Tura Draft Master Plan – 2015-35

o/o District Urban Planner, West Garo Hills, Tura

PREFACE

The GIS Based Draft Master Plan for Tura, 2015-35 has been prepared by the office the District Urban Planner, West Garo Hills, Tura. The previous Master Plan of Tura was notified in the year 1991-2001 and was revised to 2011.

The Tura Draft Master Plan has been prepared under the provision of **The Meghalaya Town & Country Planning Act, 1973 and (Amendment) Act, 2004.** The draft masterplan has been prepared with keeping in mind the vision:-

"To make Tura a safe and liveable town."

The preparation of the GIS Based Draft Master Plan for Tura, 2015-35, is being prepared in accordance with **Section 11. Contents of the Master Plan and Zoning Regulation,** of The Meghalaya Town & Country Planning Act, 1973 and (Amendment) Act, 2004.

a) Land use Plan (Residential, Commercial, Industrial, Recreational, Public & Semi – public)
b) Zoning Plan
c) Transportation Plan including roads, rails, canals, etc,
d) Public Utility Plan

The GIS Based Draft Master Plan for Tura, 2015-35 also consist of Hazard Vulnerabilty and Risk Assessment (HVRA), prepared by NESAC.

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1. INTRODUCTION

1.1. Profile

Tura is the second largest town of Meghalaya, located 340 kilometers away from the State capital of Shillong. It is the divisional head quarters of West Garo Hills, as well as the divisional head quarters of Garo Hills Division comprising of five districts.

Although the town has been growing steadily, both demographically and geographically, it also has potential to effectively increase its economic potential thereby making it one of leading urban areas among the other areas of the North Eastern States. In order to achieve its full economic potential as well as to provide the basic requirements to the growing population within the area, it is necessary to strengthen the basic urban infrastructure requirements in the area.

1.2. Location

Tura is located approximately along 90°9'30" - 90°19'00" longitude and 25°33'30" latitude and has an average altitude of 1,300 meters above mean sea level. The Tura town lies at the foot of Tura Peak, which has an altitude of 1,412 meters above mean sea level and forms the main landmark dominating the eastern boundary of the town.

The town is connected by Naktional Highway 51. The nearest rail link to the town is in Krishnai (Assam) at a distance of 105 m. There is a helipad at Jengjal, 36 Km away from Tura connecting it to Shillong and Guwahati by helicopter. Tura is also well connected to the other District Head Quarters of Williamnagar, Baghmara, Resubelpara and Ampati. Urbanization of the town is expected to occur more rapidly with the road linking Sangsak-Salang-Nongstoin-Shillong.

1.3. Physiographic Feature

The town falls under the Central Main Plateau Region. The main physiographic feature of the area are the WNW-ESE trending Tura range with steep southern as well as Western faces. This range is a symmetric heart block with an average height exceeding 1,300 MSL with a maximum height of 1,412 MSL at Nokrek Peak. Tura Peak is the major water shed of the area and stream descending from this range flows down north and southwards with very steep gradients in the initial reaches carrying course load. The natural drainage pattern of the Town is determined by asmany as three rivers, namely Ganol, Bugi and Dareng. It is possible that the tectonic features,

the WNW-ESE thrust on the southern side and ENE-SWS fault passing almost through Tura town on the western face of Tura range might have affected the drainage pattern and the young age of these tectonic features has brought the Town under Zone V, the highest risk seismic zone of the Country's Seismic Map.

1.4. Climate

The climatic condition of Tura ranges from sub-tropical to semi temperate at the higher elevation. Fairly high temperature is experienced at certain seasons of the year. November to February are the only cold months in the year, when the temperature is comparatively low and it receive very little or no rainfall during this period. The temperature during this period ranges from 15° C to 20° C. The warm season is from March to May. The temperature remain as high as 25° C in average and dryness prevails during this season. The rainy season starts from June to October and is influenced by the Southwest monsoon. The mean temperature during this season ranges from 26° C to 30° C with an average rainfall ranging from 500 mm to 700 mm.

1.5. Historical Background

Before the coming of the British, Tura existed in the form of few tribal settlements located among the habitable parts of the valley formed by the Garo Hills. The localities were under the jurisdiction of the 'Nokmas' who administered authority over the areas. Tura was selected by the British as the official headquarter of the Garo Hills District in 1866. The British development of Tura was largely initiated by the favourable climatic conditions. Today, Tura besides being the District headquarter, also function as the commercial and economic hub of the entire Garo Hills Area. It is also emerging as a place of important educational and cultural centre.

1.6. Overview of Tura Master Plan 2015-35

The GIS Based Master Plan of Tura 2015-35, will have a planning area covers a total area of 54.65Sq. Km., including the municipal area which is 18.32 Sq. Km. in area. The Masterplan also includes villages towards its northern and western side, within its boundary.

The growth of Tura urban area is rapidly occurring towards the northern as well as the western direction. In consideration to the growth and expansion of Tura town, particularly in the last two

decades, many villages located towards the edges of the town, are rapidly undergoing development activities and are gaining semi urban characteristics.

Hence, it is required that these villages are properly developed, so that they can achieve proper facilities and amenities for improvement in the quality of life and move towards a better socio-economic relation with the city.

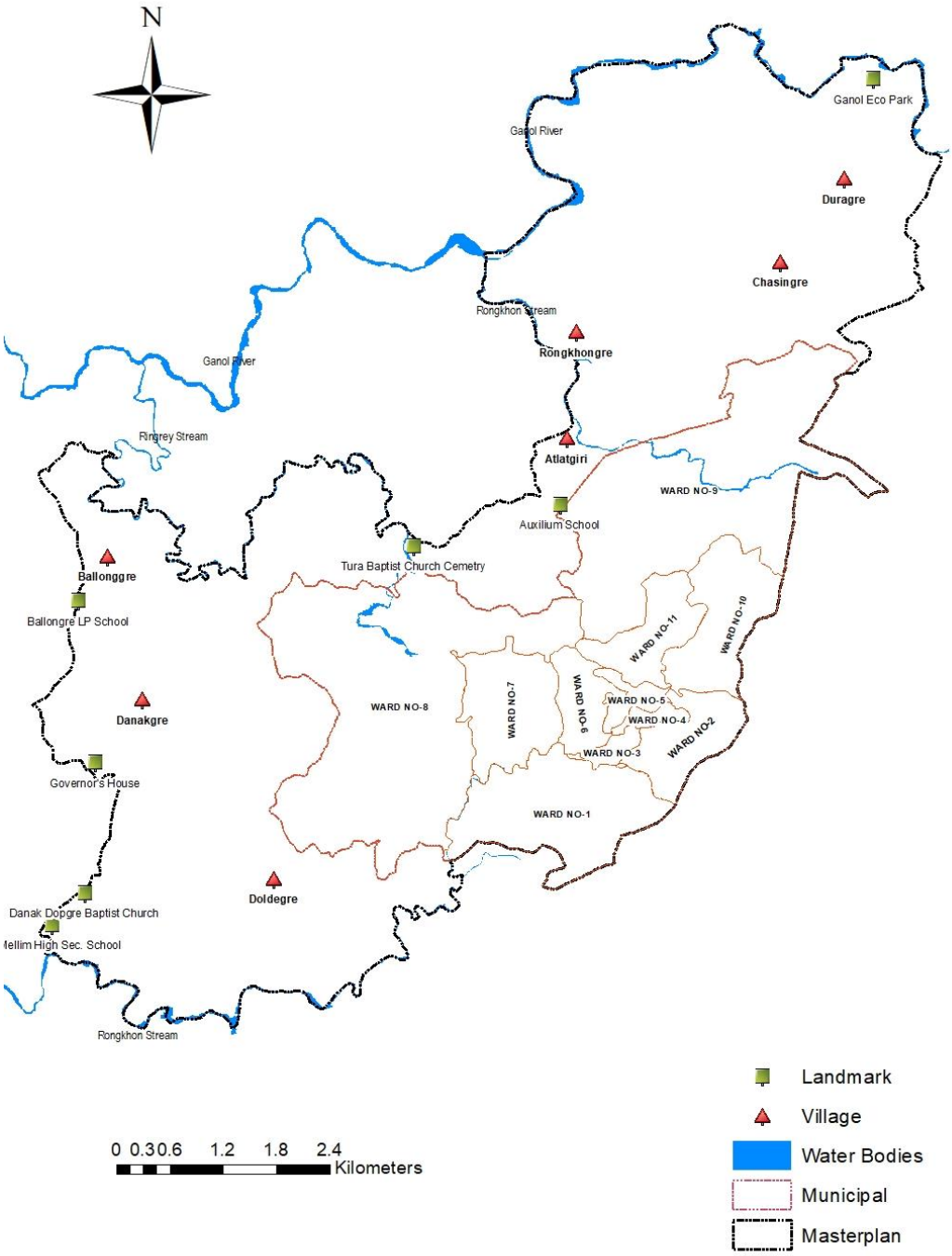
Table 1.2 Tura Master Plan, 2015-35 - Coverage Area

Sl. No.	Boundary	Area (Sq. Km.)
1	Municipal Area	18.32
2	Villages outside municipal boundary but within masterplan boundary:- ➢ Duragre ➢ Chasingre ➢ Rongkhongre ➢ Atlatgiri ➢ Ballonggre ➢ Danakgre ➢ Doldegre	36.33
3	**Total Masterplan Area**	**54.65**

The physiographical landmark as wells as physical infrastructure landmark boundary areas under the Tura Master Plan Area 2015-35 are as follows:-

i. South west boundary – Mellim Higher Sec school, DanakDopgre Baptist Church
ii. West boundary –Governor's House - Danakgre, Ballongre L.P. School
iii. North western boundary – Ringrey stream, Tura Baptist church cemetery, Auxillum School – Wadanang, tributary of Ganol river and Rongkhon stream
iv. North boundary – Ganol River, Ganol Eco Park
v. East Boundary – Foothills of Tura Peak, Municipal boundary of ward No. 1, 2 9 and 10
vi. South Boundary – Rongkhon Stream

Map 1.2 Tura Master Plan – Boundary Map



2. SOCIO-ECONOMIC PROFILE

2.1. Population of Tura

For the past 5 decades, the population growth rate of Tura has increased drastically from 8,888 to 74,858. The growth rate between these 5 decades have never been uniform. The percentages of increase have been much more between 1961-1981, as compared to that between 1981-2011. This abnormal growth was mainly due to the formation of the State of Meghalaya and the consequent filling up of urban activities centering around the administrative functions and partly due to the readjustment of the municipal boundary when eleven villages were brought under the Board's jurisdiction.

Table 2.1 Population Growth of Tura Town

Year	Existing	Increase	% (Increase)
1961	8888	-	-
1971	15489	6601	74.27%
1981	35257	19768	127.63%
1991	46066	10809	30.66%
2001	58987	12921	28.05%
2011	74858	15871	26.91%

During 1961-71, the growth rate of Tura urban area is 74.27% and drastically increases to 127.63% in 1971-81, with adding of more villages with in Tura Area. Between 1981-91, the population percentage has then severely decreased from 127.63% to only 30.66%. This may have been associated with the consistency of the urban boundary and also due to socio economic problems like health, family planning and lesser migration.By 1991-2001, the growth of the population has slightly decrease to 28.05% and between 2001-2011, it has again slightly decreased to 26.91%.

The town is expected to show increase in population growth pattern again, provide it has improvement in its socio economic considerations of health, workforce, safety,etc.

2.2. Population Density

Gross density is expressed in terms of persons per hectares. It includes the land occupied by commercial, industrial, public, semi-public, recreation and other uses along with residential uses. This establishes that the gross density for Tura town will be dependent on its Landuse Infrastructure.

The Gross density will not include any unutilized area such as forest reserve, vacant area, water bodies, etc.

As per URDPFI Guidelines, for Tura town being a medium town, it can be concluded that within the municipal area, the gross density being 106.74 per/hec, is more congested as compared to the required norms of a Hill Area being between 60 -90 per/hec. Where if we consider the Gross Density-Developed Area for the Tura Master Plan Area, the density is 87 per/hec which is within the safe density limit. However future population growth will have to require increase in developing more Landuse Infrastructure Area to prevent compact and congested living condition.

The population density within the municipal area is determined in terms of person/acre. The municipality covers an area of 4,521 acre. The wards in the core area of the municipality have the lowest area, while those towards the municipal boundaries especially towards the north direction have highest land area.

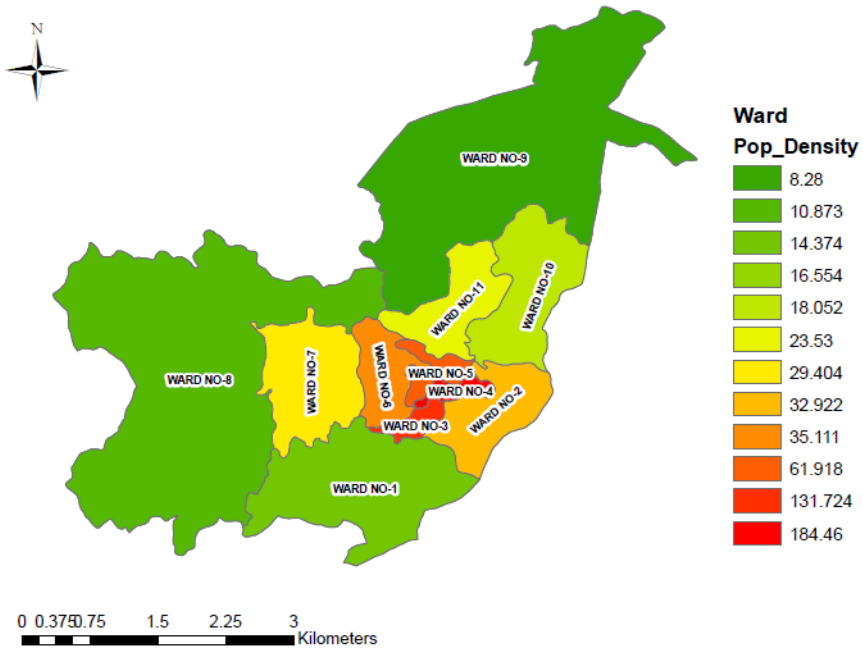
Ward Nos. 3, 4 and 5 having the highest population density between 60–190 per/acre are located in the core area of the municipality. Ward Nos. 2, 6, 7, 10 and 11 surrounds the core area of the municipality and have a population density between 22–36 per/acre. Ward Nos. 1, 8 and 9 having the lowest population density between 8–15 per/acre forms the boundary of the municipal area.

This shows that in the upcoming years there is tendency for people to shift from the core area towards the sub urban area, thereby leading to urban sprawl within the Master Plan Area. This will allow the urban fringes of the Master Plan Area to attain semi urban characteristics.

Table 2.8Population Density- Municipal Area

Sl. No.	Ward	Area (Acre)	Pop. (2011)	Pop.Den. (Per/Acre)
1	9	1,260.21	10,434	8.280
2	8	1,532.02	16,657	10.873
3	1	518.91	7,460	14.376
4	10	321.23	5,799	18.052
5	11	172.97	4,070	23.530
6	7	296.52	8,719	29.404
7	2	197.68	6,508	32.922
8	6	123.55	4,338	35.111
9	5	49.42	3,060	61.918
10	3	24.71	3,255	131.728
11	4	24.71	4,558	184.460
	Municipal	**4,521.93**	**74,858**	**16.554**

Map 2.1Population Density- Municipal Area



2.3. Population Projection

The estimated population of Tura is based on Arithmetic Progression and Geometric Progression. Population estimate is necessary to assess the various need of the urban area for sustainable development in terms of land and various social and physical infrastructure. 2011 is taken as the base year with a population of 74858, to analysis in terms of Arithmetic and Geometric Progression. The projection is taken upto the year 2061, which will consider 5 decades of increase in population growth.

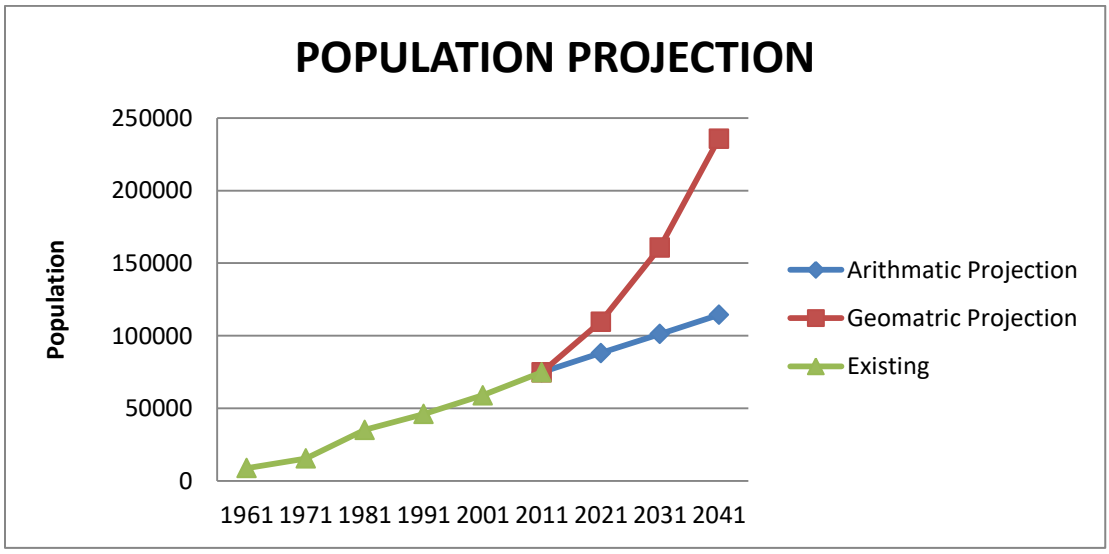
Table 2.2Decadal growth

Year	Population
1961	8,888
1971	15,489
1981	35,257
1991	46,066
2001	58,987
2011	74,858

Table 2.3Projected Population

Arithmetic Method		Geometric method	
Pn = P + nC		Pn = P (1 + Ig/100)^n	
Year	Population	Year	Population
2021	88,052	2021	1,09,728
2031	1,01,246	2031	1,60,840
2041	1,14,440	2041	2,35,761

Fig 2.1Population Projection



As per the Fig 2.1, projection by Geometric Method indicates that the population is increasing drastically with every decadal growth. While Arithmetic Method shows a more linear increment and follows the growth trend of the existing population. Hence it is more considerable to consider the population projection by Arithmetic Progression.

By 2021, the population is expected to reach 88,052 and by 2031, the population is said to increase to 1,01,246. By 2041, the population is said to be 1,14,440.

3. LANDUSE PLANNING

3.1. Aim and Objectives

Tura urban area comprises of a number of localities. The physical features of the town as such, separate one area with another with reduction in social and cultural integration. The details of the landuse planning for the Tura Masterplan aim to achieve efficient and proper utilization of land, coherent relationship between various uses and activities and removing the existing disorder of haphazard urban growth. The Master Plan of Tura has been prepared as per 'THE MEGHALAYA TOWN AND COUNTRY PLANNING ACT, 1973 AND (AMENDMENT) ACT 2004'. The contents of the Master Plan

The contents of the landuse plan for the Tura Masterplan is prepared in accordance with, section 11, of 'The Meghalaya Town and Country planning Act, 1973 and (Amendment) Act 2004', which includes:-

i. Propose Landuse (Existing, existing builtup and propose)
ii. Zoning Regulations.

3.2. Existing Landuse

The existing landuse pattern of the Tura Master Plan has been categorized as

i. Built up area, which is the existing infrastructure which includes urban as well as rural builtup
ii. Transportation, which is the existing road network
iii. Urban Agriculture, which comprises of vegetated land
iv. Vacant
v. Forest Area
vi. Water bodies, which constitutes the main rivers

The Tura Master Plan covers an area of 54.65 Sq. Km, out of which 9.16 Sq. Km. (901.27 falls on existing built up area, which comprises of 16.76% of the existing landuse pattern. Most of the existing built up are located within the municipal boundary

Transportation sector contributes only 1.50% of the existing landuse, which is 0.82 Sq. Km. The road network forms an irregular pattern, but it has an effective coverage area throughout the master area, except in the area towards the north eastern side. This is particularly due to absence of infrastructure in the are. The urban agriculture is 6.56 Sq. Km. which constitutes about 11.77 %. The urban agriculture are wide spread within the master plan area but are mostly concentrated within the

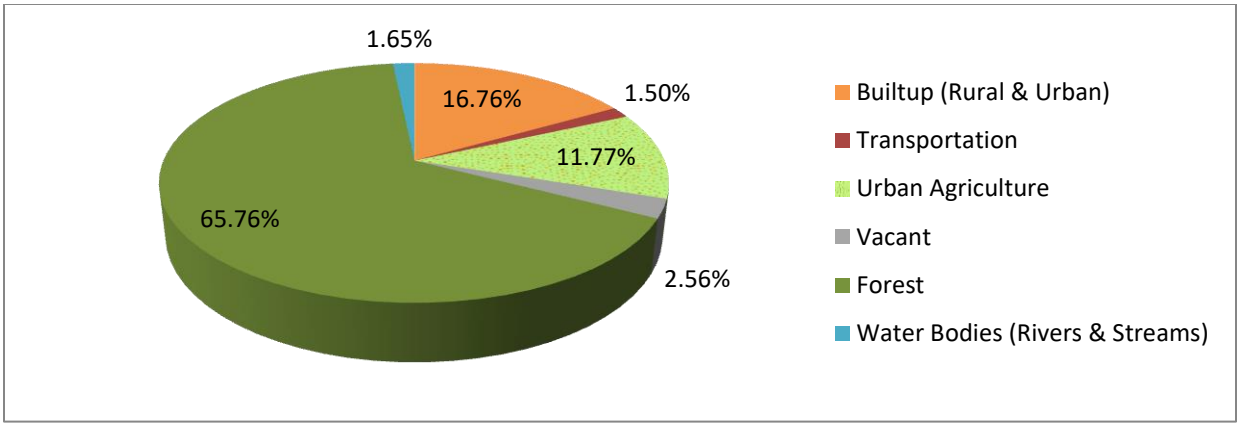
municipal boundary. The vacant area, which is the unutilized area has an area of 1.40 Sq. Km. which is about 2.56%. These unutilized area are all located within the municipal boundary.

The forest area is the most domination sector in terms of landuse allocation within the master plan. It has 35.94 Sq. Km. and comprises of almost 65.76% of the entire master plan area, which is more than half. It is entirely located outside the municipal area. The water bodies which comprises of the main rivers i.e., the Rongkhon River and the Ringre River flowing through the town area. It contributes of 1.65% of the existing landuse, which is 0.90 Sq. Km.

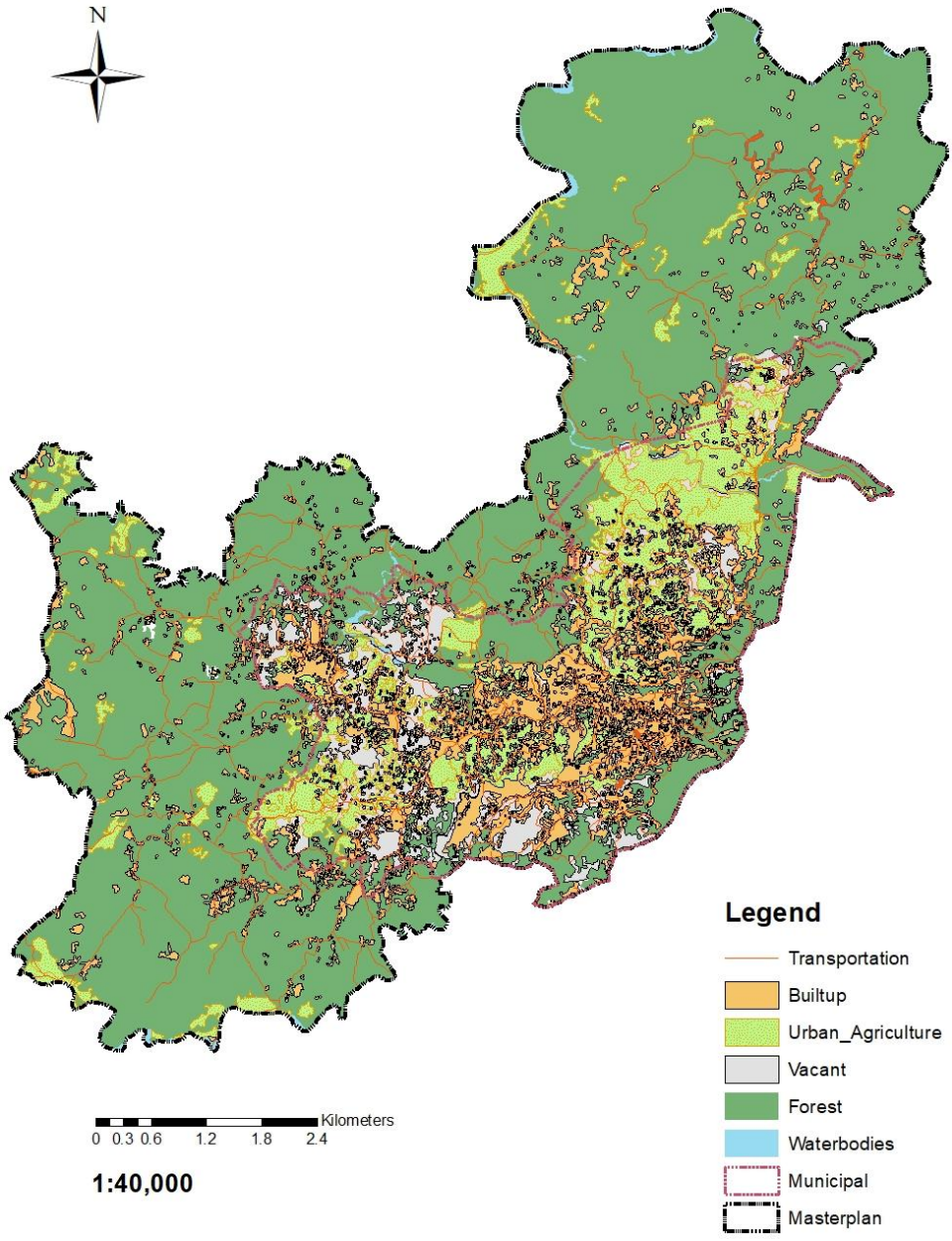
Table 3.1Existing Landuse

Landuse	Area (Sq. KM.)	Area (%)
Builtup (Rural & Urban)	9.16	16.76%
Transportation	0.82	1.50%
Urban Agriculture	6.43	11.77%
Vacant	1.40	2.56%
Forest	35.94	65.76%
Water Bodies (Rivers & Streams)	0.90	1.65%
	54.65	**100.00%**

Fig 3.1Existing Landuse



Map 3.1Existing Landuse



2.3. Existing Landuse (Existing Builtup)

The existing builtup of the Tura urban area has been decentralized into various categories in order to give a better understanding of the different type of landuses in the urban area of Tura. The different type of landuse infrastructure are residential, commercial, mixed landuse, public semipublic, mixed landuse, public utilities, communications, industries, recreational and rural settlements.

i. **Residential Use:-**The residential units in Tura consist of single dwelling units as well as clustered of a group of dwelling units. The residential units within the master plan area covers a total of 4.97 Sq. Km. It has the highest occupied area, covering nearly half, of existing landuse infrastructure, being about 55.28%.

ii. **Commercial:-**Presently the Tura market is the C.B.D. of the town. Both the retail and whole sale activities are functioning in the area, leading to congestion, further some retail units have sprung up along the road sides. The other operating commercial area is Nazing bazaar. The commercial unit covers a total area of 0.22 Sq. Km. which is 2.45% of the builtup area.

iii. **Public & Semi Public:**-The Public and Semi Public consist of administrative as well as the institutional setup.

The Public and Semi Public consist of the Government and Semi Government of various levels of State and Central Office and local administration. A administrative setup will include the area of D.C. complex, Hawakhana, Araimile and Dakopgre. The Government and Semi Government offices in Tura are well organized in terms of zonal planning strategy.

The institutional will include education facilities and health care facilities. Tura has a considerable no. of primary schools located in the urban area. However the higher educational facilities of university and colleges are mostly located either towards the urban fringes or outside the municipal area. This helps in decongesting the core area of the town. The health care facilities such as Civil Hospital is located I also present New Tura.The Public and Semi Public covers a total area of 0.85 Sq. Km. which is 9.45% of the infrastructure landuse.

iv. **Mixed Landuse:-**This allotment allows integration of Public and Semi Public usage with commercial activities. Residential units are also a part of mixed landuse. They are mostly present near the C.B.D. of the town. In areas of New Tura and Chandmari,

mixed landuse is also present. It has an area of 0.69 Sq. Km. which is 7.67% of the existing landuse infrastructure.

v. **Industrial:-**Only small scale industrial work are prevalent in Tura. However, the main location is location is the Industrial TrainingCentre located in Dakopgre. It has an area of only 0.001 Sq. Km. (0.05 Hectares) which is negigible of the existing landuse infrastructure, being the least.

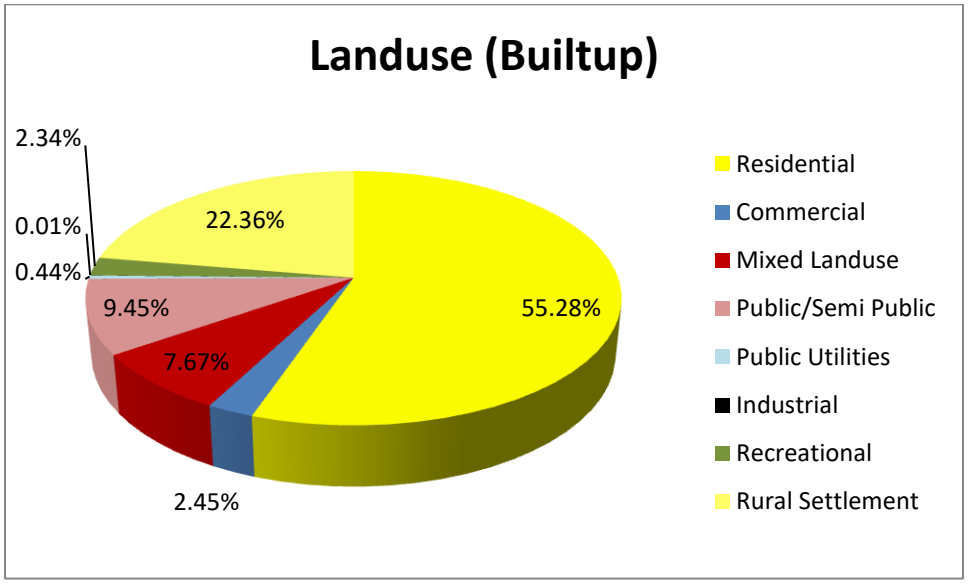
vi. **Recreational:**- The town is highly deficient in terms of recreational facilities. However small playfields are parks such as the Botanical Garden and D.C. Park. The main area in Tura having an inter relation of social infrastructure with the population is in Chandmari area, located around mission compound. The other recreational area include the social activities in M.P. Stadium and Parade Ground. They have a total area of 0.21 Sq. Km. which is 2.34% of the existing landuse infrastructure.

vii. **Rural Settlement:**- Within the past few years the highest emergence of infrastructure are mostly located outside the municipal boundary. Most of these rural settlements that have come up during the past few years are located in northern area of Chandmari and Rongkhongiri and towards the western area of Danakgri. These rural settlements are residential areas of single dwelling units. This shows that Tura is mostly experience a change of semi urban area characteristics. The rural settlements cover a total area of about 2.01 Sq. Km. which is 22.36% of the existing landuse infrastructure. This being the second highest to that of residential unit prevalent within the municipal area.

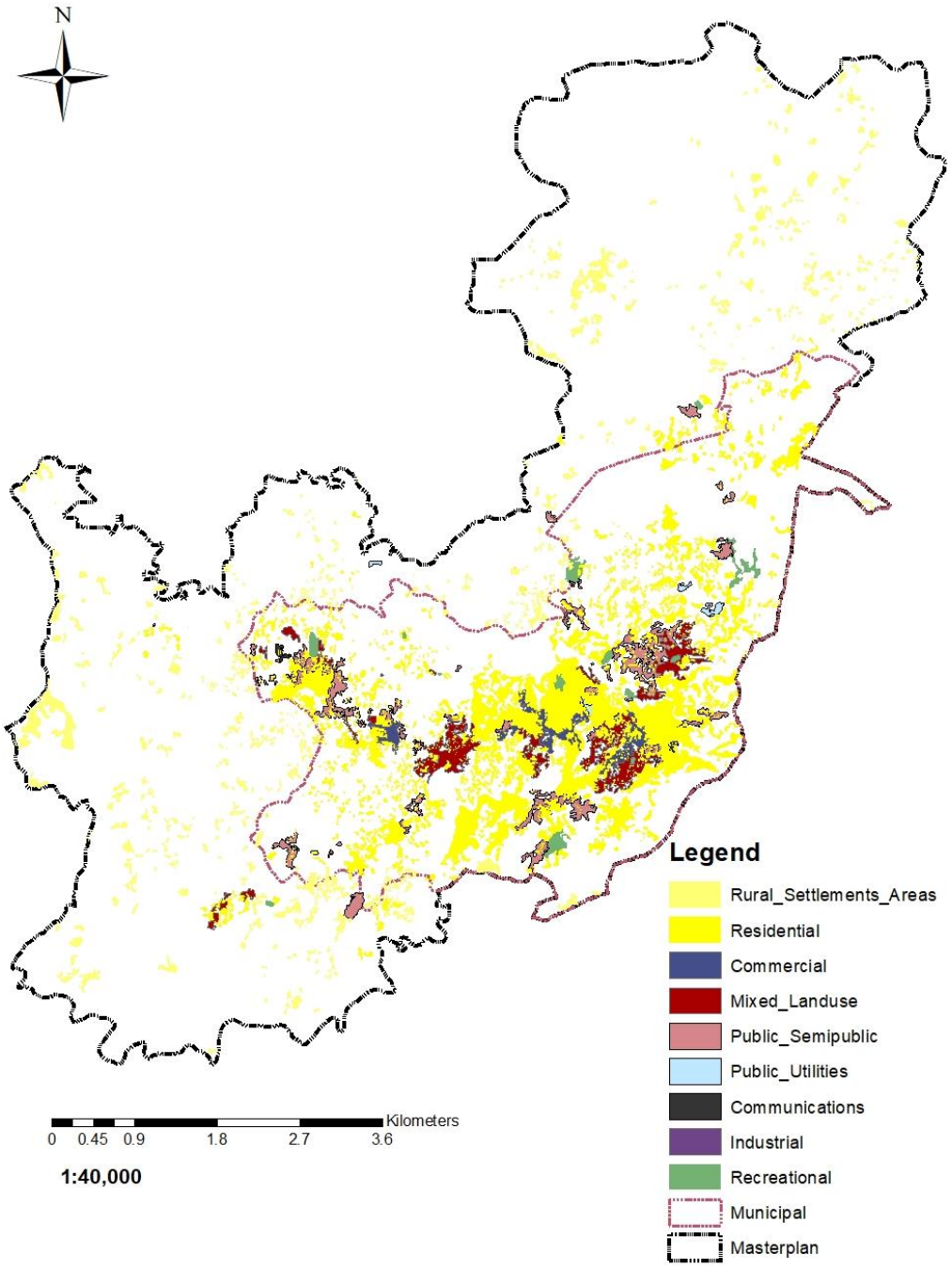
Table 3.2Existing Landuse (Existing Builtup)

Landuse	Area (Sq. KM.)	Percentage	% (Masterplan Area)
Residential	4.97	55.28%	9.09%
Commercial	0.22	2.45%	0.40%
Mixed Landuse	0.69	7.67%	1.26%
Public/Semi Public	0.85	9.45%	1.56%
Public Utilities	0.04	0.44%	0.07%
Industrial	0.001	0.01%	0.00%
Recreational	0.21	2.34%	0.38%
Urban Builtup	**6.98**	**77.64%**	**12.77%**
Rural Settlement	2.01	22.36%	3.68%
Total (Builtup Area)	**8.99**	**100.00%**	**16.45%**
Non Builtup Area	**45.66**		**83.55%**
Master Plan Area	**54.65**		**100.00%**

Fig 3.2Existing Landuse (Existing Builtup)



Map 3.2Existing Landuse Map (Existing Builtup)



2.4. Propose Landuse Plan

The propose landuse plan for Tura Masterplan can be propose in accordance with Section 4.7 of the URDPFI Guidelines, gives landuse classification in accordance:-

1. **Urbanisable Zone**: In Regional Plan, the areas under existing development and those earmarked for future development shall be termed as 'U Zone'. This zone is envisaged at three levels U-1, U-2 and U3.
   - 'U -1' zone shall primarily cover the existing areas where more intensive urban development and economic activity are expected in future.
   - 'U-2' zone shall cover the new town areas/ satellite towns/counter magnet/growth centres where urban development and economic activity is expected or proposed.
   - 'U-3' zone shall be zone outside the existing or proposed urban zones, which have potential for urban development such as lands around major roads and corridors, railway stations etc. No formal development plan may be prepared for U-3 zone but the development shall be regulated on the basis of road widths and development promotion regulations.

     In U Zone all residential, commercial, light and service industry, public and semi-public buildings, transport zones and recreation area may be permitted depending upon the compatibility of the uses.
2. **Transport and Communication Zone**: The areas earmarked for the transport and communication use shall be termed as 'T Zone'. This zone can be sub divided into Roads/ BRTS: T-1, Railway/ MRTS: T2, Airport: T-3, Seaports/ Dockyard: T-4, Bus depots/ truck terminals and freight complexes: T-5 and Transmission and Communication T-6.
3. **Primary Activity Zone**: The areas earmarked for primary activity use shall be termed as 'PA Zone'. This zone can be sub divided into Agriculture: PA-1, Forest: PA-2, Poultry and dairy farming: PA-3, and Brick kiln and extractive areas: PA-4.

Fig 3.3 Regional Landuse Classification as per URDPFI

Table 4.4: Simplified Regional Land use Classification

Level I			Level II		
N	A-N	Use Zone	N	A-N	Use Zone
1.	U	Urbanisable Zone	11	U-1	Existing Zone
			12	U-2	New Area Zone
			13	U-3	Potential for Urban Development Zones
2.	I	Industrial Zone			
3.	T	Transportation & Communication Zone	31	T-1	Roads/ BRTS
			32	T-2	Railways/ MRTS
			33	T-3	Airport
			34	T-4	Seaports, Dockyards and Dry ports
			35	T-5	Bus Depots/ Truck Terminals and freight Complexes
			36	T-6	Transmission and Communication
4.	PA	Primary Activity Zone	41	PA-1	Agriculture
			42	PA-2	Poultry and Dairy Farming
			43	PA-3	Rural Settlements
			44	PA-4	Brick Kiln and Extractive Areas

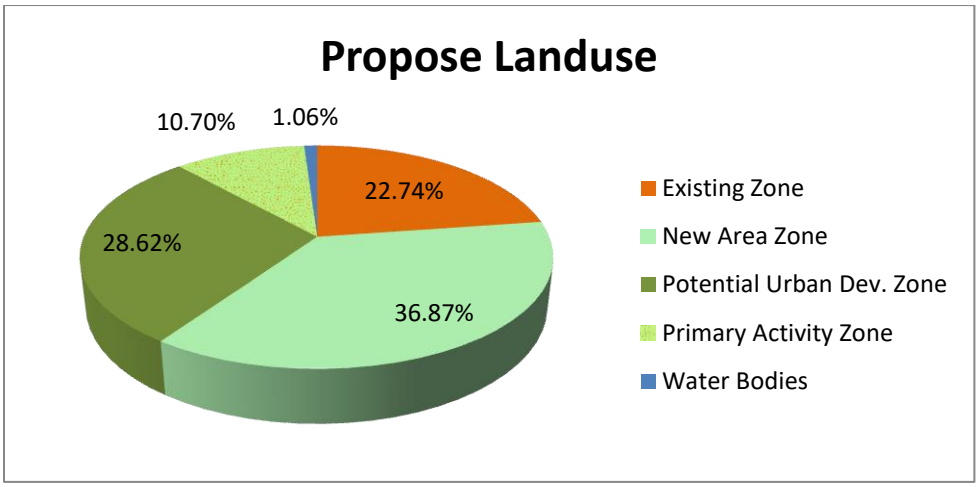
The propose landuse map of the Tura Master Plan consist of various classification of zones, which is as per the URDPFI Guidelines, which includes Urbanisable Zone (Existing Zone, New Area Zone & Potential for Urban Development Zone), Transportaion Zone and Primary Activity Zone.

The includes the Existing Zone will have a total area of 12.43 Sq,Km. which is 22.74% of the total landuse area. The New Area Zone will have an area of 20.15 Sq.Km. which contributes about 36.87%, while the Potential for Urban Development Zone will have an area of 15.64 Sq.Km. which is 28.62% of the total landuse. Primary Activity Zone will have 5.85 Sq.Km which is 10.70% of propose landuse distribution. Water bodies will have an area of 0.58 Sq.Km. which is 1.06% of the propose landuse area.

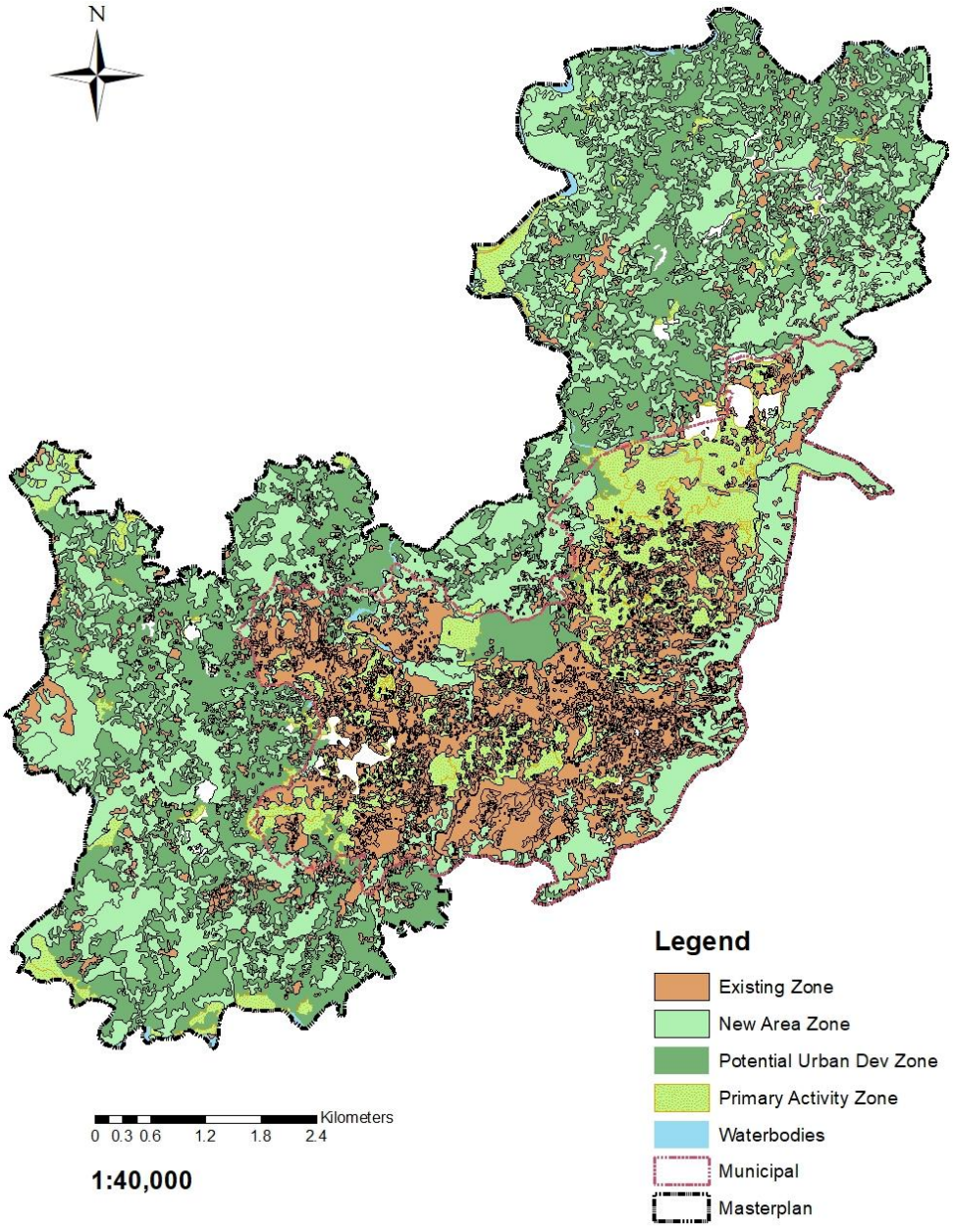
Table 3.3Propose Landuse Classification

Landuse	Area (Sq. Km.)	MasterPlan Area (%)
Existing Zone	12.43	22.74%
New Area Zone	20.15	36.87%
Potential Urban Dev. Zone	15.64	28.62%
Primary Activity Zone	5.85	10.70%
Water Bodies	0.58	1.06%
Masterplan Area	**54.65**	**100.00%**

Fig 3.4Propose Landuse Classification



Map 3.3 Propose Landuse Map



2.5. Zoning Regulation

The Tura Master Plan has been categorized to distribute the different type of land uses in terms of different categories of land resources. Thiswill require development of a zonal regulations of the propose landuse classification.The zoning regulations of Tura Masterplan is done in accordance with the URDPFI Guidelines 2014, given in table below.

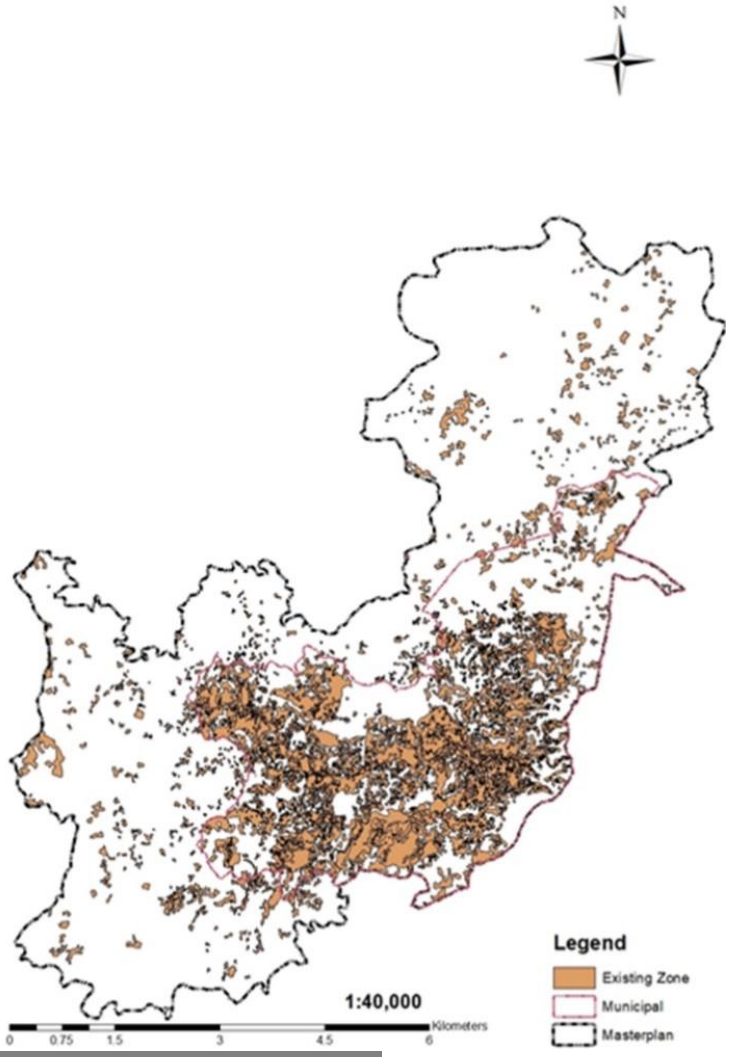
Zoning regulation of Tura masterplan is done by classifying the different zones as residential (R), commercial (C), Public & Semi-public(PS), Transportation(T), Primary Activity (A), Protective Area (E), Special Area (S), Recreational(P) and Industrial(I), for the propose landuse distribution.

i. **Residential (R)** – Primary Residential Zone (R1), Mixed Residential Zone (R2.
ii. **Commercial (C)** - Retail Shopping Zone (C1), Gen. Business & Commercial Centres (C2), Wholesome, Warehouse, etc. (C3), Service Sector. (C4) and Informal Market. (C5)
iii. **Public & Semi-public (PS)** - Govt./Semi Govt./Public Office (PS1), Govt. Land (PS2), Security & Safety Service – Police & Fire Station (PS3), Academic Service (PS4), Medical Service (PS5), Socio-cultural & Religious (PS6) & Other Utility Service (PS7)
iv. **Transportation (T)** - Road (T1), Truck Terminus/Bus Station (T2) & Transmission & Communication (T3)
v. **Primary Activity (A)** - Tree Clad Area (A1), Agriculture (A2) & Farming (A3)
vi. **Protective Area (E)** - Water Bodies (E1), Reserve Forest, Tribal Forest, Dense Forest (E2) & Slope Areas above 45°(E3)
vii. **Special Area (S)** - Heritage & Conservation Area (S1), Govt. restricted Area, Defence (S2 & Other Uses(S3)
viii. **Recreational (P)** - Heritage & Conservation Area (S1), Govt. restricted Area, Defence (S2 & Other Uses(S3)
ix. **Industrial (I)** - Service & Light Industry (I1) & Heavy Industry (I2)

Sl.	Zoning Regulations	Propose Landuse			
		Existing Zone	**New Area Zone**	**Potential Urban Dev. Zone**	**Primary Activity Zone**
1.	Residential (R)	• Primary Residential Zone (R1) • Mixed Residential Zone (R2)			
2.	Commercial (C)	• Retail Shopping Zone (C1) • Gen. Business & Commercial Centres (C2) • Wholesome, Warehouse, etc. (C3) • Service Sector. (C4) • Informal Market. (C5)			
3.	Public & Semi-public (PS)	• Govt./Semi Govt./Public Office (PS1) • Govt. Land (PS2) • Security & Safety Service – Police & Fire Station (PS3) • Academic Service (PS4) • Medical Service (PS5) • Socio-cultural & Religious (PS6) • Other Utility Service (PS7)			
4.	Transportation (T)	• Road (T1) • Truck Terminus/Bus Station (T2) • Transmission & Communication (T3)			
5.	Primary Activity (A)	• Tree Clad Area (A1) • Agriculture (A2) • Farming (A3)			
6.	Protective Area (E)	• Water Bodies (E1) • Reserve Forest, Tribal Forest & Dense Forest (E2) • Slope Areas above 45°(E3)			
7.	Special Area (S)	• Heritage & Conservation Area (S1) • Govt. restricted Area, Defence (S2) • Other Uses(S3)			
8.	Recreational (P)	• Playgrounds, Stadiums (P1) • Public Open Spaces (P2)			
9.	Industrial (I)	• Service & Light Industry (I1)			

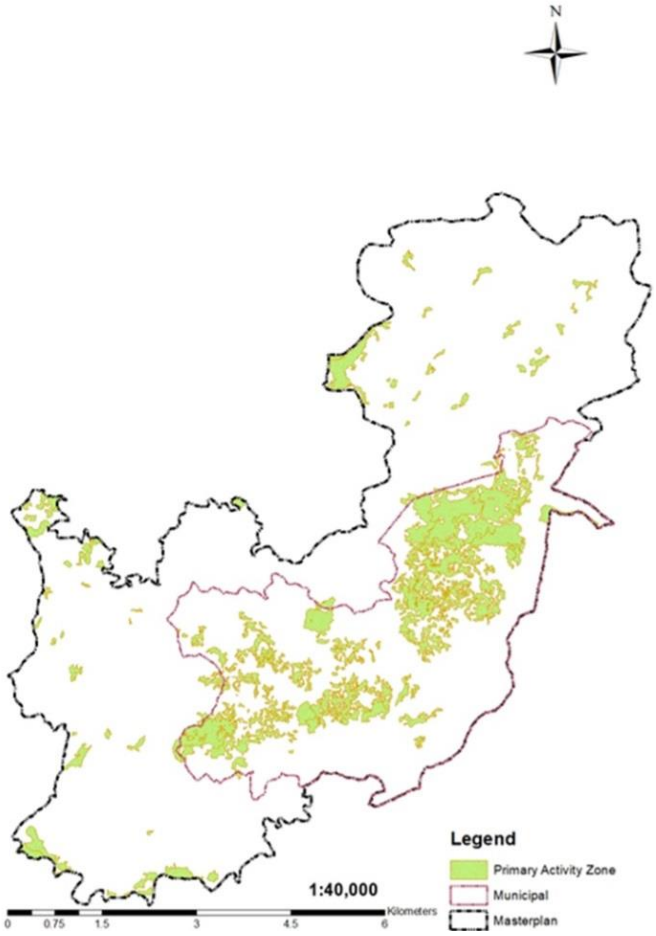
Map 3.4 Zoning Map (Existing Zone)

Sl.	Zoning Regulations	Propose Landuse Existing Zone
1.	Residential (R)	• Primary Residential Zone (R1) • Mixed Residential Zone (R2)
2.	Commercial (C)	• Retail Shopping Zone (C1) • Gen. Business & Commercial Centres (C2) • Wholesome, Warehouse, etc. (C3) • Service Sector. (C4) • Informal Market. (C5)
3.	Public & Semi-public (PS)	• Govt./Semi Govt./Public Office (PS1) • Govt. Land (PS2) • Security & Safety Service – Police & Fire Station (PS3) • Academic Service (PS4) • Medical Service (PS5) • Socio-cultural & Religious (PS6) • Other Utility Service (PS7)
4.	Transportation (T)	• Road (T1) • Truck Terminus/Bus Station (T2) • Transmission & Communication (T3)
5.	Primary Activity (A)	• Tree Clad Area (A1)
6.	Protective Area (E)	• Water Bodies (E1) • Reserve Forest, Tribal Forest & Dense Forest (E2) • Slope Areas above 45°(E3)
7.	Special Area (S)	• Heritage & Conservation Area (S1) • Govt. restricted Area, Defence (S2) • Other Uses(S3)
8.	Recreational (P)	• Playgrounds, Stadiums (P1) • Public Open Spaces (P2)
9.	Industrial (I)	• Service & Light Industry (I1)



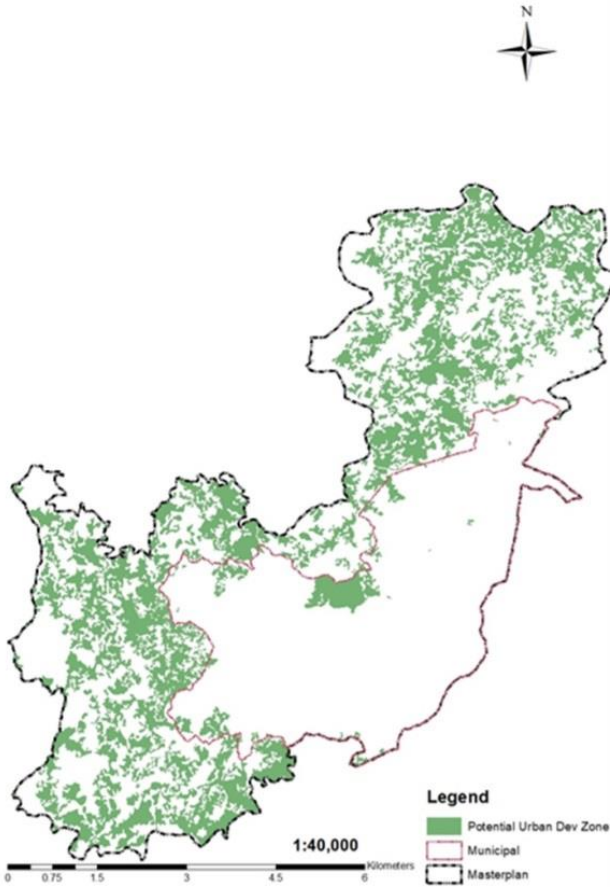
Map 3.5 Zoning Map (Primary Activity Zone)

Sl.	Zoning Regulations	Propose Landuse Primary Activity Zone
1.	Residential (R)	• Primary Residential Zone (R1) • Mixed Residential Zone (R2)
2.	Commercial (C)	• Retail Shopping Zone (C1) • Gen. Business & Commercial Centres (C2) • Wholesome, Warehouse, etc. (C3) • Service Sector. (C4) • Informal Market. (C5)
3.	Public & Semi-public (PS)	• Govt./Semi Govt./Public Office (PS1) • Govt. Land (PS2) • Security & Safety Service – Police & Fire Station (PS3) • Academic Service (PS4) • Medical Service (PS5) • Socio-cultural & Religious (PS6) • Other Utility Service (PS7)
5.	Primary Activity (A)	• Tree Clad Area (A1) • Agriculture (A2) • Farming (A3)
6.	Special Area (S)	• Heritage & Conservation Area (S1) • Govt. restricted Area, Defence (S2) • Other Uses(S3)
7.	Recreational (P)	• Playgrounds, Stadiums (P1) • Public Open Spaces (P2)



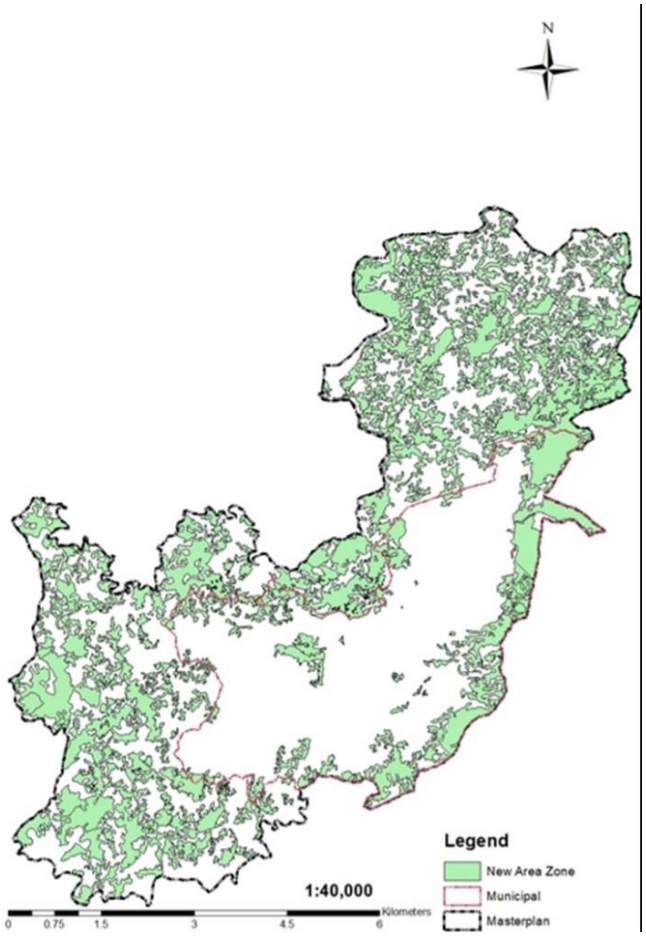
Map 3.6 Zoning Map (Potential Urban Development Zone)

Sl.	Zoning Regulations	Propose Landuse Potential Urban Dev. Zone
1.	Residential (R)	• Primary Residential Zone (R1) • Mixed Residential Zone (R2)
2.	Commercial (C)	• Retail Shopping Zone (C1) • Gen. Business & Commercial Centres (C2) • Wholesome, Warehouse, etc. (C3) • Service Sector. (C4) • Informal Market. (C5)
3.	Public & Semi-public (PS)	• Govt./Semi Govt./Public Office (PS1) • Govt. Land (PS2) • Security & Safety Service – Police & Fire Station (PS3) • Academic Service (PS4) • Medical Service (PS5) • Socio-cultural & Religious (PS6) • Other Utility Service (PS7)
4.	Transportation (T)	• Road (T1) • Truck Terminus/Bus Station (T2) • Transmission & Communication (T3)
5.	Special Area (S)	• Heritage & Conservation Area (S1) • Govt. restricted Area, Defence (S2) • Other Uses(S3)
6.	Recreational (P)	• Playgrounds, Stadiums (P1) • Public Open Spaces (P2)
7.	Industrial (I)	• Service & Light Industry (I1) • Heavy Industry (I2)



Map 3.7 Zoning Map (New Area Zone)

Sl.	Zoning Regulations	Propose Landuse New Area Zone
1.	Residential (R)	• Primary Residential Zone (R1) • Mixed Residential Zone (R2)
2.	Commercial (C)	• Retail Shopping Zone (C1) • Gen. Business & Commercial Centres (C2) • Wholesome, Warehouse, etc. (C3) • Service Sector. (C4) • Informal Market. (C5)
3.	Public & Semi-public (PS)	• Govt./Semi Govt./Public Office (PS1) • Govt. Land (PS2) • Security & Safety Service – Police & Fire Station (PS3) • Academic Service (PS4) • Medical Service (PS5) • Socio-cultural & Religious (PS6) • Other Utility Service (PS7)
4.	Primary Activity (A)	• Tree Clad Area (A1)
5.	Protective Area (E)	• Water Bodies (E1) • Reserve Forest, Tribal Forest & Dense Forest (E2) • Slope Areas above 45°(E3)
6.	Special Area (S)	• Heritage & Conservation Area (S1) • Govt. restricted Area, Defence (S2) • Other Uses(S3)
7.	Recreational (P)	• Playgrounds, Stadiums (P1) • Public Open Spaces (P2)



2.6. Building Bye Laws

The Tura Masterplan will exercise the powers of *The Meghalaya Building Bye Laws2021,* asdevelopment control regulations in accordance with section 74, of 'The Meghalaya Town and Country planning Act, 1973 and (Amendment) Act 2004'.

Thepowers of executing the Meghalaya Building Bye Laws 2021, will be within the Tura Masterplan area, which will include the Tura municipal area and its adjoining developing urban area. The enforcing authority and functions of the Meghalaya Building Bye Laws 2021, within the Tura Masterplan, is given according to the following table:-

Table 3.4Meghalaya Building Bye Laws, 2021

SL.	JURISDICTION	ENFORCING AUTHORITY	RESPONSIBILITIES
1.	**Enforcing of building plans and monitoring of building construction as per Meghalaya Building Bye Laws 2021.**		
i.	Within Tura Municipal Area of the Tura Masterplan area	• Meghalaya Urban Development Authority (M.U.D.A.) • Tura Municipal Board (T.M.B.)	Responsibilities are as follows - i. Conducting regular surveys on localities to check newly constructed buildings, if they have obtained building permission or not from the respective authority. ii. If building permission have been obtained for a respective building, inspection and monitoring of the construction of the building, if it is per the building plan submitted to the respective authority, which should follow the Meghalaya Building Bye Laws 2021, which include- a. Maintaining the permissible setbacks. b. Maintaining the prescribe Floor Area Ratio (F.A.R.), plot coverage, number of floors.. c. Checking the structural stability of the buildings. d. Checking that construction of sanitation infrastructure. e. Checking for any construction next to water bodies. f. Maintaining other development control regulations of the MBBL 2021..
ii.	Outside Municipal Area but within the Tura Masterplan area	• Garo Hills Autonomous District Council	

4. TRANSPORT PLANNING

4.1. Integrated Transport Plan

The Tura Masterplan will include, an Integrated Transport Plan, that provides a long term vision of mobility patterns and focuses on integration of landuse and transport and improvement of the mobility of the people. This is done in accordance with section 11, para (c) of 'The Meghalaya Town and Country planning Act, 1973 and (Amendment) Act 2004'.

The Integrated Transport Plan will includeroad network system and transport infrastructure supporting transport system that consist of interstate bus terminus, off street parking areas, traffic junction regulation and efficient public transport.

4.2. Existing Circulation Network

The area of Tura Master Plan is well connected with an extensive road network of 219.37Km. out of which 133.41 Km. is metalled road and 85.96 Km. is unmetalled. At present and all the unmetalled road are to be converted to metalled road.

Tura urban area forms the regional linkage to the other districts falling under Garo Hills Division. Around 46% of the existing road network falls under municipal area and around 38% are located along the peri urban areas particularly around Danakgre.

i. NH Highway 51 transverse through the CBD area of the town.
ii. The existing road network within the Master Plan follows no specific grid pattern due to topographical features of the area.
iii. There is no by-pass to divert the north and south bound through traffic.
iv. Most of the road length is single lane.
v. The length of footpath in the town is unmeasured.
vi. A total of 16 major intersections are present within the town.
vii. The unmetalled roads are mostly present outside the municipal area

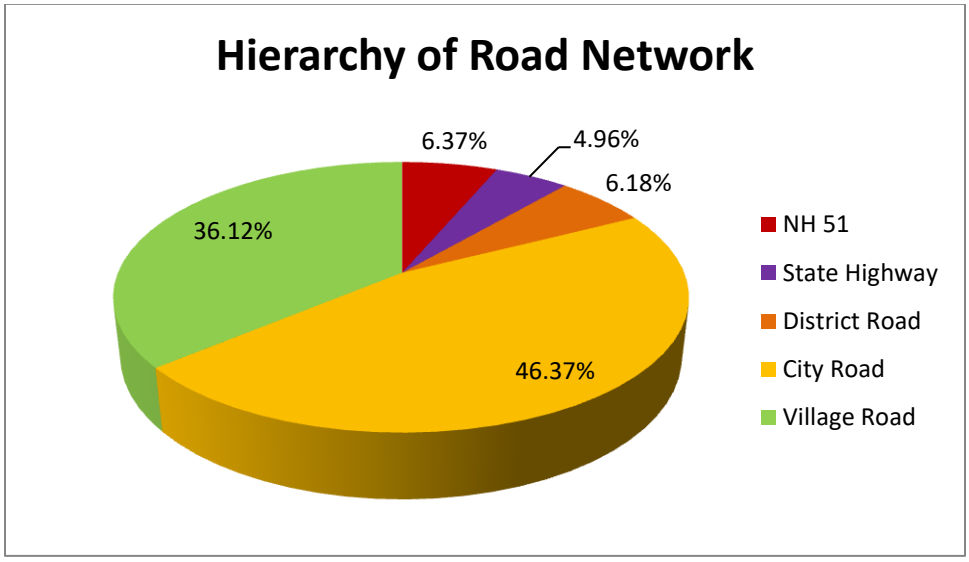
Table 4.1 Existing Road Network

Road_Type	Length (KM)	Percentage
Metalled	137.19	64.52%
Unmetalled	75.45	35.48%
Total	**212.64**	**100.00%**

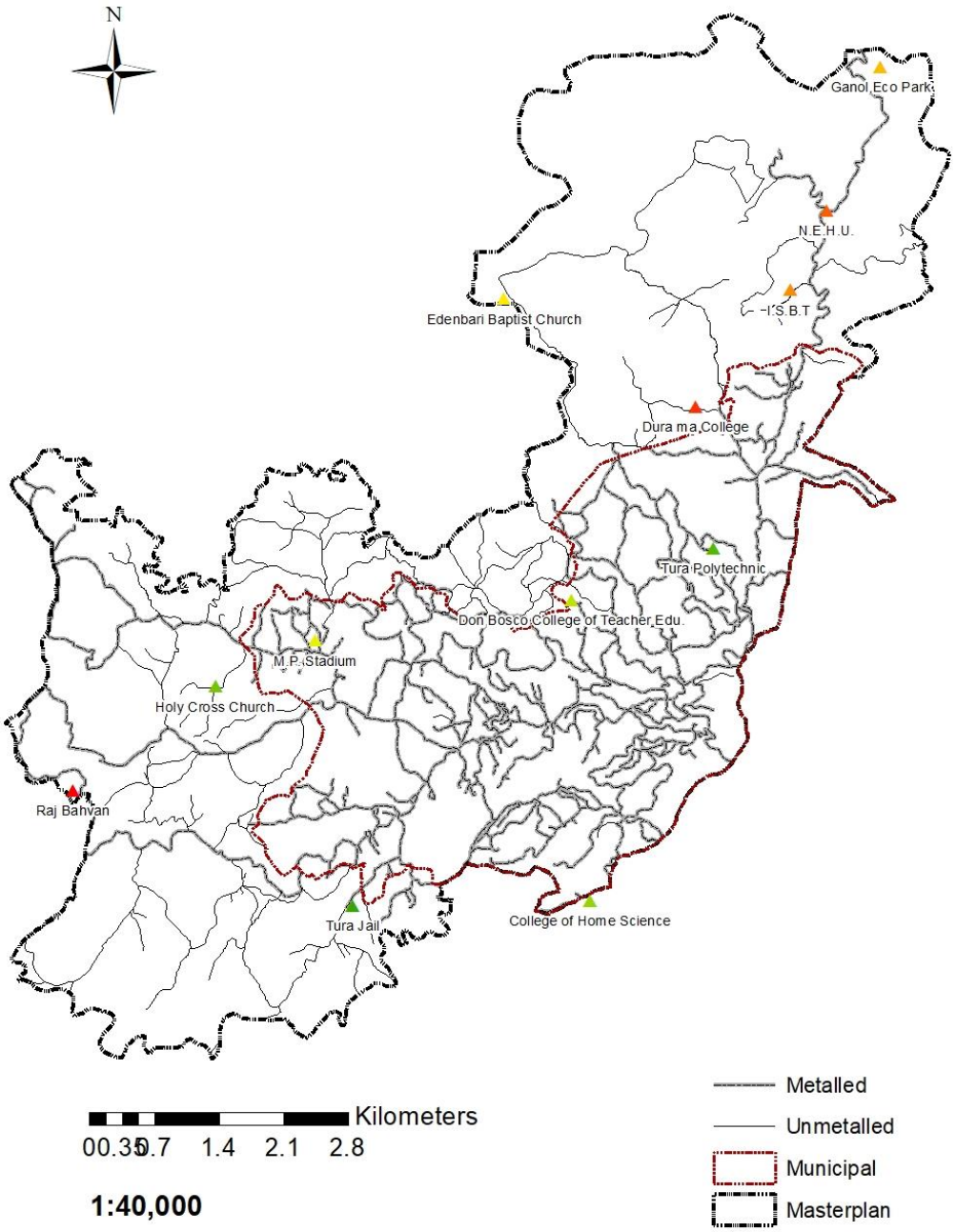
Table 4.2 Hierarchy of Road Network

Road Type	Length (M)	Length (KM)	Percentage
NH 51	13522	13.522	6.37%
State Highway	10540	10.54	4.96%
District Road	13128	13.128	6.18%
City Road	98480	98.48	46.37%
Village Road	76716	76. 716	36.12%
Total	**212386**	**212.386**	**100.00%**

Fig 4.1 Hierarchy of Road Network



Map 4.1 Existing Road Network



Map 4.2 Hierarchy of Road Network

4.3. Existing Transport System

The economic and socio cultural life of the town is dependent on good transportation network. The traffic problems within Tura urban area are related to lack of parking lots within central area, growth of commercial activities on all major roads, poor geometric design of road intersections and junction. The transportation network of Tura consists of the following:-

i. **Urban Traffic Movement-** The location of institutions and market along the major roads in different parts of the town has restricted the mobility of vehicular movement. The average speed of vehicles, in the C.B.D. area is observed to be 10-15 Km/hr. Absence of pedestrian footpath along busy corridors of the road, have affected the movement of smooth vehicular movement. Since, the National Highway passes through the town, it comes into conflict with the local traffic and creates congestion within the core area of the town.

ii. **Parking Facilities –** There are two parking facilities of private vehicles are located in the CBD area. The most functional is the super market parking area. The other parking area near the CBD area is the urban parking complex near Rikman Hotel.A parking lot is located at Chandmary, is used for regional transport.A parking lot is located at Chandmary, is used for regional transport.

iii. **Public Transport Services-** T.P.T.S. and Maxi Cab are the main public transport service for catering the main transport service in Tura town. Also, para transit service such as auto rickshaws and mini bus syndicate are well known to operate within Tura urban area. These para transit service are the dominant sector of public transport, due to poor coverage area and poor frequency of the T.P.T.S.

The total number of trip generated by the public transport service as well as para transit service per day has been of the order of 206 with roughly 6000 people commuting to and fro the town.

iv. **Logistics Service-** In the absence of railway, road connection serves as the only means of goods transport to the area. At present, three parking areas at old jail complex, Dobasipara. Also Akhonggre sumo parkingis where HMV logistic vehicles load and unload the goods brought into the city. Loading and unloading of goods is carried out on the main street of at Tura market area during non peak hours. The freight movement also takes place within the town due to absence of a city byepass.

v. **Regional Transport Service-** Turabeing the administrative head of the entire Garo Hills Division has a high number of people commuting to and fro, on daily basis. It has regional linkages to Shillong, Guwahati, Williamnagar, Resubelpara, Baghmara, Dalu, Ampati, etc. The trip distribution from Tura towards Williamnagar, Phulbari, Baghmara and Dalu area found to more as compared to the other routes, Night bus service are known to operate from the town towards Shillong and Guwahati.

Table 4.3 Trip Distribution- Regional Transportation

Destination	No. of Vehicles	Trip Distribution (%)
Shillong- Guwahati	12	15.58%
Williamnagar-Resubelpara, -Pullbari	27	35.06%
Baghmara-Dalu	20	25.97%
Ampati-Tikirkila	18	23.38%
Total	**77**	**100.00%**

vi. **Growth of Vehicles-** Information as per records of D.T.O. Tura, shows, the decadal growth of vehicles in Tura. As there is no large urban centre in Garo Hills, other than Tura, the records mostly reflect the growth of vehicles in Tura. From 2001 to 2011, the growth of private car and two wheeler ownership has been the highest as compared to other mode of vehicle transport. There is a much higher growth of autos as compared to buses, which shows that demand for public transport is more towards para transit service.

Table 4.3 Growth of Vehicles (2001-2011)

Vehicle Type	2001	2011	Growth of Veh. (2001 to 2011)	Growth of Veh. (Percentage Inc.)
Jeep	739	1,081	342	46.28%
Car	859	3,946	3,087	359.37%
Truck	1,014	2,273	1,259	124.16%
Bus	348	376	28	8.05%
Auto	621	1,080	459	73.91%
Two Wheeler	3,311	6,078	2,767	83.57%
Total	**6,892**	**14,834**	**7,942**	**115.24%**

Map 4.3 Urban Traffic Volume

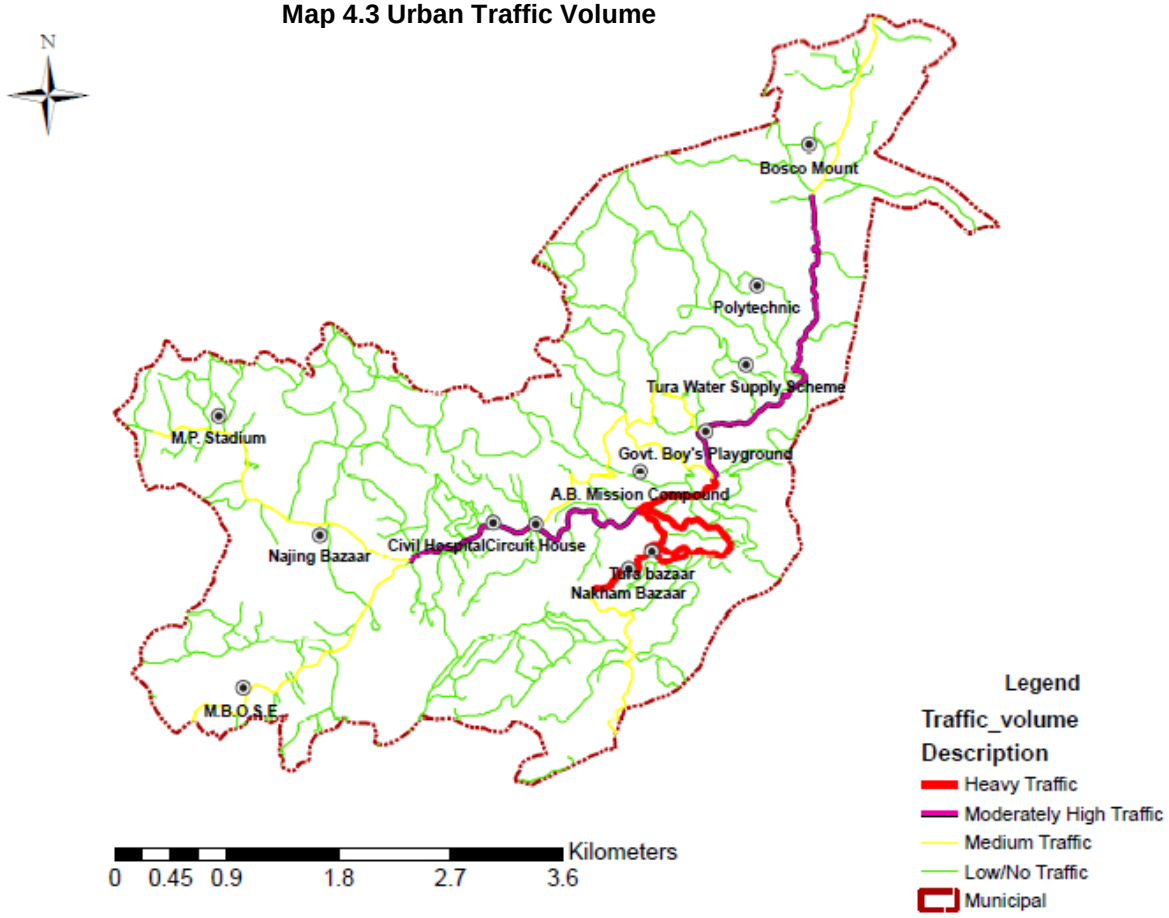
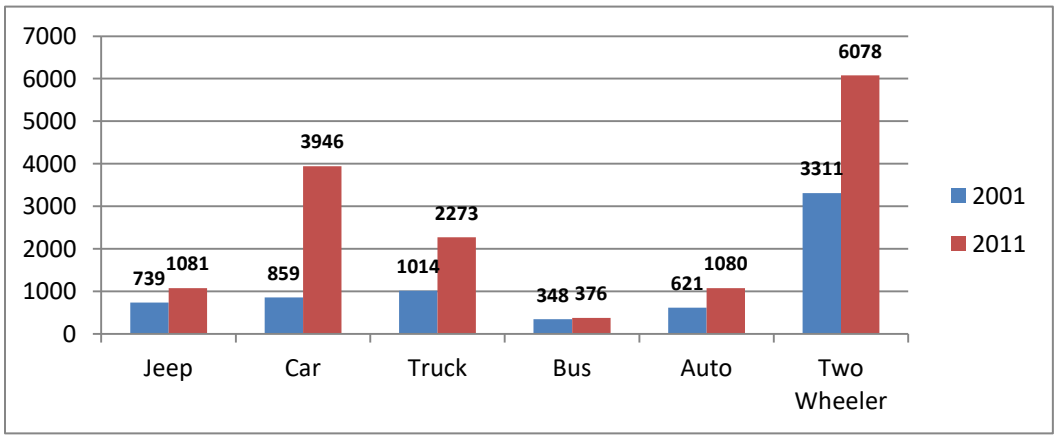


Fig 4.2 Urban Traffic Volume



4.4. Propose Transportation Plan

Traffic congestion in the urban area of the town has found to be increasing rapidly during the past two decades. This is due to the rapid growth of vehicles over the past years, lack of public transport and proper road network system.

The proposal will include planning for transportation infrastructure services and planning of Transit public and regional transport services.

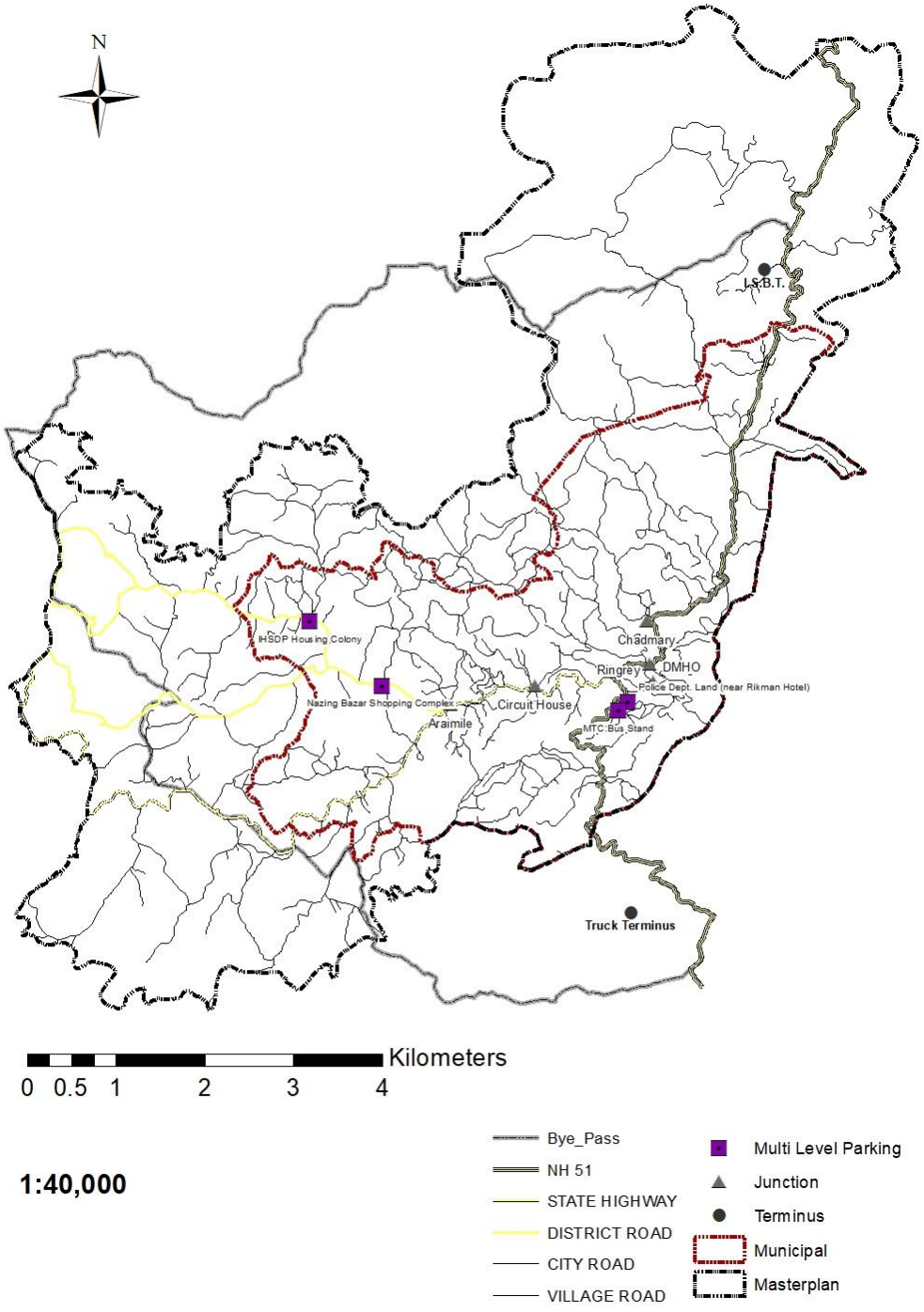
Table 4.4 Transportation Plan (Highway and Infrastructure)

Sl. No.	Transportation Infrastructure Components	Proposal
1.	Creation of Bye Pass – Semi Ring Road	• Diversion of south west and north bound regional traffic from NH-51, through construction of a bye pass, from Chasingre connecting through Rongkhongiri. • It will connect the district road going towards Ampati through Damalgri. A roads for this alignment has already been developed, for segregation of regional traffic and urban traffic. • Segregation of Traffic – Main purpose of the bye pass (semi ring road), is to diverge the regional traffic away from the core area of the town to prevent collision with the local traffic of the town.
2.	Junction Improvements	• Rerouting traffic as a main roundabout – Junction at Hawakhana Petrol Pump uptoRingrey hub junction at DMHO. • Introduction of Traffic Island - Chandmary Junction, Ringrey Junction, Circuit House Junction and Araimile Junction.
3.	Parking	• Tura Market area – ✓ Additional multi level parking facility with top floor as vendors market can be built near the Rikman Hotel on land belonging to Police Dept. ✓ The MTC bus stand can be converted to an off street level parking complex with top floor as vendors market. • Nazing Bazaar - A multilevel parking area can be construct near the commercial centre of Najing bazaar, to ease the congestion during weekly market in the area. • Chandmary – Upgradation of Chandmary Shopping Complex into a mix utility building with multi level parking and top floor commercial utility. • Dakopgre – New multilevel parking facility located near housing for urban poor.
4.	Insterstate Bus Terminus	• The I.S.B.T. located at Chasingre will serve as the main regional bus terminus for all the buses plying towards other districts. • All bus should ply from the I.S.B.T. and not enter the main town other than early in the morning, to prevent mixing with local traffic.
5.	Truck Terminus	• The terminus location at Dobasipara can be upgraded into a truck terminus, which is of close proximity from the main market area. • The Akongre parking area can be use for loading/unloading of goods for HMV vehicles.
Sl.	**Transit**	**Proposal**

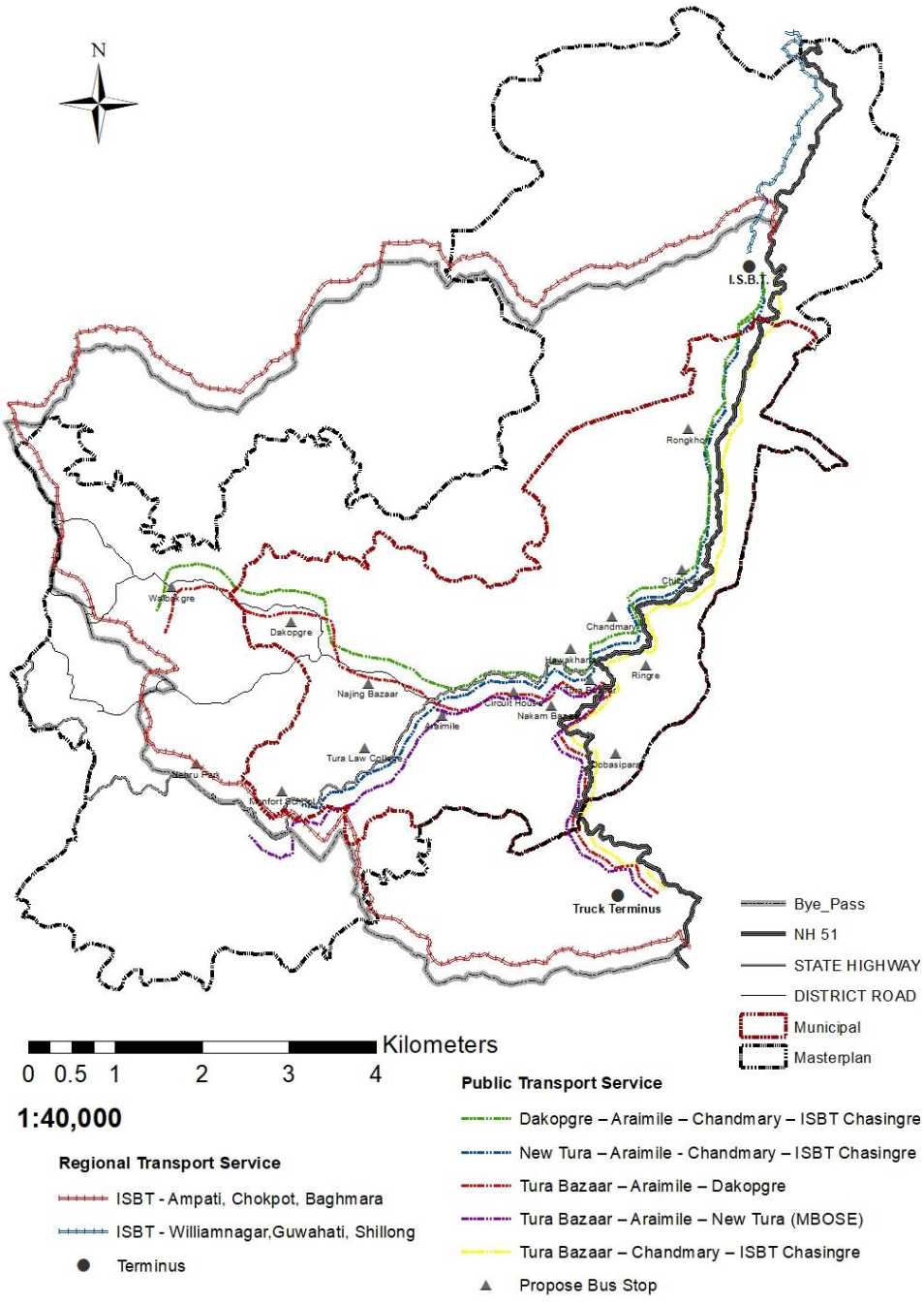
Table 4.3 Transportation Plan (Transit System & Services)

No.	Service Components	
1.	Public Transport Services (TPTS) Integrated with Intelligent Transport System	• The level of service of the public transport services will involve integrating the main transport corridor services (T.P.T.S.) along with feeder services (Maxi Cab). The main transport corridor services, will be place along the route of higher traffic densities, while the feeder services can be place in locations where the main transport corridor cannot be accessible. • The main transport corridors will have 5 route:- i. Tura Bazaar – Chandmary – ISBT Chasingre ii. Tura Bazaar – Araimile – Dakopgre – Ballongre (ICFAI) iii. Tura Bazaar – Araimile – New Tura (MBOSE) iv. Ballongre (ICFAI) - Dakopgre– Araimile – Chandmary – ISBT Chasingre v. New Tura (MBOSE) – Araimile - Chandmary – ISBT Chasingre • Feeder Services (maxi cab) will enter into the interior roads of the Tura town. • Intelligent Transport System – integrate the bus system with G.P.S
2.	Regional Transport Service (Regional and Interstate Buses)	• The proposal route for the regional bus services will circulated along the bye pass connecting the NH-51 from the north, with the district road of Ampati from the south western part. • The regional traffic will circulate outside/along the Master Plan boundary i.e., along the outer circumference of the town, while the local traffic will circulate along the inner area of the town, i.e., along the inner circumference of the town. • Public transport service will be provided from the urban area towards the I.S.B.T. that will allow passengers to commute between the town and the I.S.B.T..
3.	Logistic & Goods Services (Trucks)	• Similarly as in the case of the regional transport services, the freight movement will be circulated along the outer periphery of the town, as in the same pattern of the regional transport. • The trucks will halt at atDobasipara for loading and unloading of goods, which will not interfere with the local traffic and at the same time, that it will not be located too far from the market area.

Map 4.4 Propose Transport Plan (Highway Infrastructure)



Map 4.5 Propose Transport Plan (Transit System)



5. INFRASTRUCTURE PLANNING

5.1. Basic Consideration

Provision of adequate infrastructure in relation to the requirement of the urban population will correspond to sustainable development of Tura with high quality of living standard of the residing population. The planning of infrastructure shall be based on the physical infrastructure of water supply, sanitation, power supply, housing facilities and social infrastructure.

5.2. Water Supply

The objective of a public protected water supply system is to supply safe and clean water in adequate quantity, conveniently and as economically as possible. Presently, water supply in Tura is made from Tura Water Supply Shceme (Phase-I) by tapping water through gravity from the nearby stream Rongkhon. This project was commissioned way back in 1970 to feed a population of 50,000.

The existing Tura Phase-I and Phase-II (for 50,000 population and 87,827 respectively), water supply schemes which have been catering to the water demand of the water demand of the town have become obsolete. Since the machinery used are in depleted condition. In order to solve this problem, another scheme called as Tura Water Supply Scheme Phase-III (32,225 population) was taken up in 2003, is implemented. Under this scheme, it is proposed to draw water by gravity from river Didare located 28 KM away from the town. The scheme is designed to cover the newly developed localities in the periphery of Tura Township. Surplus water from Tura Phase-III WSS is being supplemented to Tura Water Supply Scheme Phase-I & II.But the discharge of Didare stream which is the source of Phase-III has also reduced considerably due to massive deforestation of the catchment area.

Presently, water supply in Tura is looked after by two authorities- State Public Health Engineering (PHE) department and the Garo Hills Autonomous District Council (GHADC). While the PHE department harvests and treats the water and finally sends it to the zonal reservoir. The GHADC distributes the water to domestic and other consumers at a nominal tariff.

Table 5.1 Existing Water Supply, Tura Water Supply Scheme

Sources	**Capacity (Lac Gallon/day)**
Rongkhon Stream (Gravity Scheme)- Phase-I	6.19
Ganol Stream (Pumping Scheme)- Phase-II	13.05
Rongkhon Stream (Pumping Scheme)- Phase-III	30.64
Didare Stream (Pumping Scheme)- Phase –I & II (Augmented)	21.09
Total	**70.97**

Table 5.2 Analysis - Existing Water Supply, Tura Water Supply Scheme

Description	**Rongkhon Stream (Phase-I)**	**Ganol Stream (Phase-II)**	**Didare Stream (Phase-III)**
Population	50,000	87,827	32,225
Water Supply Level (100 lpcd)	50,00,000	87,82,700	32,22,500
Water Supply Level (Gallon per day)	13,20,000	23,18,632	8,50,740
Required Water Supply Level (Gallon Lac per day)	13.20	23.19	8.51
Actual Water Supply Level (Gallon Lac per day)	6.19	13.05	30.64
Difference in Water Supply Level (Gallon Lac per day)	**-7.01**	**-10.14**	**22.13**
Deficient in Water Supply Phase I & II	-17.15		Gallon Lac per day
Water Supply level Augmented Phase I & II	21.09		Gallon Lac per day
Difference in Phase I & II	**3.94**		**Gallon Lac per day**
	1.8		**MLD**

Analysis of existing water supply of Tura under shows that there is shortage in water supplied by the Water Supply Scheme (Phase – I & II) as compared with the required water to be supplied to the targeted population. Phase III more than the required water supply level of 22.13 Gallon Lac/day. The augmented water supply of Phase I & II, is use to cater the deficient areas of Phase I & Phase II, which generates 21.01 Gallon Lac/day. Thereby there is additional shows that 3.94 Gallon Lac/day (1.8 MLD) .

This shows the need extensive checking by the authorities for the water losses from water generation to water distribution at household level. However if water loss can be reduce to a near 100%, the amount of water required for a population projection of 1,14,440 by the year 2041, is approx. 8 MLD, within the Tura masterplan area. Also the area required for water supply will be 0.19 hectares as per URDPFI Guidelines.

Table 5.3 Water Supply Requirement for projected population of Tura

Sl.	Description	Details
1.	Water supply level for towns with piped water supply but without sewerage system *(as per URDPFI Guidelines 2014)*	70 lpcd
2.	Projected Population of Tura for year 2041	1,14,440
3.	**Water supply required for Tura by year 2041**	**80,10,800 lpcd**
		8 MLD
4.	**Land required for water supply system***(as per URDPFI Guidelines 2014)*	**0.19 Hectares**

5.3. Sanitation

Tura does not have a centralized sewerage system. It mostly consist of septic system of sewage disposal or conventional pit latrine. Due to lack of funds and infrastructure deficiency, a centralized system of sewage disposal is not economically feasible.

Existing Sanitation Situation- The sanitation status of residential unit within the municipal boundary. The sanitation status will depend on the type of sanitation facilities used by the residential units within Tura urban area, such as water closets, pit latrines, etc.

Many places within the municipal area, have no access to any sanitation facilities. Certain locations around Wadanang, Akhongre, Beldapara, Lower Chandmary, Rishipara are to have severe shortage in proper sanitation facility.

Propose Sanitation Plan- It is emphasized that if the sewage from the urban and peri urban areas of the town, are properly treated, it will have a direct positive effect on the safe and healthy living condition of the entire town.

- There should be strict enforcement by the office of MUDA to have water closet facilities and septic tanks at every single household unit.
- All traditional sanitation facilities should be upgraded to technological sanitation facilities.
- The household septic tank should be discharge from time to time, base on its design capacity.
- There should be sufficient number of desulging trucks to transport the sewage to an offsite location for proper treatment.
- Final disposal site should be located far from the urban residing areas and away from water bodies or any water source. They should consist of modern method of sewage disposal without hampering the surrounding environment.
- Public Awareness about safe sanitation should be conducted at regular basis.
- Creating required setbacks for construction of any building close to a water source or main stream.
- Availability of public toilets in commercial and high density areas.

5.4. Solid Waste Management

The Municipal Solid Waste Management (MSWM) presently being adopted in Tura is taken care by the Tura Municipal Board. The role of the TMB requires cooperation from the public, for efficient municipal solid waste management. Efficient management of solid waste by TMB will require a systematic process that comprises of waste segregation at source, transportation, secondary, resource recovery, treatment, and final disposal of solid waste.

Existing MSWM- At present, solid waste are collected from secondary collection points, by municipal vehicles. There is no segregation of waste during the process. TMB uses a total number of around 17 vehicles for solid waste transport. The garbage is then transported to a dumping ground owned by TMB, which is located at Rongkhongre. On a daily average, the municipal vehicles make around 11 trips from different secondary collection points to the dumping ground.At the dumping ground, mixed garbage including inert materials is openly dumped and burnt down. Vegetable waste are very composed at the dumping ground to produce manure.

Table 5.9 Solid Waste Generation Per Capita Per Day *(CPHEEO, 2000)*

Land use type	Estimated waste generation
Residential refuse	0.3 to 0.6 kg/cap/day
Commercial refuse	0.1 to 0.2 kg/cap/day

Table 5.10 Estimation of Solid Waste Generation

Year	Projected Population	Waste Generated per Capita per Day; 0.3 kg/cap/day (CPHEEO norm)	Waste Generated per Capita per Day; Metric Ton (MT)/day
2011	88,052	26,415	26.42
2021	1,01,246	30,373	30.37
2031	1,01,246	30,373	30.37
2041	1,14,440	34,332	34.33

Propose MSWM Plan- For effective MSWM following steps should be followed, hence appropriate considerations should be made at planning stage.

- Collection of solid waste in the town, should be door from primary source, i.e., from door to door household collection.
- Segregation of biodegradable and non biodegradable waste should be done at primary source.
- Separate secondary disposal units for residential, commercial and institutional waste.
- Efficient final disposal site for both degradable and non biodegradable waste.

5.5. Housing

Housing is one of the basic requirements of basic human life and the condition of housing influences the quality of urban life and which in turn affectys the efficiency of the settlement. Since, housing constitutes the largest landuse of the builtup infrastructure in the entire city, it has significant impact on the entire urban infrastructure development of the town.

The increase rate of population over the past decade has created a considerable shortage of housing in both private and government. Areas falling under Ward No. 3, 4 & 5 are known to

have congested living conditions because of their high current population density. The growth of population exceeds the housing availability of any town.

To meet this huge demand the government, corporations and large institutions should encourage to provide housing facilities for their own employees besides private sector housing also.

Table 5.11 Housing Status

Description	2001	2011
Population (Municipal Area)	58,978	74,858
Number of Household Unit (Municipal Area)	10,184	13,743

Slum Development- There are eight notified slums within Tura urban area, they are Wadanang, Lower Chandmary, Ringregittim, Akhongre, Breldapara, Rishipara, Matchakolgre and Hawakhana. These slum areas are mostly characterized by their physical lack of infrastructure facilities.

Most of the notified slum areas are based on the lack of sanitation facilities. The either have pit latrines or go for open defecation. A majority share of these slum areas, use shared tap water facilities. More than 50% of these houses are made up of traditional mud blocks. None of these houses are known to have any drainage facilities.

Besides these notified slum areas, certain areas in Araimile and Nakham Bazaar, are known to show semi slum like characteristic growth. New slums have also been identified and they mostly emerge on Govt. Land.

Rehabilitation of these slums will require-

- Relocating of slums that have encroached on Govt. Land to a new location at Dakopgre.
- Provision of public toilets near the notified slum areas.
- Restriction of encroachment of illegal buildings.
- Enforcement of building bye law on newly constructed houses of avoid slum like infrastructure development.

Table 5.12 Notified Slum Areas

Sl. No.	Localities	No. of HH's	Houses Type (%)		Latrine (%)			Water Supply (%)	
			Semi. Pucca	Kutcha	Water Closet	Pit latrine	No Latrine	Private	Public
1	Wadanang	377	46.44	53.56	7.2	45.5	47.3	30.93	60.07
2	LowerChandmary	383	32.15	67.85	8.3	38.4	53.4	32.48	67.52
3	Ringregittim	164	30.30	69.70	25.6	39.8	34.6	37.87	62.13
4	Akhongre	256	39.02	60.98	12.9	41.4	45.7	46.34	53.66
5	Breldapara	220	26.32	73.68	9.7	41.1	43.2	39.47	60.53
6	Rishipara	335	25.36	74.64	6.9	38.8	54.8	31.64	68.36
7	Matchakolgre	429	46.30	53.70	45.4	59.7	14.3	48.81	51.19
8	Hawakhana	259	40.20	59.71	9.8	59.56	30.64	36.16	63.84

5.6. Social Amenities

It is observed that a number of social amenities particularly in regard to education and health infrastructure operate in private residential premises due to their proximity to the area of demand.

1. **Education-** Tura is one of the most important educational centers for the whole of the Garo Hills. The town has sufficient number of educational facilities to serve the present population as well the projected population. Tura has 48 Lower primary schools, 28 High Schools & Higher Sec. Schools, 13 Colleges and 2 Central Universities.

   It is important to upgrade the lower primary schools into Higher secondary schools and improve the existing higher secondary schools. It is also important to create more colleges (general and professional) to cater to the demand of quality education within Tura. A proposal of 45 higher secondary schools and 35 colleges (general and professional) is required in Tura by 2041.

Table 5.14 Educational Facilities Requirement

Description	Didare Stream (Phase-III)
Projected Population - 2041	1,14,440
A. High School & Higher Sec. School Facilities	
Percentage of Students (Sec. School & Higher Sec School)	40% of Projected Population - 2041
Population of Students	45,776 (approx.)
College with hostel facilities (Sec. School & Higher Sec School) as per URDPFI Guidelines 2014	1,000 student capacity
Number of Integrated School with hostel facilities (Class I to XII) required within Tura Master Plan area by 2041	**45**
B. College Level Education Facilities	
Percentage of Students (College)	30% of Projected Population - 2041
Population of Students	34,332 (approx.)
College with hostel facilities (General & Professional Courses), as per URDPFI Guidelines 2014	1,000 student capacity
Number of Colleges with hostel facilities (General & Professional Courses) required within Tura Master Plan area by 2041	**35**

2. **Health Care Facilities-** Tura has a total of 6 hospitals. 3 of them can be termed as specialized. Advanced facilities having surgery and mental disorder treatment, are however lacking. At present Tura Civil Hospital is the main Health Centre operating in the urban area. There are proposal for upgrading the civil hospital to a specialized facilities and also to increase the number of bed as per URDPFI Guidelines 2014.

Table 5.14 Health Care Beds Requirement

Description	Didare Stream (Phase-III)
Projected Population - 2041	1,14,440
Annual Rate of admission (as per URDPFI Guidelines)	1 per 50 Population
No. of Bed required in Tura Hospital by 2041	2290 (aaprox)

6. DISASTER ASSESSMENT AND PLANNING

6.1. Hazard Consideration

The Tura Masterplan will include, a Hazard Vulnerability and Risk Assessment (HVRA) analysis, which will address various hazards, including landslides, floods, and lightning, and to assess both social and physical vulnerability and associated risks. In order to create a vulnerability map, account population vulnerability was considered by using demographic information of the Tura Town as well as building vulnerability considering socio-economic survey data with respect to the specific hazard. The risk was finally computed by incorporating the findings of each hazard and vulnerability evaluation.

6.2. Hazard Vulnerability and Risk Assessment (HVRA)

Hazard Vulnerability and risk assessment in Tura town to evaluate the susceptibility of critical infrastructure, socio-economic, demographics, and vulnerable populations to identified hazards. The project has the following objectives**:**

- **Preparation/generation of Hazard/Susceptibility zonation to various hazards, namely, flood, landslide and thunderstorm/Lightning.**
- **Assessment of building and population vulnerability using socio- economic and census data.**
- **Assessment of associated risk with hazard/ susceptibility and preparation of technical report.**

1. **Landslide Susceptibility:** From the *Figure 6.1* on the landslide susceptibility map, the study area was divided into four susceptible zones: "Very Low," "Low," "Moderate," and "High." The percentages of the total area found in each of these zones are as follows:

   Very Low Susceptibility Zone: This zone encompasses an area of 0.32 km² and holds the least likelihood of experiencing landslides. The "Very Low" susceptibility zone constitutes 0.84% of the total area. *Low Susceptibility Zone:* The zone labeled as "Low" susceptibility, spanning 10.38 km², signifies an area with a comparatively low risk of landslides. This zone comprises 27.17% of the total area under consideration. *Moderate Susceptibility Zone:* The "Moderate" susceptibility zone includes an area (23.20 km^2) with a moderate probability of landslides. The percentage of the total area in this zone is 60.70%. *High Susceptibility Zone:* The zone classified as "High" susceptibility, covering an

area of 4.31 km², exhibits the greatest likelihood of experiencing landslides. This zone constitutes 11.29% of the total area under consideration.

2. **Flood Hazard Zonation:** The flood inundation areas generated were classified according to Flood Hazard classes according to *Mihu-Pintilie et al. 2019 (Table 6.1).* The hazard map as shown in *Figure10.*

Table 6.1: Classification according to Mihu-Pintilie et al. 2019

Flood Hazard	Flood Depth (m)	Hazard Classes
H1	<1	Low
H2	1-2	Moderate
H3	2-5	High
H4	>5	Very High

3. **Lightning Hazard Zonation:** Meghalaya is one of the most lightning vulnerable areas in the NER regions. Meghalaya, being a region with diverse topography and climatic conditions, may experience varying degrees of lightning hazards. Tura, located in the West Garo Hills district, may be susceptible to lightning hazards due to its geographical and climatic conditions. Chandragiri, Danakgiri and Ringiri areas are most hazardous *(Figure 6.3)*. The months of April, May and June are most vulnerable month for lightning hazard. Implementing lightning safety measures and raising awareness about lightning risks could be crucial for mitigating potential hazards in the area.

4. **Vulnerability Assessment:** Vulnerability is the risk caused by any natural and man-made hazard toward the community or substances. A community's vulnerability is determined by physical, social, economic, and environmental factors and location and hazard categories (UNISDR, 2017). These impacts are partly due to characteristics inherent in a community's social interactions, institutions, cultural values, and economic structure. The vulnerability zones are categorized into high, moderate, low and very low categories based on the degree of vulnerability. Hence, three hazards, e.g. landslides, floods and lightning, have been considered for the building vulnerability of the Tura town area.

   The study shows that 251.32 hectares (20%), 524.05 hectares (41%), 300.44 hectares (24%) and 188.48 (15%) of built-up areas are very low, low, moderately and highly vulnerable to landslides, respectively. It also found that 475.83 hectares (38%), 258.01 hectares (20%), 335.33 hectares (27%) and 195.12 (15%) of built-up areas are low, moderate, high and very highly vulnerable areas to

flooding, respectively. Moreover, the study area is highly vulnerable to lightning, like other parts of Meghalaya. In this context, 193.25 hectares (15%) built-up is low, 81.18 (7%) moderate, 496.44 hectares (39%) is high, and 493.42 hectares (39%) are very highly vulnerable to lightning hazards. This socio-economic building vulnerability study will help the local authorities and other stakeholders identify the most vulnerable area in the planning. Figure 6.4 shows Landslide Building Vulnerability Map, Figure 6.5 shows Building Vulnerability for Flood Map, Figure 6.6 shows Building Vulnerability for Lightning Map and Figure 6.7 shows Population Vulnerability Map.

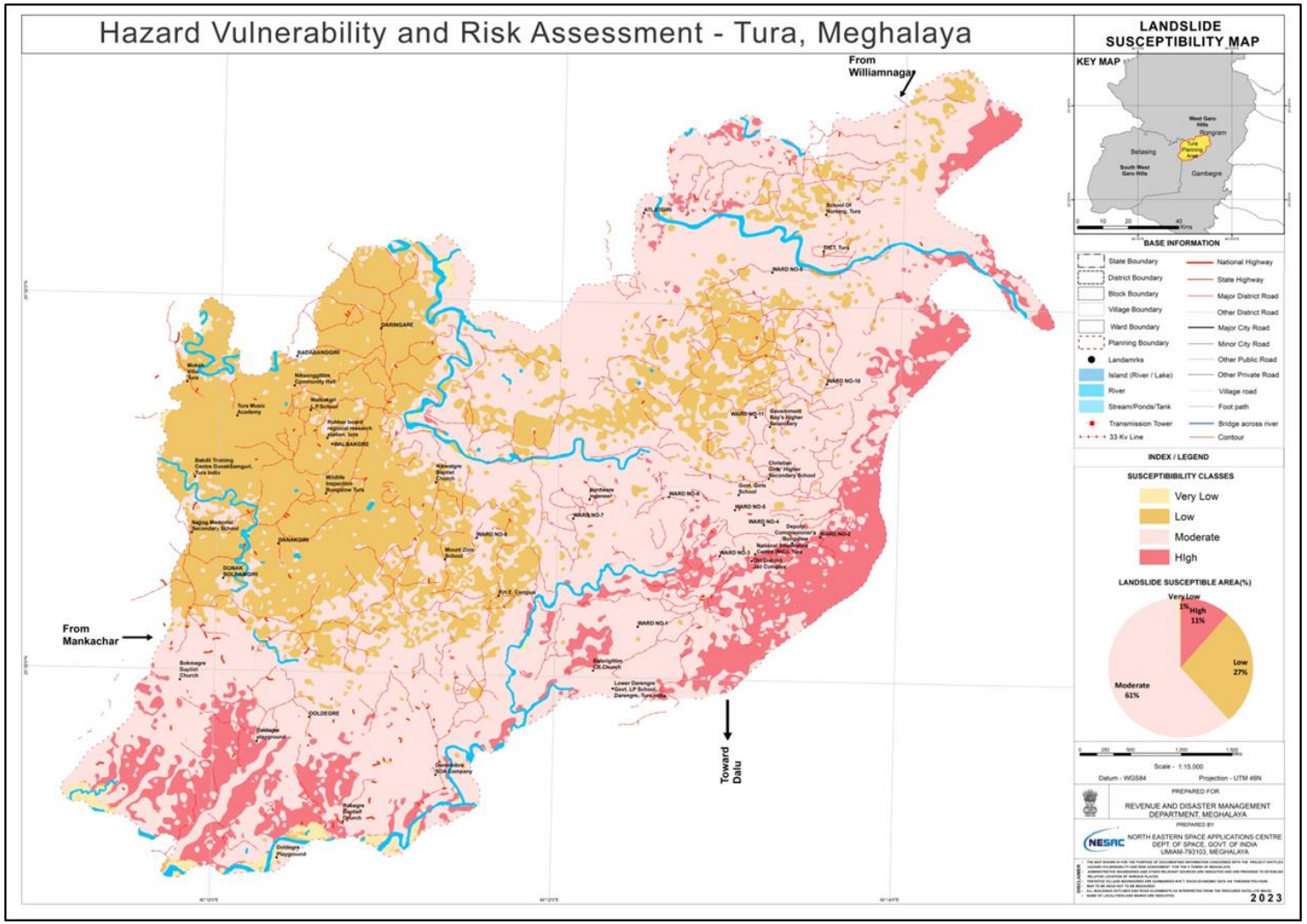
5. **Slope Analysis**: In hilly and valley regions, Figure 6.8, shows slope analysis aspect and Figure 6.9 indicates elevation aspect, or the compass direction a slope faces, plays a significant role. Different aspects influence sunlight exposure, temperature variations, and water drainage patterns. South-facing slopes receive more direct sunlight, affecting vegetation types, while north-facing slopes may experience cooler conditions. Valleys, with varying orientations, impact microclimates and water flow. Understanding slope aspect is vital in land use planning, guiding decisions related to agriculture, forestry, urban development, and conservation efforts in these diverse landscapes.

Table 6.2 Categories of Slope

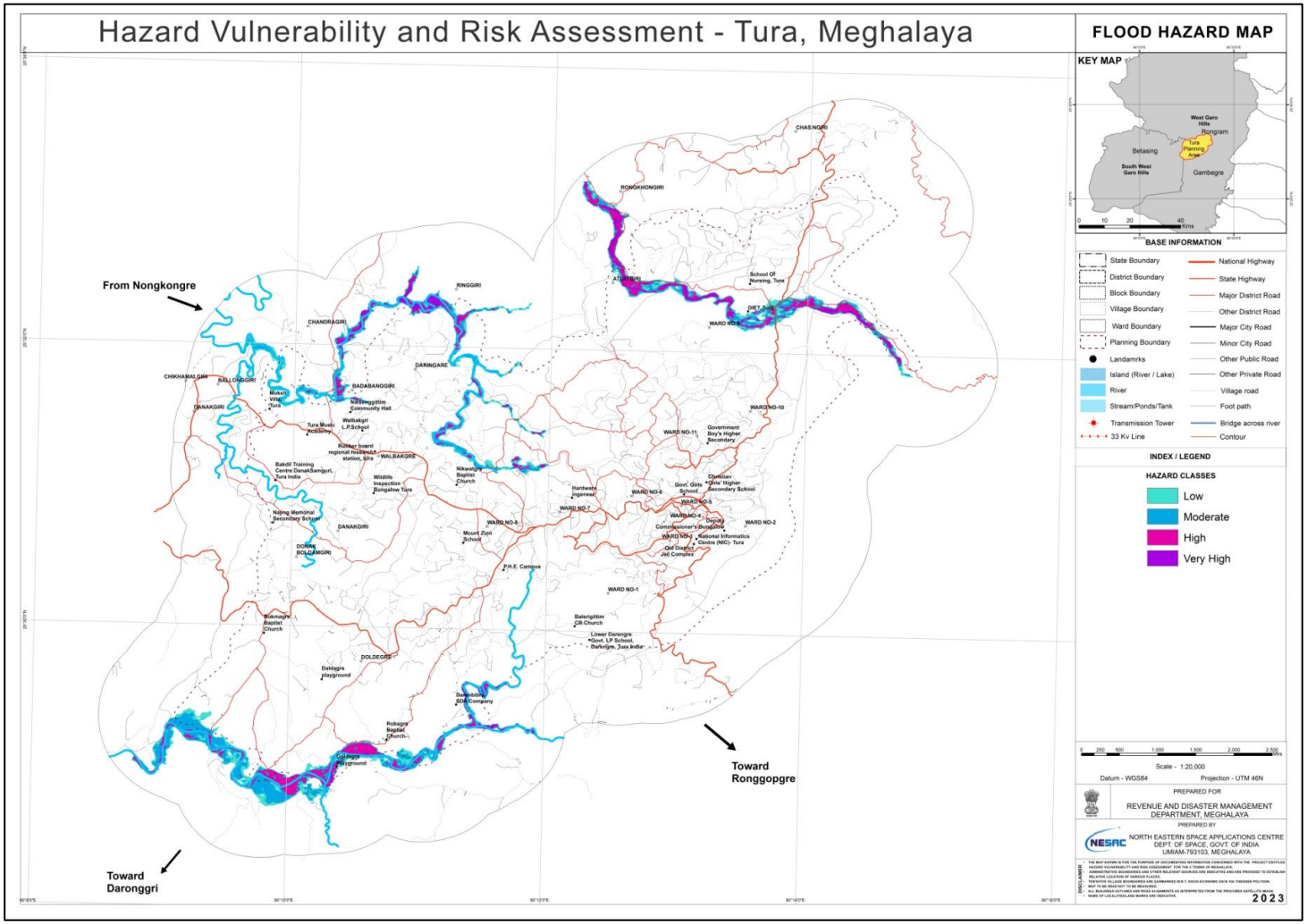
Slope (Deg)	Area (Sq. Km.)
<5	7.02
5 -15	21.12
15 – 30	9.8
30 – 45	0.6
>45	0.004
Total Planning Area	**38.58**

In this hilly area, the topography unfolds across various slopes, challenges and opportunities for land use and planning. The region comprises gentle slopes of less than 5 degrees, expansive spaces of 5-15 degree slopes, and areas with more pronounced elevation changes ranging from 15 to 30 degrees. The terrain becomes even more complex with slopes of 30-45 degrees, while the most rugged slopes exceeding 45 degrees occupy a smaller yet distinct portion.

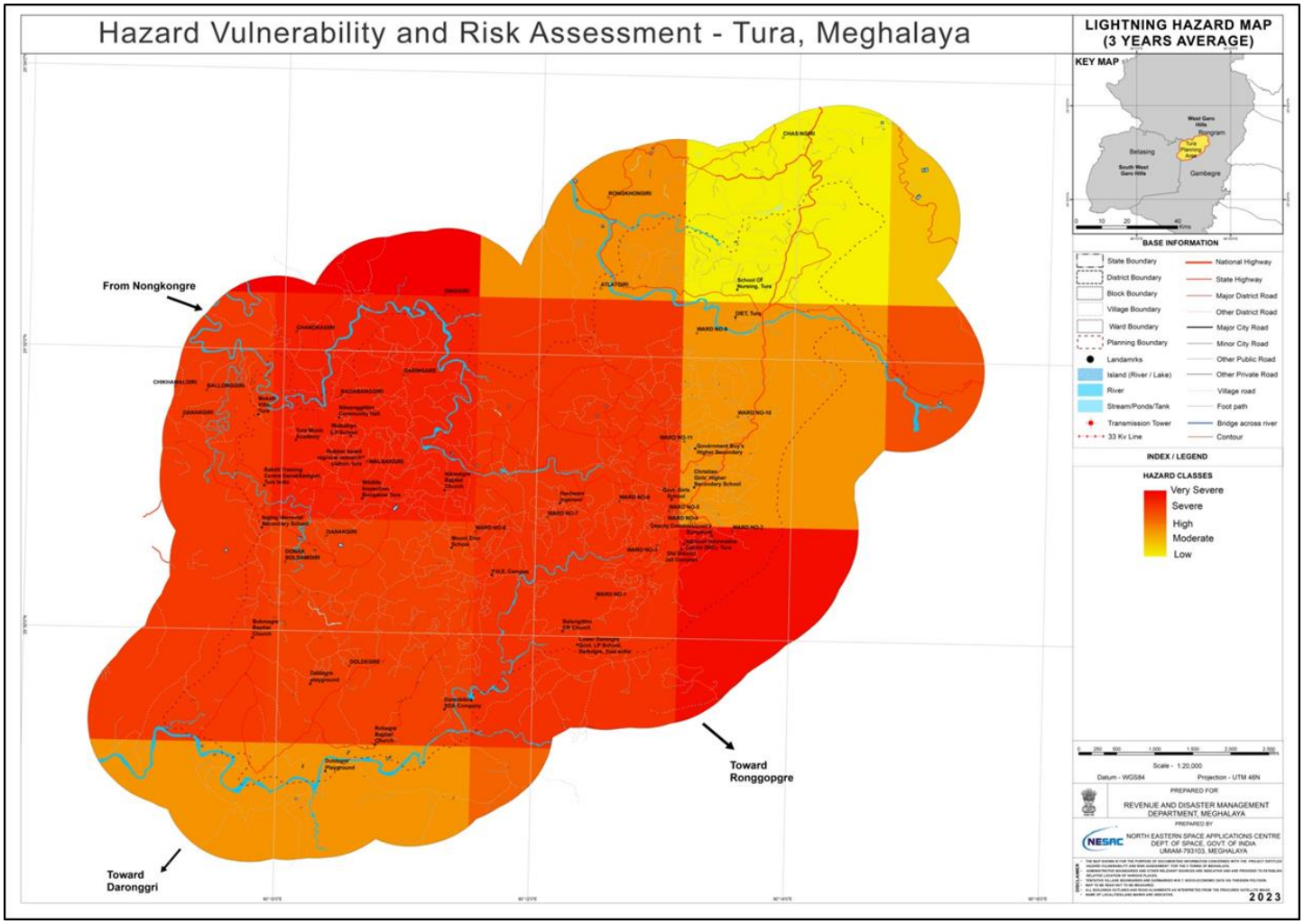
Map 6.1 Landslide Susceptibility Map



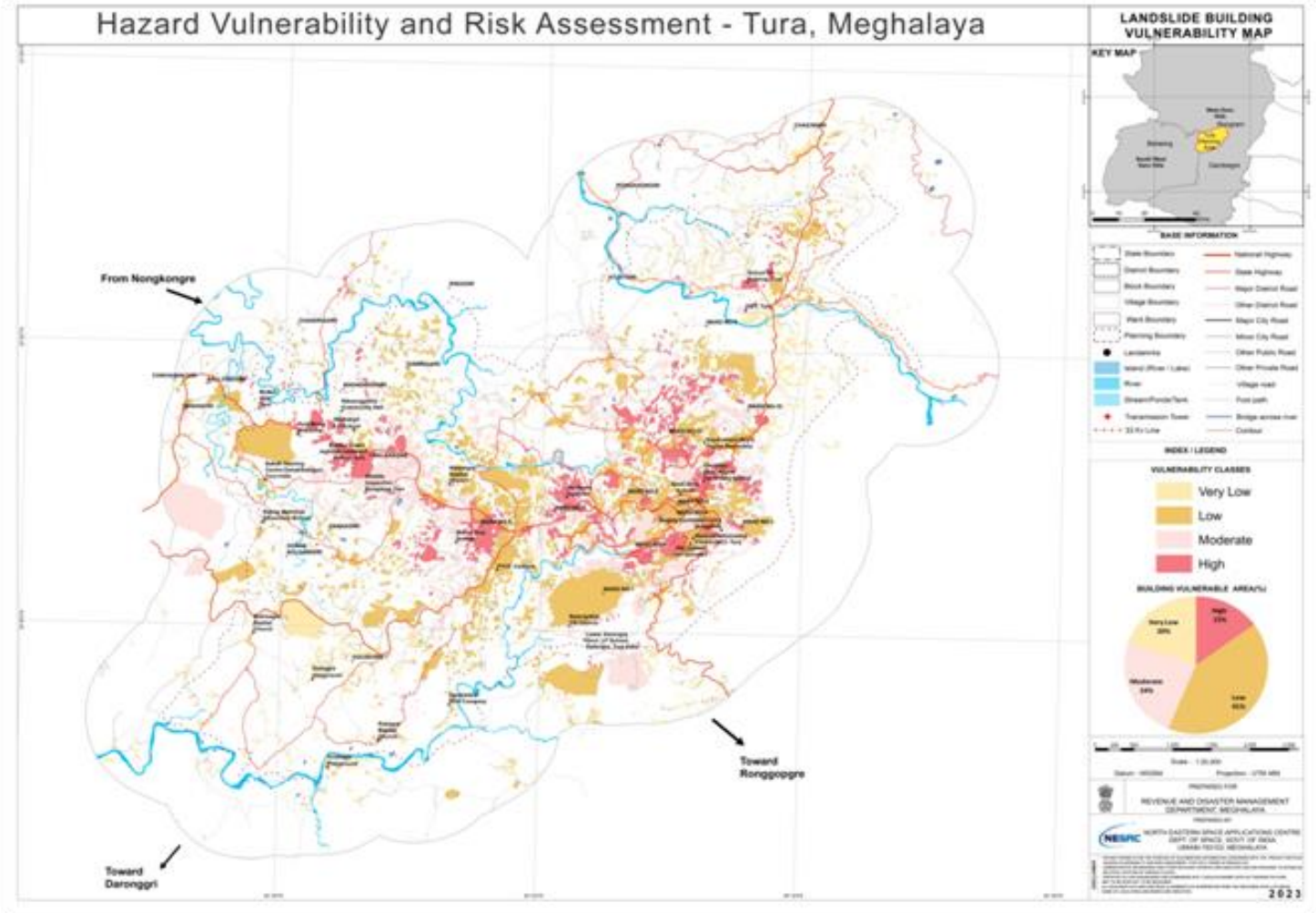
Map 6.2 Flood Hazard Map



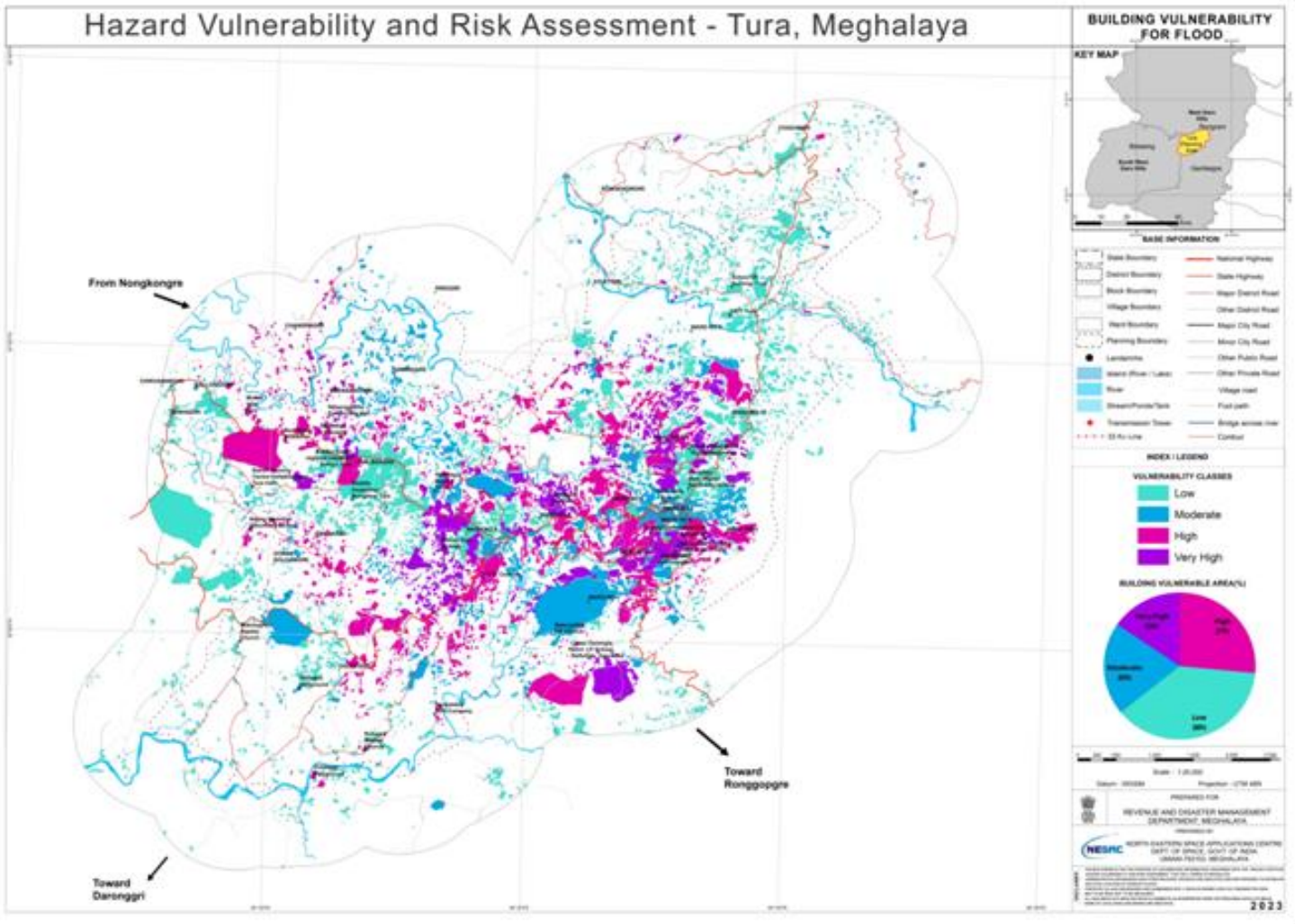
Map 6.3 Lightning Hazard Map



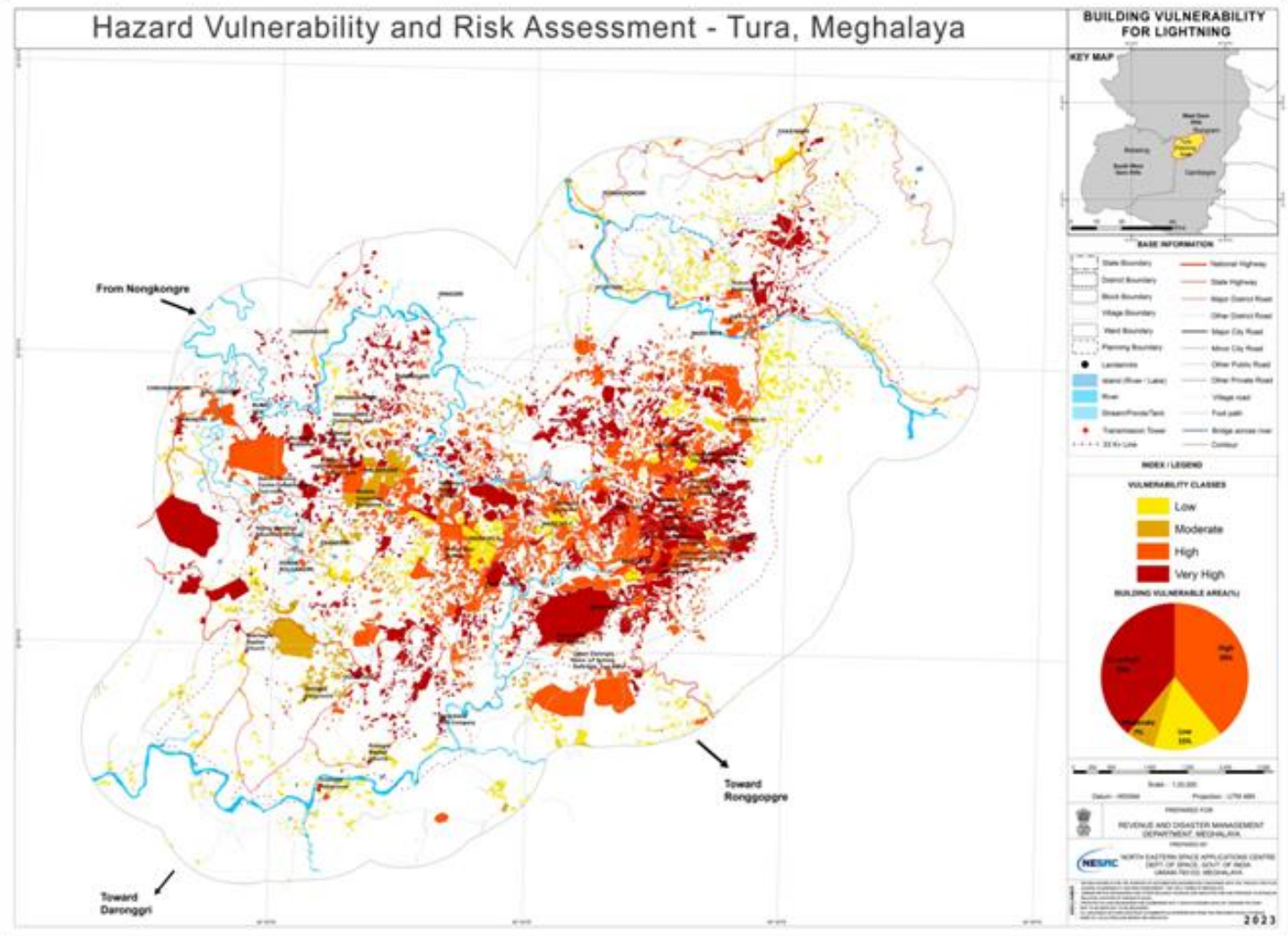
Map 6.4 Landslide Building Vulnerability Map



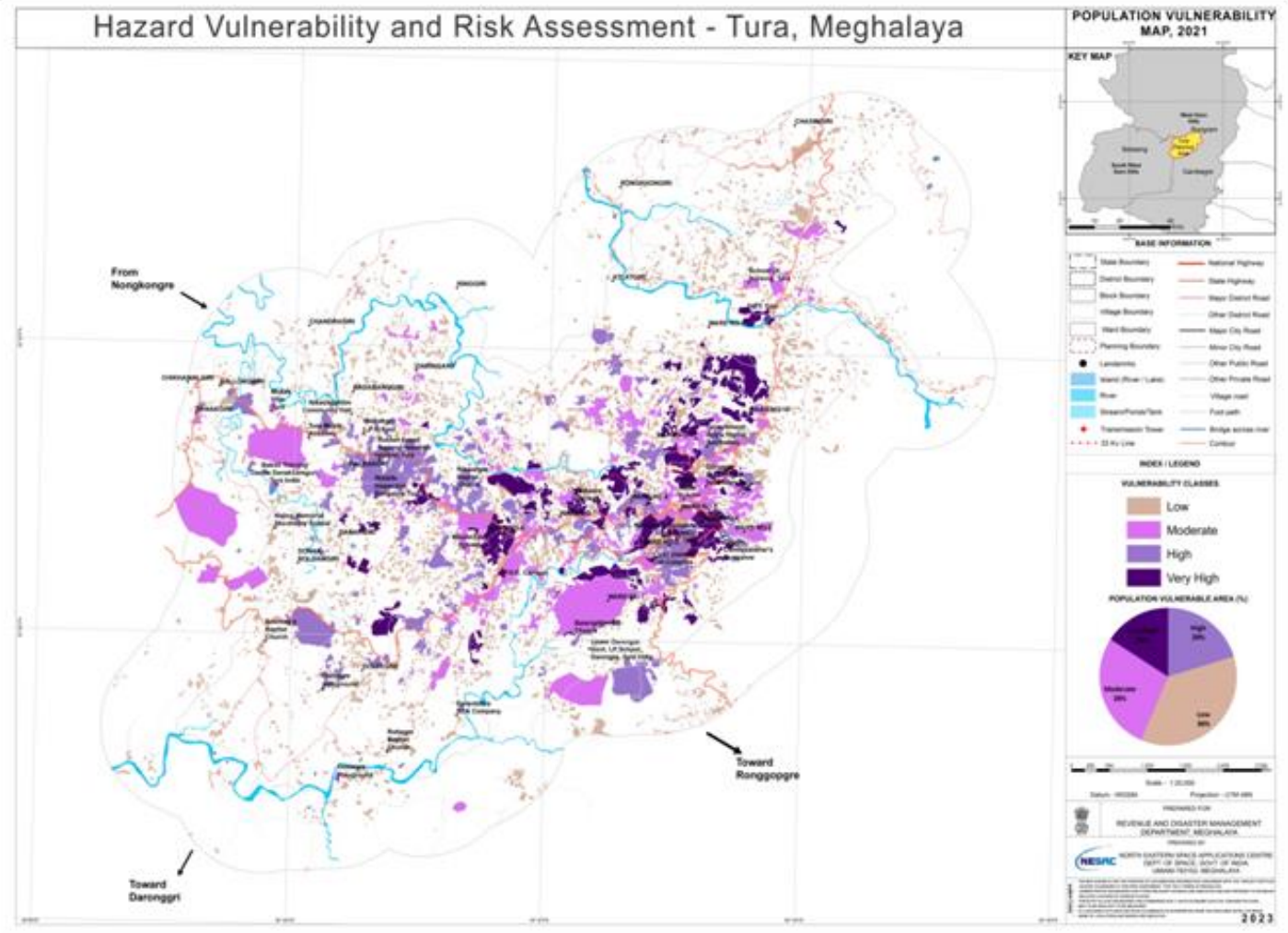
Map 6.5 Building Vulnerability for Flood Map



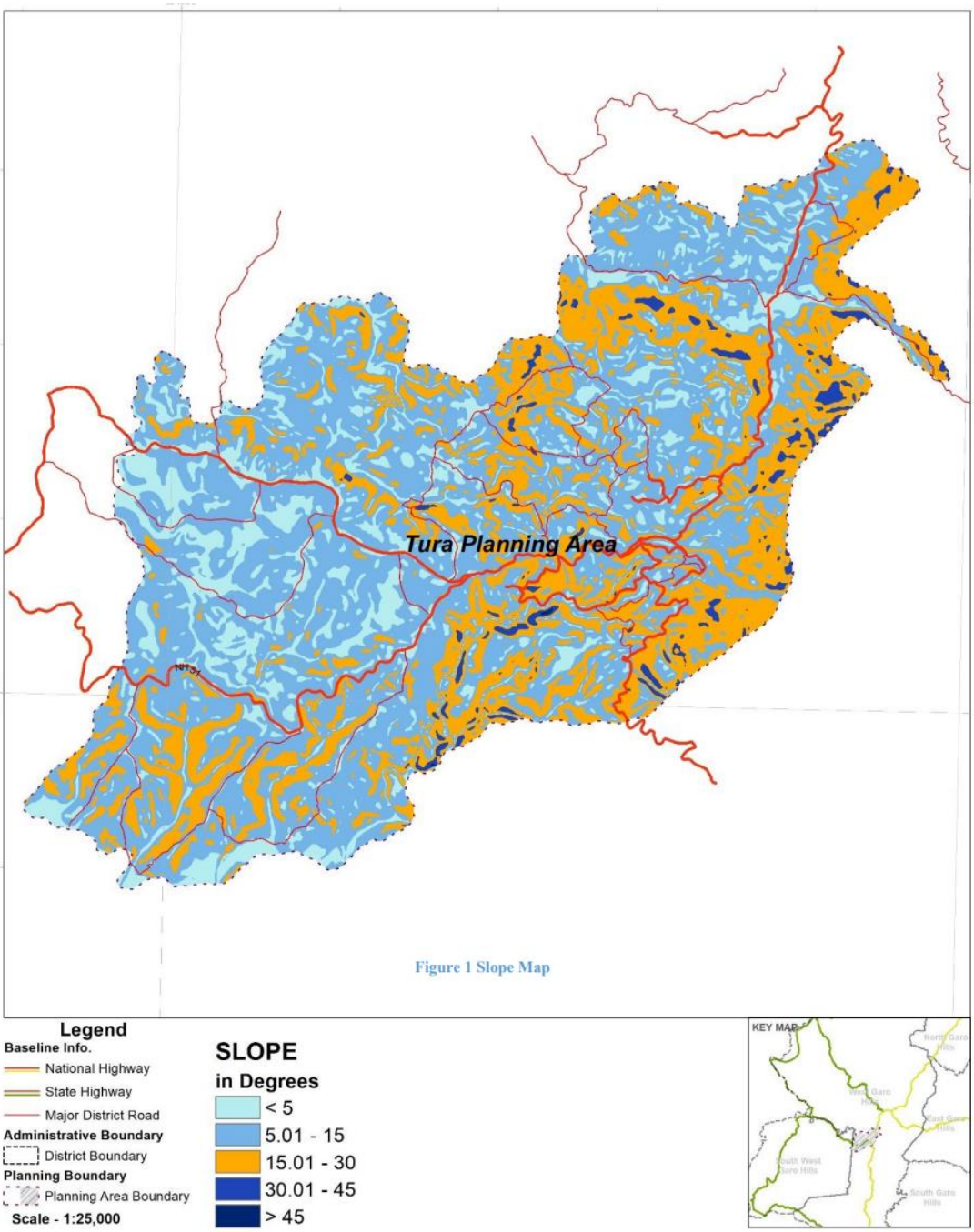
Map 6.6 Building Vulnerability for Lightning Map



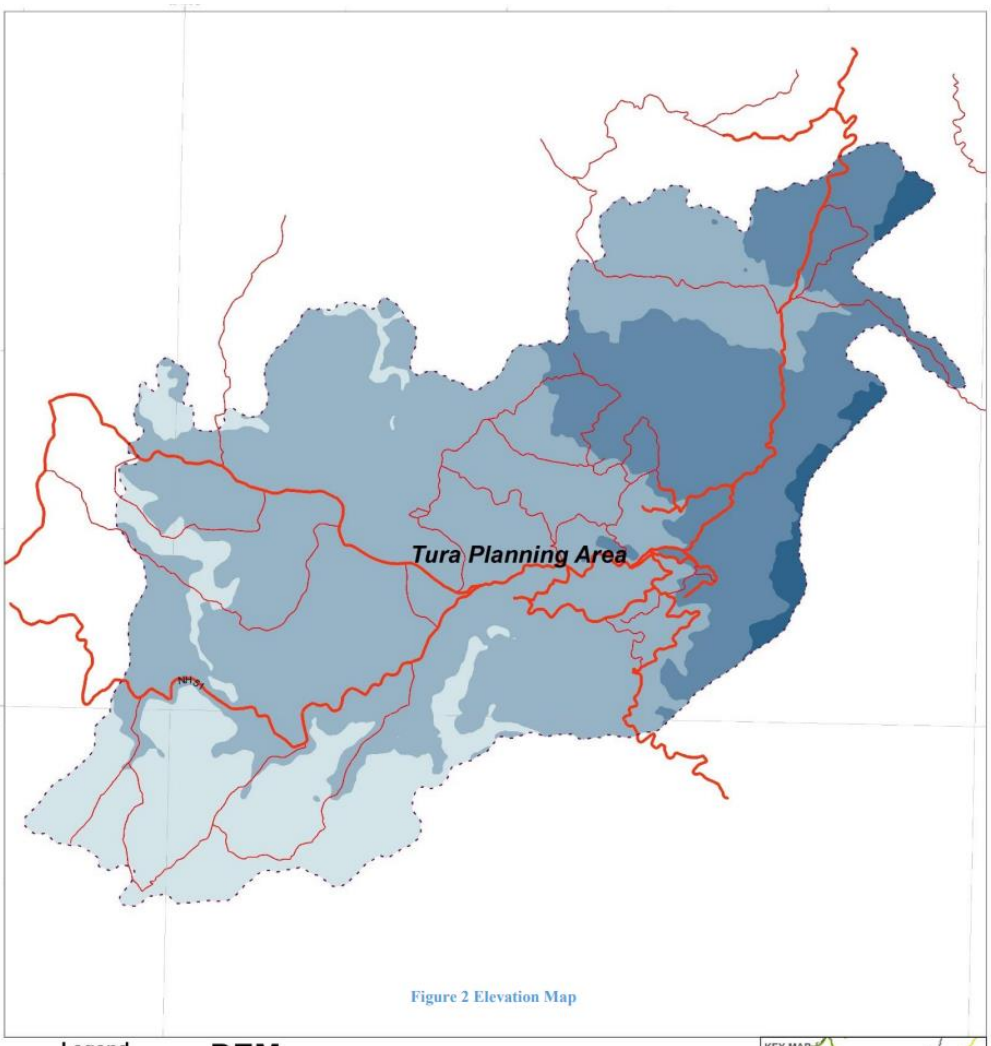
Map 6.7 Population Vulnerability Map



Map 6.8 Slope Analysis Map



Map 6.9 Elevation Analysis Map

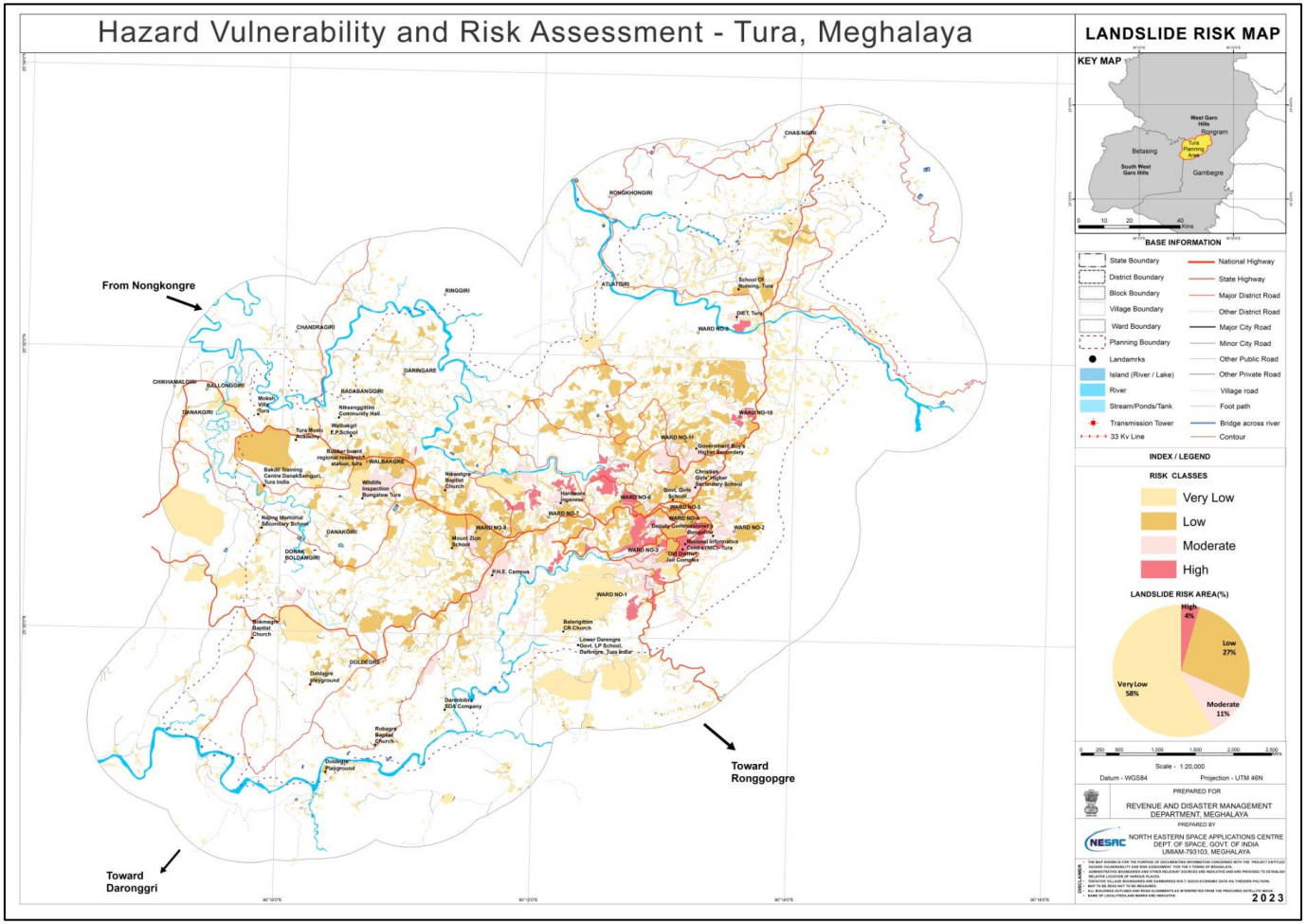


6.3. Risk Assessment: Risk = Hazard x Element at Risk x Vulnerability.

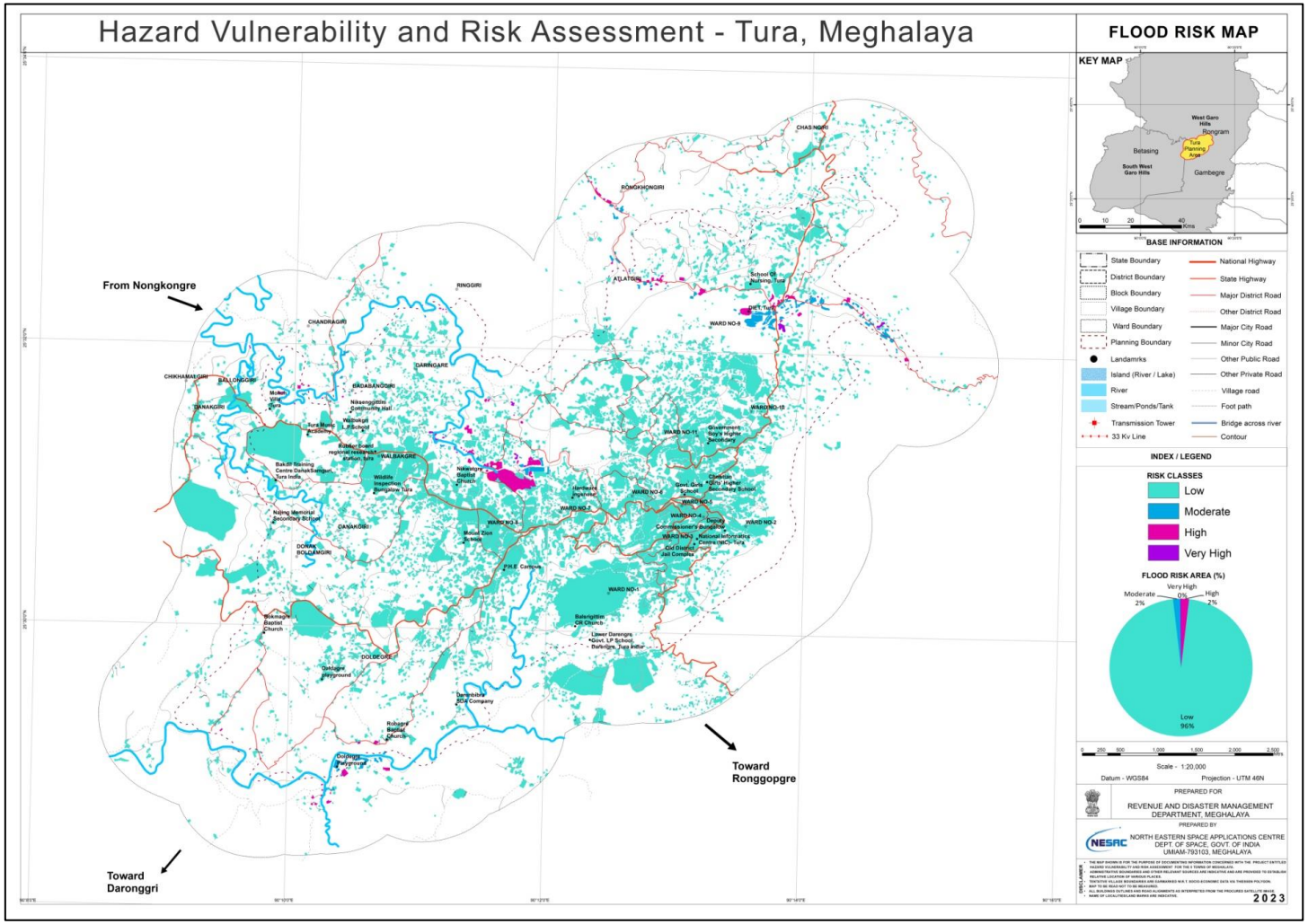
The geographical representations of vulnerability and hazard zones are the foundation for risk estimation. Detail on the factors at risk, such as buildings, the economy, and the population, is needed to assess an area's risk in connection to a certain hazard. Hazard risk assessment requires specific building information based on location, building type, number of floors, construction, roof, etc. Based on the kind and density of the building structure/footprint determined from high-resolution satellite images with ground truth and census data, this data was obtained from field data collected in various areas.

MCDA technique has been used for multi hazard risk assessment of Tura planning area after integrating hazard with vulnerability layers. Tura is very low to highly vulnerable to landslide risk *(Figure6.10)*. It is inferred that about 54.95 hectares (4%), 134.32 hectares (11%), 346.87 hectares (27%) and 727.58 hectares (58%) of the area came under the study area's high, moderate, low and very low-risk zone. In case of flood risk, the planning area lies in a very low-risk zone due to its topographical structure. Flood risk assessment *(Figure 6.11)* of Tura planning area depicts that only 22.63 hectares (2%) area comes under high risk zone and 1218.81 hectares (96%) is coming under low risk zone. However, from the local information, it is observed that flash floods inundated the urban area, and the flood lasted less than 30 minutes. Lightning risk *(Figure 6.12)* evaluation reveals that 349.87 hectares (28%), 683.36 hectares (54%), 210.60 hectares (17%).

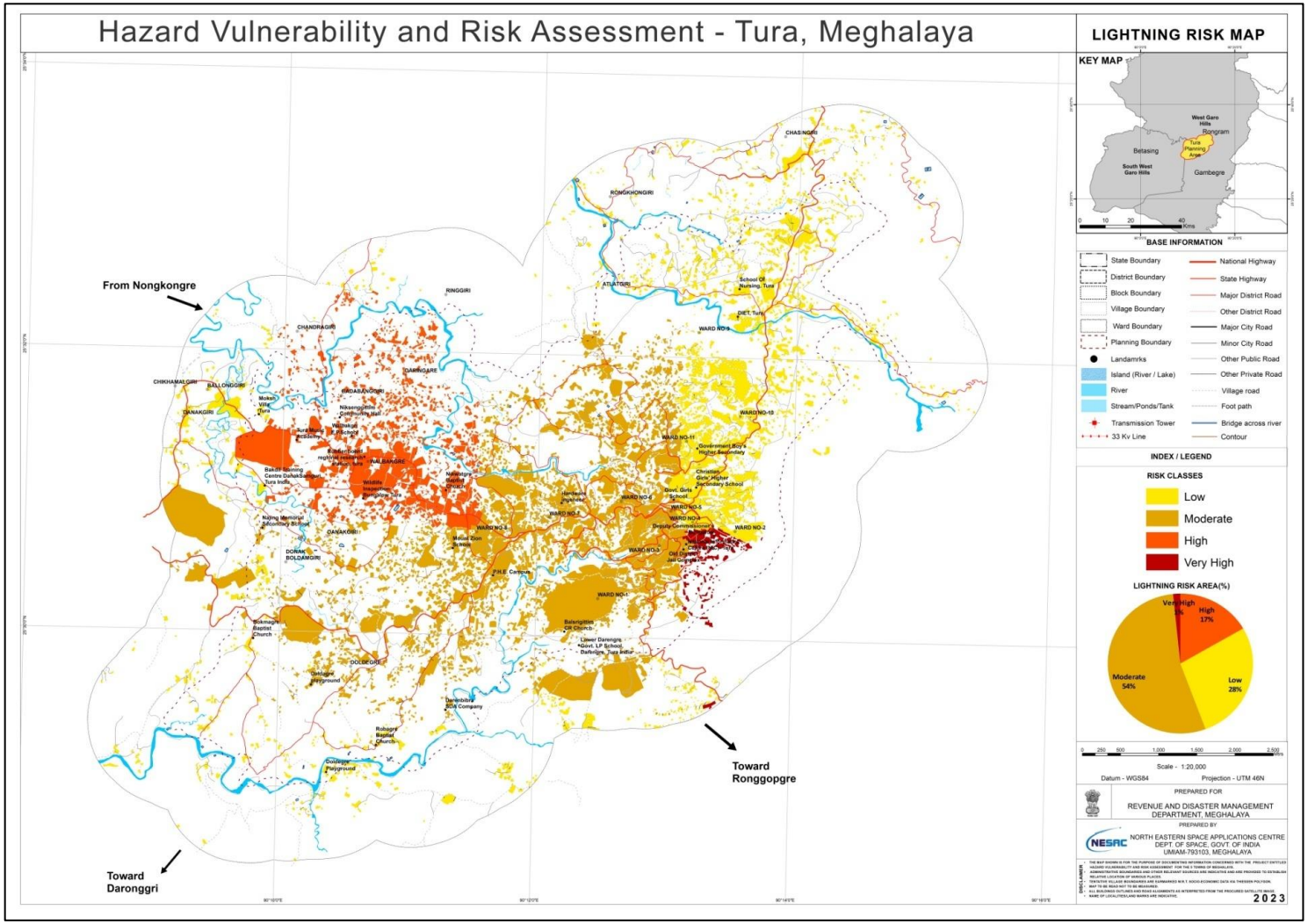
Map 6.10 Landslide Risk Map



Map 6.11 Flood Risk Map



Map 6.12 Lightning Risk Map



6.4. Risk and Hazard Mitigation Plan.

Hazard mitigation measures should not only be infrastructure-related. They can include community level communication, preparedness planning, and other non-structural measures. Whenever possible, mitigation measures should work to mimic natural processes rather than engineered solution.

Table 6.3 Mitigation Plan

Sl.	Mitigation Plans	Description
1.	Land use Plan	i. Risk Assessment - Risk Multi Attribute Rating Technique (MCDA technique) has been used for multi hazard risk assessment of Tura planning area after integrating hazard with vulnerability layers – so as to prevent future incidences of floods and landslide. ii. Restriction on Construction on Slope- The Propose land has included zoning regulation on New Area Zone, which restrict construction on slopes a. from 40 to 50 degree is degree – regulated zone b. 50 degree is no construction zone
2.	Development Control Regulations	The buffer zone defined by the Forest and Environment Department, Govt. of Meghalaya shall be reflected from the edge of these water bodies (Ref. No – FOR/CC/29/2019/Pt/688), given as i. Sitting Norms for Riverine Waterbodies in Urban Areas other than Municipal Area. ii. Sitting Norms for Riverine Waterbodies in Urban Areas other than Municipal Area.
		i. IS 14680 (1990): This standard covers the guidelines for selection of ,various landslide control methods for effective correction measures to avoid landslides in hill areas. ii. IS 14815 (2000): This standard lays down the guidelines for computation of design flood for temporary diversion of river during construction
3.	Structural Provisions	i. Construction of embankments against water spills from source of flooding like rivers, large drains, etc. ii. Construction pf drains and culverts of drainage paths to effectively drain the water from the planning area.
4.	Incident Response System (I.R.S.)	Setting up of Incident Response System (I.R.S.), in response to occurrence of landslide or flood (Ref No. DDMA/WGH/MMDE/87/2023/558), given as i. District Agriculture Office – Planning Section (P.S.) and Operational Section. ii. Circuit House – Staging Area (S.A.), Relief Camp (R.C.), iii. Tura Government College - Logistic Section (L.S.), Base camp.

Table 6.4 Sitting Norms for Building and other Structures for Riverine Waterbodies in Urban Areas other than Municipal Areas and Cantonment.

Width of Riverrine Waterbody	Extent of Waterbody Setback	Parameters of Regulated Zone				
		Max Plot Coverage	Max. .F.A.R.	Max. No. of Floors	Max building height	Type of building
Upto 3 meters	5 meters	As per Meghalaya Building Bye Laws 2021				
More than 3 meters	10 meters	As per Meghalaya Building Bye Laws 2021				

Table 6.5 Sitting Norms for Building and other Structures for Riverine Waterbodies in Urban Areas in than Municipal Areas and Cantonment.

Width of Riverrine Waterbody	Extent of Waterbody Setback	Parameters of Regulated Zone				
		Max Plot Coverage	Max. .F.A.R.	Max. No. of Floors	Max building height	Type of builfing
Upto 3 meters	3 meters	As per Meghalaya Building Bye Laws 2021				
More than 3 meters	6 meters	As per Meghalaya Building Bye Laws 2021				