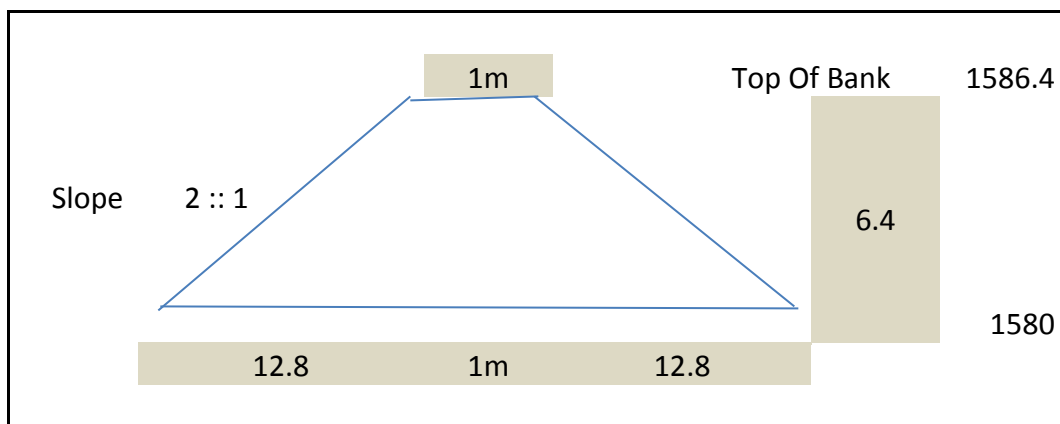
Detailed drawings is shown in **Dwg No.: WAP-JLM-BR-01**

## 11.2 Design of Pitching

### Terminal at Chainage (115 Km)

$$\begin{aligned} \text{Design Discharge } Q &= 3260 \text{ cumecs} \\ \text{Av. Width} &= 114 \text{ m} \\ \text{HFL} &= 1584.90 \end{aligned}$$

Bed Level	=	1580.0
Tap of Bank	=	HFL + FB
	=	1584.90 + 1.5 m
	=	1586.40 m
Height of Bank	=	1586.40 – 1580.0
	=	6.4 m
Assume Bank width	=	1 m
Side slope	=	2:1



Thickness of Pitching	=	$.06 R^{1/3}$
	=	$.06 (3260)^{1/3}$
	=	0.89 m
	=	Provided 1 m
Thickness of Apron	=	1.9 T
	=	1.9 x 1m = 1.9 m
Length of Apron	=	$R = 0.47 \left(\frac{Q}{F}\right)^{1/3}$

---

Assume to size of particle = 0.2 m

f = 0.8

R =  $0.47 \left( \frac{3260}{0.8} \right)^{1/3}$

= 7.5 m

= Say 8 m

D = 1.5 R – Y

Where Y = Depth of water

= HFL – Bed Level

1584.90 – 1580

= 4.90 m

= 1.25 x 8 -4.9

= 10 – 4.9

= 5.1

Length of Apron = 1.5 D

= 1.5 x 5.1

= 7.55

= say provided 10 m

For Cost

Starting height =  $\sqrt{12.8^2 + 6.4^2}$

= 14.30 m

Quantity of stone = on scoping surface to apron

---

Length of Pitching	=	100 (14.3 x 1 + 10 x 1.9)
100 m	=	100 (14.3 + 19)
	=	3330 cum
Earth filling	=	Av.B = $1 + 26.6 = \frac{27.6}{2}$
	=	13.8 m
Total volume	=	13.8 x 6.4 x 100 <sup>m</sup>
	=	88.32 x 100
Compaction	=	8832 cum

Detailed drawings is shown in **Dwg No.: WAP-JLM-BP-01**

### 11.3 Design of Terminals

Total 9 nos. of terminal have been identified. However, terminals will be developed phase wise.

**Table 11.1 Design of Terminals**

Sr. No.	Tentative Location	Districts	Size	Type	HFL (m)	Land Mark	Chainage (km)	Lat-Long
1	Sangam Bridge	Anantnag	60m x 10m	Concrete	1595.00	Sangam Bridge	179.60	33°49'47.79"N, 75° 4'10.83"E
2	Pantha Chowk	Srinagar	50m x 5 m	Floating	1587.00	Lasjan Bridge	133.20	34° 2'25.01"N, 74°52'22.02"E
3	Zero Bridge	Srinagar	50m x 5 m	Floating	1587.36	Zero Bridge	122.36	34° 4'9.41"N, 74°49'46.56"E
4	Amira Kadal	Srinagar	50m x 5 m	Floating	1586.56	MA Kadal Bridge	121.07	34° 4'14.54"N, 74°48'26.15"E
5	Shah-e-Hambam bridge	Srinagar	50m x 5 m	Floating	1585.58	New Zaina Bridge	117.91	34° 5'29.00"N, 74°48'26.80"E
6	Safa Kadal / Chattabal Shrine	Srinagar	50m x 5m	Floating	1584.91	Chattabal Weir	115.76	34° 5'25.81"N, 74°47'19.43"E
7	Sumbal Bridge	Ganderbal	50m x 5 m	Floating	1582.48	Sumbal Bridge	91.90	34°13'41.06"N, 74°39'4.79"E
8	Gund Parang	Bandipora	60m x 10m	Concrete	1581.18	Hajin Bridge (5.7 km d/s)	74.42	34°20'40.10"N, 74°37'51.20"E
9	Sopore	Baramulla	50m x 5 m	Floating	1580.29	Sopore Bridge	39.55	34°16'55.24"N, 74°28'18.51"E

**Table 11.2 Terminals Chainage**

Sr. No	Phase	Terminal
1	Phase-1	Pantha Chowk (Ch. 133.20) Zero Bridge (Ch. 122.36) Amira Kadal (Ch. 121.07) Shah-e-Hambam bridge (Ch. 117.91) Safa Kadal / Chattabal Shrine (Ch. 115.76)
2	Phase-2	Sangam Bridge (Ch. 179.60) Sumbal Bridge(Ch.91.90) Gund Parang(Ch. 74.42)
3	Phase-3	Sopore (Ch. 39.55)

**Table 11.3 Details of Type of jetty**

Sr. No	Phase	Type of Jetty
1	Phase-1	Pantha Chowk (Floating) Zero Bridge (Floating) Amira Kadal (Floating) Shah-e-Hambam bridge (Floating) <b>Safa Kadal / Chattabal Shrine (Floating)</b>
2	Phase-2	<b>Sangam Bridge (Concrete)</b> Sumbal Bridge(Floating) <b>Gund Parang(Floating)</b>
3	Phase-3	<b>Sopore (Concrete)</b>

Detailed drawings is shown in **Dwg No.: WAP-JLM-TML-01 to Dwg No.: WAP-JLM-TML-05**

**Salient Features of Jetty:**

**PHASE-1:**

**Terminal 1 (Pantha Chowk), Terminal 2 (Zero Bridge), Terminal 3 (Amira Kadal), Terminal 4 (Amira Kadal) & Terminal 5 (Chattabal Shrine) :**

Since permanent construction is not viable at Zero Bridge, floating Jetty is proposed under the project, for embarking & dis-embarking of passengers. To cater to the berthing requirements for easy embarkation/disembarkation to the taxi, a floating jetty of 50 m x 5 m is considered suitable. The floating jetty shall be used to facilitate embarking/disembarking of passengers between the terminal and water taxi. It will

have sufficient space for accommodating passengers along with their luggage. The floating jetty will have appropriate arrangement to cater to the mooring requirements of the water taxi. The appearance of the jetty will be good and shall have superior finish as per international standards.

Floating jetties to be supplied shall meet the following broad technical specifications:

Sr. No.	Particulars	Details
<b>A.</b>	<b>JETTY</b>	
1.	Size	50m. x 5m.
2.	Max. loaded Draft	1.7 m.
3.	Minimum Free Board	0.5 m. for loading of 2 KM/m <sup>2</sup> on total deck area of 120 sq. m.
4.	Load Capacity	Deck designed for UDL of 3 KN/m <sup>2</sup> or concentrated load of 4.5 KN over an area of 0.3m x 0.3m.
5.	Material for construction of module/block	Concrete
8.	Deck/Top Cover	Concrete
9.	Minimum Reserve Buoyancy	25% under design loading conditions
10.	Frames	Aluminum Alloy Grade – 6082 T5/T6 marine grade or equivalent
12.	Working Life	50 years or more
15.	Handrails	Fabricated out of Stainless Steel, 750 mm high. Reflective stickers to be provided on all the four sides.

### Mooring arrangements

Eight bollards, on the berthing side for water taxi will be fixed for the safe mooring of the water taxi.

### Fenders

Protective fenders shall be provided on berthing side to prevent damage at the interface area.

### Approach trestle/ gangway

The gangway proposed is floating type with all the specifications, including material of construction, similar to Para - 2.1.

The broad dimensions are tabulated below: -

**Table 11.4: Broad Dimensions**

Length Over All	10.00 m
Breadth Over All	2.00 m
Draft not more than	1.2 m
Free board minimum	0.50 m for loading

Terminal layout is shown in **Dwg No.: WAP-JLM-TL-01 to Dwg No.: WAP-JLM-TL-05.**

## PHASE-2:

### Terminal 6 (Sumbal):

Since permanent construction is not viable at **Sumbal** , floating Jetty is proposed under the project, for embarking & dis-embarking of passengers. To cater to the berthing requirements for easy embarkation/disembarkation to the taxi, a floating jetty of 50 m x 5 m is considered suitable. The floating jetty shall be used to facilitate embarking/disembarking of passengers between the terminal and water taxi. It will have sufficient space for accommodating passengers along with their luggage. The floating jetty will have appropriate arrangement to cater to the mooring requirements of the water taxi. The appearance of the jetty will be good and shall have superior finish as per international standards.

Floating jetties to be supplied shall meet the following broad technical specifications:

Sr. No.	Particulars	Details
<b>A.</b>	<b>JETTY</b>	
1.	Size	50m. x 5m.
2.	Max. loaded Draft	1.7 m.
3.	Minimum Free Board	0.5 m. for loading of 2 KM/m <sup>2</sup> on total deck area of 120 sq. m.

Sr. No.	Particulars	Details
4.	Load Capacity	Deck designed for UDL of 3 KN/m <sup>2</sup> or concentrated load of 4.5 KN over an area of 0.3m x 0.3m.
5.	Material for construction of module/block	Concrete
8.	Deck/Top Cover	Concrete
9.	Minimum Reserve Buoyancy	25% under design loading conditions
10.	Frames	Aluminum Alloy Grade – 6082 T5/T6 marine grade or equivalent
12.	Working Life	50 years or more
15.	Handrails	Fabricated out of Stainless Steel, 750 mm high. Reflective stickers to be provided on all the four sides.

### Mooring arrangements

Eight bollards, on the berthing side for water taxi will be fixed for the safe mooring of the water taxi.

### Fenders

Protective fenders shall be provided on berthing side to prevent damage at the interface area.

### Approach trestle/ gangway

The gangway proposed is floating type with all the specifications, including material of construction, similar to Para - 2.1.

The broad dimensions are tabulated below: -

Length Over All	10.00 m
Breadth Over All	2.00 m
Draft not more than	1.2 m
Free board minimum	0.50 m for loading of 2kN/m <sup>2</sup>

### Terminal 7 (Gund Parang):

The proposed jetty is required to handle Self-propelled, carrying capacity 100 DWT, Size **(32m X 5m)**, Loaded draft 1.0m (Class-I). The jetty is planned as a berthing structure proposed to be on piles, which provide least resistance to natural equilibrium and ease of extension/addition of facilities at a later date. The berthing structure is of length 60m and width 10m.

Plan, elevation & cross-section of proposed jetty is shown in **Dwg No.: WAP-JLM-MJ-01 to Dwg No.: WAP-JLM-TL-03**

The deck level of jetty is w.r.t MSL. The thickness of the deck slab of jetty is 0.45 m. The slab at deck level is supported on Cross beams of 0.65m x 0.65 m in the lateral direction, secondary beams of 0.65 m x 0.65m in the longitudinal direction. The Cross beams rest on the pile caps/ pile muffs (250mm) which in turn support the longitudinal beams. The 650 mm diameter bored cast in situ piles with 6mm thick liner are fixed to the pile caps at the top and fixed into the ground at the bottom. The plan and cross section of jetty is shown as **Dwg No.: WAP-JLM-MJ-01 to Dwg No.: WAP-JLM-TL-03**. The important design levels taken into consideration are discussed as follows:

**Table 11.5 Design Parameters (Gund Parang)**

Top Level of Jetty (Deck slab)	1582.68
Top level of Piles	1581.33
Diameter of piles (D)	0.65m
Unit wt. of RCC	25.0 KN/m <sup>3</sup>
Unit wt. of sea water	10.0 KN/m <sup>3</sup>
Unit wt. of Steel	78.50 KN/m <sup>3</sup>
Founding Level of Piles	-15.00 m below bed Level

### Terminal 8 (Sangam):

The proposed jetty is required to handle Self-propelled, carrying capacity 100 DWT, Size **(32m X 5m)**, Loaded draft 1.0m (Class-I). The jetty is planned as a berthing structure proposed to be on piles, which provide least resistance to natural equilibrium and ease of extension/addition of facilities at a later date. The berthing structure is of length 60m and width 10m.

Plan, elevation & cross-section of proposed jetty is shown in **Dwg No.: WAP-JLM-MJ-01 to Dwg No.: WAP-JLM-TL-03.**

The deck level of jetty is w.r.t MSL. The thickness of the deck slab of jetty is 0.45 m. The slab at deck level is supported on Cross beams of 0.65m x 0.65 m in the lateral direction, secondary beams of 0.65 m x 0.65m in the longitudinal direction. The Cross beams rest on the pile caps/ pile muffs (250mm) which in turn support the longitudinal beams. The 650 mm diameter bored cast in situ piles with 6mm thick liner are fixed to the pile caps at the top and fixed into the ground at the bottom. The plan and cross section of jetty is shown as **Dwg No.: WAP-JLM-MJ-01 to Dwg No.: WAP-JLM-TL-03.** The important design levels taken into consideration are discussed as follows:

**Table 11.6 Design Parameters (Sangam)**

Top Level of Jetty (Deck slab)	1596.50 m
Top level of Piles	1595.15m
Diameter of piles (D)	0.65m
Unit wt. of RCC	25.0 KN/m <sup>3</sup>
Unit wt. of sea water	10.0 KN/m <sup>3</sup>
Unit wt. of Steel	78.50 KN/m <sup>3</sup>
Founding Level of Piles	-15.00 m below bed Level

### PHASE-3:

#### Terminal 9 (Sopore):

Since permanent construction is not viable at **Sopore** , floating Jetty is proposed under the project, for embarking & dis-embarking of passengers. To cater to the berthing requirements for easy embarkation/disembarkation to the taxi, a floating jetty of 50 m x 5 m is considered suitable. The floating jetty shall be used to facilitate embarking/disembarking of passengers between the terminal and water taxi. It will have sufficient space for accommodating passengers along with their luggage. The floating jetty will have appropriate arrangement to cater to the mooring requirements of the water taxi. The appearance of the jetty will be good and shall have superior finish as per international standards.

Floating jetties to be supplied shall meet the following broad technical specifications:

Sr. No.	Particulars	Details
<b>A.</b>	<b>JETTY</b>	
1.	Size	50m. x 5m.
2.	Max. loaded Draft	1.7 m.
3.	Minimum Free Board	0.5 m. for loading of 2 KM/m <sup>2</sup> on total deck area of 120 sq. m.
4.	Load Capacity	Deck designed for UDL of 3 KN/m <sup>2</sup> or concentrated load of 4.5 KN over an area of 0.3m x 0.3m.
5.	Material for construction of module/block	Concrete
8.	Deck/Top Cover	Concrete
9.	Minimum Reserve Buoyancy	25% under design loading conditions
10.	Frames	Aluminum Alloy Grade – 6082 T5/T6 marine grade or equivalent
12.	Working Life	50 years or more
15.	Handrails	Fabricated out of Stainless Steel, 750 mm high. Reflective stickers to be provided on all the four sides.

### Mooring arrangements

Eight bollards, on the berthing side for water taxi will be fixed for the safe mooring of the water taxi.

### Fenders

Protective fenders shall be provided on berthing side to prevent damage at the interface area.

### Approach trestle/ gangway

The gangway proposed is floating type with all the specifications, including material of construction, similar to Para - 2.1.

The broad dimensions are tabulated below: -

Length Over All	10.00 m
Breadth Over All	2.00 m
Draft not more than	1.2 m
Free board minimum	0.50 m for loading of 2kN/m <sup>2</sup>

## 11.4 Design of Terminals

### Structural System of Berthing Jetty

The proposed jetty is required to handle Self-propelled, carrying capacity 100 DWT, Size **(32m X 5m)**, Loaded draft 1.0m (Class-I). The jetty is planned as a berthing structure proposed to be on piles, which provide least resistance to natural equilibrium and ease of extension/addition of facilities at a later date. The berthing structure is of length 60m and width 10m.

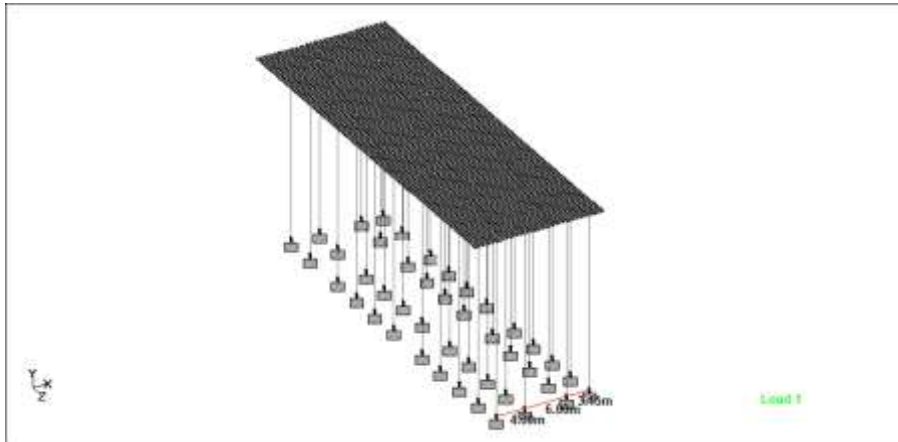
Plan, elevation & cross-section of proposed jetty is shown in **Dwg No.: WAP-JLM-MJ-01 to Dwg No.: WAP-JLM-TL-03**

The deck level of jetty is w.r.t MSL. The thickness of the deck slab of jetty is 0.45 m. The slab at deck level is supported on Cross beams of 0.65m x 0.65 m in the lateral direction, secondary beams of 0.65 m x 0.65m in the longitudinal direction. The Cross beams rest on the pile caps/ pile muffs (250mm) which in turn support the longitudinal beams. The 650 mm diameter bored cast in situ piles with 6mm thick liner are fixed to the pile caps at the top and fixed into the ground at the bottom. The plan and cross section of jetty is shown as **Dwg No.: WAP-JLM-MJ-01 to Dwg No.: WAP-JLM-TL-03**. The important design levels taken into consideration are discussed as follows:

### Analysis of Jetty

#### STAAD Pro Modeling

The dimension of the jetty is 60m x 10m. The analysis of the structure has been performed in STAAD Pro 2007 as shown in **Fig. 11.1**. In the model the piles are assumed to be fixed at base. The pile length used in analysis is based on fixity length i.e 15m. The cut off level of piles is 1587.15m.



**Fig. 11.1: STAAD Panel of the Jetty**

### **Design Loads and Load Combinations**

The jetty, approach and bay have been designed considering the following loads:

#### **A. Vertical Loads**

- a) Dead Load
- b) Live Loads
  - i) Uniform loading
  - ii) Truck loading (IRC Class)

#### **B. Horizontal Loads**

- c) Berthing load
- d) Mooring load
- e) Wind load
- f) Current load
- g) Seismic load

#### **C. Combination of above**

The loading has been considered taking into account the guidelines of IS 4651 (Part III): 1974, IRC 6:2000, IS 1893: 2002 (Part 1), IS 875 : 1987 (Part 1 and Part 3). UFC 4-152-01 2005.

#### **(a) Dead Load**

The dead load consists of the weight of the entire structure, including all the permanent attachments such as mooring hardware, light poles, utility booms, brows, platforms, vaults, sheds, and service utility lines. A realistic assessment of all present and future attachments has been made and included. Overestimation of dead loads generally will not adversely affect the cost of the structure. However, overestimation of dead loads would not be conservative for tension or uplift controlled design. Standard unit weights have been used to calculate dead loads. Dead load of the structure can be applied on STAAD MODEL.

**Table 11.7 Dead Weight of Slab**

Component	Depth of Slab (mm)	Unit Weight (KN/m <sup>3</sup> )	Load (KN/m <sup>2</sup> )
Jetty	450	25	11.25

### Dead weight of Rails

#### (b) Live Loads

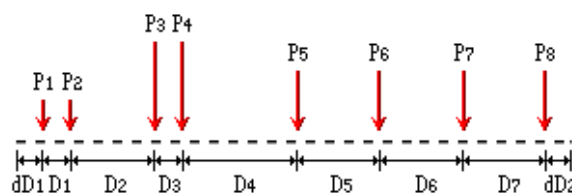
##### Uniform Live Loads

- (i) 30 KN/m<sup>2</sup> (As per IS 4561: part-3, Page-5, Cl. 5.1.2)
- (ii) 38KN/m<sup>2</sup> (As per UFC 4-152-01 2005, Page-54, Cl. 3-3.2, Table-3-2)

Critical Load is 38KN/m<sup>2</sup>

### Truck Loading

IRC Class A truck load has been applied as moving load. The load specification of IRC Class A train of vehicles (with impact factor) is given as under:



$P_1 = 27 \text{ KN}$	$dD_1 = 0.5 \text{ m}$
-----------------------	------------------------

P <sub>2</sub> =27 KN	D <sub>1</sub> = 1.1 m
P <sub>3</sub> = 114 KN	D <sub>2</sub> = 3.2 m
P <sub>4</sub> = 114 KN	D <sub>3</sub> = 1.2 m
P <sub>5</sub> =68 KN	D <sub>4</sub> = 4.3 m
P <sub>6</sub> =68 KN	D <sub>5</sub> = 3.0 m
P <sub>7</sub> =68 KN	D <sub>6</sub> = 3.0 m
P <sub>8</sub> =68 KN	D <sub>7</sub> = 3.0 m

**(c) Berthing Force**

Berthing force is calculated for Self-propelled, carrying capacity 100 DWT, Size (32m X 5m), loaded draft 1.0m. The actual kinetic energy E absorbed by the fender system is calculated as per the following

$E_{\text{fender}}$  = Energy to be absorbed by the fender system

$$E_{\text{fender}} = M_D V_b^2 (C_m C_e C_s C_c) / 2$$

Where:

$W_D$	Displacement Tonnage (DT) of the vessel, (t)
$V_b$	Velocity of vessel in m/s, normal to the berth
$C_m$	Mass coefficient
$C_e$	Eccentricity coefficient
$C_s$	Softness coefficient
$C_c$	Configurational Coefficient

**(d) Mooring Force**

This force is taken according to IS-4561- 1974-Part-III,

**(i) Mooring force due to wind**

**Mooring Force due to wind:  $F_w = C_w A_w P$**

$C_w$ = Shape Factor

$$A_w = \text{Windage Area in sqm} = 1.175 * L_p (D_m - D_L)$$

$$P = \text{Wind Speed pressure in N/sqm} = 0.6 V_z^2$$

$V_z = V_b * k_1 * k_2 * k_3$ , where the  $k_1$ ,  $k_2$  and  $k_3$  are probability factor and terrain height and structure size factor and Topography factor respectively. Values of coefficients are taken from IS-875-Part-III,

$$k_1 = 1.06$$

$$k_2 = 1.05$$

$$k_3 = 1.00$$

- The wind speed is considered as 39m/s for Srinagar (IS - 875-III Part 3 1987, cl-5.4 & pg-9)
- Shape Factor  $C_w=1.5$  is taken for calculation of Mooring force due to wind.

Calculation summery of mooring force is given below

$$A_w = 1.175 * L_p (D_m - D_L)$$

$$= 167.49 \text{ m}^2$$

$$P = 0.6 V_z^2 = 0.6 * (50 * 1.06 * 1.05 * 1)^2$$

$$= 1130.50 \text{ N/m}^2$$

$$F_w = 43 \text{ KN}$$

As per IS : 4651( Part III ) – 1974 When the ships are berthed on both sides of a pier, the total wind force acting on the pier, should be increased by 50 percent to allow for wind against the second ship.

$$\text{Accordingly, } F_w = 1.5 * 43 = 64.5 \text{ KN}$$

## (ii) Mooring force due to current

$$\text{Mooring force due to current: } F_c = L_{pp} D_r P_c$$

$F_c$  = Mooring Force due to current in kg

$L_{pp}$  = Length between the perpendiculars in m

$D_r$  = Loaded draft of vessel in m

$P_c$  = Pressure due to current in kg/sq.m

The current velocity is assumed as **1.07 m/s** based on survey provided by IWAI

$$\begin{aligned} F_c &= L_{pp} * D_r * P_c \\ &= 4.7 \text{ T} \end{aligned}$$

Assuming that the mooring force due to current and wind act simultaneously in the same direction.

$$\begin{aligned} \text{Total Mooring Force } (F_T) &= F_w + F_c \\ &= 64.7 \text{ t} \end{aligned}$$

Considering at least 4 nos. of bollards per vessel, mooring force at each pile,

$$F_T = 64.7/4 = 16.17 \text{ t} \quad \text{Say } 17 \text{ t}$$

Details of above calculation is shown in **Annexure 6.2**

#### (e) Wind Load

The wind loads on the structure has been considered as per IS 875:Part3. The basic wind speed for Surat is 39 m /sec. Design Wind Speed can be obtained by the following formula:

$$\text{Design Wind Speed } V_z = K_1 * K_2 * K_3 * V_b$$

Where,

$K_1$ , Risk Coefficient as 1.06

$K_2$ , Terrain (Category 1), Height (10m) and structure size factor (class A) as 1.05

$K_3$ , Topography Factor as 1.0

Accordingly, the design wind pressure,  $p_z = 0.6 V_z^2$

$$\begin{aligned} p_z &= 0.6 V_z^2 = 0.6 * (39 * 1.06 * 1.05 * 1)^2 \\ &= 1130.50 \text{ N/m}^2 \end{aligned}$$

#### (f) Current Force

The current force is given by  $\gamma V^2/2g$

$$\begin{aligned}\text{Where } \gamma &= \text{Unit weight at water} = 1.00 \text{ t/m}^3 \\ V &= \text{Current velocity} = 1.07 \text{ m/sec.} \\ F_c &= \gamma V^2/2g \\ &= 1.00 * 1.07^2 / (2 * 9.81) \\ &= 0.059 \text{ t}\end{aligned}$$

**(g) Seismic Force**

The seismic force has been calculated as per IS-1893-2002. The design horizontal seismic coefficient  $A_h$  for a structure shall be determined by the following expression:

$$A_h = (Z/2) * (I/R) * (S_a/g)$$

Where,

**Z** = Zone factor given in Table 2, IS-1893-2002. Z at the site has been adopted as 0.24 corresponding to Zone III. Map showing the seismic zone from IS 1893-part – I, **Jammu & Kashmir** falls in Zone – IV.

**I** = Importance factor = 1.5 has been used.

**R** = Response reduction factor has been taken as 3.0 for RCC Structures as per Table 7 of IS-1893-2002.

**S<sub>a</sub>/g** = Average response acceleration coefficient has been taken as 1.4 as per Figure 2 of IS-1893 (Part 1):2002 corresponding to  $(T=0.075h^{0.75})$  refer page 24 IS-1893-2002. The earthquake force has been applied in X as well main as Z directions.  $(T=0.075 \times 10^{0.75} = 0.42 \text{ Seconds})$ . Computed **(S<sub>a</sub>/g=2.25)**

**(h) Load Combinations as per IS 4651 Part IV 2007**

Method of Design: The Berth and its structural components have been designed as per Limit State Method. The partial safety factors for loads in limit state design method has been used. Accordingly, following load combinations have been considered as per IS: 4651-2007 (Draft copy)

**Limit state of serviceability**

1.0(DL+LL)

1.0(DL+LL+BF-S)

1.0(DL+LL+BF-(L)

1.0(DL+LL+MF-S)

1.0(DL+LL+MF-L)

1.0(DL+LL+SFX)

1.0(DL+LL+SF-X)

**Limit state of collapsibility**

1.2(DL+LL)+(CLX)

1.2(DL+LL)+(CL-X)

1.5(DL+LL+BF-S)+1.0CLX

1.5(DL+LL+BF-L)+1.0CLX

1.5(DL+LL+BF-S)+1.0CL-X

1.5(DL+LL+BF-L)+1.0CL-X

1.5(DL+LL+MF-S)+1.0CLX

1.5(DL+LL+MF-L)+1.0CLX

1.5(DL+LL+MF-S)+1.0CL-X

1.5(DL+LL+MF-L)+1.0CL-X

1.2(DL+LL)+1.0CLX

1.2(DL+LL)+1.0CL-X

1.2(DL+LL)+1.0CLX+1.5SFX

1.2(DL+LL)+1.0CL-X+1.5SFX

1.2(DL+LL)+1.0CLX+1.5SF-X

1.2(DL+LL)+1.0CL-X+1.5SF-X

1.2(DL+LL)+1.0CLX+1.5SFZ  
1.2(DL+LL)+1.0CL-X+1.5SFZ  
1.2(DL+LL)+1.0CLX+1.5SF-Z  
1.2(DL+LL)+1.0CL-X+1.5SF-Z  
1.2(DL+LL)+1.5SWLX+1.0CLX  
1.2(DL+LL)+1.5SWLX+1.0CL-X  
1.2(DL+LL)+1.5SWL-X+1.0CLX  
1.2(DL+LL)+1.5SWL-X+1.0CL-X  
1.2(DL+LL)+1.5SWLZ+1.0CLX  
1.2(DL+LL)+1.5SWLZ+1.0CL-X  
1.2(DL+LL)+1.5SWL-Z+1.0CLX  
1.2(DL+LL)+1.5SWL-Z+1.0CL-X  
DL – Dead Load  
LL – Live Load  
MF-S – Mooring Force Sea Side  
MF-L – Mooring Force Lee Side  
BF-S – Berthing Force Sea Side  
BF-L – Berthing Force Lee Side  
SF – Earthquake load  
CL-Current Load  
WL-Wind Load

### **Design of jetty**

The governing STAAD Results for Longitudinal Beams, Cross Beams, and columns have been summarized as below:

## 11.5 Detailed Engineering

Table 11.8 Critical Forces in structural members of jetty

Beams	Design Moment (KNm)	Shear (KN)	
	1561	2100	
Piles	P (KN)	$M_{ux}$ (KNm)	$M_{uy}$ (KNm)
	810	1310	21
Slab	Design Moment (KNm)		
	320		

Details are shown in **Dwg. no. WAP-JLM-MJ-01 to Dwg. no. WAP-JLM-MJ-03**

## CHAPTER – 12 IMPLEMENTATION SCHEDULE

### 12.1 Time Frame

Time scheduling is the assigning of start dates and completion dates to the various activities that take place in project implementation. The important points to be noted to schedule the time are:

- The earliest time that an activity can start
- The latest time that an activity may be completed without delaying the project completion
- The leeway or float or degree of freedom available in scheduling an activity
- The resultant critical path

Before scheduling time of a project with different activities of work, following facts have been considered.

- Determination the parts or implementation phases of the project and the sequence in which the associated activities shall be carried out
- Then estimate the amount of time required for each activity
- List the activities that can be carried out at the same time and identify those to be carried out sequentially

Total time of the project completion is as follows:

Phase-1: 1.5 Years

Phase-2: 2.0 Years

Phase-3: 2.0 Years

### 12.2 Phasing:

Phasing of activities has been done keeping importance of the event in project completion. However, ultimate aim was stick to early completion of project.

**Construction of terminals & ancillary structures at following locations.**

Sr.No	Phase	Stretch	Length of Waterway	Class of Waterway
1	Phase-1	Chhatabal to Pantha Chowk	17.44 Km	Special Class

Sr.No	Phase	Stretch	Length of Waterway	Class of Waterway
2	Phase-2	Gund Parang to Sumbal	17.48 Km	Class-1
	Phase-2	Sumbal to Chhatabal	23.86 Km	Class-1
	Phase-2	Shah-E-Hambam to Sangam Bridge	61.69 Km	Class-1
3	Phase-3	Sopore to Chhatabal	76.21 km	Class-1

### Phase 3: Fairway Development (Dredging, Port Crafts & Navigational Aids)

Activity 1: Dredging-Phase wise

Activity 2: Purchase & instalment of navigational aids

Sequence of all activities is shown in time schedule

#### Progress Flow Chart

The setting / curing time for concrete has been taken as 6 days. Monsoon time of 60 days & other delay of 120 days has already considered for total time calculation. The slow rate of work during monsoon has also been considered in the PERT chart.

### 12.3 Suggested Implementation Mechanism

If availability of funds with IWAI to implement e-governance initiatives is limited, IWAI can go for PPP models to implement these projects. PPP initiatives not only save the costs but also inject the much needed private sector efficiency in the government sector domain. While there is a need to create PPP deals, these need to be structured to ensure a win – win for all the stakeholders.

In the new regime, standard norms are prescribed for determining the investment and operational efficiency of the project. Target revenue is then calculated as the sum of operating cost, depreciation and an allowable return on capital employed. Target revenue is then categorized into revenue from various services based on estimated demand for each service. These ceiling tariffs are indexed to WPI and escalated year on year, there by removing the effects of varying demand on tariffs (as used to happen in the previous regime during tariff revisions).

#### Contractual Framework of PPP projects

- All intentions need to be set out in a contract
- Concession Agreement - bundle of rights & obligations and consequences in case of non-fulfilment
- Usually the only tangible security available
- Contracting parties : Government Agency – Concessioneing Authority and Private Party – Concessionaire
- Other parties – state government, Lenders, Suppliers of services

- A concession is a license – rights enjoyed for obligations performed

#### **Issues**

- Striking a balance between differing concerns & objectives of parties
- Legislative Back up
- Rights and obligations of parties
- Identification and allocation of risks
- Penalties and rewards which would ensure performance

In case fund is not available with IWAI, **DBFOT model** is the best model for implementation of the project as a whole.

#### **Design Phase**

The Independent Engineer shall review the Designs and Drawings submitted by the Concessionaire and provide its comments/observations and suggestions on the same within 21 (twenty one) Days from the date of the receipt of such Designs and Drawings.

In the event that the Independent Engineer has observed that the Designs and Drawings are not in conformity with the Project Requirements, the Concessionaire shall promptly and without any undue delay revise and resubmit the Designs and Drawings or satisfy the Independent Engineer with regards its compliance.

If the Independent Engineer does not make any observation/comments with respect to the Designs and Drawings submitted to it by the Concessionaire within 21 (twenty one) Days of the submission, it shall be deemed that the Independent Engineer has no suggestions to make with respect to the Designs and Drawings and the Concessionaire shall be entitled to proceed with the Project accordingly.

The Concessionaire shall not be entitled to any extension of time for completing construction or any other relief on account of delay caused due to providing any clarification or in resubmitting the Designs and Drawings. Provided however the Concessioning Authority at its sole discretion may suitably extend the Construction Phase or provide other relief to compensate for any such delay not attributable to the Concessionaire.

Notwithstanding the review by the Independent Engineer, the Concessionaire shall be solely responsible for any defect and/or deficiency in the Designs and Drawings relating to the Project or any part thereof and accordingly the Concessionaire shall at all times remain responsible for its obligations under this Agreement.

Any review of the Designs and Drawings conducted by the Concessing Authority is solely for the Concessing Authority's own information and that by conducting such review, the Concessing Authority does not accept any responsibility for the same.

The Concessionaire shall in no way represent to any Person that, as a result of any review by the Independent Engineer, the Concessing Authority has accepted responsibility for the engineering or soundness of any work relating to the Project/ the Project Facilities and Services or part thereof carried out by the Concessionaire and the Concessionaire shall, in accordance with the provisions of this Agreement, be solely responsible for the technical feasibility, operational capability and reliability of the Project/ the Project Facilities and Services or any part thereof.

### **12.3.1 Construction Phase**

The Concessionaire shall promptly commence and complete the works, including installation of equipment in accordance with the Project Schedule and shall also obtain from the Independent Engineer a certificate as to completion of construction of Project Facilities and Services

During the Construction Phase, the Concessionaire shall:

- Arrange for, in a timely manner all necessary financial and other resources required for construction and installation of the Project Facilities and Services.
- Engage professionally competent Persons for project management and construction and ensure that all works are carried out in compliance with the Construction Standards;
- Give written notice to the Concessing Authority within 7 (seven) Days of any material modification or change to any of the Financing Documents and/or any Equity Documents and shall simultaneously therewith also furnish copies of such modified/amended documents to the Concessing Authority. Provided no such modification/amendment will be made if it in any manner whatsoever has the effect of imposing an additional financial obligation or increasing the financial obligation of the Concessing Authority in addition to that contemplated under the Financing Documents provided on Financial Close, without the prior written consent of the Concessing Authority. For avoidance of doubt any such modifications/amendments made without the prior written consent of the Concessing Authority will not be enforceable against the Concessing Authority;
- Obtain Applicable Permits, comply with Applicable Laws and Applicable Permits and give priority to safety in its construction and planning activities in order to protect life, health, property and environment;
- Provide to the representative(s) of the Concessing Authority, at reasonable times and upon prior intimation, access to the Project Site to review progress in construction and

to ascertain compliance with any of the requirements of this Agreement. Provided that non-inspection by the Concessing Authority of any works shall not, in relation to such works,

- Amount to any consent or approval by the Concessing Authority nor shall the same be deemed to be waiver of any of the rights of the Concessing Authority under this Agreement; and (ii) release or discharge the Concessionaire from its obligations or liabilities under this Agreement in respect of such work;
- Provide monthly reports on the progress of Construction Works or such other relevant information as may be required by the Independent Engineer;
- Promptly carry out at its cost such further works as may be necessary to remove any defects or deficiencies observed by the Independent Engineer and ensure timely completion of construction of the Project / the Project Facilities and Services in all respects in accordance with the provisions of this Agreement; and
- To ensure safe and timely construction and completion of the Project/Project Facilities and Services, the Concessionaire may, at its cost, interrupt and divert/create barriers on the flow of water or on the road or port traffic, adjacent to the Project Site if such interruption and diversion is imperative for the efficient progress of Construction Works and conforms to Good Industry Practice; provided that such interruption and diversion shall be undertaken by the Concessionaire only with the prior written approval of the Independent Engineer which approval shall not be unreasonably withheld. For the avoidance of doubt, it is agreed that the Concessionaire shall at all times be responsible for ensuring safe operation of Construction Works and shall remove the interruption or diversion within the period specified by the Independent Engineer.

### **12.3.2 Operations & Maintenance**

The Concessionaire shall manage, operate, maintain and repair the Project Facilities and Services, entirely at its cost, charges, expenses and risk in accordance with the provisions of this Agreement. The Concessionaire's obligations shall include but shall not be limited to the following:

#### **(i) Berth and Terminal Operations:**

The Concessionaire shall:

- Promptly commence operations upon the Project Facilities and Services being declared by the Concessing Authority as ready for operations;
- Make efforts to maximise cargo handled so as to achieve optimal utilization of the Project Facilities and Services;
- Ensure compliance of the Project Facilities and Services at least with the Project Requirements;
- Ensure compliance of the Project Facilities and Services at least with the Performance Standards;

- Ensure that the Project Facilities and Services shall adhere to the Operations and Maintenance Standards and Safety Standards and there is safe, smooth and uninterrupted flow of traffic normal operating conditions;
- Minimise disruption to traffic in the event of accidents or other incidents affecting the safety and use of the Project Facilities and Services by providing a rapid and effective response and maintaining liaison with emergency services of the Concessions Authority or other agencies;
- Make available all necessary financial, technical, technological, managerial and other resources for operation, maintenance, repair and replacement of the Project Facilities and Services in a timely manner;
- Except for the priority and preferential berthing that may be authorized in terms of guidelines issued by the Government from time to time, manage and operate the Project Facilities and Services on a first come - first serve, common-user basis, open to any and all shipping lines, importers, exporters, shippers, consignees and receivers, and refrain from indulging in any unfair or discriminatory practice against any user or potential user thereof;
- Ensure maintenance of proper and accurate record/data/accounts relating to operations of the Project Facilities and Services and the revenue earned therefrom;
- Obtain, maintain and comply with Applicable Permits and comply with the Applicable Laws including those relating but not limited to dock side safety, health, environment and labour;
- Subject to the provisions of this Agreement, perform, undertake or provide, in connection with the Project, all services which the Concessions Authority is authorized to perform, undertake or provide under the provisions of the MPT Act; and
- Prevent, with the assistance of concerned law enforcement agencies, any encroachment or unauthorized use of the Project Facilities and Services.

#### **12.3.4 Repairs, Maintenance and Replacement**

The Concessionaire at its own cost promptly and diligently maintain, replace or restore any of the project facilities or part thereof which may be lost, damaged, destroyed or worn out.

While carrying out the repairing, maintaining and replacing the project facilities, the Concessionaire acknowledges and accepts that it is holding and maintaining the concession or assets, project facilities in trust for eventual transfer to the Concessions Authority on termination of the agreement and therefore, will not do any act as a result of which the value of Port Assets and Project Facilities and Services is diminished.

The Concessionaire shall, at all times during the Concession Period, at its own risk, cost, charges and expenses, performance and pay for maintenance repairs, renewals and

replacement of various type of assets and equipment in the concessionaire premises and /or the project or any parts thereof, whether due to use and operations or due to deterioration of materials and /or parts, so that on the expiry or termination of Concession, the same shall except normal wear and tear be in good working condition as it were at the time of commencement of the Concession.

While carrying out the repair, maintenance and replacement of the project facilities, the Concessionaire shall carry out the work in accordance with the manufacturer's recommendations and the relevant latest Indian Standards or in its absence ISO/OISD Standards. In the event that the concessionaire, by necessity or otherwise need to follow any other country standard and it shall be equal or superior to the standard specified above.

The repairs and maintenance shall generally conform to the following specifications.

#### **E.1 Maintenance Standards**

ISO 4308-1-2003	Maintenance of lifting appliances
ISO 4309-2004	Cranes wire rope care, maintenance and discard
IS 13367: Part 1 : 1992	Safe use of cranes – Code of Practice Part 1 General
BS 7121-2-2003	Code of Practice for safe use of cranes, inspection, testing & examination
BS 7121-4-1997	Code of Practice for safe use of cranes (Lorry Loaders)
BS 7121-5-2006	Code of Practice for safe use of cranes (Tower Cranes)

#### **12.3.5 Safety Standards**

The Concessionaire shall ensure compliance with the safety standards set out under Applicable Law/international conventions, as relevant, from time to time including those required under the following:

- Dock Workers (Safety, Health and Welfare) Act, 1986 & Regulations framed thereunder of 1990.
- The Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989.
- The Petroleum Act, 1934 along with the Petroleum Rules, 2002.

- OISD – Guidelines – 156 (Oil Industry Safety Directorate): Fire Protection Facilities for Port Oil Terminals.
- The Explosives Act, 1884 along with The Explosive Substance Act, 1983 & The Explosive Rules, 1983
- Guidelines by Fire Advisor, CCE & DG FASLI, Government of India
- National Fire Codes (National Fire Protection Association – USA)
- Drill Manual for the Fire Services of India.
- International Safety Guide for Oil Tankers & Terminals.
- ISPS (International Ship & Port Facility Security) Code (2003 Edition)
- MARPOL CONVENTION
- International Maritime Dangerous Goods Code

## CHAPTER – 13

### NAVIGATION & COMMUNICATION SYSTEM

#### 13.1 Navigation Aids

Aids to navigation are required to be provided to identify the fair way for safe navigation. These are various types of marks fixed on river banks, floated on water and moored into the channel bed on both sides of the fairway to guide the master.

In open reaches of River Jhelum NW 49, the marking of the navigational channel by floating buoys is most ideal considering the traffic potential on the waterway, permanent type of lighted buoys are recommended to facilitate round the clock navigation including night navigation. The buoys are to be moored to the bed on either side of the fairway and also at the river confluences of open reaches by means of anchor and chains. The anchor chains need to have sufficient length to facilitate their shortening/lengthening as required during lean and flood periods to suit the prevailing water level. The permanent shore marks are required to be provided on the river banks wherever sharp bends exist so as to align the craft / barge in a straight line along the fairway. Sheets of adhesive scotch lite or luminous paint are required on the shore marks for night navigation.

##### 13.1.1 Proposed aids to navigation system on River Jhelum NW 49

The system and different type of navigation marks proposed are given as follows.

- **Lateral Marks**  
To mark the left and right sides of the navigation route to be followed by navigator.
- **Bifurcation Marks**  
To mark the middle grounds between the navigational channel, bifurcated channels and isolated dangers in the middle of the navigational channel.
- **Shore Marks**
  - Bank wise Marks, to indicate the channel at points where it approaches a bank.
  - Crossing Marks, to indicate crossings and alignment of the channel from one bank to another
- **Marks of Prohibited Areas**  
To indicate no permission of entry.
- **Sound Signal Marks**  
To indicate use of honning or other sound signals.
- **Marks for Traffic Control**

To control up bound or down bound vessels in one-way or sequential passage or to prohibit navigation.

- **Marks on Bridges**

To indicate the passage through bridges.

The channel marking as per the regulations of Inland Waterways Authority of India (IWAI) under—National Waterway, Safety of Navigation and Shipping Regulations, 2002 are come into force after publication in the official Gazette are placed in the **Annexure 13.1** of this report. The channel marks published by IWAI may be provided for the safety of vessels plying in the waterway NW 49.

### 13.1.2 Estimates of requirements of aids to navigation in proposed waterways

The navigational marks required in the proposed waterways have been worked out. This provision is required for safe and efficient navigation. The numbers of Beacon Stations and buoys have been worked out for the safe and efficient navigation during night along the waterway. The Summary of details of the Navigational Marks and beacon stations required to be provided in the waterway is given as under to increase the accuracy of navigation. It is the advance version of GPS system.

**Table 13.1 Details of Navigation Aids**

S. No.	Location	Type of Navigation aids
1.	At Bridges	Fixed shore Markers
2.	At Bends	Fixed shore Markers
3.	At Terminal locations, Bifurcations etc.	Fixed shore Markers
4.	Navigational Channel Marking	Lighted Beacons/Buoys

### 13.1.3 IALA Buoyage System

Within the IALA Buoyage System there are 5 types of marks which may be used in combination. The mariner can easily distinguish between these marks by readily identifiable characteristics.

Lateral marks differ between Buoyage Regions A and B as described below, whereas the other 4 types of mark are common to both regions.

#### Lateral Marks

Following the sense of a conventional direction of buoyage, Lateral marks in Region A utilize red and green colours by day and night to denote the port and starboard

sides of channels respectively. However Region B these colours are reversed with red to starboard and green to port.

A modified lateral mark may be used at the point where as channel divided to distinguish the preferred channel, that is to say the primary route or channel which is so designated by an authority.

### **Cardinal Marks**

Cardinal marks indicate that the deepest water in the area lies to the named side of the marks. This convention is necessary even though for example, a North mark may have navigable water not only to the North but also east and west of it. The mariner will know he is safe to the North, but must consult his chart for further guidance.

Cardinal marks do not have a distinctive shape but are normally pillar or spar. They are always painted in yellow and black horizontal bands and their distinctive double cone top-marks are always black.

Cardinal marks also have a special system of flashing white lights. The rhythms are basically all “very quick” (VQ) or “quick” (Q) flashing but broken into varying lengths of the flashing phase. “Very quick flashing” is defined as a light flashing at a rate of either 120 or 100 flashes per minutes; “quick flashing” is a light flashing at either 60 or 50 flashes per minutes.

The characters used for Cardinal marks will be seen to be as follows.

North: Continuous very quick flashing or quick flashing

East: Three “very quick” or “quick” flashes followed by darkness

South; Six "very quick" or "quick" flashes followed immediately by a long flash, then darkness

West: Nine "very quick" or "quick" flashes followed by darkness.

The concept of three, six, nine is easily remembered when one associates it with a clock face. The long flash, defined as a light appearance of not less than 2 seconds, is merely a device to ensure that three or nine "very quick" or "quick" flashes cannot be mistaken for six,

It will be observed that two other marks use white lights. Each has a distinctive light rhythm which cannot be confused with the very quick or quick flashing light of the Cardinal marks.

### **Isolated Danger Mark**

The Isolated Danger mark is placed on a danger of small area which has navigable water all around it. Distinctive double black spherical top marks and Group flashing (2) white lights, serve to associate Isolated Danger marks with Cardinal Marks.

## Safe Water Marks

The Safe Water mark has navigable water all around it but does not mark a danger. Safe Water marks can be used, for example, as mid-channel or landfall marks. Safe water marks have an appearance quite different from danger marking buoys. They are spherical, or alternatively pillar or spar with a single red spherical top mark. They are the only type of mark to have vertical stripes (red and white). Their lights, if any, are white using is phase, occulting, one long flash or Morse “A” rhythms.

## Special Marks

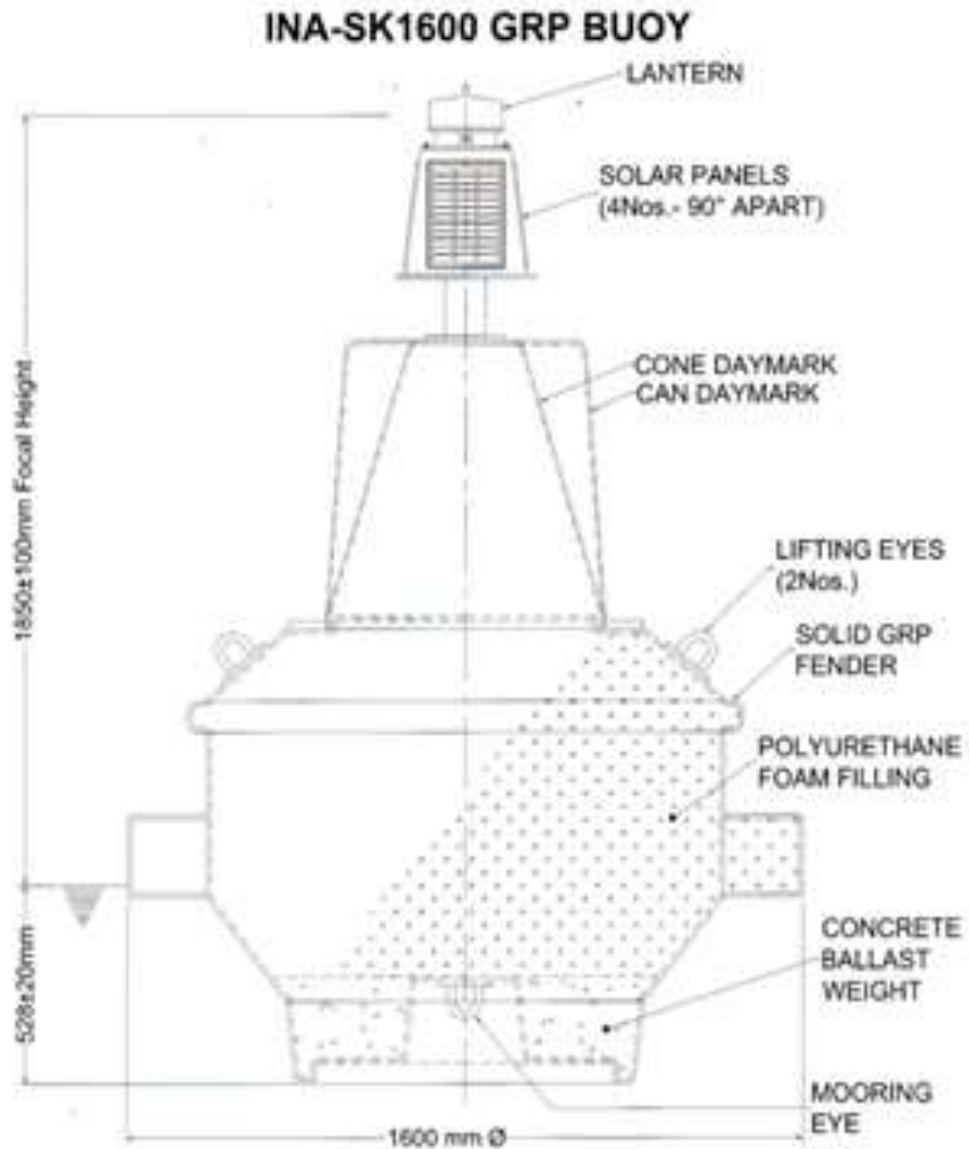
Special marks are not primarily intended to assist navigation but are used to indicate a special area or feature whose nature may be apparent from reference to a chart or other nautical document. Special marks are yellow. They may carry a yellow “X” top mark, and any light used is also yellow. To avoid the possibility of confusion between yellow and white in poor visibility, the yellow lights of special marks do not have any of the rhythms used for white lights. Their shape will not conflict with that of navigational marks, this means, for example, that a special buoy located on the port hand side of a channel may be cylindrical, but will not be conical. Special marks may also be lettered or numbered to indicate their purpose.

## New Dangers

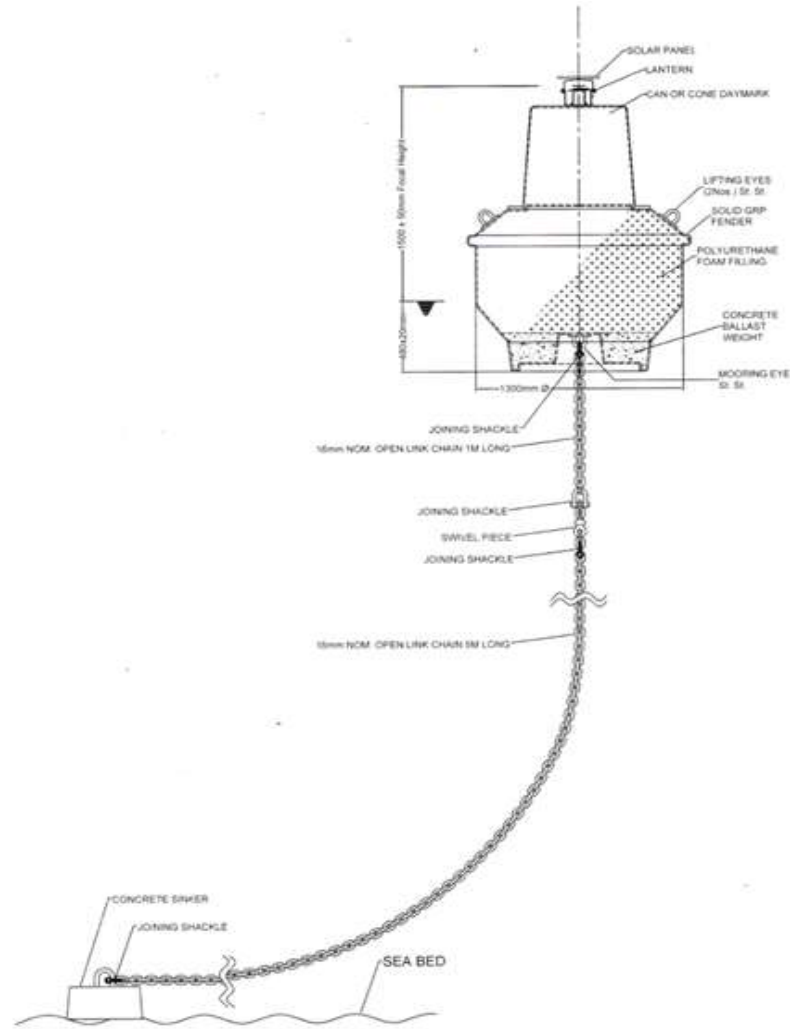
It should be specially noted that a “new danger” which is one not yet shown in nautical documents, may be indicated by exactly duplicating the normal mark until the information is sufficiently promulgated. A “new danger” mark may carry a Racon coded Morse “D”.

Body	:	ABS Plastic sealed to IP68 Standard.
Lens	:	185 dia moulded UV stabilized Poly- carbonate lens
Color	:	Red, Green, Yellow, White
Range	:	2 to 3 NM at 0.74 ATF (Specify while ordering)
Light Control	:	Automatic on/off by Photo diode
Light Source	:	High Intensity light emitting diodes LEDs with 100, 000 hours of life
Divergence	:	360 <sup>0</sup> Horiz. X 15 <sup>0</sup> Vertical (at 50%) of Peak Intensity
Character	:	Any one character from 256 IALA recommended character can be achieved
Input Voltage	:	Nominal 12 VDC
Battery	:	Maintenance free lead-acid fitted with inside Base
Autonomy	:	200 to 300 Hours period
Solar Panel	:	Fitted on the Lantern Dome
Fixing	:	Four – 10 mm dia Hole on 200 PCD
Weight	:	3 Kg approx.

Marine Lantern @ 2km C/C is provided along the proposed waterway. Designed aid is on the basis of light intensity, soil condition and wind direction and velocity  
General assembly of proposed buoy is shown in Fig. given below



**Fig. 13.1 (A) General Assembly – Partial**



**Fig. 13.1 (B) General assembly-Full**



**Fig. 13.2 Navigational buoys**

## 13.2 Communication Systems

### 13.2.1 VHF/HF

VHF communication system is a part of VTS/VTMS system i.e. Vessel Traffic system or Vessel Traffic Management System. This navigational system is required when there is heavy traffic at port or terminals. Though there are international standards published by IMO, each Country and each state or province also follows its own standard. It helps to locate exact position for berthing of vessels and decide traffic lane for vessels accordingly. VHF also comes under Marine Communication Systems. VHF Radio also known as very high frequency radio used for communicating between shore & vessels or between two vessels. Depending upon area of operations of various ships activity of VHF system differs. As per nautical miles from shore of vessels, various types of VHF radio frequency system are used for communication. For NW49 vessels could contact terminal Manager via VHF system and would be provided guidance for berthing or for anchorage etc. This system would also help in planning vessels arrival & departure schedule for terminal or port.

### 13.2.2 Differential Global Positioning System (DGPS)

DGPS is satellite-based system. Generally DGPS system has two reference stations, two integrity monitors, control computer, communication system, marine radio beacons and continuous power supply. All these equipment's are necessary for DGPS system to function. Vessel monitoring & controlling could be done from various DGPS stations or remotely from other control stations. Using DGPS corrections could be made in GPS receiver to increase the accuracy of navigation. It is the advance version of GPS system.

### 13.2.3 RIS/AIS/Radar

- **River Information System (RIS)**

First RIS system has been introduced in India on NW 1 in Fy-16. RIS is a combination of software & hardware equipment used for optimization of traffic & vessels movement in Inland waterways for navigation purposes. RIS is used for electronic data transfer between vessels & shore. Using RIS system many waterway transportation risks like vessels collisions, Vessel – bridge collisions could be avoided. River Jhelum also has many bridges on it. Vessels/barges that would use river could be benefitted by using RIS system and safely navigate in complete stretch of the river.

- **Automatic Identification System (AIS)**

AIS & RIS system together provides safe navigation for vessels. Both these systems are used simultaneously. Under AIS, vessels that would ply on whole river stretch are monitored. Remote stations/base stations site would be

installed/developed for monitoring vessels and identify it. This would further strengthen safe navigation for vessels.

- **Radar**

Radar is basically used to locate other ships and nearby land area. In radar system there are X frequency & S frequency. X stands for secret & S for small range. Radar screen on ship display each and every object that are in the coverage of particular radar on ship. There is antenna on the top of radar, which continuously rotates, & flashes in order to find out any objects on the navigable path of the ships. It not only identifies objects but also shows its distance from ship. This also helps in avoiding accidents in the waterways. Radar system is also considered as user friendly and economical to install due to less consumption of power & electricity.

### **LIST OF EQUIPMENTS:**

#### **Sensor System**

- a. AIS Base Station
- b. RADAR
- c. VHF System
- d. Meteo Sensor
- e. Automatic Tank Gauge

#### **Tracking**

- a. RIS Hardware (Servers & Computers)
- b. RIS Software

#### **Power Supply**

- a. UPS
- b. DG Set

#### **Civil Deliverables**

- a. Trestle Tower for installation RADAR
- b. Building for installing RIS equipment / Porta cabin

**Phase-1:**

**Table – 13.2 Estimation of Equipments  
RIS SYSTEM RIVER JHELUM(NW-49)**

Sr. No.	Equipment	Qty	Unit Price	Total
1	AIS Base Station	1	3000000	3000000
2	RADAR	1	5000000	5000000
3	Meteo Sensor	1	700000	700000
4	ATG	1	900000	900000
5	VHF	1	500000	500000
6	DG Set 10 KVA	1	700000	700000
7	UPS	1	500000	500000
8	RIS Software	1	3500000	3500000
9	RIS Hardware	1	10000000	10000000
10	Installation Testing & Commissioning	1	2000000	2000000
11	Porta cabin	3	1200000	3600000
12	Trestle Tower	1	1000000	1000000
			<b>Total</b>	<b>31400000</b>
	Operation			-
1	Engineer 1 * Site 1 * Months 12 per year	12	35,000.00	420000
	Operator 3 * Site 1 * Months 12 per year	36	20,000.00	720000
	Security 3 * Site 1 * Months 12 per year	36	15,000.00	540000
2	Second Year			1797600
3	Third Year			1923432
4	Fourth Year			2058072.24
			<b>Total</b>	<b>7459104.24</b>
	<b>CAMC for 3 Years</b>			-
1	1st Year	1	3140000	3140000
2	2nd Year	1	3454000	3454000
3	3rd Year	1	3799400	3799400
				-
			<b>Total</b>	<b>10393400</b>
			<b>Overall Cost</b>	<b>49252504.24</b>

In Phase-II also, one more RIS shall be installed. However, there is no requirement of RIS in Phase-III.

**13.3 Existing System**

At present there is no navigable or communication system developed on Jhelum River.

### 13.4 Additional requirement

Once the terminals on River Jhelum gets developed, all these basic safety norms need to be installed for safe navigation of vessels and to have complete control on traffic handled at terminal.

### 13.5 Costing

#### 13.5.1 Capital Cost

**Table 13.3 Capital Cost for Navigation Aids (Phase-1)**

(II)	Navigation & Communication Cost	
(A)	DGPS	1.00
(B)	Marine Lantern/Buyos (11 nos.)	0.22
(C)	RIS	4.93
	Total Cost(II)	6.15
	3% Contingencies and 7% Supervision charges on Base cost	0.61
	<b>Total Navigation &amp; Communication Cost</b>	<b>6.76</b>

**Table 13.4 Capital Cost for Navigation Aids (Phase-2)**

(II)	Navigation & Communication Cost	
(A)	DGPS	1.00
(B)	Marine Lantern/Buyos (45 nos.)	0.90
(C)	RIS	4.93
	Total Cost(II)	6.83
	3% Contingencies and 7% Supervision charges on Base cost	0.68
	<b>Total Navigation &amp; Communication Cost</b>	<b>7.51</b>

**Table 13.5 Capital Cost for Navigation Aids (Phase-3)**

	(II) Navigation & Communication Cost	
(A)	DGPS	-
(B)	Marine Lantern/Buyos (31 nos.)	0.62
(C)	RIS	-
	Total Cost(II)	0.62
	3% Contingencies and 7% Supervision charges on Base cost	0.06
	<b>Total Navigation &amp; Communication Cost</b>	<b>0.68</b>

#### 13.5.2 O&M Cost

**Table 13.6 Operation & Maintenance Cost (Phase-1)**

Phase-I

S.No.	O & M Cost	In Crores
(i)	Dredging @ 10%	0.10
(ii)	Civil works @ 1%	0.20
(iii)	Mechanical & Electrical Cost @ 5%	0.125
(iv)	Ports Crafts/Nav. Aids @ 5%	0.34
(v)	Fuel Cost	2.50
(vi)	Power Cost	2.50
(vii)	Manpower Cost	7.00
(viii)	Miscellaneous	5.00
	<b>Total</b>	<b>17.76</b>

**Table 13.7 Operation & Maintenance Cost (Phase-2)**

**Phase-II**

S.No.	O & M Cost	In Crores
(i)	Dredging @ 10%	2.11
(ii)	Civil works @ 1%	0.16
(iii)	Mechanical & Electrical Cost @ 5%	0.095
(iv)	Ports Crafts/Nav. Aids @ 5%	0.34
(v)	Fuel Cost	1.50
(vi)	Power Cost	1.50
(vii)	Manpower Cost	4.40
(viii)	Miscellaneous	5.00
	<b>Total</b>	<b>15.10</b>

**Table 13.8 Operation & Maintenance Cost (Phase-3)**

**Phase-III**

S.No.	O & M Cost	In Crores
(i)	Dredging @ 10%	1.79
(ii)	Civil works @ 1%	0.03
(iii)	Mechanical & Electrical Cost @ 5%	0.0715
(iv)	Ports Crafts/Nav. Aids @ 5%	0.34
(v)	Fuel Cost	0.50
(vi)	Power Cost	0.50
(vii)	Manpower Cost	1.47
(viii)	Miscellaneous	5.00
	<b>Total</b>	<b>9.70</b>

## Annexure 13.1

### A. BUOYAGE AND MARKING OF THE WATERWAY:

#### (i) DIRECTION OF BUOYAGE:

The direction of buoyage shall be defined as follows

- (a) The general direction taken by the mariner when approaching, river or estuary or waterway from seaward
- (b) In case of non tidal rivers the direction against the flow of the river
- (c) The direction in which the kilometer chainage increases in case of estuary

#### (ii) PORT HAND MARKS :

these marks indicate the left hand side of the channel

BY DAY: Red Buoys, preferably cylindrical (CAN), or red spars, red cylindrical top marks is compulsory on the spars and on the buoys if they are not cylindrical.

BY NIGHT: Rhythmic red lights of any type



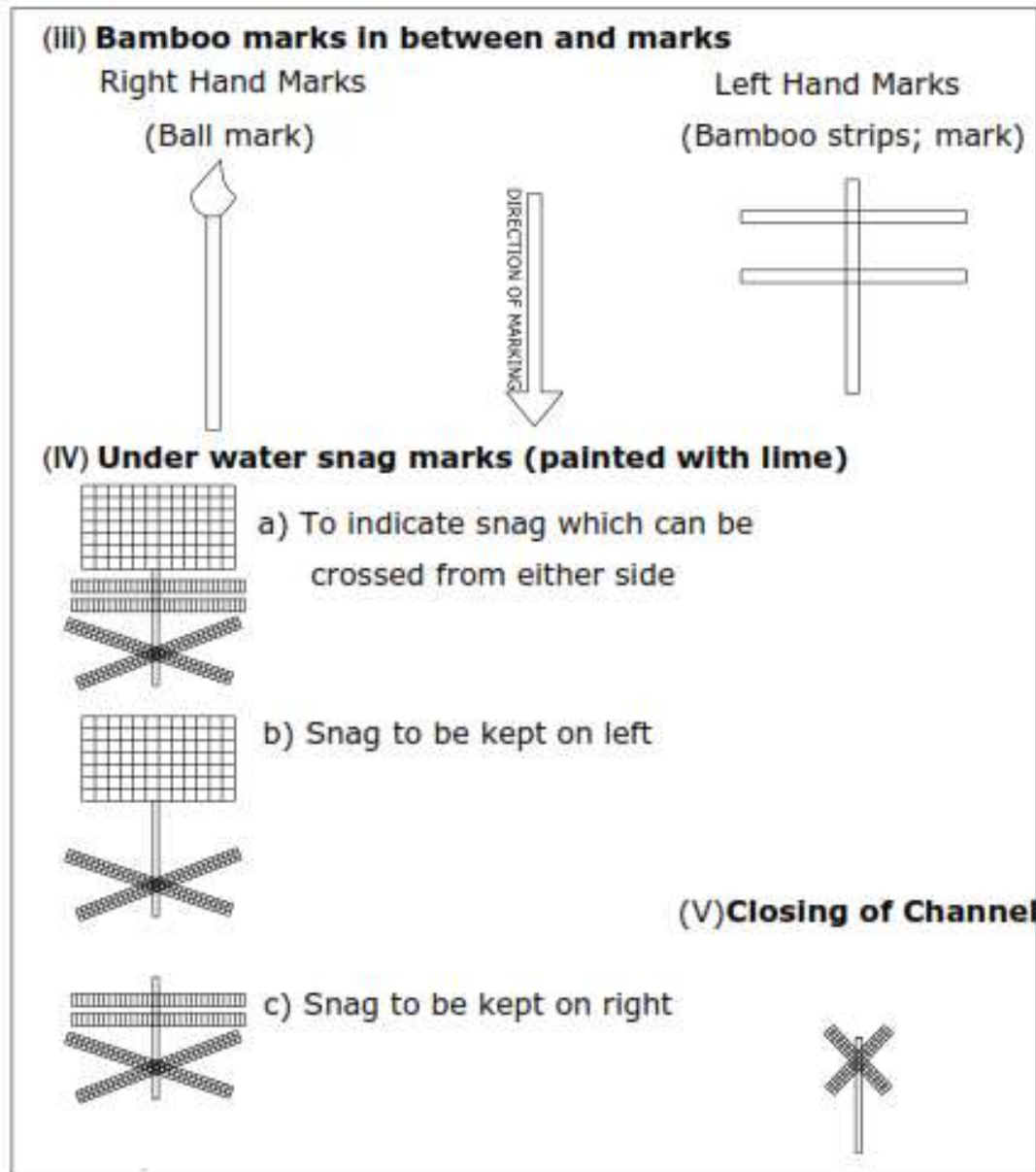
### B. STARBOARD HAND MARKS

These marks indicate the right side of the channel

**BY DAY:** Green buoys preferably conical, or green spars. A green conical top mark point upward is compulsory on the spars and on the buoys if they are not conical.

**BY NIGHT:** Rhythmic green lights, of any type





## C. Signs and Signals

### 1. Day and Night marking

Where the prescribed mark consists of:-

- (a) Light only, the lights may be used by day and by night;
- (b) Boards only, the boards may be used as night marks if illuminated. Boards shall be rectangular in shape of 1.5 meter x 1 meter size minimum;
- (c) Boards and lights, by day, either boards or lights may be used; by night either lights or illuminated boards may be used.

### 2. Lighting

Lights may be provided at night for lighting of the lower parts of a bridge, of the piers of a bridge, of the approaches to a lock, of a section of small canal etc.

### 3. Intensity of lights

The lights recommended in this rules shall be visible for a distance of at least 2 kms, and shall be distinct from the surrounding lights.

### 4. Fixed lights

- (i) Single red light



"No passage"

Either to some of the channels or arms of the waterway, or to the whole of the waterway

- (ii) Two red light placed one above the other



Complete and prolonged stoppage of navigation (blockage) of water-way bridges or locks out of service)

- (ii) Two or more red lights set apart



"No passage" (between the lights)

## CHAPTER – 14

### SOCIO-ECONOMIC ENVIRONMENTAL ASSESSMENT

#### 14.1 Introduction

Inland waterways transportation (IWT) is one of the oldest, economic and environmental sustainable modes of transportation. Inland waterways play a vital role in economic development of a region, especially in remote areas where IWT is the only means of mobility and access to basic services. The potential opportunities for IWT sector depends considerably on the specific regional context, such as geographical conditions, level of road development and socio-economic conditions. This section would examine the mechanisms by which the inland waterway transport system in river Jhelum would influence economic growth and development of the hinterland. Developing and maintaining NW 49 is an opportunity to improve sustainable development of this waterway and the hinterland.

Increase in population put pressure on existing transportation modes to meet increased demand. If towns and cities along the banks of river Jhelum fails to keep up with the growing need of transportation and are prone to lack of infrastructural facilities, then it reduces the living standard of people. In such situation, development of NW 49 for passenger and tourism movement would create a brand value to Jhelum's hinterland. Development of river Jhelum for passenger and tourist movement opens a new door of transportation and would help to ease the burden of existing modes. Waterway is considered as green infrastructure and is environmental friendly mode of transportation. Development of IWT route in river Jhelum would not only provide transportation for passengers/ tourists, but would also offer numerous services and benefits to the society.

The utilization of IWT in river Jhelum is the most important factor that determines the variation in the opportunities of inland waterways on socio-economic development of the hinterland of the river. Waterways develop economic activities, recreational activities, tourism industry, enhance the socio-economic life of local community and provide sustainable mobility. Inland waterways boosts the economic productivity of the hinterland. The proposed waterway NW 49 in river Jhelum would not only offer an alternative mode of transportation for the community but also generate more new economic activities, like tourism, boat building and fishing industry.

#### 14.2 Economic Role of Inland Waterway Transport

Inland waterways would open up districts located in the hinterland of river Jhelum to economic activities. One of the roles of IWT is to provide access between spatially separated locations, like Gunderbal and Bandipore, which are located along river Jhelum for passengers and tourists. For passenger

sector, NW 49 would provide people with access to workplaces, education facilities, shops, mandis, medical facilities etc. as well as social, recreational and community. For tourism sector, NW 49 would connect major tourist destinations, located on the bank of river Jhelum. Tourists would use IWT in river Jhelum for short or long route boat ride for leisure activity and observing the scenic beauty.

In India, Inland waterway development is in an infant stage and the majority of the costs of system investment, operations and maintenance need to be taken care by government. Government also needs to promote and subsidise IWT to attract potential customers to inland waterways. In the country, existing modes of transportation like roadway and railway are already developed and more funds are allocated every year for development and upgradation of these modes. Passengers/tourists prefer roadway and railway as these are already established modes. To compete with these modes of transportation, IWT needs full support from Government. More investment would be required for the development of IWT, so that it could be developed at par with the existing and established modes and could compete with them.

Better IWT links and services would lead to lower costs and enhanced accessibility. Increased access and connectivity create increased opportunities for trade and passenger movement, which can lead to longer-term productivity gains. The potential for inland waterway transport is high in future; however waterway development would not accelerate economic development of the region instantly. Due to over utilization of existing modes, it would take time to establish IWT as a preferred mode of transportation.

### **14.3 Impact of IWT on community and the region**

The waterway network is an important catalyst to boost the socio economic activity among the local community. Development of NW 49 will involve development in both physical and human resource development in the region. These types of development will provide more opportunities and benefits to the surrounding communities. This spill-over effect of development has economic as well as social benefits. Some of the positive impacts of IWT on the community and the region are mentioned below.

#### **14.3.1 Development of Tourism activity**

River Jhelum flows through the Kashmir Valley, which is popular for its natural scenic beauty. After the development of NW 49, tourism activity on the hinterland of river Jhelum would flourish. Tourism activity has the potential to boost the local economy and bring along additional income. Heritage structures, lakes and gardens around river could provide a substantial boost to economic impact. There are many places of tourism interest located on the bank of river Jhelum.

There is also the potential to increase water related tourism avenues for the tourists visiting Kashmir Valley. Waterway on river Jhelum would provide attractive opportunities for boat ride tourism. Houseboats and shikaras are already operational on some stretches of river Jhelum. Development of NW 49 would boost the attractiveness of the river. Long route rides, which would ply between Anantnag/Srinagar to Baramulla, would be a major attraction. NW 49 would provide an opportunity to tourists to take a tour of city using boat and enjoy the natural beauty of Kashmir. It would help to attract domestic as well as foreign tourists, thereby increasing range of users.

Srinagar is a famous tourist destination. There are many heritage buildings and sites, lakes, gardens and parks in the city, which witness major tourist footfall. These tourists would be attracted to NW 49 for leisure boat rides or traveling from Anantnag to Baramulla via Srinagar.

Wular Lake is another popular tourist spot. It is the second largest fresh water lake in Asia. Tourists from Srinagar could reach Bandipora using NW 49 and explore Wular Lake. Boat/ferry ride on river Jhelum from Srinagar to Bandipora would be a beautiful experience for tourists.

Another attraction would be short distance boat rides between different terminals of Srinagar. Well developed passenger terminals would serve tourist/passenger traffic for inter and intra district movement on NW 49. Development of other tourism related facilities near the terminals would also contribute in the revenue from tourism related activities on NW 49.

#### **14.3.2 Employment generation and growth in per head Income**

Development of inland waterway would impact development of the hinterland. Inland waterway would generate employment for the population living in the hinterland of river Jhelum. Economic growth of the region would certainly facilitate the enhancement of per head income growth.

Inland waterway could facilitate geographic and employment mobility in response to shifting economic activity to the hinterland of the river. The development of the waterway will itself help support employment. Employment generation during development of NW 49 is a one-time impact. However, once NW 49 gets operational, it would generate more employment for local people. Every proposed terminal on NW 49 would require staffs for handling various tasks, like technical jobs, administration related jobs etc. Hence, NW 49 would benefit the region and community by providing employment opportunities.

Locals residing just near the bank of river Jhelum would be exposed to bigger opportunities compared to those who live far away from the hinterland of Jhelum. This is likely to result in lifting up their social and economic standard. Development of NW 49 could help to decrease unemployment rates in the hinterland.

Development of river Jhelum would also encourage business activities, like establishment of shops, hotels, stores selling local products etc. This will provide more money-making activities for the local community. Waterway development would also result in growth in vessel/boat making industry, boat rental activity etc. Other segments, like Boat operating, boat building,

boat hire companies, equipment manufacturing, hospitality sector (restaurants, accommodations) would also grow in the hinterland of NW 49.

### **14.3.3 Alternative Mode of Transportation**

Inland waterway would provide an alternate mode of transportation for passengers and tourists. IWT networks and improved transport technology would play a crucial role in economic growth and opening up some remote areas to people and economic activity. Waterway transportation for passenger and tourist movement was already introduced in Jhelum. The locals of Srinagar have historically used boats for transportation of passengers and goods. They are willing to use water transportation to avoid congestion on city roads.

NW 49 would connect different cities and would be used for various inert district movements, for instance, between Anantnag, Srinagar, Ganderbal, Bandipora and Baramulla. IWT would help to link many remote regions with cities, as these remote areas lack good roadways/railways. Districts, like Ganderbal and Bandipora are mostly forest areas and roadways are not much developed in these two regions. Development of NW 49 would open new avenues for locals by providing an alternate mode of transportation. Ganderbal lacks well developed roads; hence people travel by small local roads to reach Srinagar. NW 49 would facilitate smooth transportation from Ganderbal to Wular Lake and Srinagar. By using waterway transport, residents of this district would have direct access to mandis of Srinagar without getting affected by city road congestion and traffic of Srinagar. This could eventually save their time.

### **14.3.4 Growth in construction and other sectors**

Construction companies are other major beneficiaries of waterway development in river Jhelum because of development and maintenance contracts of IWT, which includes activities like bank protection, dredging and aquatic weed control (like Ningli (willow) plantations from Wular Lake) by using environment friendly techniques etc.

Water transport sector would also provide additional employment opportunities to manufacturing sector of souvenirs and handicrafts. These arts and cultural based industries would likely grow along the banks of river, especially in the tourism centric places like Srinagar. Small-scale industries, which produce Kashmiri shawls, carpets, handicrafts etc. would thrive in these cities.

### **14.3.5 Development of backward areas**

Development of NW 49 would help in faster development of backward areas, located on the bank of river Jhelum. This would reduce the gap between rural & urban areas and help to minimize the economic disparity between the two communities. NW 49 would support small-scale units in rural areas.

Waterway tourism is very much important especially in rural areas, as these areas would be developed holistically. Existence of any tourist sites in these areas automatically increases appeal of the waterway. Some of the neglected areas under rural regime that need immediate refurbishment would be largely benefitted from the development of NW 49.

#### **14.3.6 Health and well being of communities**

Inland waterway will bring huge potential to intensify recreational activities, like fishing, boating, water sports etc. Waterway recreational activities play an important role in maintaining health of communities. Developing riverside path supports sport activities and indirectly helps to maintain physical & mental fitness of nearby region. Diversity, beauty, history and natural environment of river Jhelum would have positive results to the health and the subjective well-being of the local communities.

#### **14.4 Economic Benefits of NW 49 Development**

Inland waterway in river Jhelum would provide improved access at lower cost and consequently would boost economic growth of the region. Development of river Jhelum would revolutionise passenger movement in the regions, located on the bank of the river.

The links between inland waterway in NW 49 and the economy also tend to become more complex, with transport investment having to meet multiple objectives. These objectives may include lower transportation cost compared to existing modes, improvement in safety, travel conditions, accessibility, environment, integration and social inclusion. An increased proportion of investment may be allocated for infrastructure and other schemes that address multiple objectives rather than solely maximise contributions to economic development.

The economic benefits that will accrue with the development of NW 49 have been classified into following categories:

- Reduction of road congestion and lessen burden on existing modes
- Reduction in accidents and noise emission
- Less cost of development
- Less land occupancy
- Property uplift and regeneration
- Transportation of passengers
- Ecosystem services
- Carbon credit earned

##### **14.4.1 Reduction of road congestion and lessen burden on existing modes**

Infrastructure developed on IWT route in river Jhelum would enable to divert road traffic on waterway. Inland waterway transportation reduces road congestion by undertaking load of road transport. Roadways in Srinagar often

face congestion, as around 80% of the population use public transportation. Specially during peak hours, when people travel to their work place, education centres, shops etc. Places, like Jahangir Chowk, Zero Bridge, Pantha Chowk, etc. in Srinagar, which are densely populated, are located on banks of river Jhelum. NW 49 runs through the populated parts of cities, which create possibilities to use waterway for public transport on proposed routes.

Intra-District terminals on NW 49 could be used for daily commute. It could be a preferable option instead of city buses, which are unreliable due to improper timetable. IWT movement within Srinagar may play an important role in rush hours. Water transport is mostly leisure oriented, but it could also provide services for daily commute. For instance, in Sweden, there are waterbus services running in Karlstad that provide both types of services, leisure, as well as daily commute. NW 49 could follow the same model for handling local passengers and tourists at the same time.

To attract passengers to NW 49, it is necessary that prices and timetable for users is competitive with existing modes of transportation (road/rail). IWT system is still an untapped market and an emerging mode of transportation; hence after development of NW 49, it is very unlikely that there would be profitability in near future. However, well developed IWT system on river Jhelum with proper promotion and awareness, would result in social and environmental gains in future.

#### **14.4.2 Reduction in accidents and noise emission**

There are other benefits associated with transportation activities through inland waterways. These benefits have been identified in terms of average external costs due to accidents, noise pollution, infrastructure, wear and tear cost etc. Development of NW 49 would help to reduce external cost of existing transport system. IWT has significant advantages over road in terms of lower average external costs which is lesser compared to roadway.

IWT mode has negligible cost associated with accidents, noise pollution and congestion. In case of road, external costs due to accidents, air pollution and congestion are quite significant. This low marginal average external costs of IWT operation is perhaps one of the strongest reasons that modal shift to IWT from other modes should take place in the interests of the society. In a country like India, where larger number of road accidents occur every year, IWT becomes more relevant. Due to enormous growth of vehicles on roads and increased population in Srinagar, the city witnesses a surge in accidents and collisions. Though the fatality rate in Srinagar is less than other major cities of India, but still it is a matter of concern as the traffic volume of Srinagar is less as compared to other big cities. Development of NW 49 would provide people a safer mode of transportation.

Transport on roads, railways and inland waterways causes noise emissions, which affect populations in adjacent areas. The level of emissions varies significantly among buses and other public transit vehicles, trains and inland

vessels. Both roadway and railway cause high noise emissions, whereas IWT causes lower noise emissions.

#### **14.4.3 Less Cost of development**

The per km cost of development of inland waterway is less compared to that of an equivalent length or equivalent traffic capacity of railway or highway. The maintenance cost of a waterway is also less compared to the corresponding costs for rail or road. The time taken to develop waterway routes is also negligible.

#### **14.4.4 Less land occupancy**

For development of roadway and railway, acquisition of land is a major hurdle. This is not the case with waterway. IWT routes are developed along existing rivers, canals and waterways. Unlike road and rail, IWT does not need to get into the complexities and problems of land acquisition. However, land would be required for development of terminals on national waterways. Parcels of land are usually available on the bank of the rivers. Acquisition of these lands would not be as difficult as land acquisition for longer stretch for developing railway track or highway.

For river Jhelum, there is adequate land parcels available on the bank of river for terminal development and related activities. There exist some ghats on the river, which are currently non operational. These ghats could also be developed as terminals.

#### **14.4.5 Property uplift and regeneration**

Waterfront development and other related services on NW 49 would likely to increase the property rates in nearby areas. It would also increase the appeal of the river and nearby region, thereby attracting large number of workers, businessmen, students and tourists to the hinterland.

It has been observed that waterfront locations result in increasing the value of properties located close to them. In the case of residential properties, value increases by up to 20%. These effects accrue to the landowners in the first instance and only occur once. However, they can help support the sustainable development of an area by increasing the desirability of a location for new residents and businesses. By providing an attractive environment and a scenic backdrop, waterfronts of NW 49 can attract both locals and tourists.

#### **14.4.6 Transportation of passengers**

Waterway faces tough competition from existing modes of transportation, i.e. roadway and railways. Waterways network could be a preferable mode for transportation of large number of passengers. There are aspirations to increase the use of waterways as a transport conduit to reduce social and environmental impacts from other modes of transport.

One of the main impacts of development of inland waterway has been to reduce the costs of long-distance movement. Vessels in inland waterway have bigger capacity, which facilitate transportation of more passengers per km. per unit of fuel than what is possible with other modes. This benefits the environment and makes IWT relatively cost-efficient. One of the supply drivers for using NW 49 for passenger movement is changing costs and demand drivers including the growth of the region and variations in regional economic activity.

The demand for passenger transport using IWT arises from the need for travel to work, education, consumption centers, and social needs. Users want several things from the transport system, placing different weights on their relative importance. The key characteristics, which are valued, are travel time, travel time reliability, cost, network coverage, comfort, safety and security. These factors could be addressed by IWA while developing NW 49. This would help both intra and inter district movement on NW 49 to attract large number of passengers and tourists.

#### **14.4.7 Ecosystem Services**

Apart from being an environment friendly transportation method, IWT provides a range of ecosystem services, such as flood control and water transport. While these benefits are difficult to cost, they do make a contribution to sustainable economic development. In the case of NW 49, it will help in managing water movements in the defined stretch of river Jhelum throughout the year. Development of waterway on the river would also prevent occurrence of flood. River Jhelum is prone to flood, as water level rises due to heavy rainfall during monsoon. Flood of 2014 witnessed massive destruction in the region. Such calamities could be prevented by development of inland waterway on river Jhelum.

#### **14.4.8 Carbon credit earned due to savings on fuel consumption in IWT movement**

Use of NW 49 would help to reduce social and environmental impacts such as pollution, created by other modes of transportation. The amount of CO<sub>2</sub> emissions, which are particularly responsible for climate change, can be directly derived from the amount of fuel consumption. The highest CO<sub>2</sub> emissions are caused by burning of fuel mostly by vehicles on roadways. IWT is relevant in present scenario when climate and environment protection is a matter of grave concern. IWT causes less CO<sub>2</sub> emissions compared to roadways. Modal shift from road to IWT would have a dramatic impact on overall CO<sub>2</sub> emissions.

Low emission of air pollutants compared to roadways is a major strength of inland waterway. Savings on fuel consumption have a commensurate savings of CO<sub>2</sub> emission. This CO<sub>2</sub> equivalence savings on fuel consumption when quantified using market instruments is carbon credit earned.

## 14.5 Conclusion

There exists a need to involve NW 49 development agenda under major Government policies and objectives to increase socio economic benefits offered by NW 49. By doing so, it would attain long-term sustainability and would gain a wider recognition as a waterway dedicated for transport and leisure. Government should promote carbon-sensitive policies to reduce sector emissions, which would encourage people to opt inland waterways. Apart from being an alternate option of transportation, NW 49 would generate various economic activities such as tourism, boating, vessel/boat building & repairs, dredging services, hydrographical survey, safety management etc. Apart from industries, NW 49 would be attractive to both local residents and to visitors/tourists. For both of these groups, planning and investment is required to maximize the level of engagement on river Jhelum.

There are few upcoming projects, which would compliment the development of NW 49. For instance, new projects under Srinagar Municipal Corporation (SMC), Srinagar Development Authority (SDA) and INTACH are dedicated for the development and beautification of Srinagar. These projects would create more opportunity for NW 49 near Srinagar.

The efficiency of NW 49 could be increased by providing training to local government of districts, located on the bank of Jhelum. This would increase their knowledge of IWT development, Terminal operation etc. Economic and social benefits of NW 49 could be further increased by following methods

- Providing support and encouragement for IWT development
- Proper integration of public & private sector to create profitable situation for involved parties
- By putting emphasis on city and rural development
- By promoting waterways
- Supporting & preserving river bank protection & conservation

There exists a need to involve both public and private sector for development and operation of inland waterway on river Jhelum. Involvement of both the sectors would ensure that the waterway is developed with all required facilities and technologies and there would be smooth operation and maintenance of the waterway. Government needs to generate public interest, encouragement and involvement in the prospects and potential inherent in the inland waterways in river Jhelum. Government needs to be determined to provide an investment friendly climate and generate policy and incentives that will encourage new investors and investments in NW 49.

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## CHAPTER – 15

### CAPACITY BUILDING AND FINANCING

**15.0** Capacity Building is the process by which the Organization assesses and assists in sustainable development and improvement of the performance. Capacity Building involves more than training. It should be a strategy that involves a long time vision towards the enhanced production, modernization, and development of human resources leading to overall organizational objectives. In order to improve the efficiency of the navigation education & training in the field of inland navigation should be provided. Capacity building need to target at ensuring safety of vessels and providing safe and secured navigation on waterway. For fulfilling agenda, mandatory infrastructure, equipment and other requirements to be placed at appropriate locations.

#### **15.1 Financing Mechanism**

##### **15.1.1 Public Investment**

This type of funded projects are built, financed, operated and managed by government. Private participation could take place for nominal works. Under this method, investment in Infrastructure is undertaken, primarily, to increase public characters in the early stage of the development plan. Through initial capital investment in the public sector, a sense of security prevails and private investments are encouraged.

This method of financing is being discarded globally, unless the project is commissioned only for social needs or strategic needs (defense and security). There is a growing inclination, globally, for governments to focus on governance and all the business related or commercial activities should be left to the private sector. With time and globalisation, some of the items of necessity such as development of roads, railways, airports, educations (in some countries), etc. has been regarded as commercial activity. Private sector has been allowed to make investments in development of infrastructure and operation of project. Hence, the use of public progression method of financing has been limited by government depending upon the local laws and economy of country including funds available with government.

##### **15.1.2 Private Investment**

The investment from government institutions will be utilized to support the infrastructure industry in distress. A grant or concessional loan will be provided from advanced nations to countries that are still under development. The projects that are usually invested under private initiative are used for small and medium-sized projects, not large infrastructure projects.

### 15.1.3 Public-Private Partnership

Public Private Partnership model is a actual or notional partnership between government and private developer to develop the project. In this model, private party commits to provide specific service by assuming all financing, technical and operational risk of the project and government provides the right to build on waterway, connecting roads, evacuation, etc. The Public-Private Partnership method is the most advantageous, for the government to supplement its limited financial resources at its disposal with private funds, while obtaining strategies of those businesses.

The private developer finds it attractive to fund only projects that are commercially viable on a stand-alone basis (i.e. the project after commissioning should generate enough funds to be sustainable and recover initial investments). The private developer makes initial investments using their own and borrowed funds. The initial investment of the project along with annual operation and maintenance cost is recovered over a period of time from the income generated by project. There could be some income from tourism activity induced by the proposed inland water transportation.

Government intervention is needed for projects that are commercially not viable. However, needed in the country due to strategic and social needs of the country. For such projects, government has come up with Viability Gap Funding (VGF) scheme. Under this scheme, government could provide some funds to fill the financial gaps that is rendering project commercially unviable. With government support project becomes commercially viable and attracts investors. Ministry of Finance takes care of this scheme and project mount id provided by annual budget. Usually central government grants maximum 20% of total capital cost and this can be clubbed with additional 20% grant by state government. IWT project would fall in the category where government support is inevitable. This is primarily due to very high project cost.

#### 15.1.3.1 PPP Funding Mechanism

Different types of funding options that can be exercised for development of NW 49 is presented in the following tables.

**Table 15.1 Different types of funding mechanisms**

Types	Funding Mechanism Description	IWT Project
Full Government Funding	Government provides whole funding for the project, considering the associated risks in return.	Yes

Types	Funding Mechanism Description	IWT Project
Government Supported Funding	Private sector provides all debt during construction period, with government taking 70% of debt after construction completion	Yes
	Public sector provides all the debt to the project and then receives credit guarantees from banks that mean the government is repaid in the event of a default.	
Viability Gap Funding (VGF)	Government (Centre & State) invest maximum 40 % of total capital cost in any PPP Project in name of VGF/Subsidies.	Yes
Co Funding Mechanism	Government provides a proportion (50%) of the total funding requirement as a loan at very low rate of interest.	Yes
Capital Contribution Mechanism	Government provides a capital, either through payment of portion of total capital costs, or by providing an element of the works (enabling works) in order to reduce the funding requirement for the private sector.	No

To facilitate unhindered private investment, IWAI can earmark some incentives, in the form of VGF/Subsidies, and attract more private parties in bid participation. The inland waterways project involves significant investment/operating cost, and such a backing from government could prove critical in presenting the project as a lucrative business opportunity to the private sector.

Below Table describes, in brief, different types of PPP models that are taken into consideration for the Development of River Jhelum (NW 49).

**Table 15.2 - PPP Models description**

Types of PPP Models	Reasons
Management contract	Management Contract, Design Build (DB) and Operation & Maintenance (O & M) are applicable because government is ready to invest 100 % for the project in respective models. As the project is high capital intensive, therefore, government is willing to initiate the project for the development of NW 49 (Jhelum River).
Design Build (DB)	
Operation & Maintenance (O & M)	

Source: By Analysis

Taking into account the project specificities, and the prevailing conditions that govern it, Below Table proposes a shortlist of PPP models that will benefit river Jhelum NW 49 Project.

## 15.2 Modalities of IWAI

Inland Waterways Authority of India as the nodal agency for development of national waterways including River Jhelum (NW-49) would require involvement of several departments for successful development of transportation on river Jhelum (NW 49). These departments would involve a combination of government and private entities including various government departments and local district administration where the terminals are proposed. Some of the critical stakeholders for development of River Jhelum (NW-49) would include financial agencies, stakeholders predominantly Irrigation & Flood department, local residents, tourists etc. The policy development for creation of infrastructure, ensuring its functional and safety requirement along with regular upgradation would have to be undertaken by IWAI.

IWAI would like to encourage private participation in the development of Terminals and other associated infrastructure for development of NW-49. IWAI would only play a role of facilitator and regulator. It would invite private developers and operators to bid for the project wherever it would be commercially viable. However, IWAI would have to make investments in high capital investment areas wherever a private developer is unlikely to make any investment due to lack of favourable financial returns. However, IWAI would be responsible to make whole stretch of NW-49 navigable for waterway movement.

Following charts and tables have been drawn to showcase likely scenario for investment modalities for development of various infrastructure on NW-49. The indication for selection on one model over other has been made based on funding mechanism for the project along with the benchmarks of past developments and practices followed in ports, terminals and navigation channel developments in Rivers of India as well as Sea ports in India.

**Table 15.3 Financing under PPP Models for development of NW 49**

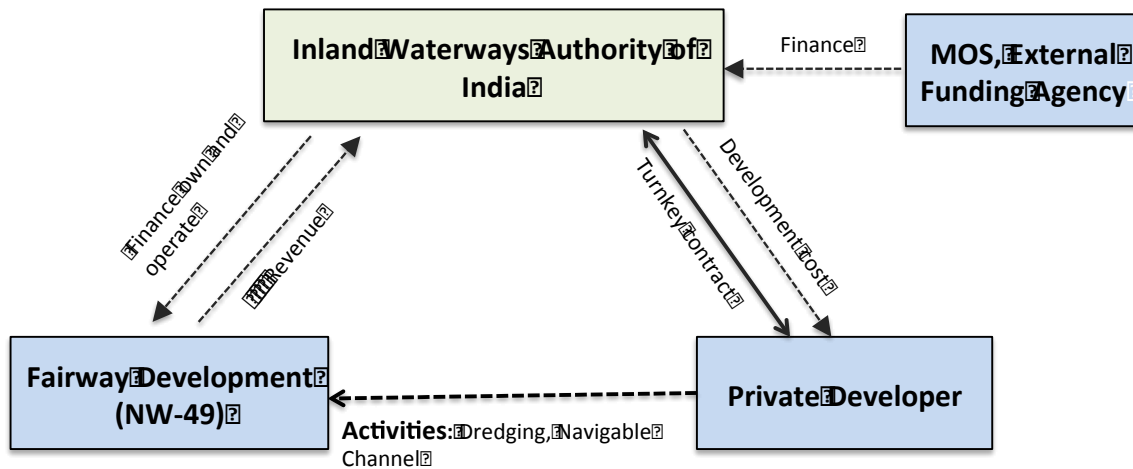
Types of PPP Models	Applicable for IWT	Facility
Design Build	✓	Fairway Development
Operation & Maintenance	✓	Terminal Development
Management contract	✓	
Design Build Finance Operate	✗	N.A
Build Own Operate	✗	N.A
Build Operate Transfer	✗	N.A
Build Own Operate Transfer	✗	N.A

Types of PPP Models	Applicable for IWT	Facility
Build Operate Lease Transfer	✘	N.A
Lease Develop Operate	✘	N.A

Source: Consultant's Analysis

### 15.3 Fairway Development

Development of fairway for round the year navigability of NW-49 (River Jhelum) is the most essential part of waterway transportation. Fairway consists maximum capital cost in case of water transportation, among the total stretch of the river.



**Figure 15.1 Modality for Fairway Development**

Source: Consultant's Analysis

The development of fairway as described in the figure above could be summarized in the following.

- Private developer designs and builds infrastructure on Government funding and transfer facility to government body after completion of development
- IWAI would provide funds for development of Fairway of NW 49.
- IWAI could either operate & maintain fairway on its own or it could commission a Project Management Unit (PMU) to manage it on its behalf for a fixed cost.

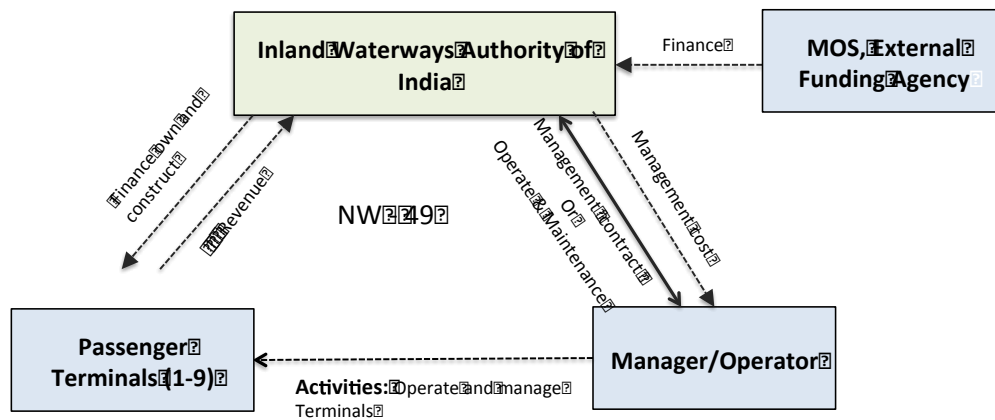
Development of River Jhelum (NW-49) for transportation would require dredging, river navigation system, etc.

There has been no precedence of waterway development and fairway development under PPP, worldwide. As, there exists uncertainty in maintaining desired depth of river due to siltation. This segment of waterway development has very high risk associated with it. The silt below water keeps shifting. Hence, even maintenance dredging would be expensive. Thus, due to above-mentioned reasons, it is very unlikely that any private investor would show interest in fairway development work.

Hence, navigation development by Inland Waterways Authority of India would have to be made using Design and Build system. It is the basic contract system in which Government awards the contract to private party for creation of infrastructure. Entire 100% investment under design and build contract is provided by government.

#### 15.4 Passenger Terminals – Local

Terminals developed for passenger & tourism transportation locally operates on a very small scale. The main principle behind development of NW 49 is social benefits rather than profit maximization. Several similar passenger terminals are developed by various government authorities such as MMB in Maharashtra & Capt. of Ports in Goa etc. These terminals have traffic of local residents and tourists.



**Figure 15-2 Modality for Development of Passenger Terminals**

Source: Consultant’s Analysis

The operation of terminals could be summarized as below

- IWAI would hire a Private Operator for management
- Operator / Manager is given a fixed fee for his services
- IWAI retains the ownership of facility & infrastructure at Passenger Terminals
- The private operator would have to deploy passenger ferries for local movement of passengers & tourists.

## CHAPTER – 16 PROJECT COSTING

### 16.1 General and Financial Assumptions

The technical aspects of development of National Waterways for handling of the projected traffic are dealt with in the previous chapters. In the present chapter project cost estimates has been done. In order to arrive at capital cost for the proposal it is necessary to ascertain, for budgetary purposes, unit rates of materials used for construction, dredging etc. Accordingly, efforts were made to obtain the above information from the relevant sources.

### 16.2 Basis of Costing

An estimate of the capital cost of various facilities is made. The cost arrived at are based on the budgetary quotes and the in house data base available on cost estimates. The rates for various items of work have been prepared on the basis of current rates for various items of work prevailing in the region.

The items and costs have been arrived at broadly on the following:

- Rates taken from current works of similar nature
- Updated rates of work of similar nature completed in the recent past.
- Consultant's in house data bank of cost estimates and budgetary quotations.

The rates for preparation of cost estimates for the scheme have been worked out based on J&K Schedule of Rates 2012 sanctioned vide Govt. Order No: 198-PW(R&B) of 2013 Dated: 13-06-2013 and applicable w.e.f. 1.6.2013. An escalation of 50% has been considered over the scheduled rates on account of price escalation for 5 years. The general cost abstract and detailed cost estimates have been prepared as per the general guidelines.

### 16.3 Development Cost

Development cost of waterway in Jhelum River is given as below:

Waterway development cost includes;

- Land Acquisition
- Dredging

- Bank Protection
- Aids to Navigation
- Civil Works including Land Acquisition for terminals
- Mechanical Handling Facilities
- Miscellaneous

#### 16.4 Capital Expenditure

The estimate of capital cost is made for the various items of civil, mechanical, electrical and utilities works for the development of terminals in the waterway stretch, cost estimate is presented in Table 16.1 to Table 16.3.

The capital cost worked out is excluding the cost of demolition and reconstruction of bridges.

**Table 16.1: Capital Cost Estimate (Phase-1)**

<b>PHASE-I</b>		
<b>A</b>	<b>Capital Cost</b>	<b>In Crores</b>
<b>(I)</b>	<b>Civil Cost</b>	
	<b>Terminals</b>	
<b>T1</b>	<i>Pantha Chowk(50x5)-Floating</i>	1.68
<b>T2</b>	<i>Zero Bridge(50x5)-Floating</i>	1.68
<b>T3</b>	<i>AmiraKadal(50x5)-Floating</i>	1.68
<b>T4</b>	<i>Shah-e-HambamBridge(50x5)-Floating</i>	1.68
<b>T5</b>	<i>SafaKadal/Chattabal(50x10)-Floating</i>	1.68
	<b>Bank Protection</b>	8.81
	<b>Land Cost</b>	6.40
	<b>Infrastructure Reqt</b>	11.45
	<i>Total Cost(I)</i>	35.07
	3% Contingencies and 7% Supervision charges on Base cost	3.51
	<b>Total Civil Cost</b>	<b>38.57</b>
<b>(II)</b>	<b>Navigation &amp; Communication Cost</b>	
<b>(A)</b>	DGPS	1.00
<b>(B)</b>	Marine Lantern/Buyos (11 nos.)	0.22
<b>(C)</b>	RIS	4.93
	<i>Total Cost(II)</i>	6.15
	3% Contingencies and 7% Supervision charges on Base cost	0.61
	<b>Total Navigation &amp; Communication Cost</b>	<b>6.76</b>
<b>(III)</b>	<b>Handling Equipments</b>	
	Mechanical & electrical	2.5

PHASE-I		
A	Capital Cost	In Crores
	3% Contingencies and 7% Supervision charges on Base cost	0.25
	<b>Total Handling Equipments Cost</b>	<b>2.75</b>
(IV)	Other cost including financing cost and interest during construction (10% of (I))	3.86
	<b>Total Cost ( (I)+(II)+(III)+(IV)</b>	<b>51.94</b>
(V)	<b>Dredging</b>	
	Dredging (0.05 Mm3)	0.99
	Total Cost	
	<b>Total Capital Cost</b>	<b>52.94</b>

Detailed BOQ for the capital cost estimate is given in Annexure-II.

Table 16.2: Capital Cost Estimate (Phase-2)

PHASE-II		
A	Capital Cost	In Crores
(I)	<b>Civil Cost</b>	
	<b>Terminals</b>	
T6	Sangam(60x10)-Concrete	3.89
T7	Gund Prang(60x10)-Concrete	3.84
T8	AmiraKadal(50x5)-Floating	1.68
	<b>Bank Protection</b>	6.06
	<b>Land Cost</b>	3.81
	<b>Infrastructure Reqt</b>	9.90
	<i>Total Cost(I)</i>	29.18
	3% Contingencies and 7% Supervision charges on Base cost	2.92
	<b>Total Civil Cost</b>	<b>32.10</b>
(II)	<b>Navigation &amp; Communication Cost</b>	
(A)	DGPS	1.00
(C)	Marine Lantern/Buyos (45 nos.)	0.90
(D)	RIS	4.93
	<i>Total Cost(II)</i>	6.83
	3% Contingencies and 7% Supervision charges on Base cost	0.68
	<b>Total Navigation &amp; Communication Cost</b>	<b>7.51</b>
(III)	<b>Handling Equipments</b>	
	Mechanical & electrical	1.9
	3% Contingencies and 7% Supervision charges on Base cost	0.19
	<b>Total Handling Equipments Cost</b>	<b>2.09</b>

PHASE-II		
A	Capital Cost	In Crores
(IV)	Other cost including financing cost and interest during construction (10% of (I))	3.21
	<b>Total Cost ( (I)+(II)+(III)+(IV)+(V)</b>	<b>44.91</b>
(V)	<b>Dredging</b>	
(A)	Dredging (0.73 Mm3)	21.10
	Total Cost	
	<b>Total Capital Cost</b>	<b>66.00</b>

Detailed BOQ for the capital cost estimate is given in Annexure-II.

**Table 16.3: Capital Cost Estimate (Phase-3)**

PHASE-III		
A	Capital Cost	In Crores
(I)	<b>Civil Cost</b>	
	<b>Terminal Cost</b>	
T9	Sopore(50x5)-Floating	1.68
	<b>Land Cost</b>	0.56
	<b>Infrastructure Reqt</b>	1.90
	<b>Bank Protection</b>	1.27
	<i>Total Cost(I)</i>	5.41
	3% Contingencies and 7% Supervision charges on Base cost	0.54
	<b>Total Civil Cost</b>	<b>5.96</b>
	<b>(II) Navigation &amp; Communication Cost</b>	
(A)	DGPS	-
(B)	VTMS	-
(C)	Marine Lantern/Buyos (31 nos.)	0.62
(D)	RIS	-
	<i>Total Cost(II)</i>	0.62
	3% Contingencies and 7% Supervision charges on Base cost	0.06
	<b>Total Navigation &amp; Communication Cost</b>	<b>0.68</b>
(III)	<b>Handling Equipments</b>	
	Mechanical & electrical	1.3
	3% Contingencies and 7% Supervision charges on Base cost	0.13
	<b>Total Handling Equipments Cost</b>	<b>1.43</b>
(IV)	Other cost including financing cost and interest during construction (10% of (I))	0.60
	<b>Total Cost ( (I)+(II)+(III)+(IV)+(V)</b>	<b>8.66</b>
(V)	<b>Dredging</b>	
(A)	Dredging (0.8 Mm3)	18

PHASE-III		
A	Capital Cost	In Crores
	Total Cost	
	<b>Total Capital Cost</b>	<b>26.55</b>

Detailed BOQ for the capital cost estimate is given in Annexure-II.

## 16.5 Operation and Maintenance Expenditure

The annual operation and maintenance cost on different components of the project will be dependent on a number of variables such as the life of the component, repair and maintenance requirements, wages of crew of consumables, etc. Hence, accurate assessment of cost is not possible. Further even if all the variables are fixed such as the maintenance schedules for each structure and equipment is determined, crew strength is fixed, requirement of consumables quantified, etc., the estimation of O&M costs cannot be precise because of unpredictable breakdowns incurring considerable expenditure on repairs and replacement. The only practicable approach in this scenario is to fix the annual repair expenditure as a percentage of capital cost of project. This percentage is to be fixed on the basis of the past performance of similar structures and equipment functioning in the project or elsewhere under similar marine conditions.

Based on above criteria, the annual maintenance cost is estimated as a percentage and is presented in Table 16.4 and Table 16.6.

**Table 16.4 Operation & Maintenance Cost (Phase-1)**

Phase-I		
S.No.	O & M Cost	In Crores
(i)	Dredging @ 10%	0.10
(ii)	Civil works @ 1%	0.20
(iii)	Mechanical & Electrical Cost @ 5%	0.125
(iv)	Ports Crafts/Nav. Aids @ 5%	0.34
(v)	Fuel Cost	2.50
(vi)	Power Cost	2.50
(vii)	Manpower Cost	7.00
(viii)	Miscellaneous	5.00
	Total	17.76

**Table 16.5 Operation & Maintenance Cost (Phase-2)**

Phase-II		
S.No.	O & M Cost	In Crores
(i)	Dredging @ 10%	2.11
(ii)	Civil works @ 1%	0.16
(iii)	Mechanical & Electrical Cost @ 5%	0.095
(iv)	Ports Crafts/Nav. Aids @ 5%	0.34
(v)	Fuel Cost	1.50
(vi)	Power Cost	1.50
(vii)	Manpower Cost	4.40
(viii)	Miscellaneous	5.00
	<b>Total</b>	<b>15.10</b>

**Table 16.6 Operation & Maintenance Cost (Phase-3)**

Phase-III		
S.No.	O & M Cost	In Crores
(i)	Dredging @ 10%	1.79
(ii)	Civil works @ 1%	0.03
(iii)	Mechanical & Electrical Cost @ 5%	0.0715
(iv)	Ports Crafts/Nav. Aids @ 5%	0.34
(v)	Fuel Cost	0.50
(vi)	Power Cost	0.50
(vii)	Manpower Cost	1.47
(viii)	Miscellaneous	5.00
	<b>Total</b>	<b>9.70</b>

## CHAPTER –17 INSTITUTIONAL REQUIREMENTS

### 17.1 Organizational Set up / Establishment

The Authority envisaged is Navigational waterway maintenance, transportation enterprise dealing with passenger and cargo handling, transit and transfer as well as being an administrative unit and an organ of Government which implements Government policies. This organization should integrate administrative functions with operation, maintenance and development function and run this enterprise on sound Business Management Principals. The set up should also have jurisdiction and control over all other Government, Public and Private Vessel Operators on the River Jhelum (NW-49)

Other Government, Public and Private Parties can be allowed to carry on their present business as usual but under the administrative control on IWAI which frames rules and regulations for such operation.

This envisages setting up of Inland Waterway Authority construction and maintenance division for River Jhelum with its headquarters at Srinagar.

The Inland waterway authority will specifically control and will be responsible for following in River Jhelum (NW-49).

- Developing and maintaining navigable waterway.
- Enforcement of rules and regulations of IWT Act.
- Channel Patrol.
- River route survey
- Issue of river notices, river, chart, river warnings
- Rescue and salvage operations on route.
- River training and maintenance works such as bandalling, bottom – paneling, dredging, bank protection etc. required to the extent of maintaining navigable waterway - **By Irrigation & Flood Control Department (J&K)**
- Registration of vessels and issue of certificate of survey (compulsory for any sailing vessel)- **By Tourism Department kashmir**
- Issuing certificate of competency to masters, seamen, watch-keeping officers, engineers and to all the crew members of the sailing vessel. **By Tourism Department kashmir**
- Policing the waterway through patrol and police boats. Checking, catching and prosecuting offenders, cancellation of registration certificates and taking other appropriate legal action.
- Providing pilotage to vessels wherever required.

- Levy and collection of vessel registration fee which will be related to capacity of vessels and river route it travels. (Normally this levy will be related to river route development and maintenance expenditure).
- Operation and maintenance of terminals run by IWAI and collection of berthing, handling and storage charges.
- Operation and levy of pilotage charges on river route.
- Operation and maintenance of various vessels, equipments and other facilities owned by IWAI.
- Maintaining liaison with Irrigation & Flood Control Department (J&K) Waterway Authorities to ensure smooth passage of vessels and loading / unloading of cargo.
- Purchasing new equipment/ floating craft as and when required.
- Planning and developing new terminals in Kashmir depending on traffic and additions to existing terminals, fleet and other facilities.
- Liaison with various concerned organization to ensure efficient functioning.
- Business development and expansion of facilities.
- Financial/ administrative/ technical control of operations with a view to raise efficiency, reduce cost and accomplish better handling.

To implement above responsibilities, staff requirement is suggested in chart 10.1

The administrative function and jurisdiction of various departments are briefly described below:

**Director:** The organization setup of Inland Water Transport division of River Jhelum shall be headed by a Director who will have his headquarters at Srinagar. He will be in charge of all constructions, operation and maintenance works assisting the Director is carrying out the tasks are given in Table 10.2 and the specific tasks of some key personnel are detailed below:

### 1) Repairs Division

Dy. Director (Repairs) heads this division. The main function of this division is to maintain the floating crafts owned by IWAI in working order. Minor repairs are carried out by the Departmental personnel and vessels will be sent to different repair yards if in need of major repair or overhauling. Adequate stocks of spares are kept in ready stock by timely ordering and procurement of same. Fuel and lubricants required for operation will be arranged by the division. Replacement or additional vessels if required will be arranged by division.

### 2) Waterway Maintenance Division

For effective maintenance waterway the river stretch will be under the joint administrative control of Deputy Director and Senior Hydrographic Surveyor. The

major task of this group is to maintain the waterway navigable. The following tasks are entrusted to Deputy Director and Senior Hydrographic Surveyor.

**Dy. Director:** Deputy Director will be incharge of dredging works, patrol tasks, security of waterway, pilotage and salvage duty.

This department will perform specifically following tasks:

- Patrolling the navigational waterway and gathering information on status of waterway and transmitting this information to barge operators on the route.
- Finding and marking best channel for navigation and clearing these channels of obstructions.
- Checking on observation of rules and regulations of waterways and bring to book the offenders.
- Go to rescue of boats in distress.
- Maintenance of river training work such as bank protective works, bandalling works, bottom paneling works etc. (normally major works are contracted out).
- Maintain required minimum depth in the waterway by dredging the shallow patches wherever required.
- Pilot the cargo boats in difficult reaches.
- Legal enforcement of rules and regulations by catching offenders and legally prosecuting them.
- Operating and maintain communication equipments.

**Senior hydrographic surveyor:** The task will include checking the water levels, changes in channels, checking position of marking systems and buoys, collection of morphological data, regular cross section soundings and bank levels, discharge measurements etc. This department would make available to barge operators on daily basis following information in the form of river notice and over radio contact.

- Water level at fixed gauge stations.
- Available depth for particular river section in their command and the location of shallowest place/ stretch.
- General information on changes in channels and marking system.
- Execution of river works, dredger location etc. Route mapping shall be carried out on regular basis once in two to three weeks and charts issued to barge operators immediately. Their tasks include maintaining the system of channel marking, buoys and beacons.

### 3) Terminals

Each terminal will be under the control of Terminal Manager. Terminal Manager will be responsible for operation and maintenance of the terminal. Their tasks include:

- Operations and maintenance of all mechanical handling equipment.
- Berthing and deberthing of cargo and passenger vessels.
- Loading and unloading of cargo vessels.
- Storage and dispatch of cargo
- Collection of berthing, handling, handling and storage charges.
- Operation and maintenance of all utilities in the terminal area.
- Terminal security and communication.

### 17.2 Man Power Requirement

Man power requirement for Development of waterway in River Jhelum includes for terminal operations and departmental requirement. Departmental regional office will be set up at Srinagar. Every terminal will require institutional setup for proper functioning of terminal operations. Terminal manager will be the head at terminal responsible for overall terminal operations.

S.No.	Staff detail	No. of Personnel Required Phase-1	No. of Personnel Required Phase-2	No. of Personnel Required Phase-3
1	TERMINAL MANAGER	5	3	1
2	ADM OFFICER	5	3	1
3	OPERATION MANAGER	5	3	1
4	MAINTENANCE MANAGER	5	3	1
5	SURVEYOR	5	3	1
6	Mechanical	10	6	2
7	Civil	10	6	2
8	Electrical	10	6	2
9	Office Staff			
	Clerical Staff	10	6	2
10	Security Staff	5	3	1
	<b>Total</b>	<b>66</b>	<b>42</b>	<b>14</b>

However, it is to be noted that River Jhelum (NW-49) can be allocated to **Irrigation & Flood Control Department** for development. In present case scenario, officer at level of assistant director and junior account officer at Head Office may be required to monitor various developments & monitoring of fund utilization.

### 17.3 Training Requirement / Capacity Building

Capacity Building is the process by which the Organization assesses and assists in sustainable development and improvement of the performance. Capacity Building involves more than training. It should be a strategy that involves a long time vision towards the enhanced production, modernization, and development of human resources leading to overall organizational objectives. In order to improve the efficiency of the navigation education & training in the field of inland navigation should be provided to the man power required.

#### Training Module

Dredging Technical Training  
 Safety training courses  
 Dredging management  
 Terminal Management & Operation Courses

### 17.4 Infrastructure

Establishment of Navigable, Administrative and other supporting infrastructure is one of the major requirements of this setup. Administrative office, security office, waiting room, ticket counter, shops, canteens, etc. are the immovable infrastructure that comes under one time construction. This involves capital and civil maintenance investment. While, movable infrastructure like equipment at terminals for traffic handling, vehicles, survey boats, etc. will be procured. The proposed movable infrastructure demands injection of maintenance and repair cost on regular basis.

### 17.5 Cost Implications

Cost implication for establishing institutional requirement will include salaries of employees deployed at terminals, navigational lock and regional offices. Institutional setup required for operation and maintenance of waterway, locks and terminals. Capacity building through education and training to the staff and employees will also have cost implications. Average annual salary of top management is taken as Rs1600000 (PB-4+ Rs. 8700). Average annual salary of officers and staff at Dy. Director, Terminal Managers offices is taken as 70000 (PB-3+ Rs. 5400).

#### Phase-1

Item	Quantity	Rate	Amount
Salaries(Top Management)	20	1600000	32000000
Middle Management	31	700000	21700000
Clerical Staff	10	400000	4000000
Unskilled	5	120000	600000
Misc	Lump sum(20%)		11660000
Total(Annual)			69960000

### Phase-2

Item	Quantity	Rate	Amount
Salaries(Top Management)	12	1600000	19200000
Middle Management	21	700000	14700000
Clerical Staff	6	400000	2400000
Unskilled	3	120000	360000
Misc	Lump sum(20%)		7332000
Total(Annual)			43992000

### Phase-3

Item	Quantity	Rate	Amount
Salaries(Top Management)	4	1600000	6400000
Middle Management	7	700000	4900000
Clerical Staff	2	400000	800000
Unskilled	1	120000	120000
Misc	Lump sum(20%)		2444000
Total(Annual)			14664000

## CHAPTER – 18 ECONOMIC AND FINANCIAL ANALYSIS

### 18.0 Cost-benefit analysis

Cost-benefit analysis (CBA), sometimes called benefit-cost analysis (BCA), is an economic decision-making approach, used particularly in government and business. CBA is used in the assessment of whether a proposed project, programme or policy is worth doing, or to choose between several alternative ones. It involves comparing the total expected costs of each option against the total expected benefits, to see whether the benefits outweigh the costs, and by how much.

In CBA, benefits and costs are expressed in money terms, and are adjusted for the time value of money, so that all flows of benefits and flows of project costs over time (which tend to occur at different points in time) are expressed on a common basis in terms of their "present value." This is often done by converting the future expected streams of costs and benefits into a present value amount using a suitable discount rate.

### 18.1 Revenue

A major source of revenue should arise from the passenger cargo. Their traffic projection is given in the table below.

**Table 18.1 Traffic Projections for various terminals**

Jhelum Phase-1 (Fig in Lakhs)						
Passengers	FY 22	FY 27	FY 32	FY 37	FY 42	FY 47
Traffic(Passenger in Nos.)	2,11,001	3,23,083	4,49,251	6,27,878	8,91,428	12,72,589
Revenue in Cr.	<b>0.71</b>	<b>1.1</b>	<b>1.5</b>	<b>2.1</b>	<b>3.1</b>	<b>4.4</b>

*Tariff assumed based on past ferry services rates/operation ferries rates*

Routes	Tariff (Rs. per Person)
<b>Local Travel - Srinagar</b>	
Pantha Chowk	60
Zero Bridge	50
Amira Kadal	25
Shah-e-Hamdan	25
Safa Kadal	25
<b>Long Distance</b>	
Srinagar - Sangam Bridge	220

Routes	Tariff (Rs. per Person)
Srinagar - Wular Lake	210
Srinagar - Sumbal	350
Srinagar to Sopore	140

**Table 18.2 (a) Revenue Details**

Phase 1	FY22	FY23	FY24	FY25	FY26	FY27
1. Pantha Chowk	760	838	925	1,020	1,124	1,240
2. Zero Bridge	2,765	3,011	3,279	3,572	3,890	4,237
3. Amira Kadal	1,414	1,539	1,676	1,824	1,986	2,161
4. Shah-e-Hamdan	1,033	1,123	1,221	1,327	1,442	1,567
5. Safa Kadal/Chattabal Shrine	1,129	1,227	1,334	1,450	1,576	1,714

**Table 18.2 (b) Revenue Detail**

Phase 1	FY28	FY29	FY30	FY31	FY32	FY33
Pantha Chowk	1,341	1,451	1,569	1,697	1,836	1,986
Zero Bridge	4,526	4,836	5,167	5,520	5,897	6,301
Amira Kadal	2,308	2,464	2,631	2,809	3,000	3,203
Shah-e-Hamdan	1,671	1,781	1,898	2,023	2,157	2,299
Safa Kadal/Chattabal Shrine	1,827	1,948	2,077	2,214	2,361	2,517

**Table 18.2 (c) Revenue Detail**

Phase-1	FY34	FY35	FY36	FY37	FY38	FY39
Pantha Chowk	2,148	2,324	2,514	2,719	2,971	3,247

Phase-1	FY34	FY35	FY36	FY37	FY38	FY39
Zero Bridge	6,732	7,192	7,684	8,209	8,817	9,470
Amira Kadal	3,420	3,652	3,899	4,163	4,467	4,793
Shah-e-Hamdan	2,451	2,612	2,785	2,968	3,176	3,398
Safa Kadal/Chattabal Shrine	2,684	2,862	3,051	3,253	3,482	3,727

**Table 18.2 (d) Revenue Detail**

Phase-1	FY40	FY41	FY42	FY43	FY44	FY45	FY46
Pantha Chowk	3,548	3,877	4,237	4,630	5,059	5,529	6,041
Zero Bridge	10,171	10,924	11,733	12,602	13,535	14,537	15,613
Amira Kadal	5,143	5,518	5,921	6,353	6,817	7,314	7,848
Shah-e-Hamdan	3,636	3,890	4,162	4,453	4,765	5,098	5,455
Safa Kadal/Chattabal Shrine	3,990	4,270	4,571	4,893	5,237	5,606	6,000

## 18.2 Possible ancillary revenue

As far as now, there is no possible ancillary revenue.

## 18.3 Economic Analysis / EIRR

Economic analysis attempts to measure the overall impact of the project on improving the economic welfare of the citizens of the country. It would assess the project in context of national economy rather than project entity. Economic analysis of an investment proposed differs from the financial analysis in terms of identification of identification and evaluation of inputs and outputs and in measurements of cost benefits. Economic and Financial analysis shall be carried out for the feasible stretches.

The economic analysis would be carried out by determining the economic cost involved in the project and economic benefits being accrued with the development of project. The economic cost and benefits associated with a project ultimately leads to EIRR computation.

### Economic cost

For EIRR computation, economic cost shall be calculated as a percentage of total cost of project. The total cost for a project consists of capital cost during construction period and operation and maintenance cost over project life.

Capital costs generally involve:

- Land acquisition,
- Dredging,
- Bridges,
- Civil works,
- E & M works
- Navigational aids

### Economic benefits

The economic benefits that will accrue with the development of waterways shall be classified as:

- Employment benefits
- Fuel savings
- Carbon credits earned
- Other benefits such as accidents, noise, Traffic Jam & Pollution etc.

### Shadow Pricing

The value of Project cost and benefits have been expressed in terms of market prices. These prices do not reflect the real resource cost and value of benefits derived from the project to the economy. The market prices are distorted due to variety of factors. These factors could be controlled/administered prices of inputs, monopolistic market of inputs, Tax structure etc. The factors used for converting project inputs and outputs to economic costs are given in following Table:

**Table 18.3 Shadow Pricing**

S. No	ITEM	FACTOR
1	Capital Cost	0.67
2	Operations & Maintenance Cost	0.67

Considering life of project to be 30 years, the **EIRR analysis** is shown in table 18.3:

**Table 18.4 EIRR Analysis**

Cases considered	EIRR
Phase 1	-ve

## 18.4 Financial Analysis / FIRR

For projects involving heavy investment, it becomes very important to analyze the benefits of owner i.e. IWAI/ Govt. & users, i.e. Barge/ ship operators who would use the IWT facility as compared to other modes of transport. FIRR shall be evaluated for IWAI/ Government and Users (barge / Ship operators).

### FIRR for IWAI / Govt.

The financial analysis shall be carried out to drive possible levy charges per tonne kilometer of cargo transported through IWT that IWAI / Govt may levy to recover the costs of project from users. For calculations, economic cost along with cargo projection shall be considered for various scenarios.

### FIRR for Barge/Ship operators

The development of waterway that include heavy investments is completely defined and meaningful if the user or Barge operator is getting minimum financial benefits as compared to other modes and is therefore attracted to invest money and time. The total cost to be invested by the barge operator may be classified as Capital cost and Operation and maintenance cost (O & M cost)

Capital/Initial cost depends upon the infrastructure proposed and depicts the future planning. A high initial cost may act as burden on the operator and therefore phase-wise development of all infrastructure and allied facilities shall be proposed.

The running profits are usually governs by less operating cost and operational viability. Operating viability depends upon various factors as:

- Vehicle costs,
- Fuel costs
- Crew costs / Administrative expenses
- Repair and Maintenance costs
- Loading Unloading costs
- Cost of insurance
- Manpower cost

### Phase: 1

Considering life of project to be 30 years, the **FIRR analysis** is shown in table 18.4:

### O&M Cost

**Table 18.4: O&M Cost**

S.NO.	O & M Cost	In Crores
(i)	Dredging @ 10%	0.10
(ii)	Civil works @ 1%	0.20
(iii)	Mechanical & Electrical Cost @ 5%	0.125
(iv)	Ports Crafts/Nav. Aids @ 5%	0.34
(v)	Fuel Cost	2.50
(vi)	Power Cost	2.50
(vii)	Manpower Cost	7.00
(viii)	Miscellaneous	5.00
	<b>Total</b>	<b>17.76</b>

## Revenue

**Table 18.5: Revenue**

Jhelum Phase-1						
Passengers	FY 22	FY 27	FY 32	FY 37	FY 42	FY 47
Traffic(Passenger in Nos.)	2,11,001	3,23,083	4,49,251	6,27,878	8,91,428	12,72,589
Revenue in Cr.	<b>0.71</b>	<b>1.1</b>	<b>1.5</b>	<b>2.1</b>	<b>3.1</b>	<b>4.4</b>

**Table 18.6 FIRR Analysis**

Charges	FIRR
As mentioned above	-ve Return

## 18.5 Risk Factors

Pre-operative task risks	
External linkages	Refers to the risk that adequate and timely connectivity to the project site is not available, which may impact the commencement of construction and overall pace of development of the project.
Financing risks	Refers to the risk that sufficient finance will not be available for the project at reasonable cost (eg, because of changes in market conditions or credit availability) resulting in delays in the financial closure for a project.

Planning risks	Refers to the risk that the pre-development studies (technical, legal, financial and others) conducted are inadequate or not robust enough resulting in possible deviations from the outcomes that were planned or expected in the PPP project development.
<b>Construction phase risks</b>	
Design risk	Refers to the risk that the proposed design will be unable to meet the performance and service requirements in the output specification. It can result in additional costs for modification and redesign.
Construction risk	Refers to the risk that the construction of the assets required for the project will not be completed on time, on budget or to specification. It may lead to additional raw materials and labour costs, additional financing costs, increase in the cost of maintaining existing infrastructure or providing a temporary alternative solution due to a delay in the provision of the service.
Approvals risk	Refers to the risk that delays in approvals to be obtained during the construction phase will result in a delay in the construction of the assets as per the construction schedule. Such delays in obtaining approvals may lead to cost overruns
<b>Operation phase risks</b>	
Operations and maintenance risk	Refers to the risks associated with the need for increased maintenance of assets or machinery over the term of the project in order to meet performance requirements. In a brownfield PPP, where the private partner takes over operation of existing assets, O&M risk is very sensitive to the starting condition of the assets. In this case the private operator's O&M risk is related to the risk of poor or incomplete information about the quality of the assets that it will take over.
Volume risk	Refers to the risk that demand for water or sanitation services will vary from the initial forecast, such that the total revenue derived from the project over the project life

	will vary from initial expectations.
Payment risk	Refers to the risk that charges for services are not collected in full or are not set at a level that allows recovery of costs. Who bears the payment risk depends on whether the charges for services are paid directly by users, or are paid by the municipality. If charges are paid by the municipality (via taxes) the public sector bears this risk.
Financial risk	Refers to the risk that the concessionaire introduces too much financial stress on a project by using an inappropriate financial structure for the privately financed components of the project. It can result in additional funding costs for increased margins or unexpected refinancing costs.
Performance risk	This is a risk that the quality of services delivered will not meet the performance standards agreed in the Concession Agreement. The Concession Agreement should stipulate penalties or compensation terms in this case.
Environmental risk	Refers to the risk of environmental damage in excess of what is planned for in the environmental impact mitigation plan. For example, ground water pollution from sewerage release.
<b>Handover risks</b>	
Handover risk / Terminal value risk	Refers to the risk that the concessionaire will default in the Handover of the asset at the end of the project life, or that it will fail to meet the minimum quality standard or value of the asset that needs to be handed back to the public entity. This risk (and terminal value risk) generally relates to concession and BOT type PPPs. However, it may also be relevant to performance based management contracts in which the private partner is responsible for investing in meters.
<b>Other risks</b>	
Change in law	Refers to the risk that the current legal / regulatory regime will change, having a material adverse impact on the project.

Force Majeure	Refers to the risk that events beyond the control of either entity may occur, resulting in a material adverse impact on either party's ability to perform its obligations under the PPP contract. These events are sometimes also called "Acts of God", to indicate that they are beyond the control of either contracted party.
Concessionaire risk	Refers to the risk that the concessionaire will prove to be inappropriate or unsuitable for delivery of the project, for example due to failure of their company.
Sponsor risk	Refers to the risk that the Sponsor will prove to be an unsuitable partner for the project, for example due to poor project management or a failure to fully recognise the agreed terms of the Concession Agreement.
Concessionaire event of default	Refers to the risk that the concessionaire will not fulfil its contractual obligations and that the public Sponsor will be unable to either enforce those obligations against the concessionaire, or recover some form of compensation or remedy from the concessionaire for any loss sustained by it as a result of the breach.
Government event of default	Refers to the risk that the public Sponsor will not fulfil its contractual obligations and that the concessionaire will be Unable to either enforce those obligations against the Sponsor, or recover some form of compensation or remedy from the Sponsor for any loss sustained by it as a result of the breach.

### 18.6 Necessity of Govt. support (VGF/PPP)

The guide lines were notified by the ministry of finance, department of economic affairs for financial support to infrastructure project that are to be undertaken through Public Private Partnerships (PPP).

Proposal is to be made under this scheme shall be considered for providing Viability Gap Funding (GAF), one time or deferred with the objective of making a PPP project commercially viable.

The proposal shall relate to a public private partnership (PPP) project which is based on a contract or concession agreement between a Government or statutory entity (Inland

Waterways Authority of India) on the one side and a private sector company on the other side, for delivering an infrastructure service on payment of user charges.

This scheme will apply only if the contract/concession is awarded in favour of a private company in which 51% or more of the subscribed and paid up equity is owned and controlled by a private entity.

A private sector company shall be eligible for VGF only if it is selected on the basis of open competitive bidding and is responsible for financing, construction, maintenance and operation of the project during concession period.

The project should provide a service against payment of a predetermined tariff or user charge.

The proposal for seeking clearance of the Empowered Institution shall be sent (in six copies, both in hard and soft form) to the PPP cell of the Department of Economic Affairs in the prescribed format. The proposal should include copies of all project agreements (such as concession agreement, state support agreement etc.) and the project report.

Once cleared by Empowered Institution, the project is eligible for financial support.

Financial bids shall be invited by the concerned ministry, state Government or statutory entity, as the case may be, for the award of the project within four months of the approval of the Empowered Institution. This period may be extended by the Department of Economic Affairs.

The private sector company shall be selected through a transparent and open competitive bidding process. The criterion for bidding shall be the amount of VGF required by a private sector company where all other parameters are comparable.

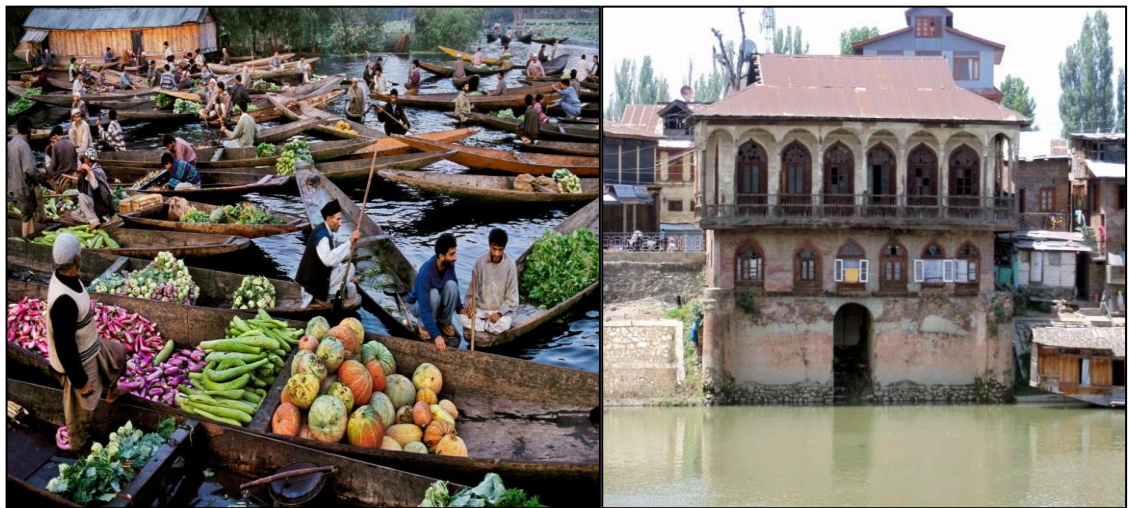
## CHAPTER – 19 SWOT ANALYSIS

### 19.1 Introduction

**SWOT analysis** is a framework used to evaluate a project strengths, weaknesses, opportunities and threats. Specifically, **SWOT analysis** is a foundational assessment model that measures what project can and cannot do, and its potential opportunities and threats.

### 19.2 STRENGTH:

- (1) History of navigation in river Jhelum. Ghats at various locations are present alongside of river.



- (2) Good water availability
- (3) People are showing good response in IWT as road transport is not well developed.
- (4) Narrow roads in Srinagar, which creates havoc especially during summer.



- (5) Kashmir has been tourist destination.
- (6) Presence of historical sites along river Jhelum.

**19.3 WEAKNESS:**

- (1) Stretch from Zero Bride to chatabal weir is full of garbage. People use to dump all household related garbage at banks & inside the river.



- (2) Swirls due to non-clearance of debris are present at maximum bridges in River Jhelum. This is very dangerous for river navigation



- (3) Swirls due to left out items at construction site. They are causing lot of swirls.



- (4) In general practice, locals uses rope for sand mining, Rope along the width of river cause hindrance during navigation.



(5) Re-occurring Complex Problem of Flood



(6) Locals are using Jhelum as dump yards. Also, Sewage is dumped without prior treatment, causing unhygienic condition in the river.



- (7) Presences of 60 bridges across river Jhelum are major problem.
- (8) Unstable conditions in Jammu & Kashmir. Frequent strikes and local shutdowns are major problem.
- (9) Banks are untidy and almost full of garbage. They are causing very unhygienic condition especially in Srinagar city.



- (10) Monuments nearby Banks are deteriorated and non- functional.
- (11) No Proper Lighting throughout Jhelum River because of the same reason earlier attempt by state government in IWT was unsuccessful.

#### 19.4 THREATS:

- The width of Jhelum River is narrow. Hence, any motorized boat sailing at high speed creates ripple effects of water in the river and the banks. This adversely affects the banks of the river and the houseboats stationed near them. This is one of the biggest threats which have to be considered before planning boating activities in Jhelum. The owners and residents of houseboats normally protest and advise the boat owners to sail at a slow speed in such a way that there is no ripple effect of water in the river.
- Re-occurring floods are major threat to navigation, which involves loss of life and infrastructure.
- Unstable condition in Jammu & Kashmir. Stone pelting events had been recorded in last IWT projects by state government.
- Frequent shutdowns

## 19.5 SWOT AT GLANCE:

<p><b>Strength</b></p> <ul style="list-style-type: none"><li>• Good water availability</li><li>• Kashmir has been tourist destination</li><li>• Presence of historical sites along river Jhelum</li><li>• History of navigation in river Jhelum. Ghats at various locations are present alongside of river</li></ul>	<p><b>Weakness</b></p> <ul style="list-style-type: none"><li>• Bridges without sufficient horizontal &amp; vertical clearance</li><li>• Unstable conditions in Jammu &amp; Kashmir. Frequent strikes and local shutdowns are major problem.</li><li>• Sewage dumping without prior treatment.</li></ul>
<p><b>Opportunities</b></p> <ul style="list-style-type: none"><li>• Possibility of Tourism, recreational and local ferry services as number of tourist places and villages exist along river bank.</li><li>• Ample opportunities for food items</li><li>• Socio-Economic development of nearby project areas.</li></ul>	<p><b>Threats</b></p> <ul style="list-style-type: none"><li>• Social problem have been faced during reconnaissance survey.</li><li>• Maintenance of navigational channel</li><li>• Narrow width restricts speed boats as it causes ripples, which is biggest threat to shikaras.</li></ul>

## CHAPTER – 20 CONCLUSIONS & RECOMMENDATIONS

### 20.1 Conclusions & Recommendations:

WAPCOS has studied terminal locations in three phases at various places on the basis of traffic potential, water availability and land availability. The details of these terminals are given in table 20.1 below:

**Table 20.1: Phase-wise details of terminals**

Terminal No.	Tentative Location	Districts	Size	Chainage (km)
1	Pantha Chowk	Srinagar	50m x 5 m	133.20
2	Zero Bridge	Srinagar	50m x 5 m	122.36
3	Amira Kadal	Srinagar	50m x 5 m	121.07
4	Shah-e-Hambam bridge	Srinagar	50m x 5 m	117.91
5	Safa Kadal / Chattabal Shrine	Srinagar	50m x 5m	115.76
6	Sumbal Bridge	Ganderbal	50m x 5 m	91.90
7	Gund Parang	Bandipora	60m x 10m	74.42
8	Sangam Bridge	Anantnag	60m x 10m	179.60
9	Sopore	Baramulla	50m x 5 m	39.55

Phase wise details of waterway in terms of length of each phase, dredging quantity, proposed class is given below in Table 20.2.

**Table 20.2: Phase-wise details of length, dredging quantity, proposed class and bridges**

Sr.No	Phase	Stretch	Length of Waterway	Dredging (M.cum)	Class of Waterway
1	Phase-1	Chhatabal to Pantha Chowk	17.44 Km	46060	Special Class
2	Phase-2	Gund Parang to Sumbal	17.48 Km	19826	Class-1
	Phase-2	Sumbal to Chhatabal	23.86 Km	218248	Class-1
	Phase-2	Shah-E-Hambam to Sangam Bridge	61.69 Km	738618	Class-1
3	Phase-3	Sopore to Chhatabal	76.21 km	828210	Class-1

## Outcomes of study:

- 1) For development, Phase-1 has been recommended. Phase1 is from Chhatabal to Pantha Chowk (17.44 Km) exclusively for passengers.
- 2) The capital for execution ofPhase-1is Rs.
- 3) Cost of the dredging coming out to be approx. Rs. 8.33 Crores for Phase-1, Rs. 10.90 Crores for Phase-2 and NIL for Phase-3.
- 4) Negative FIRR is coming out as Revenue is less than O&M cost.
- 5) In all three Phases, IWT charges are more as compared to road transport. Hence, modal shift cannot be possible without subsidy from Govt.
- 6) The longitudinal slope of the river from Sangam to Wullar lake is comparatively uniform and thereby navigability can be achieved with ease. However, the bed elevations for the reach from Wullar exit to lower Jhelum HE project is comparatively varying and steeper. Hence, achieving navigability is difficult.
- 7) The Jhelum river reach of about 28 km from Wullar outfall near Ningli to LJHEP reservoir has some stretches with steep slopes and rapids. Even with discharge of 100 m<sup>3</sup>/s, depths of the order of 0.20 m to 1.80 m will prevail in this reach. Dredging in rocky bed may not be appropriate solution.
- 8) Impact of Dredging: The flood is arriving at faster rate from the Sangam to RMB. This may have been caused by the channel improvement in the form of de-silting/dredging/sand mining undertaken earlier or being undertaken, at present, in this reach. This rate of flood wave propagation may also be possible because of construction of embankments. The effect of embankment construction will be more prominent if the embankments disconnect the low lying areas or avoid the flood water to spread into the flood plain disconnect the low lying areas or avoid the flood water to spread into the flood plain.
- 9) Impact of channelization & Bank protection work: The present proposal of Irrigation & Flood control department for “Priority Works- Comprehensive Plan for Flood Management Works on Jhelum- Phase-I” had been framed & executed at many places. This includes channelization & Bank protection work. Hence, As of now there is no need to channelize the flow again in order to avoid duplication.

***This report can be updated at a later stage when required, by considering the fresh cargo analysis, change in requirement of the Government or change in policy either of the state or government of India***