Preparation of Two Stage Detailed Project Report (DPR) of Proposed Cluster 2 Inland Waterways

Feasibility Report for Tizu and Zungki Rivers

September 2016

Inland Waterways Authority of India

Feasibility Report

September 2016

This report has been prepared under the DHI Business Management System certified by Bureau Veritas to comply with ISO 9001 (Quality Management)

Approved by

Dr. Flemming Jakobsen
Managing Director

Inland Waterways Authority of India

Draft Feasibility Report

September 2016

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Prepared for Inland Waterways Authority of India

Represented by Hydrographic Chief

Authors	Bibekananda Padhy, Arjun S, Dr. B. Sakthivel, Swarup Dutta, Dr. Mohd. Fahimuddin
Quality supervisor	Dr. Flemming Jakobsen, Team Leader

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APPENDICES

Appendix # 1 Proposed Expansions in the North Eastern Frontier Railway Zone – Detailed Map

Appendix # 2 Chainages

List of Abbreviations

BM	:	Bench Mark
CEA	:	Chainage
CH	:	Control Point
CP	:	Cubic Meter
CUM	:	Central Electricity Authority
CWC	:	Central Water Commission
DGPS	:	Detailed Project Report
DPR	:	Differential Global Positioning System
G&D	:	Gauge & Discharge
GPS	:	Global Positioning System
HFL	:	High Flood Level
HSD	:	High Speed Diesel
IHO	:	International Hydrographic Organization
IWAI	:	Inland Waterways Authority of India
IWT	:	Inland Water Transport
Km	:	Kilo Meter
LAD	:	Least Available Depth
M	:	Meter
MCM	:	Million Cubic Meter
MDR	:	Major District Roads
MoWR	:	Ministry of Water Resources
MTPA	:	Metric Tonne per Annum
NH	:	National Highway
NRSC	:	National Waterway
NW	:	National Remote Sensing Centre
OEM	:	Original equipment manufacturer
PIA	:	Project Influence Area
SBAS	:	Satellite based Augmentation System
SH	:	State Highway
SKO	:	Superior kerosene oil
SONAR	:	SOund Navigation And Ranging
SWOT	:	Strength Weak Opportunity Threat
WAAS	:	Wide Area Augmentation System
WGS	:	World Geodetic System
WRIC	:	Western Regional Instrumentation Centre

Category – II Waterways: Stage – I Reports Salient Features at a Glance

<table>
<tr><th>Sl No</th><th>Particulars</th><th>Details</th></tr>
<tr><td>1.</td><td>Name of Consultant</td><td>DHI (India) Water & Environment Pvt.ltd</td></tr>
<tr><td>2</td><td>Cluster number & State(s)</td><td>Cluster-2 (Nagaland)</td></tr>
<tr><td>3</td><td>Waterway stretch, NW# (From……to……Total length……)</td><td>42 km length of the river from Longmatra at Lat 25°46'11.98"N, Lon 94°44'35.04"E to Avanghku at Myanmar border Lat 25°35'2.94"N, Lon 94°53'6.12"E and in Zungki river from bridge at Lat 25°48'26.10"N, Lon 94°46'35.96"E to confluence of Zungki and Tizu rivers at Lat 25°46'58.03"N, Lon 94°45'20.51"E</td></tr>
<tr><td>4</td><td colspan="2">Navigability status</td></tr>
<tr><td>a</td><td>Tidal and non-tidal portions (from…… to……. Total length…….. Average tidal variation</td><td>No tidal Action</td></tr>
<tr><td>b</td><td>LAD status (wrt CD)
i) Survey period ……. To …….
ii) < 1.0 m (km)
iii) 1.0 m – 1.5 m (km)
iv) 1.5 m – 2.0 m (km)
v) > 2.0 m (km)</td><td>
<table>
<tr><th colspan="2">Chainage (kms)</th><th colspan="2">Deepest Channel (m)</th><th>Shoal length <1.0m</th><th>Shoal length > 1.0m</th></tr>
<tr><td>From</td><td>To</td><td>Min</td><td>Max</td><td>(m)</td><td></td></tr>
<tr><td>0</td><td>5</td><td>0.6</td><td>4</td><td>3.15</td><td>1.85</td></tr>
<tr><td>5</td><td>10</td><td>0.3</td><td>3.9</td><td>2.45</td><td>2.55</td></tr>
<tr><td>10</td><td>15</td><td>0.4</td><td>4.3</td><td>3.15</td><td>1.85</td></tr>
<tr><td>15</td><td>20</td><td>0.3</td><td>3</td><td>3.15</td><td>1.85</td></tr>
<tr><td>20</td><td>25</td><td>0.3</td><td>5.8</td><td>2.2</td><td>2.8</td></tr>
<tr><td>25</td><td>30</td><td>0.2</td><td>5.1</td><td>2.85</td><td>2.15</td></tr>
<tr><td>30</td><td>36</td><td>0.4</td><td>4.5</td><td>1.3</td><td>3.7</td></tr>
<tr><td colspan="4">Total</td><td>18.25</td><td>17.75</td></tr>
</table>
</td></tr>
<tr><td>c</td><td>Cross structures
i) Dams, wiers, barrages etc. (Total number: with navigation locks or not)
ii) Bridges, Power cables etc [Total number; range of horizontal and vertical clearances]</td><td>Lahori Bridge with 15 m (Horizontal Clearance) and 4 m (Vertical Clearance) w.r.to H.F.L</td></tr>
<tr><td>d</td><td>Avg. discharge and number of days</td><td>Min-4.7 Cusec. Max -740 Cusec</td></tr>
<tr><td>e</td><td>Slope of the River</td><td>Steep slope observed for the entire study reach.</td></tr>
<tr><td>5</td><td>Traffic potential</td><td>NIL</td></tr>
<tr><td>a</td><td>Present IWT operations, ferry services, tourism, cargo if any</td><td>NIL</td></tr>
<tr><td>b</td><td>Important industries within 50 km</td><td>Has a potential for Cement Plants and other mining activities.</td></tr>
<tr><td>c</td><td>Distance of rail and road from industry</td><td>Motorable roads in the vicinity of waterway.</td></tr>
</table>

6	Consultant's recommendation for going ahead with stage II (DPR preparation)	Based on the survey charts and field reconnaissance, it is proposed to recommend for development of waterway as Class I. Further studies required to prepare DPR for the stretch of 42 km from Longmantra to Avanku (International Border with Myanmar) is being initiated.
7	Any other information/ comment	NIL

Sec. 1 Introductory Considerations

Transportation is the backbone of the social and economic growth of any country. A well developed and coordinated transportation network is the primary need of it. Industries and cargo companies are looking forward for technologically advanced and economically viable ways of transportation. In the case of a large country like India, this is of prime importance.

From the government bodies to the (commercial) cargo handling and transport companies are struggling in order to make effective and economic use of the available resources. Their activities are guided by transport costs and the capacities of different transport modes. These considerations lead to one of the main advantages of Inland Water Transport (IWT): Studies have proved that the transport capacity of IWT is high and the costs are relatively low, especially for bulk transport over long distances.

In order to keep in pace with the latest advancements in the navigation and cargo handling systems and to flawlessly operate a state of the art transportation system, timely maintenance and upgradation to the latest technologies and practices are a must.

Government of India intends to develop 111 Inland Rivers on an immediate and long terms basis to bring back its lost glory, for this it is planned to conduct a Feasibility Study and recommending thereafter the possibility of preparing the DPR to achieve navigation and to develop water transport facilities in Cluster regions.

Besides the economic considerations, social and environmental issues are also key issues when developing transport modalities. Hence, an integrated, multi-disciplinary approach has to be adopted in the inland waterway transport development activities.

The steps to be taken in the decision-making process of IWT development depend largely on the level of development already in place. The central challenge for waterway development is finding the optimal balance between adapting the means of transport and the natural physical conditions and changing these in favour of improved navigability for vessels.

This report presents the feasibility of Tizu and Zungki Rivers which are part of the proposed Cluster 2 National Waterways in Nagaland, North Eastern part of India.

1.1 Objective and Scope of Study

IWAI is planned to conduct a Pre-Feasibility Study and recommending thereafter the possibility of preparing the DPR to achieve navigation and to develop water transport facilities in Tizu and Zungki Rivers under Cluster 2 in Nagaland State. The study would consist of 2 stages:

Stage 1: Reconnaissance Survey, Collection & Review of available data and Feasibility Report

Stage 2: Preparation of Detailed Project Report (DPR) for the feasible River Stretches

Stage 1 is proposed to be carried out at this stage and is aimed for definite objective, which is indicated in the scope of work of the RFP and are defined as under:

1) To analyse the existing data such as topography, bathymetry & hydraulic conditions, geological conditions, water infrastructure, navigation related data, etc.,
2) To carryout situational analysis using the available secondary data with different authorities/stakeholder/line departments and to study the available bathymetric/topographic survey carried out by IWAI to identify sustainable river navigation scenarios, and
3) To prepare the Feasibility report based on the above analysis.

1.2 Details of River Stretch & Map

Figure 1 shows the proposed rivers for development. Table 1 provides the details of river stretches that is considered for the preparation of Stage 1 Feasibility study in Tizu and Zungki Rivers. Figure 2 is the location map of the rivers under consideration. The confluence of Tizu and Zungki rivers is shown in Figure 3.

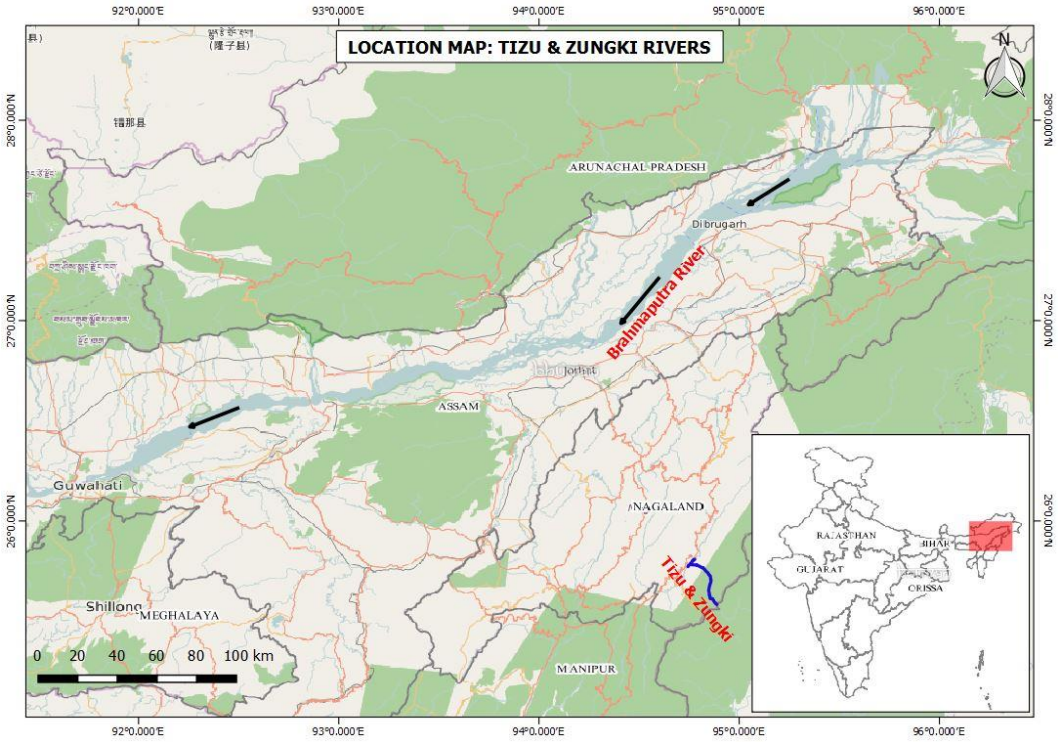


Figure 1 Geographical Location of the 4 river stretches considered for feasibility study and preparation of DPR for navigation (Tizu and Zungki Rivers in Nagaland highlighted)

Table 1 Details of the river stretches under consideration and their locations

Name of the River	Description of Inland Waterway	Districts through which River flows
Tizu and Zungki Rivers In Nagaland State	42 km length of the river from Longmatra at Lat 25°46'11.98"N, Lon 94°44'35.04"E to Avanghku at Myanmar border Lat 25°35'2.94"N, Lon 94°53'6.12"E and in Zungki river from bridge at Lat 25°48'26.10"N, Lon 94°46'35.96"E to confluence of Zungki and Tizu rivers at Lat 25°46'58.03"N, Lon 94°45'20.51"E	Kiphire Phek

Figure 2 Tizu and Zungki River stretch in Nagaland considered for feasibility study.

Figure 3 Detailed View of the confluence of Tizu and Zungki Rivers (Source Google map)

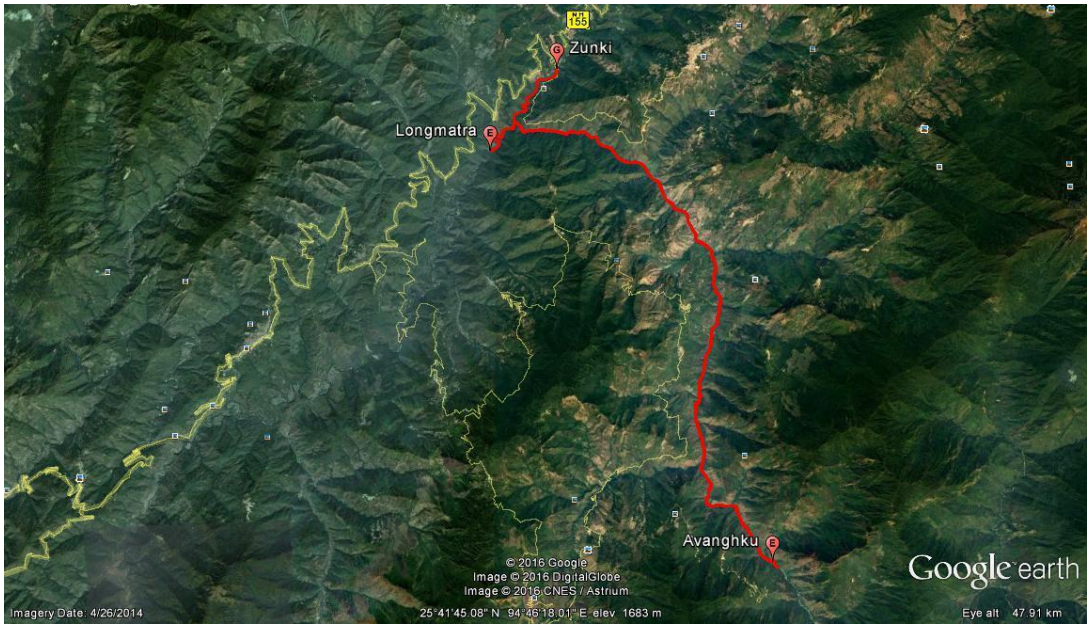


Figure 4 Total 42 km Stretch from Avankur to Longmitra and Tizu

1.3 Characteristics of Tizu and Zungki Rivers including Tributaries

Nagaland has four main rivers, namely, Doyang, Dhansiri, Dhiku and Tizu. The first three flows towards west through Assam plains to join River Brahmaputra, while Tizu River system flows towards the east and southeast and pours into the Irrawaddy in Myanmar. The Tizu River forms an important drainage system in the eastern part of Nagaland. It originates from the central part of Nagaland state and runs through a northeast direction, flows through Kiphire and Phek districts and confluneces in the Chindwin River of Myanmar. The main tributaries of River Tizu are river Zunki, Lanye, and Likimro.

The Zungki River which is the tributary of Tizu, starts from the north-eastern part of Changdong forest in the south of Teku and flows in southern direction towards Noklak, Shamator and Kiphire and finally joins Tizu below Kiphire.

As per Nagaland Water Policy report (2016), the catchment area of Tizu Basin covers 4884 sq.km, and has water yield of 4463 MCM. The details of individual catchment of Tizu and Zungki rivers are presented in the below table from the length of river measurement point described.

Sl. No	River	Length (km)	Catchment Area (sq.km)	Length of River Measurement Point
1	Zungki	80	2060	From Chingmei/ Noklak area to Tizu Confluence
2	Tizu	203	2760	From Helipong Area to Avankhu Area (International Border)

The details are presented in the following sections.

1.3.1 Drainage Systems - Tributaries/ Network of Rivers / Basin

The Tizu River forms an important watershed system in the eastern part of Nagaland and finally leaves Nagaland and drain itself into the Chindwin River in Myanmar. Rivers of the Chindwin Watershed in Nagaland include Tizu, Zungki, Likimro and Hanye.

Sl. No.	Drainage Systems	Major Watersheds/ River Basins	Sub-Watersheds	District covered
1	Chindwin Drainage System	Tizu	Zungki, Lanuye & their micro watersheds	Tuensang, Kiphire & parts of Zunheboto and Phek

1.3.2 Slope

More than 60% of the entire basin falls in the category of steep slopes. Gentle to moderate slopes are observed at the downstream of river at Avankhu. Steep slopes and valleys were observed along the length of the river which makes most of the river reach under inaccessible category.

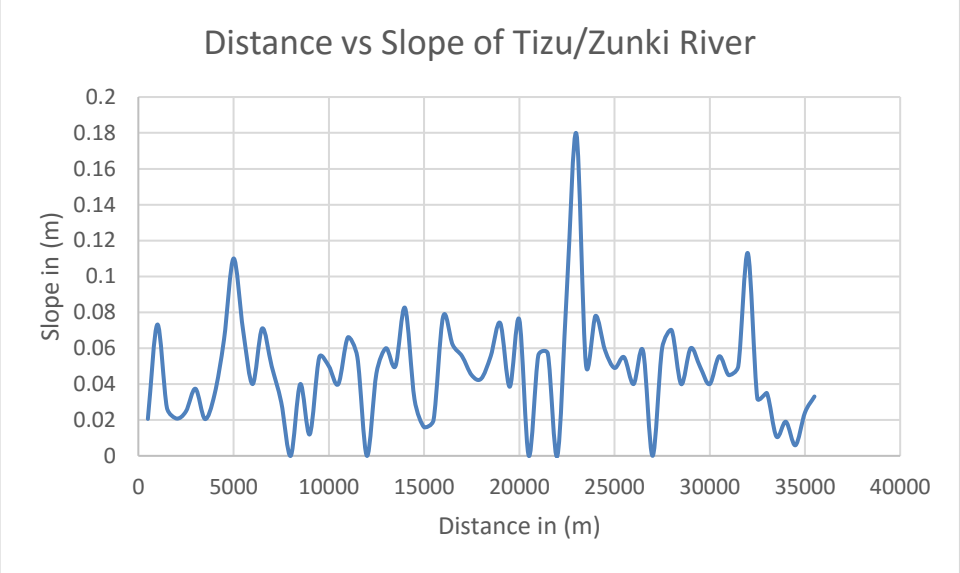


Figure 5 Slope of river in the total stretch

1.4 Methodology Adopted to undertake the Stage 1 Study

Primary and Secondary data for the study has been collected from various literature, line departments and stakeholders in the study area. The methodology adopted for achieving the objectives outlined in the Scope of Work is presented as a flow chart (Figure 6). The proposed activities in Stage 1 and 2 are briefly presented below:

Stage 1: Feasibility study would consist of the following activities:

- Reconnaissance Survey
- Collection and Review of Available Secondary Data including analyses of existing data.
  - ✓ Preparation of Inception Report as per the analysis of data
- Collection of Bathymetry and topographic primary survey data conducted by IWAI
- Preparation of Feasibility Report

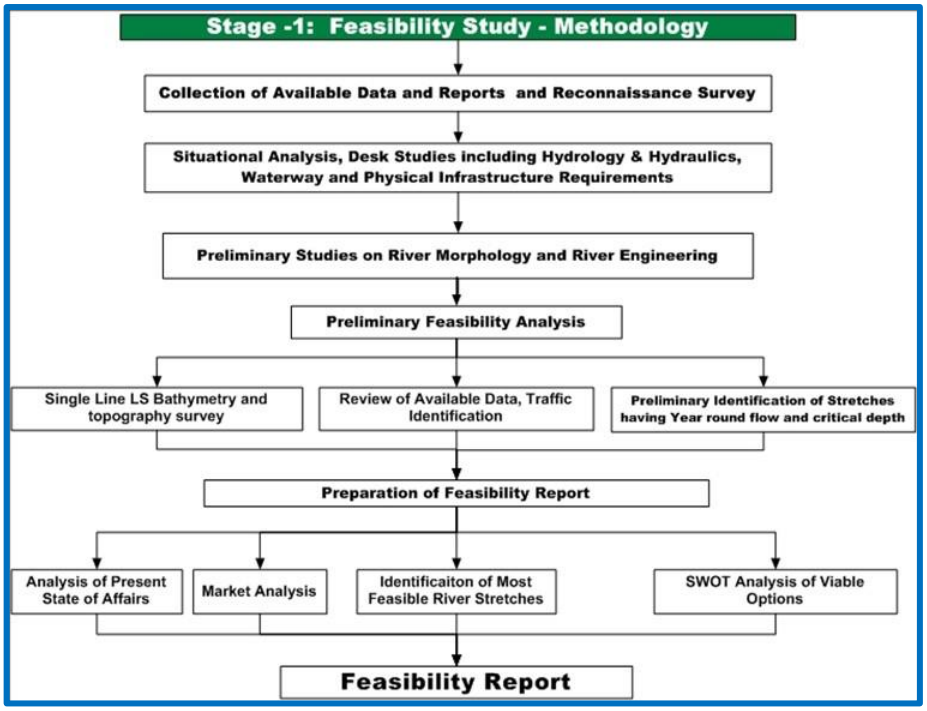


Figure 6 Flow chart showing the General Methodology adopted for the study

1.5 Primary & Secondary Data Sources

To have background knowledge and the historic navigational aspects of the study area, a detailed literature review was conducted on the following aspects.

The following data were collected:

1. Features of River Basin
   a. Climate of the Basin
   b. Physiographic Characteristics of the Basin
   c. Land Use, Land Cover and Agriculture
   d. Development of Proposed Hydropower projects in the Tizu river
2. Agriculture Practices in the Basin
3. Forests and Protected Areas

1.5.1 List of Secondary & Primary Data collected

Apart from the literature survey, a detailed primary and secondary data collection campaign was carried out for the preparation of the feasibility report. The data collected covers hydrological, topographical, navigational, traffic, socio-economic and other aspects in the Project Influence Area (PIA). Table 2 shows the list of data collected for the analysis and preparation of Feasibility report.

Table 2 Data collected for the preparation of the feasibility report

SL. NO	DATA TYPE	SOURCE/AGENCY
1	Topographic information: cross-sections / longitudinal profiles / Thalwegs if available	Based on Primary Survey conducted by IWAI during 2015
2	Water levels – historical data	Secondary data available from literature.
3	Water discharges – historical data (stage/discharge curves)	
4	Data pertaining to demographic particulars and local developments in study area	Economics & Statistics, Govt. of Nagaland. The consultant team had discussion during the limited field visit with local stakeholders including officials from Government of Nagaland, Ministers for Transportation, Planning, Members of Parliament and State Legislative Assembly, etc.
5	Goods Traffic flows by various transportation modes such as rail, road and IWT	Collected from various Govt. Agencies such as Economics & Statistics, Transport Department, Local Logistics and Freight Agents and based on Local enquiry with Public.
6	Soil type, Landuse/land cover erosional depositional features	Published literature

Sec. 2 Reconnaissance Survey

Data of the cross sectional survey conducted by IWAI in 2015 was studied in details in order to achieve the following objectives:

1. Identify the deepest channel (Data provided by IWAI).
2. Details (horizontal and vertical clearances above high flood level) of bridges and electric line en-route.
3. Topographical features of the proposed Inland Waterways.
4. Typical physical features along the alignment e.g. land use pattern.
5. Preliminary identification of stretches having year round flow and critical depth for navigational purpose.
6. Inventory of major aspects including proposed Inland Waterway width, Terrain, Bridges and structures across the proposed Inland Waterways (Type, size and location), urban areas (location extent).
7. Geologically sensitive areas environmental features and hydrological features
8. Critical areas requiring detailed investigations
9. Requirements for carrying out supplementary investigations
10. Drainage conditions.
11. Type and extent of existing utility services along the alignment.

Further data was collected and analysed for

12. Identification of various agencies of the govt. from whom the concerned project clearances for implementation are to be sought.
13. Preliminary Traffic identification on the proposed Inland Waterways

The data derived from the reconnaissance surveys will be utilized in future for planning and programming the detailed surveys and investigations if necessary.

2.1 Methodology Adopted including Resources used

The technical details of the approach and methodology adopted for the current study is provided in the following section.

2.1.1 Reconnaissance Survey (for traffic potential)

The main objective of this reconnaissance survey is to carry out Preliminary Traffic study, Analysis of present state of traffic, collect data and to analyze the market and potential usage of proposed Inland Waterway in Nagaland.

Various data and sources used for this are:

a. Basic data from state agencies, river authorities, IWAI.
b. Data of industrial, commercial / agro clusters in the hinterland of the proposed waterway from secondary sources like reports available in public domain
c. Data regarding present IWT facilities, Interstate and Intra state traffic serviced along the routes & passenger movement.
d. Data regarding commodities presently plying on the identified route and potential commodities which could be transported in future.
e. Collection of data on all aspects of transportation, trade, economics, natural resources, and the environment.
f. The rail and road connectivity to the proposed waterway to derive the costs of transport in the next phase (if found feasible only).
g. The data regarding future canal and dam projects were collected in order to identify future potential routes in the given cluster.
i. Type of crops (in different seasons) and industries along the waterway.

2.1.2 Hydrographic and Topographic survey data provided by IWAI including Description of the Waterway

Longitudinal and cross section survey at 500 m interval was conducted for the proposed stretch of the Tizu River by IWAI. The survey started near Avankhu and ended where the river confluence with Zungki. Based on this survey the Maximum and minimum depths of the deepest channel, length of shoals, cross structures, land use pattern, villages at the bank etc. are taken from the final report provided by IWAI. The results of the survey is summarised below. Detailed description of the waterway report provided by IWAI is attached as Annexure I. Table 3 shows the minimum and maximum depths corresponding to various chainage.

Table 3 Waterway Details as per the Survey data provided by IWAI

Chainage (kms)		Deepest Channel (m)		Average width of river	Average width of water portion	River Gradient / km
From	To	Minimum	Maximum	(m)	(m)	
0	5	0.6	4	65 to 100	40 to 45	0.9
5	10	0.3	3.9	65 to 100	40 to 45	0.91
10	15	0.4	4.3	60 to 100	35 to 40	0.92
15	20	0.3	3	60 to 100	35 to 40	0.93
20	25	0.3	5.8	65 to 90	35 to 40	0.94
25	30	0.2	5.1	65 to 90	35 to 40	0.95
30	35	0.4	4.5	65 to 100	30 to 35	0.96

Table 4 Shoal length each 5Km wise

Chainage (kms)		Deepest Channel (m)		Shoal length <1.0m	Shoal length>1.0m
From	To	Minimum	Maximum	(m)	
0	5	0.6	4	3.15	1.85
5	10	0.3	3.9	2.45	2.55
10	15	0.4	4.3	3.15	1.85
15	20	0.3	3	3.15	1.85
20	25	0.3	5.8	2.2	2.8
25	30	0.2	5.1	2.85	2.15
30	36	0.4	4.5	1.3	3.7
Total				18.25	17.75

2.1.3 Other information – Irrigation Canals, Outlets and Ferry Ghats

It is observed that no such structures are available in the entire reach proposed for this study.

2.1.4 Any border issue with other country

The River is a transboundary International river. The river crosses the border of the State of Nagaland and reaches Myanmar. Minor issues related to inter-border activities were noticed during the discussion with local stakeholders.

2.1.5 Current Meter Observations

Based on the Data provided by IWAI, current meter observations were carried out at 7 Locations at three layers (0.3d, 0.5d and d) along the stretch of Tizu River. The current velocity recorded was at the deepest part of every 5 km stretch of the river terrain during the survey period. The current velocity and water discharge have been calculated. The details of the current meter locations are given in Table 5.

Table 5 Locations of current speed measurements

Chainage (km)	Latitude (N)	Longitude(N)	Easting	Northing	Current Velocity (m/s)		
					Surface 0.3d	Mid Depth 0.5d	Bottom d
0.44	25°34'50.795"	94°53'17.387"	689650.26	2830608.42	3.02	2.8	2.66
9.968	25°38'50.536"	94°50'48.970"	685405.62	2837927.09	2.9	2.7	2.55
19.99	25°43'45.275"	94°50'49.973"	685306.79	2846996.84	2.92	2.6	2.45
30.014	25°46'42.003"	94°46'39.182"	678243.53	2852338.83	3.02	2.8	2.52
32.498	25°46'57.434"	94°45'20.700"	676050.73	2852784.31	3.25	2.92	2.63
35.285	25°46'12.502"	94°44'37.620"	674868.90	2851385.80	3.1	2.78	2.52

Sec. 3 Analysis of the Present State of Affair

As explained in the previous section, the present state of affairs is presented in this report on the basis of the data provided by IWAI. The data is presented for every 5 km chainage. 0 chainage was fixed near Avanghu near Indo-Burma border. The excerpts of the cross-sectional survey data provided by IWAI is discussed in this report. Detailed report is attached as annexure I.

Figure 7 shows Tizu and Zungki river stretch in North East India being considered for feasibility study and thereafter for preparing DPR for inland navigation. The proposed study river stretch is located near international border of India & Myanmar in Nagaland State.

Figure 7 Tizu and Zungki river stretch in North East India being considered for feasibility study

Figure 8 Status of Rock Outcrops and Boulder present in Tizu River (Chage 5 to 10 km)

3.1 Field data collection

Field survey was conducted from Longmatra in Kiphire district to Avankhu in Phek District. Avankhu is also part of the international border of India & Myanmar. The approximate length of the river is 35 km. Maximum width observed during the survey was approximately 150 m. The flow direction of the river is from Longmatra to Avankhu. 79 rapid places were noticed along the 35 km length of Tizu River.

The survey was commenced on 25th April 2015 and completed on 30th April 2015. The survey was undertaken on a scale of 1:1000, with sounding line spacing kept at 50 m. The soundings are plotted using UTM Projection (Zone 46).

3.1.1 Weather and condition of the river

As per the report handed over by IWAI, the weather was pleasant in April during survey period. The topography and Hydrography survey work was not hampered due to the prevailing weather conditions.

However it was specifically reported that the presence of boulders and rocky outcrops along the river stretch adversely affected the progress of sounding using boat. At some locations, the boat had to be physically controlled & moved toward the deeper area for containing the survey work.

3.2 Details of cross structures

Along the 42 km river considered for development of waterway, only one bridge was observed at Chainage 14.5 km at Lahori (Table 6) . From the horizontal and vertical clearance data of the bridge from HFL, no hindrance is expected out of the cross structures presented in the proposed waterway.

Encroachments in the waterway has not been observed apart from agriculture operations in the in the upstream side of banks. Figure 9 presents the view of Bridge at Lahori.

Table 6 Details of the bridge

Sl No	Chainage (km)	Location	Latitude (N)	Longitude (E)	Northing (N)	Easting(E)	Horizontal Clearance (m)	Vertical Clearance (m)
1	14.5	Lahori Bridge	25°41' 9.58"	94°51' 14.70"	2842215.66	686063.26	15.0	4.0

Figure 9 View of Lahori Bridge in Tizu River

3.3 Details of NH/SH/MDR along and/or in the Vicinity

NH 29 and 202 are connecting the study area (Longmatra) to Dimapur/Kohima in Nagaland. NH 29 starts from Dimapur and joins NH 202 at Jessami. NH 202 continues up to Akhegwo, which further travels to Longmatra and Kiphire. From Akhegwo, the road runs to east towards Avankhu, for a distance of 111 km. The roads are presented in Figure 10 and Figure 11.

Table 7 National and state highways in the vicinity of Tizu River

Sl. No	Category	Number	From	To
1	NH	NH 29	Dimarpur	Akhegwo
2	NH	NH 202	Imphal	Chubayimkum
3	SH	State Highway	Akhegwo	Avankhu

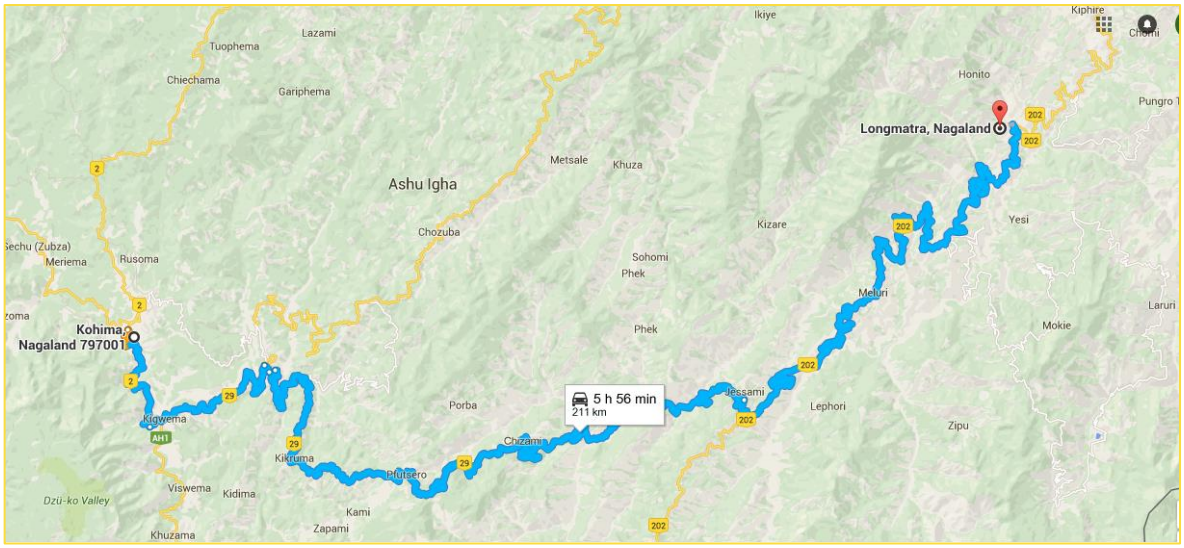


Figure 10 Details of Road connecting Kohima and Longmatra in Nagaland

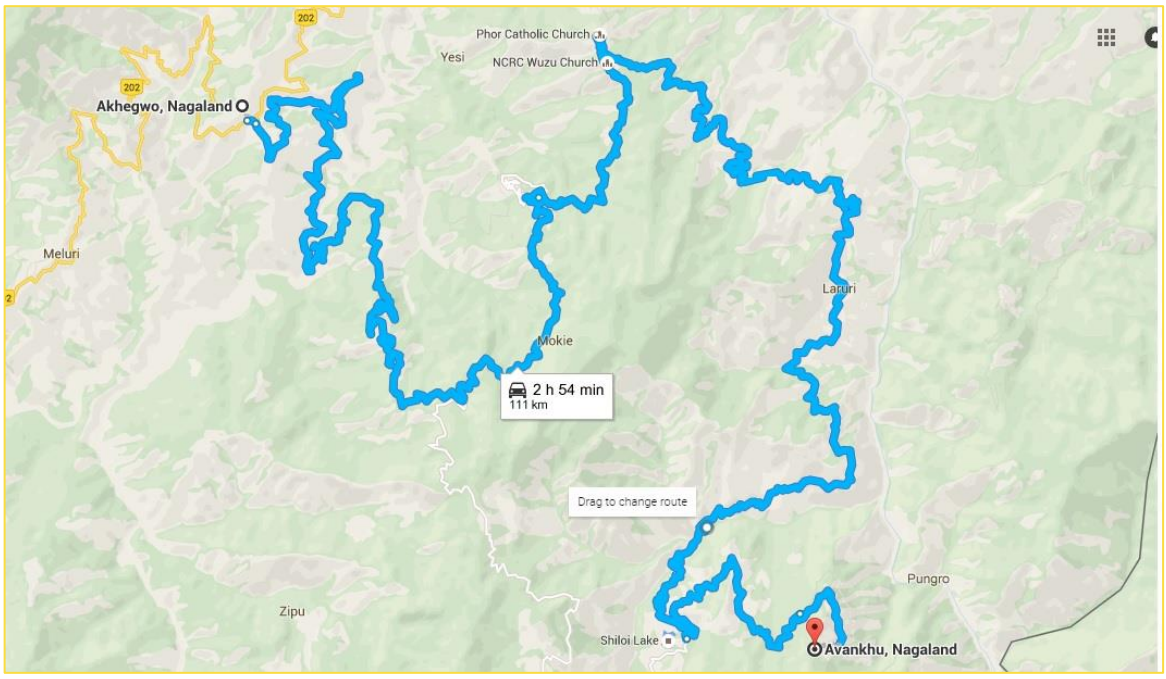


Figure 11 Details of Road connecting Avankhu and Akhegwo in Nagaland

3.4 Railway Line/Stations and Airport in the Vicinity

Nagaland is one of the least connected state in India through Railway network. Intensive expansions have been taken up by the northeast frontier railway in this region as in the case of the rest of the north east states. According to the proposals and the surveys conducted/being conducted, Nagaland will have the maximum number of new railway lines as part of these expansions. As of now there are no railway lines in the vicinity of the study area. The nearest railway station is in Dimapur, which is the largest city in Nagaland. Dimapur is more than 250 km away from Longmatra by road. A graphical representation of the expansions happening in the region is shown in Figure 12 . A detailed map of the expansions is provided in Annexure I. It can be seen that a new railway line that is 125 km long connects Dimapur with Kohima is coming up.

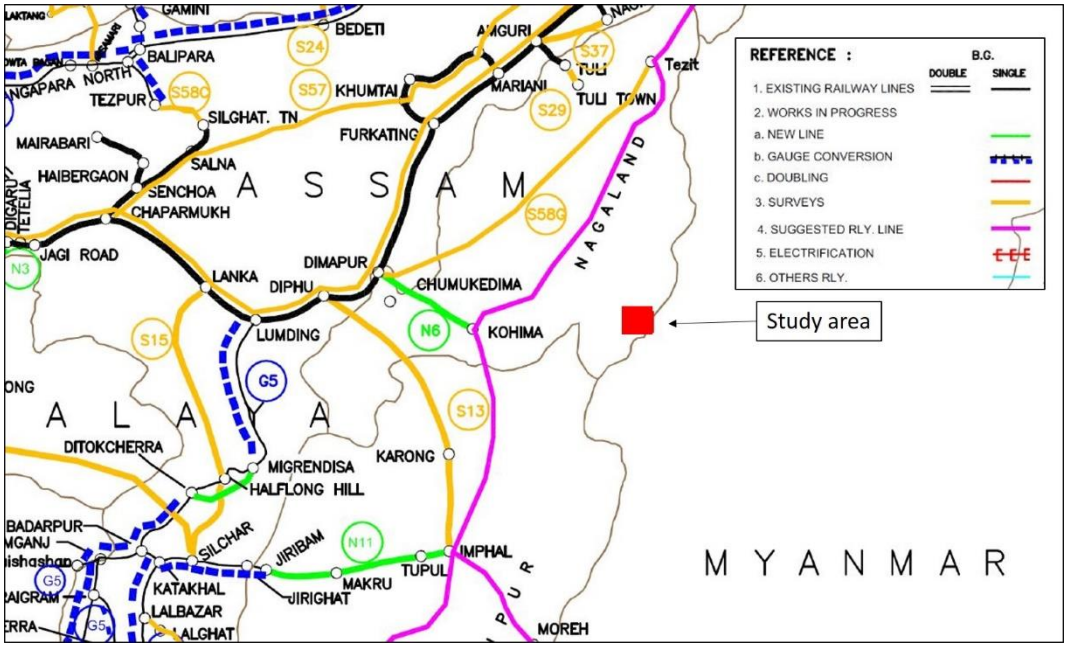


Figure 12 Graphical representation of the expansions happening in and around Nagaland (Refer Annexure I for details)

As in the case of Railway line, the nearest airport is also in Dimapur. Figure 13 shows the road that connects Longmatra with Dimapur

3.5 Field photographs

Selected photographs taken during the reconnaissance survey is presented in Figure 14 to Figure 20. The condition of the river stretch is best represented in the photographs.

Figure 13 The road that connects Longmatra with Dimapur (Source Google maps)

Figure 14 Boat being prepared for the bathymetric survey

Figure 15 Steep Banks with rock outcrop

Figure 16 Survey in progress between ch. 5 and 10 km (note the presence of boulders)

Figure 17 Survey work in progress from Ch. 15Km to Ch. 20 Km

Figure 18 Presence of huge boulders between ch. 20 and 25 km

Figure 19 Steep river banks with rock outcrop

Figure 20 Steep river banks with rock outcrop

Sec. 4 Market Analysis

4.1 Landuse Pattern, Agriculture and Crops along Waterway

Nagaland is basically a land of Agriculture. About 70% of the population depends on agriculture. Rice is the staple food and occupies about 70% of the total cultivated area, consisting about 75% of the total food grain production. Other important crops includes corn, millets, pulses, tobacco, oilseeds, sugarcane, potatoes, and fibers.

Phek and Kiphire districts are remotely located districts of Nagaland, which are full with natural resources such as minerals. They are classified as rural district in the state as majority of the people are living in villages. The climate is temperate to sub-tropical. Winter is cold at higher elevation with warm summer and seasonal rainfall of about 200 cm. The hilly region comprises of evergreen vegetation whereas lower region is comprised of deciduous forests. The important rivers are Tizu, Lanye. Agriculture is rainfed and it is the mainstay of the people of Nagaland. A traditional farming system called 'Zabo' is practiced in these areas. Paddy, maize, beans, pea, cowpea, arhar and nagadal are the common agronomical crops whereas cabbage banana, orange, passion fruit, guava, garlic, potato, ginger and cardamom are the common horticultural crops. Besides this pig, goat, backyard poultry, mithun and cattle are important livestock of the district.

As the detailed cross sectional survey conducted by IWAI does not have the details of the land use land cover details, a rough estimate was made using LISS III data. At majority of the areas, the river banks have steep terrain. The classification of land use pattern was done based on the "Natural Resource Census: Land use Land Cover" of NRSC. It can be seen from the land use land cover map (Figure 21) that the agricultural practices along the study area is comparatively less. There are a barren/ uncultivable lands and forest/ forest plantations in the vicinity. The land which is considered as built up area is also less, obviously due to the fact that this is one of the least developed region in Nagaland. A small urban built up region is observed at the bank of Zungki River.

4.2 Existing Industries along Waterway

As per the information collected from Nagaland State Mineral Development Corporation (NSMDC), Nagaland is endowed with substantial deposits of various minerals which when properly explored and exploited will give a boost to the economy of the State. The main established mineral reserves comprise of:

a. Petroleum & Natural Gas (prognosticated reserve of 600 million tonnes),
b. Limestone & Marble (inferred reserve of 1000 million tonnes),
c. Magnetite with Nickel, Cobalt and Chromium (5 million tonnes proved so far),
d. Coal (inferred reserve of 50 million tonnes),
e. Rich deposits of varieties of Decorative & Dimensional Stones and
f. Other associated metals like Zinc, Molybdenum & other possible precious metals such as Gold and Platinum groups (within ophiolites and metasediments) in the eastern parts of Phek, Kiphire and Tuensang districts.

NSMDC had identified viable mineral-based industries in the study area of this project. The same are presented below:

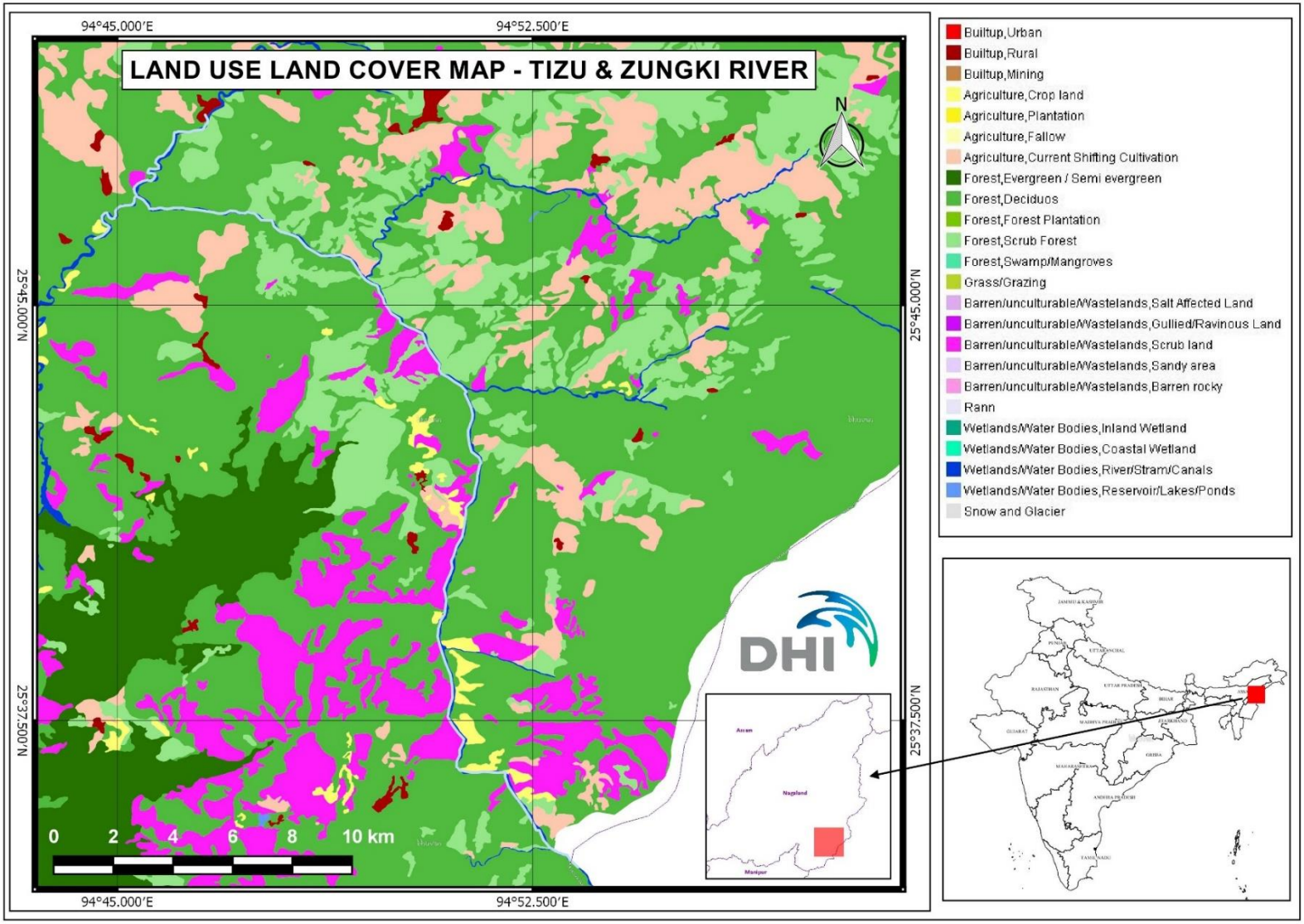


Figure 21 Landuse land cover map for Tizu and Zungki river region

4.2.1 Limestone Based Industries

Apart from the operationalisation of the expanded Wazeho Cement Plant, the following projects have been identified based on the reserves of more than 1000 million tonnes of chemical grade limestone in the 'Nimi Limestone Belt' of Eastern Nagaland bordering Myanmar:

- Export Oriented Unit Project of 3000 TPD (1 MTPA) Cement Plant under private sector or joint venture at Laluri/Nimi
- 200 TPD Lime Plant at Longpotrop (near Nimi).

4.2.2 150 TPD Mini Cement Plant:

As per the information, The Wazeho Cement Plant is located at Wazeho in Phek district of Nagaland which is at a distance of 236Km from State Capital Kohima by road. The Wazeho Village is located at a distance of 37Km from Akhewgo which lies on the State highway (Dimapur – Kiphire Road) and is connected by an all-weather road. Meluri, the Sub-Divisional head Quarter of Phek district is the nearest town, which is at distance of 65 Km from Wazeho. Dimapur is the nearest rail and air head for Wazeho lying at a distance of 310km.

Limestone quarry and clay quarry (both Phyllitic clay and Ferrogenous clay) are located within a distance of 4 – 6 Km from the plant and connected with an all-weather road. Initially 50 TPD capacity Mini Cement Plant at Wazeho was sponsored by NEC in the year 1984. The project was completed and brought it to trial operation from September 1992. The plant was operated achieving the highest possible quality standard of cement up to 53 mpa till 2003-04. The existing plant and machinery being old and facing maintenance problems, due to non-availability of spares and considering the growing demand of cement in Nagaland as well as in the neighbouring North Eastern States, NSMDC decided to go for expansion and modernization of the existing 50 TPD plant capacity to 150 TPD capacity by adding another 100 TPD capacity at the same location. The expansion and modernization of the 150 TPD Mini Cement Plant Wazeho was completed in May 2008. The plant was inaugurated on 28th June 2008 and trial operation was carried out which continued for more than a month. The factory is ready to be privatized for operation on lease basis as per the policy of the government.

As per the discussion with the Stakeholders present in the study area, it is understood that Government of Nagaland is looking for various alternatives to operationalise the above Cement factory by developing Tizu/Zungki River with necessary infrastructure for navigation of vessels.

4.2.3 Brief Industrial profile of Phek District

Phek is a district in the southeastern part of Nagaland, bounded by Myanmar in the east, Zunheboto and Tuensang districts in the north, Manipur state in the south and Kohima district in the west. According to the 2011 census Phek district has a population of 163,294. Phek has a sex ratio of 951 females for every 1000 males,and a literacy rate of 79.13 %. The census India 2011 shows that population density of Phek district (total area of 2026 sq.km) is 81 people per sq. km. As per the statistics collected from Department of Mines & Geology, Govt. of Nagaland, the following are the details of Miner Production/Reserved in the year 2012.

Sl. No	Mineral Name	Production as per 2012
1	Limestone, Iron Chromium, Nickel, Cobalt	4.0 Million Tones Reserved
2	Stone, Copper, Molybdenum, Chromite, Magnesite, asbestos	6.0 Million tones Reserved
3	Talc	1.0 Million Tones Reserved

There is no major industrial development in Wazeho Area and International Border Trade Centre at Avanku under Phek District. Large Scale industries available in Phek District are:

1. M/s Wazeho Cement Plant under NSMDC
2. M/s Wazeho Dimension Stone Plant under NSMDC.

Major exportable item is
Limestone, Marble, Talc, Chromite and Granite.

The growth trend in the district is low since no major industries exist and employment scope is also very much low. Roads are the main means of transport and communication. However, the condition of most of these roads are below standard which are hampering the expansion of economic activities in the district.

Medium to small Scale Enterprises are available in the Phek District which comprise of:

1. Handloom Units,
2. Handicraft items units,
3. Wazeho Tiles plant, etc.

Apart from the above, Micro & Small Scale industries such as small number of agro based, furniture based and other small production units are available.

Major Exportable items as on date observed are:

1) Ginger, Kholari, Maize, Chilies, Cane & Bamboo items, Honey bee products and other micro agro based products.

4.2.4 Brief Industrial profile of Kiphire District

Kiphire district is bounded by Tuensang district in North, Phek District in West and Myanmar in the east with area of 1255 sq.km. The district has a population of 1,06,138 with the majority of the people are agriculture based. Jhum cultivation is still extensively practices apart from cash crops such as potato, soybean and different kinds of local beans are also grown. Huge deposits of mineral resources are available in this district as per the survey conducted by Department of Mines & geology.

Hydropower Project

Likhimro Hydro Project (24 MW) is located in Kirphire district which is used for irrigation, hydro power and drinking water requirements.

4.2.5 Mineral Resources

The mineral rich Ophelite belt of the Indo-Myanmar continental plate runs through this district. The available mineral and location details are presented below:

Sl. No	Mineral	Location
1	Limestone	Mimi, Salumi, Kamkur
2	Magnetite	Pokphur, Thongsnyu
3	Granite	Mimi and Luthur
4	Sandstone	Seyochung, Rishisu, Chanchore, Old Monger, Kisetong and other areas.
5	Green Spillite	Moya, Likhimro
6	Boulders, Silty Sand, Sheared Serpentinite	River sides of Zungki and Thanaki Rivers and Mimi – Pungro – Salumi Road.

There is no major industrial development in Kiphire District. Large Scale industries available in Phek District is confined to Likhimro Hydro power project (24 MW).

The growth trend in the district is low since no major industries exist and employment scope is also very much low. Roads are the main means of transport and communication. However, the condition of most of these roads are below standard which are hampering the expansion of economic activities in the district.

4.3 Existing Jetties and Terminals (with Conditions and Facilities)

As per the reconnaissance and based on the survey conducted by IWAI, there are no facilities in the form of Terminals or Jetties available in the study river reach.

4.5 Existing Cargo Movement

Based on the preliminary reconnaissance survey to assess the existing cargo movement, the entire study area is depending on road movement of trucks for transport of essential commodities through Dimapur to Longmatra road via NH 29 and 202 for a length of 211 km.

4.6 Historical and tourist places

There are no major historical places observed in the study area.

Tourist attraction spots like Saramati Peak, Stone café in Khongjiri,Fakim Wild Life Sancturay, etc are available in this district

Sec. 5 Observations and Inferences

5.1 Waterway

The proposed navigation routes for a length of 42 km in Tizu river from Longmatra to Avankhu was studied on the basis of:

1) Preliminary Analysis of limited availability of water level and discharge data during lean season being critical period due to reduced depths

2) Depths is not available for navigation as per hydrographic survey data provided by IWAI.

3) Structures (weirs, bridges) across the proposed route and vertical and horizontal clearance

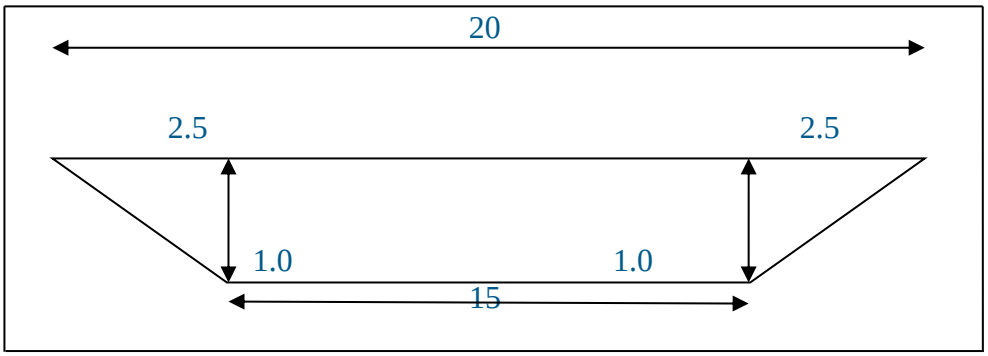
4) Shoals observed

5) Reconnaissance visit made in the study area along with identified preliminary cargo from various transport modes.

6) Based on the various reports, articles and literature studies.

5.2 Waterway Development including LAD/Flow Depths/Fairway Dimensions.

As per the IWAI study, dredging quantity was estimated for a channel dimension of 15 m x 1.0m with Side slope of 1:2.5 along the deepest route as per below figure. Similarly, the dredging quantity estimated by IWAI for 0.8 m and 0.6 m LAD has been referred for this study.



The dredging quantity estimated for LADs 1 m, 0.8 m and 0.6 m respectively based on the IWAI's survey.

It is observed that entire stretch of 42 km, the river has huge amount of boulders and presence of rock outcrops in the entire reach. As per IWAI guidelines, **Class I –** Waterways should have configuration of navigable channel with minimum 1.2 m depth, 30 meter bottom width, 300 meter bend radius, 4 meter vertical clearance and 30 meter horizontal clearance between piers are considered to be mandatory.

Based on the observation, the proposed stretch in Tizu River has an average depth of less than 1 during lean season. The vertical clearance with reference to HFL for the new bridge constructed at Lahori has vertical clearance of around 4 m.

5.2.1 Current speed

The velocity observed in the river during the survey was in the range of 2.5 m/s to 3.2 m/s which will not be conducive for the vessel movement.

Based on observations and various reports, the velocity and steep slope in combination with presence of boulders create less opportunities for developing this waterway with supporting IWT infrastructure.

5.3 Classification of Waterway: Suitable for Navigation

The classification of waterways by Inland Waterway Authority of India is discussed below:

Class I: Waterways with navigable channel of minimum depth 1.2 m, bottom width 30 m (in case of rivers) and depth 1.5 m, bottom width 20 m (in case of canals) with minimum radius at bends 300 m, minimum vertical clearance 4 m, and horizontal clearance between piers 30 m, (in case of rivers) and 20 m, (in case of canals).

Class II: Waterways with navigable channel of minimum depth 1.4 m, bottom width 40 m, (in case of rivers) and depth1.8 m, bottom width 30 m, (in case of canals) with minimum radius at bends` 500m, in minimum vertical clearance 5 m, and horizontal clearance between piers 40 m, (in case of rivers) and 30 m, (in case of canals).

Class III: Waterways with navigable channel of minimum depth 1.7m, bottom. Width 50, m,_(incase of rivers) and depth 2.2 m bottom width 40 m, (in case of canals) with minimum radius at bends 700m minimum. vertical clearance 7 m, and horizontal clearance between piers 50 m, (in case of rivers) and 40 m, (in case of canals).

Class IV: Waterways with navigable channel of minimum depth 2.0 m, bottom width 50 m, (incase of rivers) and depth 2.5m, bottom width 50 m, (in case of canals) with minimum radius at bends 800m, minimum vertical clearance 10 m, and horizontal clearance between piers 50 m, (in case of rivers) and 50 m, (in case of canals).

Class IV (A): Waterways on rivers only with navigable channel of minimum depth 2.0 m, bottom width 80 m, with minimum radius at bends 800 m, minimum vertical clearance 10 m, and horizontal clearance between piers 80 m.

Class V: Waterways with navigable channel of minimum depth 2.75m, bottom width 60 m, (in case of rivers) and depth 3.5 m bottom width 60 m, (in case at canals) with minimum radius at bends 900m, minimum vertical clearance 10 m, and horizontal clearance between piers 60 m, (both in case of rivers and canals).

Class V (A): Waterways on rivers only with navigable channel of minimum depth 2.75 m, bottom width 100 m, with minimum radius of bends 900 m, minimum vertical clearance 10 m, and horizontal clearance between piers 100 m.

On all the above cases:

Minimum depth of channel should be available for 95% of year.

Vertical clearance over the waterway should be available in at least central 75% portion of each of the spans in entire width of the waterway during lean season.

5.2.1 Condition of River Bank and Bank Protection

Based on the survey report and further reconnaissance, it was observed that both side of the river has rock outcrops and the banks are fully covered with rocks.

5.2.2 Locations for Terminal construction

Longmatra to Avankhu is connected by 217 km of road but this distance could be greatly reduced to 35 km. if the waterway in Tizu River is used for transportation. The task of transporting goods via river navigation would not only decongest the roads but would also improve the economic viability. Inspite of various bottlenecks observed as per the survey data, the State Government and Local Stakeholders are demanding the development of Tizu river with necessary IWT infrastructure. This shall need to achieved with planning and design of river training with necessary structural interventions to augment the availability of required LAD atleast to the requirement of Class I waterway.

To enable Inland Waterway Transportation (IWT), through this stretch of the river, suitable terminals would be required and to be constructed at: s

1) Longmatra
2) Laruri
3) Avankhu,

which shall be worthy of providing connectivity to hinterland. This would be in addition to the proposed dredging requirements to meet the depth needed for safe navigation.

It is learnt that development of necessary IWT infrastructure is a long pending demand of every stakeholder in that region, as per the discussion with the officials of Line departments, Representatives of Legislative and Parliament and other local people.

Total 03 (three) locations are proposed for construction of terminals along the river stretch and same request was received from the stakeholder. The locations have been proposed based on the following considerations:-

- Availability of suitable depths for vessel berthing but not having rock outcrop obstacle inside the water.
- Availability of land for construction of terminal.
- No Obstacle for connectivity to hinterland and proposed road to be constructed for connecting National Highway-202 to terminal.
- Distance from National Highway-202 to terminal is very close.
- Possibility of future expansion.
- It seems remote to set up new industry along the river stretch in future.

As per the field considerations, each of the above terminals require a minimum of 6 to 10 km of approach road from the nearby highway upto the river portion/ proposed IWT terminal location. Hence, the cost for construction of approach road in hilly terrain shall pose a construction risk and involves an additional capital expenditure.

5.3.1 Observations on Cargo Movement

It is observed during the reconnaissance survey that there are no major industries which can substantially improve the livelihood of the population in the PIA. Agricultural produce is the major livelihood option for the local population apart from food/forestry based products. Accessibility to the hinterland from the entire river reach has not been observed in the study area. Hence, possibilities are remote to attract commercial vessel players who can operate vessel movement on this reach. Hence, feasibility for developing this proposed stretch may not be an attractive and viable option considering the technical and other conditions of the project influential area.

5.4 SWOT Analysis for moving towards Stage -2

SWOT analysis (or SWOT matrix) is an acronym for strengths, weaknesses, opportunities, and threats—and is a structured planning method that evaluates those four elements of a project or business venture. Identification of SWOTs is important because they can inform later steps in planning to achieve the objective. The possibility of developing Tizu river reach from Avankhu to Longmatra looks remote due to the following aspects:

Strength	Weakness	Opportunities	Threat
Local People and Government Support	Availability of road network	Potential for Industrial Investment	Risk Natural calamities such as Floods
Availability of deposits of Mineral belt	Lack of Financial Strength for local vessel operators.	Availability of new technologies and farming practices.	Local and Political Support and Unrest
Increasing Opportunity and Livelihood of local people	Lack of Marketing Strategies	Rising demand for diversified agriculture and horticulture product.	High cost of Operation
Scope of Mineral Mining	Local Unrest and Agitations for various reasons	Focused area of Central and State Govt. Schemes	Competition from other Modes
	Flood uncertainties, fully rocky terrain and boulders throughout the river.	Commercialization and globalization of agriculture and other market	Shortage of skilled labor
	Inadequate credit for agricultural operations.		Timely implementation of projects
	High cost of infrastructure maintenance due to recurring floods.		Private Investment can not be expected. .
	No assured return on investment.		
	No Repairing and other ancillary facilities for Vessels		

Annexure #1

Proposed Expansions in the North Eastern Frontier Railway Zone – Detailed Map

Annexure #2

Chainages

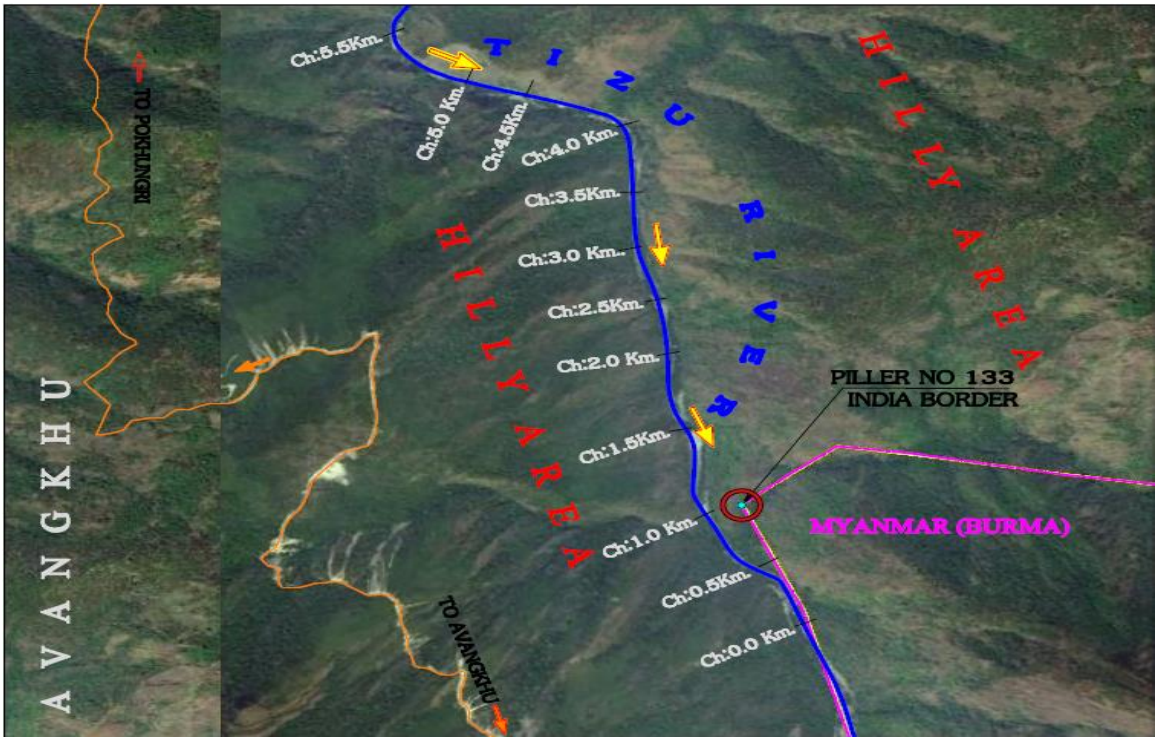


Figure 22 Ch 0.00 Km to 5.0 Km

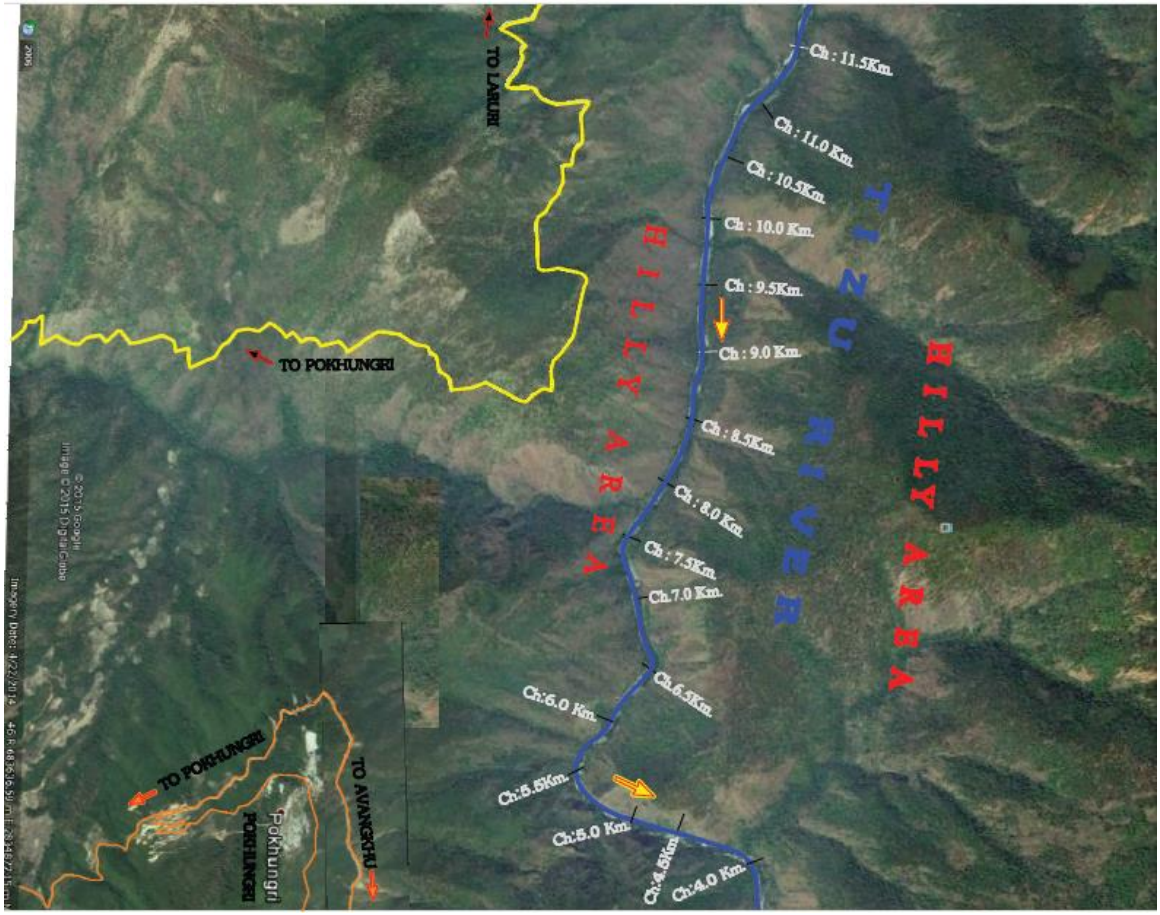


Figure 23 Ch.5 km. to Ch. 10 km

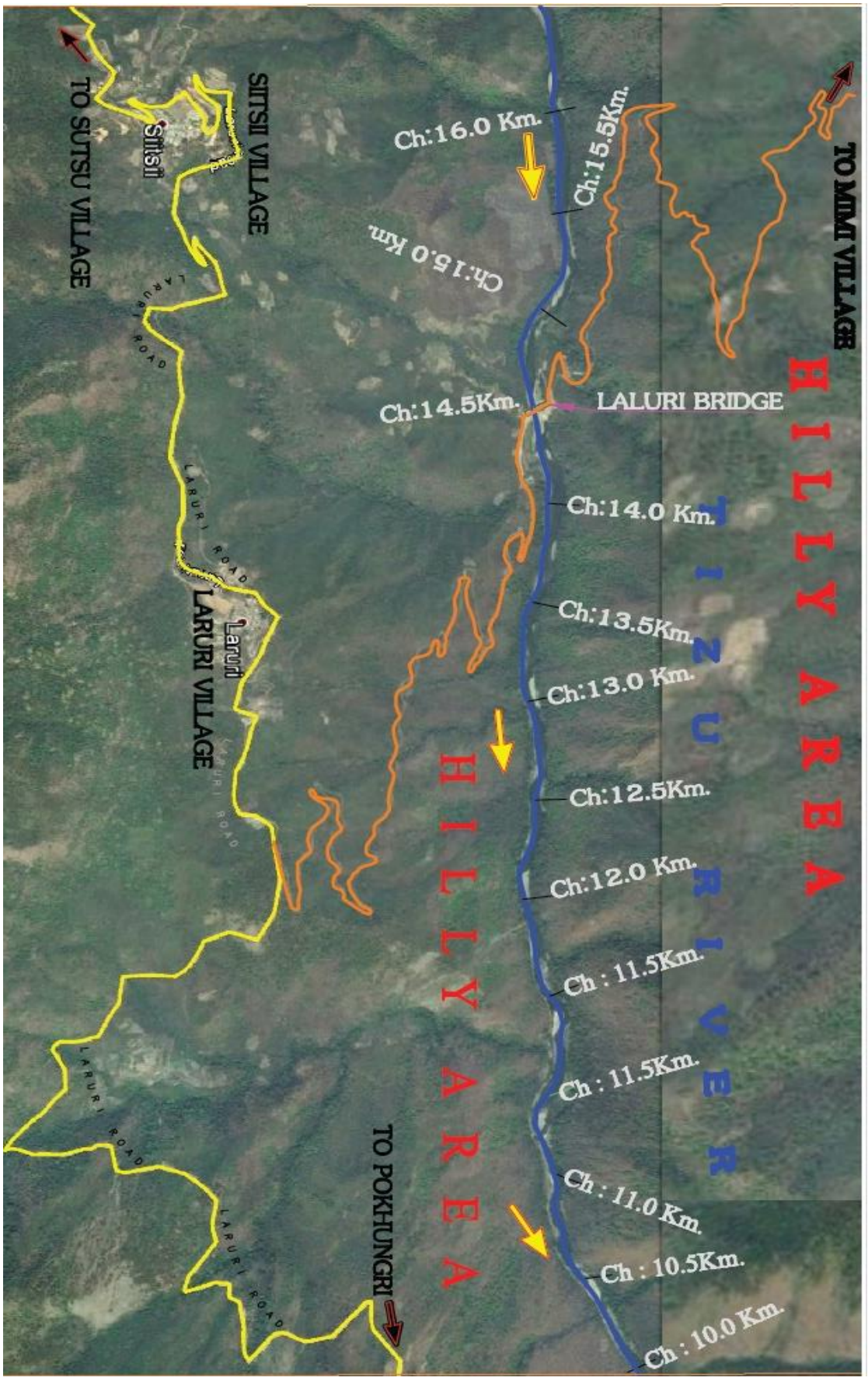


Figure 24 Ch.10 km. to Ch. 15 km

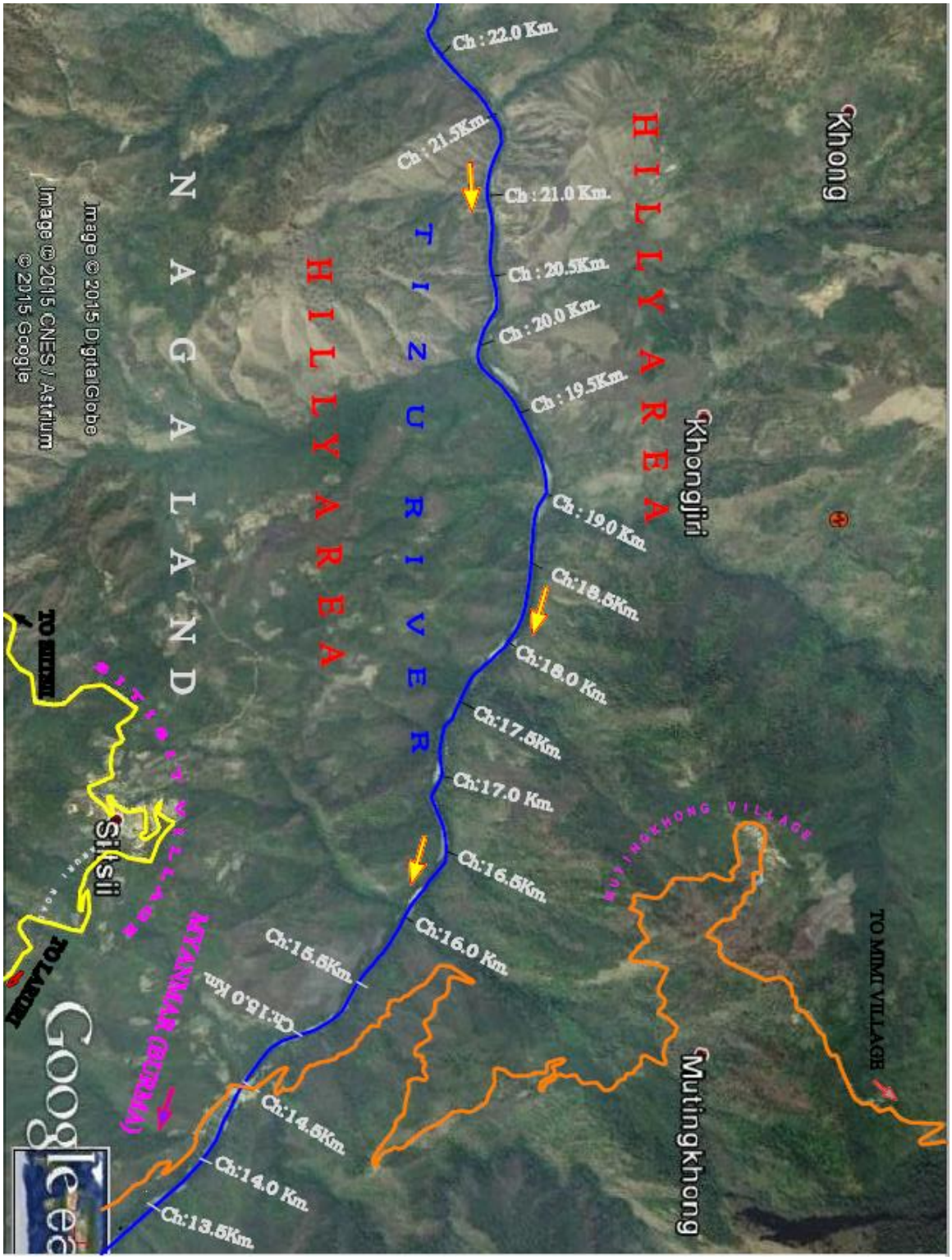


Figure 25 Ch.15 km. to Ch. 20 km

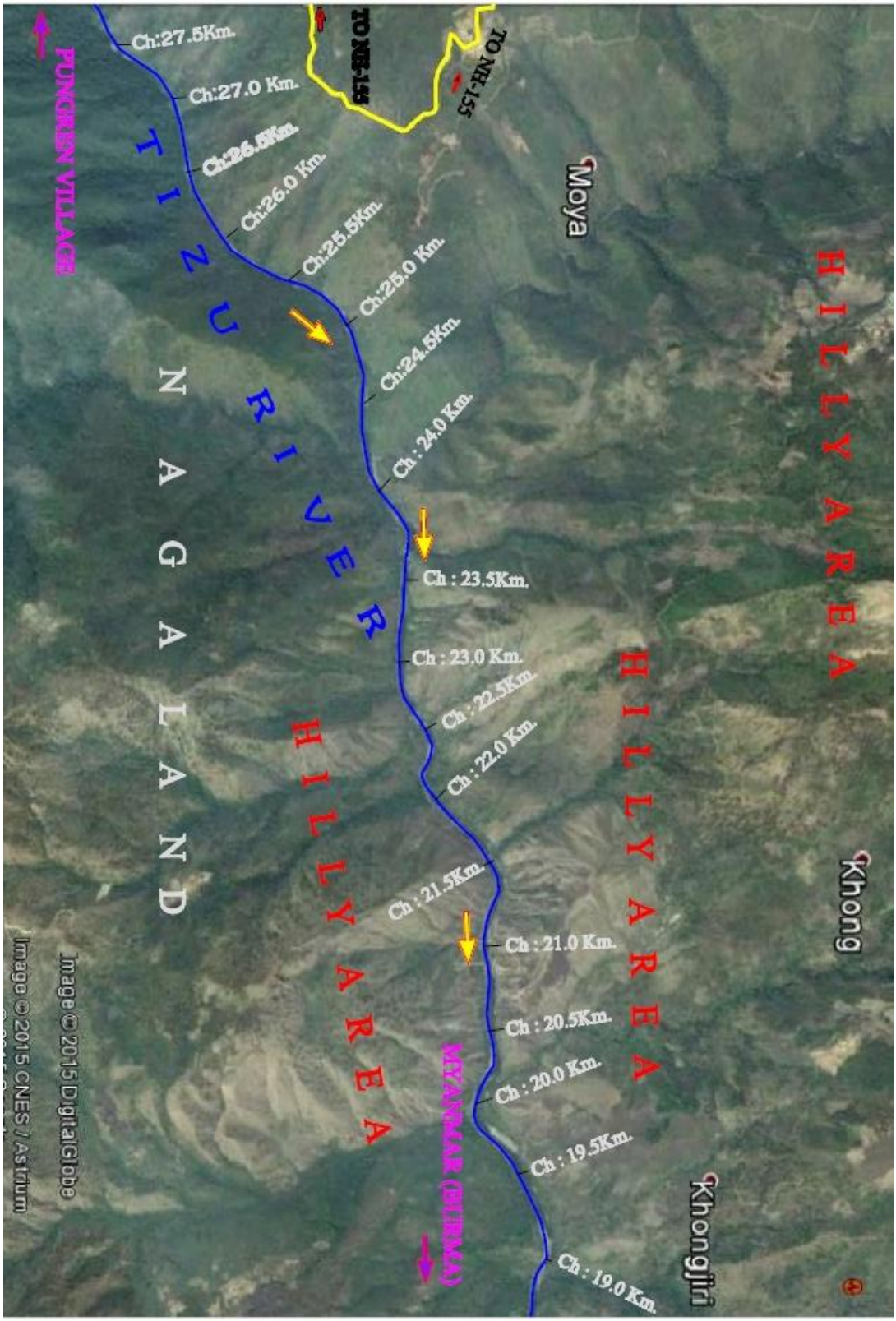


Figure 26 Ch.20 km. to Ch. 25 km

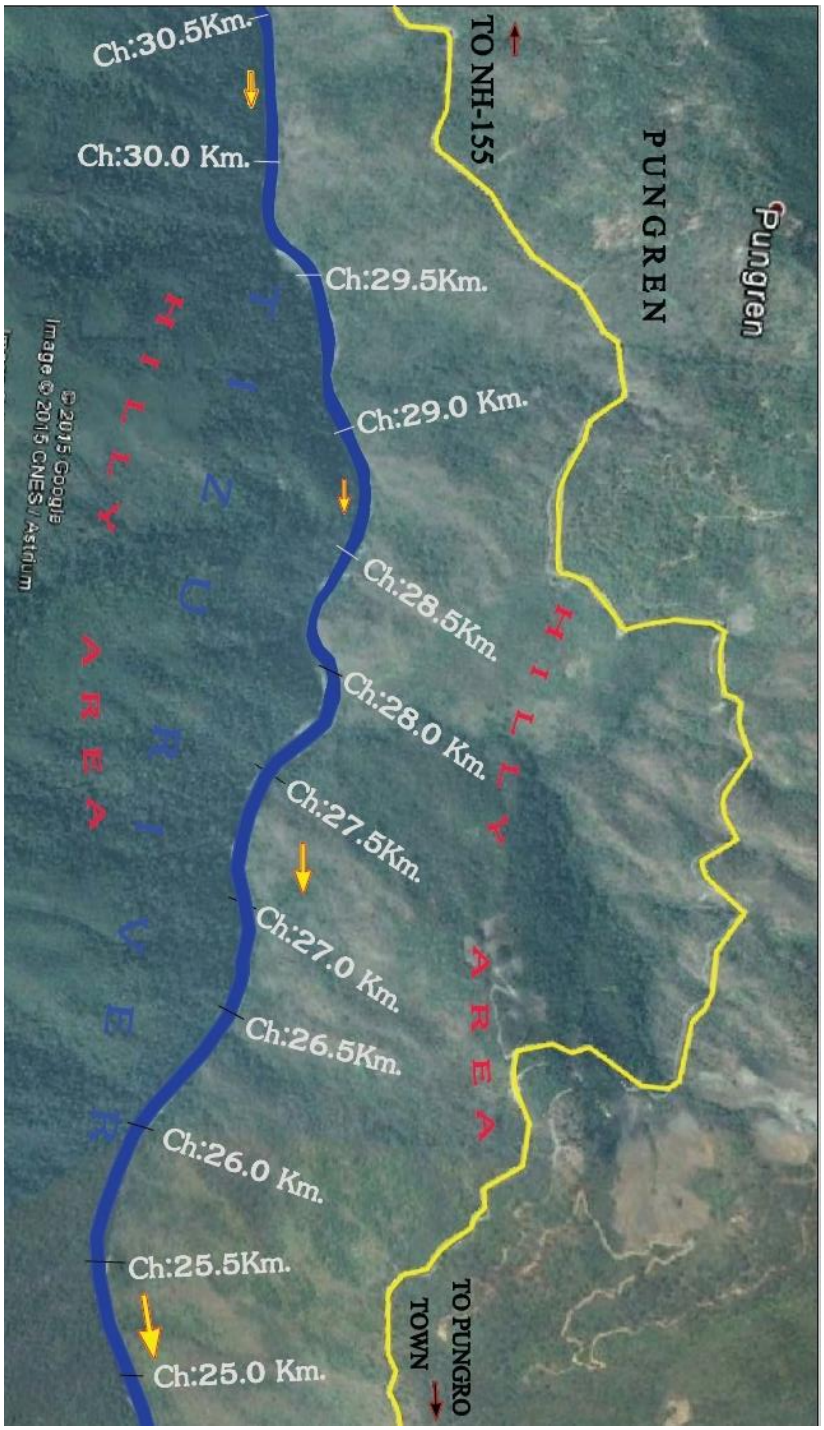


Figure 27 Ch.25 km. to Ch. 30 km

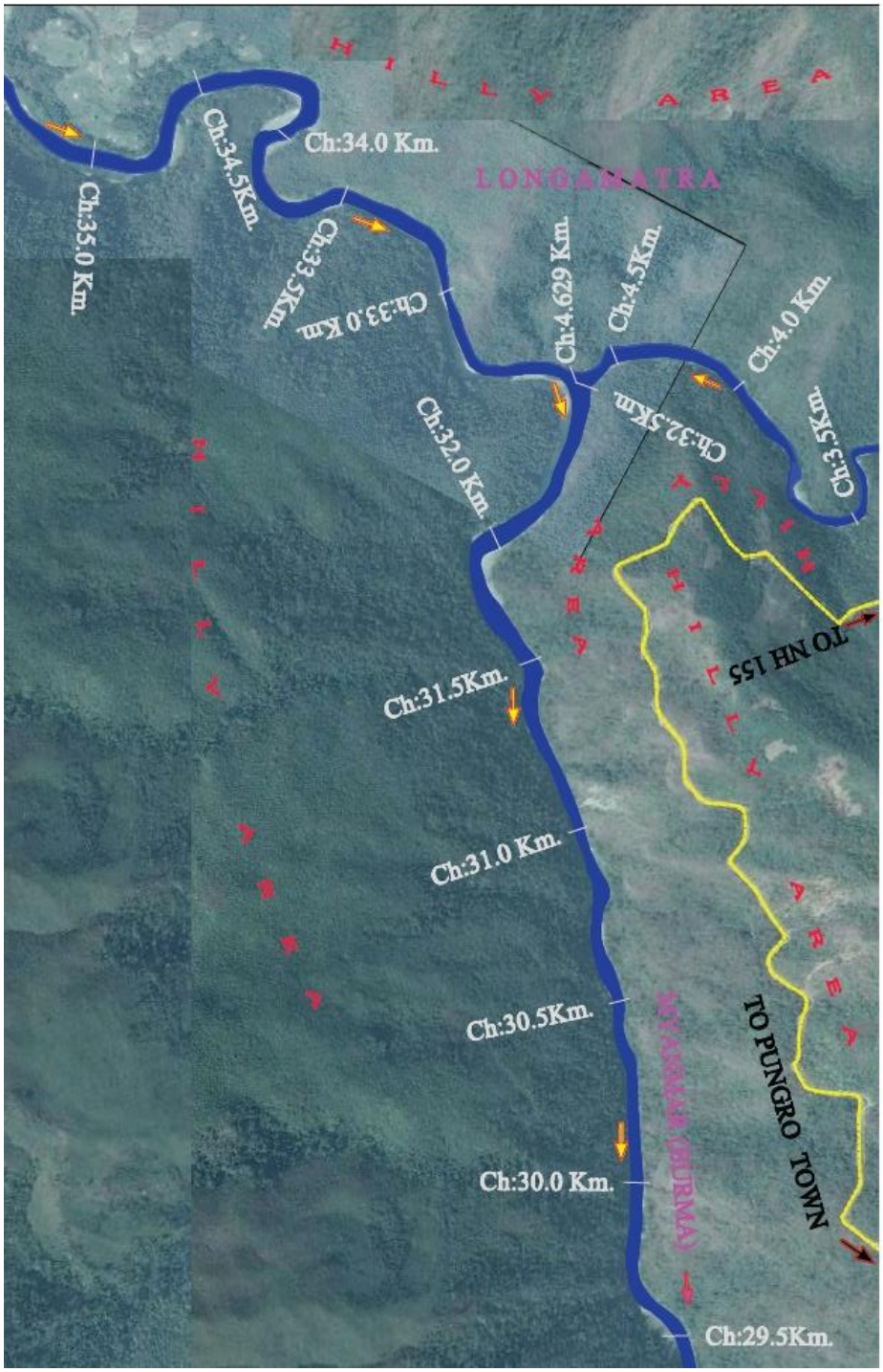


Figure 28 Ch 30 km. to Ch. 35 km