COMPREHENSIVE MOBILITY PLAN

GANGTOK

SIKKIM

Final Report: Volume I

Status, Analysis, Goals, Demand, Regulatory and Institutional Measures and Environmental Considerations

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PREFACE

Urban Development and Housing Department, Govt. of Sikkim has entrusted DDF Consultants Pvt. Ltd. (DDFCPL) the work of the preparation of Comprehensive Mobility Plan (CMP) for the capital town Gangtok which is one of the towns eligible for central Government financial assistance under JNNURM programme.
Comprehensive Mobility Plan for the capital town of Gangtok has been prepared as per guidelines and toolkits for Urban Transport Development issued by the M/O Urban Development, Govt. of India for funding of projects under JNNURM programme. This kit was also used in the CMP to focus on planning process and examining policy options. Besides, it was also used as checklist to cover all possible sectors for surveys, analysis, and inferences.

The Final CMP Gangtok has been detailed out as per chapter schemes suggested in Module 1 of CMPs in medium sized cities in India. The whole CMP has been divided in fifteen chapters including city profile, review of land use system, existing transport system, analysis of existing traffic/transport situation, development of vision & goals strategy for transport development, travel demand model, future urban growth scenario, future transport network scenario, travel demand forecast, evolution of scenarios, public transport improvement plan, regulatory & institutional measures, social & environmental considerations and implementation programmes. For the convenience of the user, CMP Gangtok has been presented in two volumes. **Volume I** contains chapters related to existing scenario, surveys, analysis, & assessment, while **Volume II** contains proposals and identified projects' sheets. These projects are further divided into three phases. Their economic benefit in terms of generation of employment has also been worked out.

This report is revised as per comments received from UT division M/o Urban Development, Government of India regarding justification of freight terminals (Volume-II, page 33 to 34), sources of funding (Volume-II page 35) and clarification related to Bus Terminals. DDFCPL appreciates the active support provided by, Sh. T. J. Dorjee, Secretary Urban Development and Housing Department, Sh. J. D. Bhutia Joint Secretary Urban Development and Housing Department, Gangtok, Sikkim. Town and Country Planning officials, Transport department, Police department, Road and Bridge and PWD department, Directorate of Economics and Statistics in completion of this exercise. Besides these organisations, certain reports like Gangtok Integrated Development Plan: 2000 by GILCON 1987, Transport related reports by CIRT Pune and RITES 1997-98 City Development Plan Gangtok by SUIDL 2006, Gangtok Structure Plan by Surbana, 2009 and NEURDP Report 2006 are duly acknowledged for their inputs in this report. This Report is very important step in the direction of secured and efficient mobility for all classes of users through implementation of identified projects.

New Delhi

April 21, 2010

Amit Bose

Director
DDF Consultants Pvt. Ltd.

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UNITS

Ha	Hectare
KM	Kilometer
KV	Kilo Volt
KW	Kilo Watt
lpcd	Liter Per Capita per Day
MCM	Million Cubic Meter
MGD	Million Gallon per Day
mld	Million Litres per Day
MT	Metric Tonnes

MW	Mega Watt
sq km	Square Kilometer
ppha	Persons per Hectare

CHAPTER 1

INTRODUCTION

1 INTRODUCTION

1.1. Introduction

Urbanization has been one of the dominant contemporary processes as a growing share of the Indian population is moving towards cities. Urban areas all over world have played a significant role in the development of economy and quality of life of people of the region and the nation as a whole. Considering this trend, urban transportation issues are of foremost importance to support the passengers and freight mobility requirements of large urban agglomerations. Transportation in urban areas is highly complex because of the variety of modes involved, the multitude of origins and destinations and the amount and variety of traffic.

Traditionally, the focus of urban transportation has been on passengers as cities have been viewed as locations of utmost human interactions with intricate traffic patterns linked to commuting, commercial transactions and leisure/cultural activities. However, cities are also locations of production, consumption and distribution, activities linked to movements of freight. Conceptually, the urban transport system is intricately linked with urban form and spatial structure. Urban transit is an important dimension of mobility, notably in high density areas.

The planners and the city Governments have had their hands full because of rapid changes in the urban environment in India, with respect to people's demand, opportunities and expectations from the city. Changes in the application of methods and technologies have further complicated the matter. To understand the complex relationships between transportation and land use and to help the urban planning process, several models have been developed.

Historically, movements within cities tended to be restricted to walking, which made medium and long distance urban linkages rather inefficient and time-consuming. Thus, activity nodes tended to be agglomerated and urban forms compact. Recently, transport demand in most Indian cities has increased substantially, due to increases in population as a result of both natural increase and migration from rural areas and

smaller towns.

Availability of motorized transport, increase in household income and commercial and industrial activities has further added to transport demand. In many cases, demand has outstripped road capacity. Greater congestion and delays are widespread in Indian cities and indicate the seriousness of transport problems. A high level of pollution is another undesirable feature of overloaded streets. The main reasons for these problems are the prevailing imbalance in modal split, inadequate transport infrastructure, and its suboptimal use. Public transport systems have not been able to keep pace with the rapid and substantial increases in demand over the past few decades. Bus services in particular have deteriorated, and their relative output has been further reduced as passengers have turned to personalized modes and intermediate public transport.

Although the nature and extent of transport problems obviously vary from one country to another, virtually all developing countries suffer from the following problems:

- Unplanned, haphazard development at the suburban fringe without adequate infrastructure, transport, and other public services
- Limited network of roads, often narrow, poorly maintained, and unpaved
- Extremely congested roads with an incompatible mix of both motorized and non-motorized vehicles traveling at widely different speeds
- Rapidly increasing ownership and use of private cars and motorcycles
- Inadequate roadway accommodations for buses and non-motorized transport
- Primitive or non-existent traffic control and management, often without even the most basic street signage
- Extremely high and rapidly rising traffic fatalities, especially among pedestrians and motorcyclists
- Overcrowded, uncomfortable, undependable, slow, uncoordinated, inefficient, and dangerous public transport
- Extremely high levels of transport-related pollution, noise and other environmental impacts, especially in large cities

Government of India launched an ambitious programme “Jawaharlal Nehru Urban Renewal Mission (JNNURM)” in 2005 aimed at encouraging reforms and fast track planned development of identified cities. Focus is on efficiency in urban infrastructure and service delivery mechanisms, community participation and accountability of ULBs/parastatal agencies towards citizens. National Urban Transport Policy (NUTP) and related guidelines for formulation of transport sector plans for the cities have been prepared to address the issues related to transport and mobility.

The Comprehensive Mobility Plan (CMP) for Gangtok aims at creating an integrated land use and transport plan which is to be used as a guideline for building an organized transport system to achieve an efficient mobility goal for the city. The mobility plan will emphasize on the movement of people and goods by all means including motorized vehicles and non motorized modes, giving priority to public transit.

The need for the CMP arises from the fact that the transport improvement projects underway or proposed in Gangtok are only projects viewed in isolation and not visualized as a part of an overall transport plan for the city. Also CMP is considered as the prerequisites for funding under JNNURM and each selected project for funding should be a part of the Comprehensive Mobility Plan.

1.2. Vision

The Comprehensive Mobility Plan seeks to move people, not vehicles. By providing a recognized and effective platform for integrating land use, transportation and economic development that minimizes the need for travel, provides mode choices that are safe, socially, economically, financially and environmentally sustainable, it seeks to achieve the objectives of National Urban Transport Policy (NUTP) in Gangtok. The vision of this CMP ensures that Gangtok will have a planned and optimized transport system that addresses the needs and concerns of the city.

1.3. Objectives

Gangtok’s popularity as a tourist spot has increased manifold in the past years with people from all over the country and even outside India visiting the city to enjoy its scenic beauty. This adds immensely to the economy but at the same time poses huge problems as the uneven terrain coupled with the increase in number of vehicles make transport a major cause of concern for the city.

Even during non-tourist seasons, the present transport system is inefficient in providing access to majority of regions of the city which in turn has prompted development mainly in the central business area. Most of the areas of Gangtok are undeveloped due to lack of connectivity and accessibility to the central area and areas of employment and growth. Having a single access point, the city is prone to traffic snarls as most of the vehicular movement is through the center of the city.

Public transport, which comprises only of a few mini buses, is vastly inadequate catering to less than 1% of the vehicular trips. The major share (98%) is of private vehicles and taxis. This indicates a great need for public transport improvement. The existing road network also needs improvement in order to cater to the demands and safety needs of the people.

In order to bring about a comprehensive solution to the aforementioned problems, this CMP aims at achieving the following objectives:

- CMP would integrate mobility plan with land use plan and would spell out the projected mobility needs of the city as also the manner in which such mobility needs are proposed to be met.
- To review the existing public transport system vis-à-vis current and future demand for public transport services to determine the optimal mix of public transport modes in integration with other modes.
- The focus would be on analyzing the existing transportation scenario, examine the pattern of growth of the town and projecting the passenger and freight mobility requirements for the next 30 years, keeping in view
  the attributes like population, employment, business, commerce, industry, growth of the cities, among others.
- To formulate a short-term traffic and transportation improvement plan for alleviating the traffic problems of the City in the short term and to suggest methods of implementing the same.
- The short term measures or the “low-cost traffic solutions” will be attempted through maximum utilization of the existing facilities through Transport System Management (TSM) Techniques. The short term proposals shall also have a short-term traffic management plan including plan for pedestrian, cyclist (NMT) and freight movement.
- To formulate a long-term development plan (upto 30 years) and a medium-

term action plan (upto 10 years) for the public transport system, which shall include a prioritized implementation strategy for an environmentally sustainable and efficient integrated public transit system. The medium/long term measures need to be reported separately. In addition, the proposals shall also have a medium/long term traffic management plan including plan for pedestrian, cyclist (NMT) and freight movement.

- To recommend the appropriate implementation scheme for the identified projects.

1.4. Scope of Services

1.4.1. Components of the study

The study has six main components:

- Development of database
- Planning of short term/intermediate improvement measures.
- Development of four stage transport demand model taking into consideration 'Do-nothing Alternative'.
- Planning of medium and long term measures.
- Identification of mass transport system technologies and its integration with other modes of transport.
- Preparation of block cost estimates for the identified projects and implementation strategy.

1.4.1.1 Development of Database

Necessary data and information has been obtained through secondary source and field surveys. This has helped in analysing existing traffic and travel pattern, gaps and identification of appropriate planning interventions

(I) Secondary Data Collection

Base year (2009-10) data like population, employment, master / development plans, CDP etc. have been collected from various sources. The following secondary data was collected as part of the study

- Ward maps of Gangtok
- Structure Plan for Gangtok
- Other relevant reports, studies and information from concerned departments

(II) Primary Traffic and Travel Surveys

Following primary surveys were carried out as part of the study:

a) Speed & Delay Surveys
b) Classified Traffic Volume Counts at mid block locations
c) Classified Turning Movement Survey at Intersections
d) Roadside Origin-Destination Survey at cordon points
e) Pedestrian Survey
f) Parking Survey
g) Household Interview Survey
h) Commuter Survey at Public Transport Terminals
i) Intermediate Public Transport (IPT) Passengers Survey
j) Road Network Inventory

(III) Data Compilation & Analysis

The data collected from various field surveys and secondary sources was screened, coded and punched as per the pre-designed survey formats. The coded data was then analyzed with the help of computer packages like cube 5.1 available with DDF pvt.ltd.

The output from various types of surveys and their respective usages are summarized in Table 1.1

Table 1.1 Traffic Surveys and Expected Outputs

S.No	SURVEY	OUTPUTS	DATA USE
1	Speed & Delay	- Journey & running speed - Delays (locations/cause/duration) - Speed Flow relationship	- Identification of bottlenecks along the corridors - Travel demand forecasting
2	Classified Traffic Volume Counts (outer cordons/ screen line /mid-block)	- Daily and Peak hour traffic intensity - Composition of traffic - Directional distribution - Hourly variation	- Short term traffic improvement schemes - Road capacity analysis - Road widening - Calibration of demand model - Validation of traffic demand forecast
3	Roadside Origin-Destination at cordon	- O-D matrix (external to external, external to internal & internal to external	- Planning of bus/IPT terminals - Public transport routing - Demand modelling
4	Turning movement survey at junctions	- Approach volume - Directional movements - Saturated capacity at junctions - PV^2 Value	- Preparation of junction improvement plans - Short term traffic improvement schemes
5	Pedestrian Volume Counts (along & across)	- Intensity of daily pedestrian traffic - Peak hour pedestrian flow - PV^2 Value	- Provision of footpaths - Planning for 'cross' pedestrian traffic (zebra crossings) - Grade separated facilities
6	Parking Patrol	- Parking accumulation - Parking duration - Parking space hours - Parking index - Parking turnover	- Preparation 'on- & off-street' parking plans - Suggest parking management measures - Parking fee
7	Household Travel Survey	- Socio-economic characteristics - Zonewise employment details - Travel characteristics - Mode & purpose-wise O-D matrices	- Travel demand modelling and forecast - Scope of passenger shift from existing modes to the recommended system
8	Public Transport Terminal OD and passenger counts	- Comfort level of use transport infrastructure	- Formulation of transport strategy - Improvement measures/system selection - Planning of existing and new terminal infrastructure
9	Mass Transport/ Intermediate public transport passengers Survey	- Comfort level of use IPT transport infrastructure	- Improvement in facilities for public transport/IPT operation - IPT parking stands - Current transport cost
10	Road Network Inventory	- Details of cross-section - Abutting landuse - Road/footpath/surface conditions - Street furniture - TSM Measures	- Network characteristics - Planning for road improvement measures - Pedestrian facilities - Node Link Diagram

(IV) Problem Audit

The outputs from the surveys and analysis of its data have been used to identify the major problem areas and their quantification in the Study Area. The demand-supply ratios of various transport facilities give an insight into the type and extent of problems in various areas, corridors and junctions.

The following parameters have been taken into consideration for problem identification:

1. Volume to Capacity Ratio (V/C)
2. Parking Parameters
3. Pedestrian Movement (PV^2 Value)

1.4.1.2 Short Term Plan/Immediate Improvement Measures

(I) Traffic Management Plans

The short-term plans are prepared with a 5-year perspective. Traffic management is the most cost-effective measure to alleviate traffic congestion, which gives immediate results. There is large scope to exploit the potential of available transport infrastructure efficiently. Various transport improvement strategies, which can prove helpful in solving the traffic problem, related to smooth flow and parking, etc. have been explored.

(II) Junction Improvement Plans

This component of work includes preparation of improvement plans for identified critical/congested junctions in the study area. Junctions requiring improvements are identified based on traffic characteristics and importance. Opinion from Gangtok Administration officials has also been sought to include priority junctions for improvement. The geometric improvement plans have been prepared for 12 critical junctions.

The improvement plans includes the detailed analysis of existing physical & traffic characteristics of the junction and development of alternative improvement options.

The improvement measures included are:

- Geometric design of the intersection (including channelisation, easing of curves, provision of suitable median design, etc.)
- Footpath of adequate width with provision of guardrails

- Traffic signs
- Road markings
- Pedestrian/Zebra Crossings

Necessary traffic management measures have also been examined for the junctions including turning restrictions in general to certain nodes. The proposals have been developed in consultation with the Client and traffic police in order to incorporate their views in the proposal.

(III) Planning of Pedestrian Facilities

It is proposed to plan the necessary pedestrian facilities for 'along' as well as 'across' movement of pedestrians on all major corridors and junctions in the study area. For the 'along' movement, the citywide footpaths have been proposed to be upgraded/improved. The basic aim is to reduce pedestrian conflicts with vehicular traffic to the minimum.

Efforts have also been made to ensure that pedestrians are not exposed to safety risks. Zebra markings are recommended at appropriate places where 'across' pedestrian traffic is significant and an analysis of PV2 (pedestrian-vehicular conflict) has also been done to assess the need for grade-separated pedestrian facilities viz. subways and pedestrian over-bridge. It has been proposed to provide pedestrian foot over bridges or at-grade pedestrian crossing at all critical junctions.

(IV) Parking Demand Management

The unprecedented growth in the number of motor vehicles, especially the taxis and cars along with the concentration of activities has led to acute parking problems in the Gangtok City area. Parking demand far outstrips the supply equation since the road space is limited and 'on-street' parking is not possible on all the roads. Moreover, there are no 'off-street' parking lots leading to spillover of 'on-street' parking on the main carriageway, thereby impeding the movement of the traffic stream. Thus, parking demand and the extent of short- and long-term parking demand as obtained from the parking survey have been analysed and suitable measures suggested to ease the parking problem.

1.4.1.3 Transport Demand Modeling

(I) Development of Traffic Zone System

A traffic zone system was developed for study area taking into account the sector/census/ward boundaries, physical barriers like road, railway line, river, drain etc. The zones were formed so that they are homogeneous within themselves with respect to broad socio-economic characteristics. The cordon O-D survey and household travel surveys were specifically based on this zoning system. The zone centroids are the generation and attraction node for a zone.

(II) Preparation of Transport Network

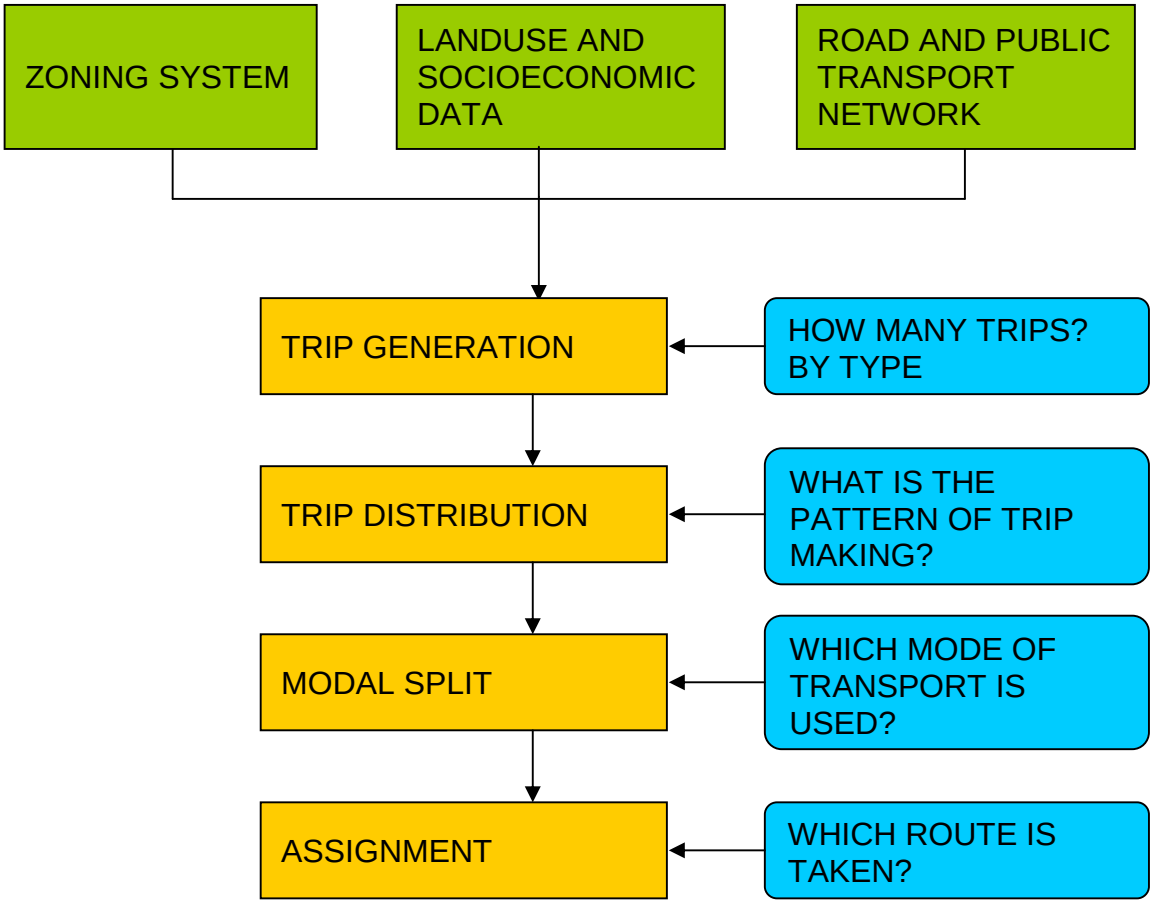
The total transport network of study area has been prepared in terms of links and nodes. The road nodes are the road intersections. The zone centroids are connected to the surrounding road/rail nodes from where users can access the available transport network/facility for movement from one zone to the other zone. The links in the transport network represents section of road network between two successive nodes. The existing link characteristics in terms of link capacity, speed, type of link, associated zone, and other such properties are associated to each link.

(III) Development of Four Stage Transport Demand Model

- **Trip End Prediction or Trip Generation:** determination of the number of person trips leaving a zone irrespective of destination, and number of trips attracted to a zone irrespective of origin.
- **Trip Distribution:** linking of trip origins (production) with their destinations (attraction).
- **Modal Split:** separation of trips by public transport and private modes.
- **Trip Assignment:** allocation of trips between a pair of zones to the most likely route on the network.

General Outline of Traffic Forecasting Procedure is shown in **Figure 1.1**

Figure 1.1: General Outline of Traffic Forecasting Procedure



(IV)Landuse Estimation for Base Year

One of the important aspects of traffic demand modelling exercise is the estimation of base and horizon year landuse parameters. Base year landuse parameters like population and employment have been taken from 2001 Census Data, and data collected from Gangtok authorities.

1.4.1.4 Planning Of Medium and Long Term Measures

(I) On the basis of transport demand forecasts and identification of major travel corridors for passenger traffic, a comprehensive set of transport planning proposals has been detailed out. The medium term planning measures mainly related to bus system planning and planning for IPT, NMV and pedestrians. Identification of road stretches for widening/strengthening, suggestions on various acts affecting traffic and transport systems.

Options for an integrated multi-modal network have been developed and evaluated

and a feasible and acceptable system has been proposed for further detailing.

All the proposals relating to public transport infrastructure, terminals, depots, road widening and new links has been integrated with ropeway based mass transit system for Gangtok Municipal Area.

The medium/long term improvement measures broadly includes the improvement/ development of pedestrian and other non-motorized transport, public transportation/MRTS, motorized transport, intermediate public transport, road network, new links and bypasses, intersections, extension of the railway line, parking facilities, freight movement, multi-modal transport options/integration of modes, traffic signage, lane marking, street furniture, passenger and freight terminals and safety.

(II) Development and Evaluation of Alternative Mass Transport Networks

Forecast of intra-city and intercity passenger trips are assigned on road only network comprising existing and proposed links so as to identify potential high-density corridors. Mass transit corridors with average speed more than expected future speeds on road in mixed traffic conditions are superimposed along potential corridors on this road network to generate more than one alternative road-cum-mass transport networks.

Assignments on road-cum-mass transport network has been repeated for alternative average mass transport speeds corresponding to bus on mixed ROW and ropeway based mass transit. For this purpose, tentative ropeway transit lines have been formulated with tentative stops and station spacing.

These alternatives has been evaluated on the basis of pre-determined set of evaluation criteria such as transport demand satisfied, length of networks, cost and productivity of networks, operational and economic feasibility.

1.4.1.5 Identification of Mass Transport System Technology and Its Integration with other Modes of Transport

After making an estimate of travel demand on the public transport network that needs to be developed, an assessment about possible alternative transport systems

in relation to various corridors has been undertaken and an objective and technology neutral evaluation has been carried out based on a set of parameters as listed hereunder:

(a) Capacity
(b) Right-of-way requirements
(c) Speed
(d) Capital & Operating Costs of various systems
(e) Affordability
(f) Environmental impacts
(g) Social impacts

Road based systems are the first choice of mass transit systems as generally the infrastructure is available and can be upgraded at minimal cost. Alternative road based systems are:

- buses operating in mixed traffic conditions
- buses operating in segregated bus ways (at grade)
- buses operating in demarcated bus ways- at grade

Alternative rail based system are metro rail, light rail transit, monorail, ropeway etc. Strengthening of ropeway Mass Transit System for the main corridors for the Gangtok municipal area is most feasible options. Therefore, other modes of transport need to be planned to integrate with ropeway.

The most appropriate option for multi-modal network and system has been recommended on the basis of above evaluation as well as in consultation with the Client.

1.4.1.6 Preparation of Block Cost Estimates for the Identified Projects and Its Implementation Strategy

(I) Broad Cost Estimates

Preliminary broad cost estimates has been prepared for short, medium and long-term measures. The cost estimates are on the basis of per km. development of new road/rail infrastructure, etc. The unit rates have been taken from recently completed/designed similar projects in and around study area. The unit costs for short-term measures have been adopted from standard practices of transport planning projects. These are based on CPWD norms with cost index applicable to

Sikkim area.

(II) Prioritization of Projects/Implementation Plan

a. Phase-wise Implementation Strategy

A Phased Implementation Plan has been prepared for developing the transport infrastructure in the study area on the basis of expected transport demand and investment required. The implementation plan has been finalised in consultation with various stakeholders in order to have an idea of the likely availability of funds for the development of various transport infrastructure and priority areas.

1.4.2. National Urban Transport Policy

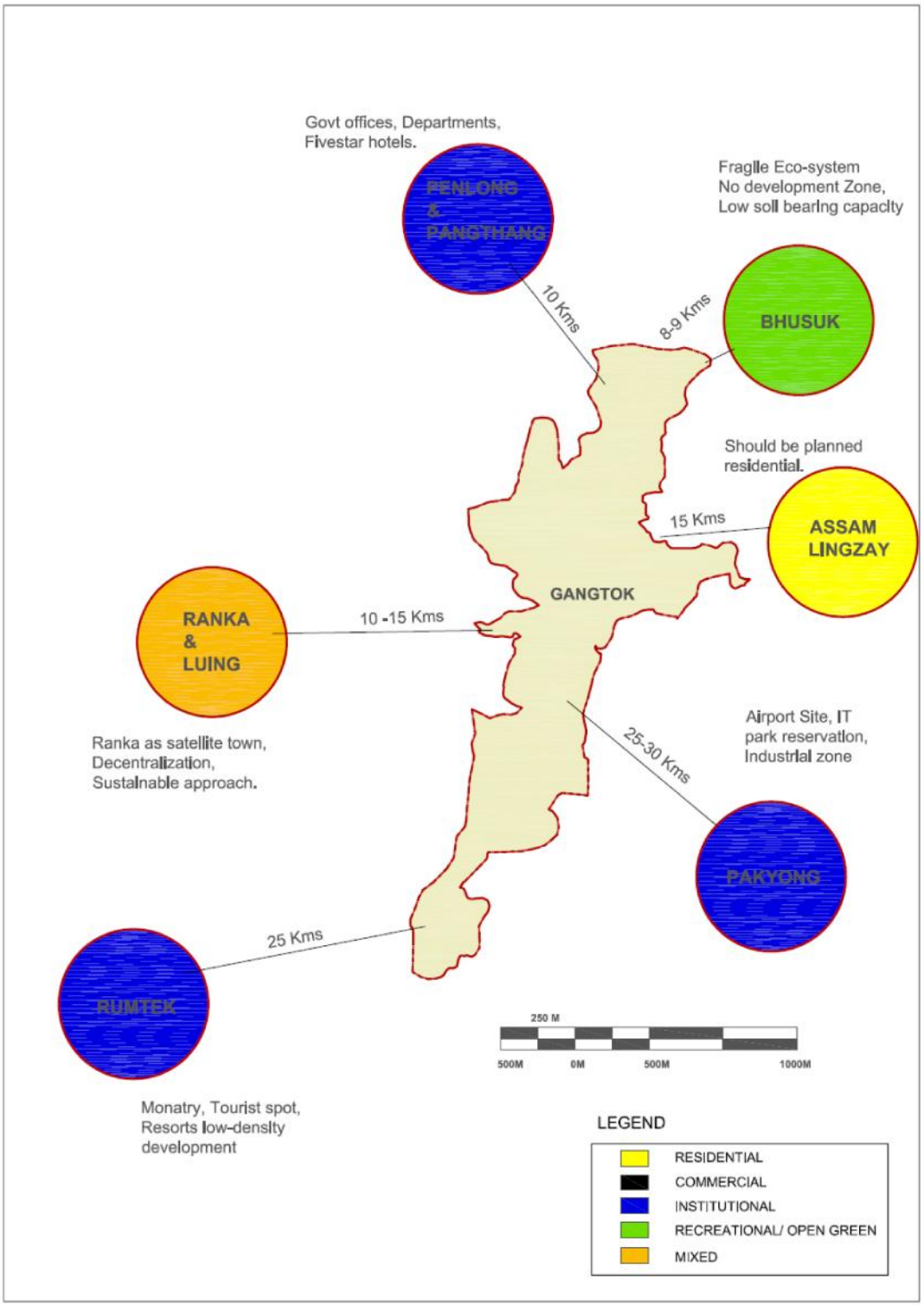
The National Urban Transport Policy, 2006 of Government of India stipulates the following objectives for urban transport planning:

- To recognize that people occupy center-stage in our cities and all plans would be for their common benefit and well being.
- To make our cities the most livable in the world and enable them to become the “engines of economic growth” that power India’s development in the 21st century.
- To allow our cities to evolve into an urban form that is best suited for the unique geography of their locations and is best placed to support the main social and economic activities that take place in the city.

1.4.3. Study Area

The study Area Considered for the preparation of the CMP is the Greater Gangtok Planning Area which comprises of 75 sq. kms including the surrounding areas namely Bhusuk, Ranka, Pakyong, Assam Lingzay, Rumtek, Penlong and Pangthang. The effect of traffic coming from outside Gangtok Planning Area and using Gangtok transport system shall also be taken into account. For this purpose the Gangtok Planning Area shall be divided into traffic zones and included in the study for the purpose of developing the origin and destination matrix affecting the transport facilities in Gangtok Planning Area. The Study Area is shown in Figure 1.1.

Figure 1.2: Study Area: Gangtok and its Satellite Towns



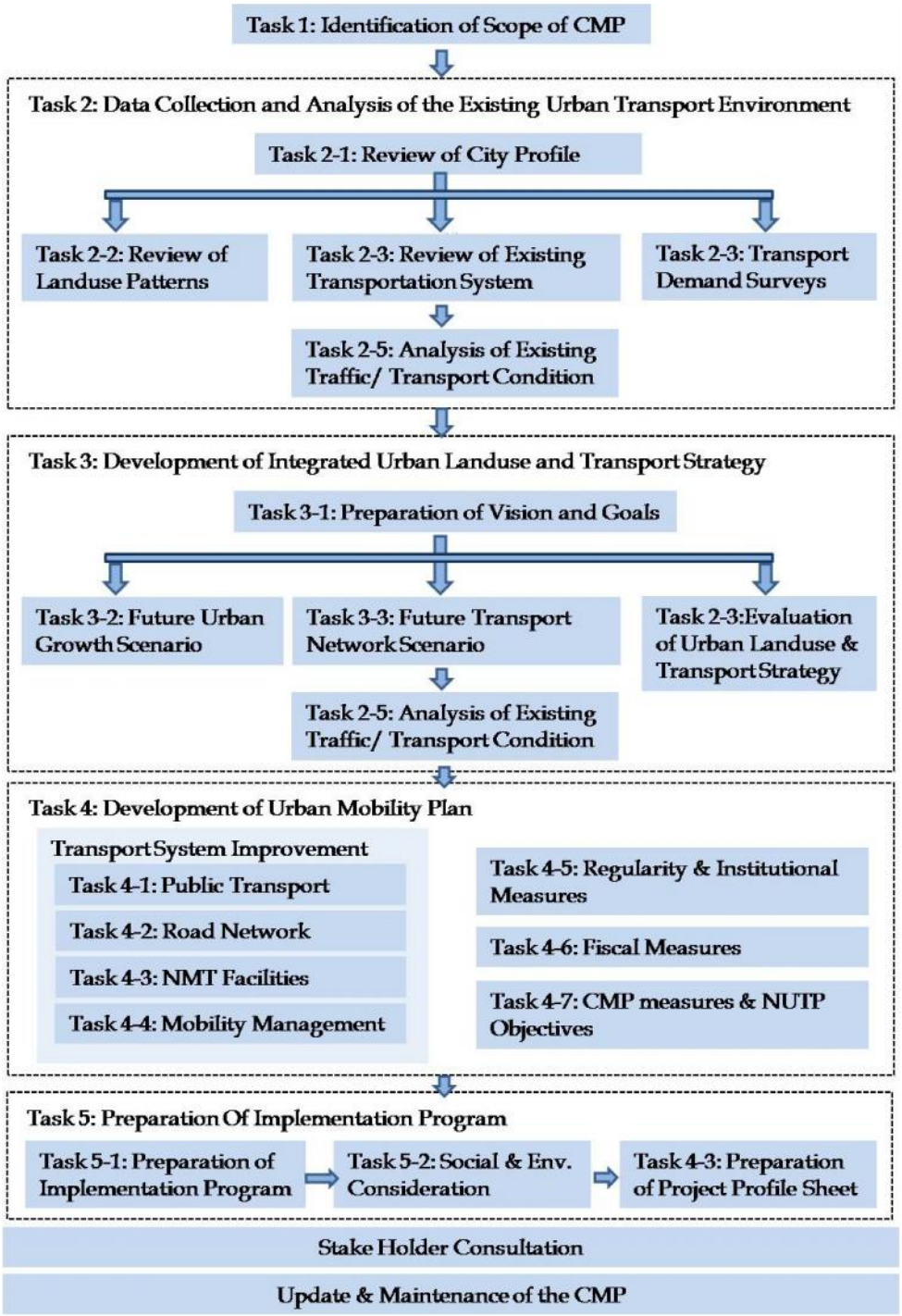
1.5. Horizon Year

The horizon year for the study is year 2041. The travel demand analysis and phasing for implementation of the network will be considered for the intermediate years of 2015, 2021, 2031 and 2041 also.

1.6. Methodology

The CMP for Gangtok city has been prepared on the basis of the methodology as detailed out in the Toolkit prepared by M/o Urban Development

Figure 1.2: Methodology



CHAPTER 2

CITY PROFILE

2 CITY PROFILE

2.1. Introduction

Photo 2.1 Himalayan Ranges

Sikkim is a small state in the North Eastern region of the India. Sikkim is located in Himalayas. It is extended approximately 114 Kms. from North to South and 64 Kms. from East to West. Total area of the Sikkim is 7096 Sq. Kms. Sikkim is having a typical geographical location, biological wealth, environmental settings and cultural diversity. The State is circled in the North by the Tibetan Autonomous region of China, Bhutan in the East, Nepal in the West and West Bengal in the South. Most of Sikkim lies on the lesser and greater Himalayan Zone with girdling ridges having some imposing peaks and high altitude passes. The exalted peaks of Khanchenjunga (8595 m) which is the third tallest mountain in the world and high altitude Nathula pass (4728m) which has recently been opened as the border trade post with the Tibet Autonomous Region of China are all located in the State.

2.1.1. Climate

Climate of Sikkim state is typical Himalayan Climate. It is altitude that controls the climate all through the year. All ranges of Himalaya acts as barrier for monsoon wind. High rainfall and low temperature observed on windward side of the mountains i.e. south side of the mountain ridge. Whereas on leeward side is comparatively dry. Heavy snow fall and precipitation is a prominent feature of the Climate.

2.1.2. Glaciers and Lakes

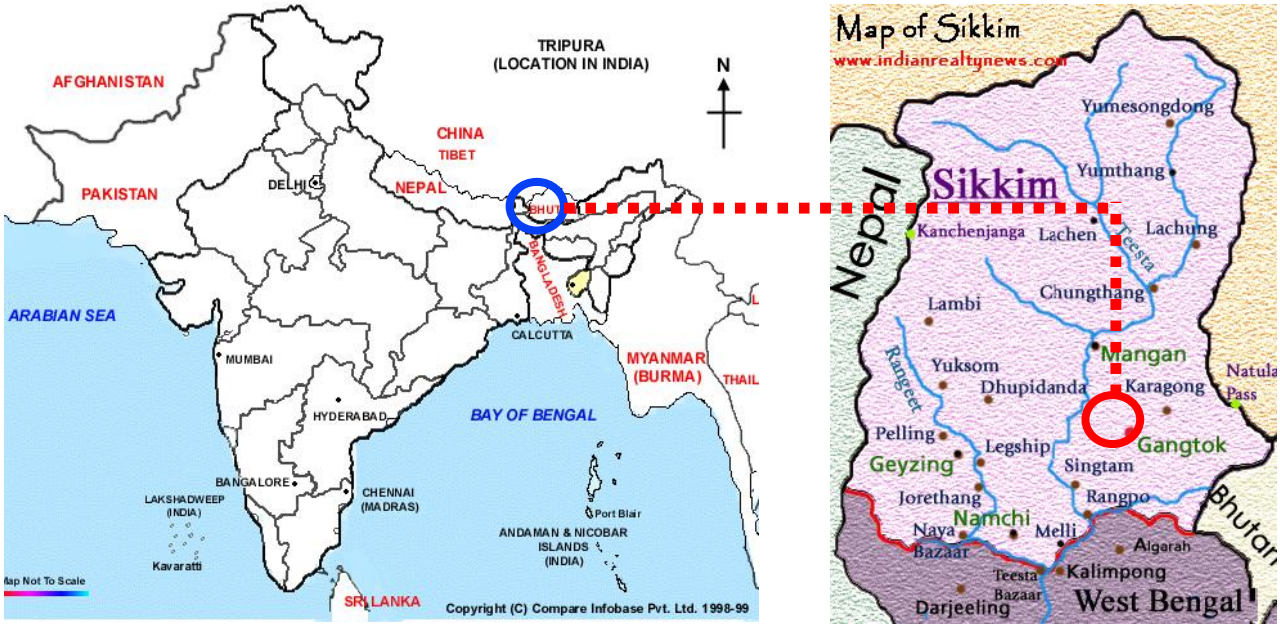
As per the survey records there are in all 84 glaciers in Sikkim covering an area of 440 Sq. Km. There are permanent snow fields also covering an area of 251 Sq. Km. These glaciers are acting as perennial sources of fresh water.

Lakes act as a major attraction for tourists in the Sikkim. There are approximately 150 lakes located at different altitude in Sikkim. Most of the lakes are with religious

significance. Most famous lakes are Tsomgo and Khecheopari lakes.

2.2. Gangtok

Gangtok the capital and largest town of Sikkim, is located in the South Eastern districts of the Sikkim with the latitude between 270 21' to 270 16' North and longitude 880 37'. Altitude of Gangtok is 5500 Ft. above mean sea level. It is also the headquarters of the East Sikkim district.



Map 2.1 Location Map

2.2.1. Connectivity

Road

Gangtok is connected by National Highway NH-31A to Siliguri. Though high altitude and terrain acted as barrier in the process of connectivity, engineering advances made it possible to improve the connectivity to Gangtok and overall all hilly towns in North eastern region of India since past few years.Modal share of city buses in Gangtok is negligible where as personlised vehicles and taxis hold the large chunk in modal split.

Air and Rail

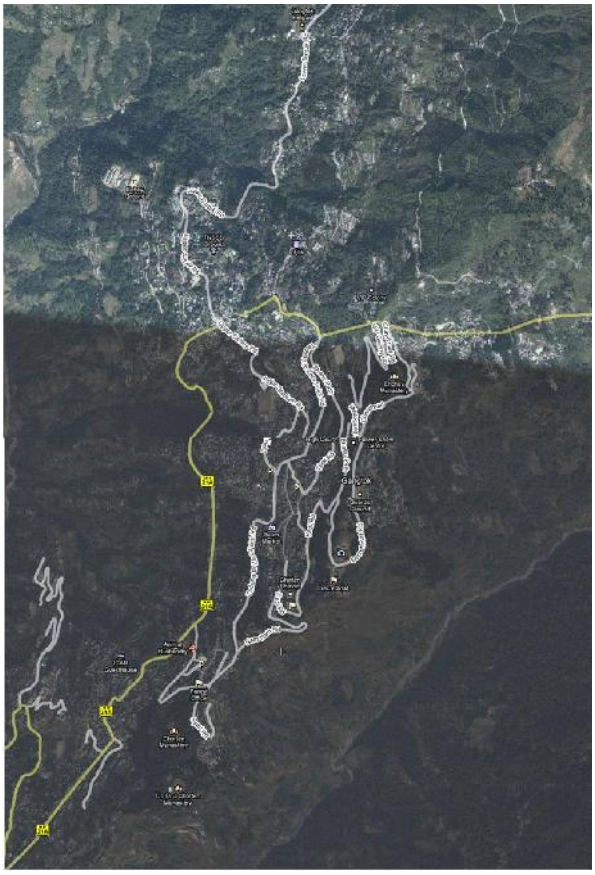
Nearest Airport is Bagdogra and the Railway station is Siliguri which is 117 Kms away from Gangtok. It also has helipad link from Bagdogra Airport.

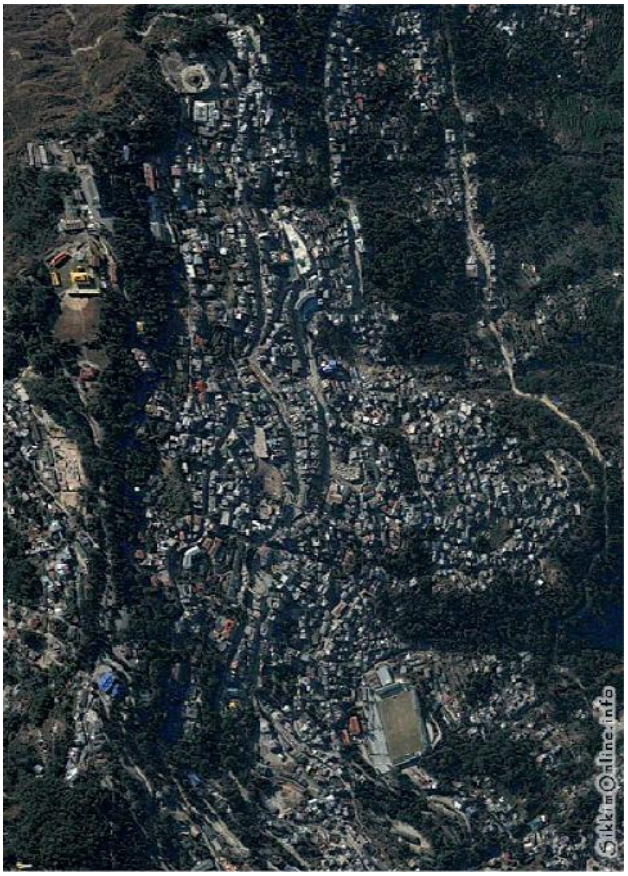
Weather

Gangtok weather is moderate in both summer and winter. Maximum average temperature of Gangtok is 25^0 C (77^0 F) and minimum of 3^0 C (37^0 F). Gangtok weather is alpine weather. Although snow fall is rare recently in 1990, 2004 and

2005 moderate snow fall observed in Gangtok. Average annual rainfall observed is 3494 mm over 164 rainy days. As Himalaya is composed of overlapping of tectonic plates landslides is general phenomenon in Sikkim. Many times landslides cut off Gangtok from other parts of India.

Map 2.2 Arial Map



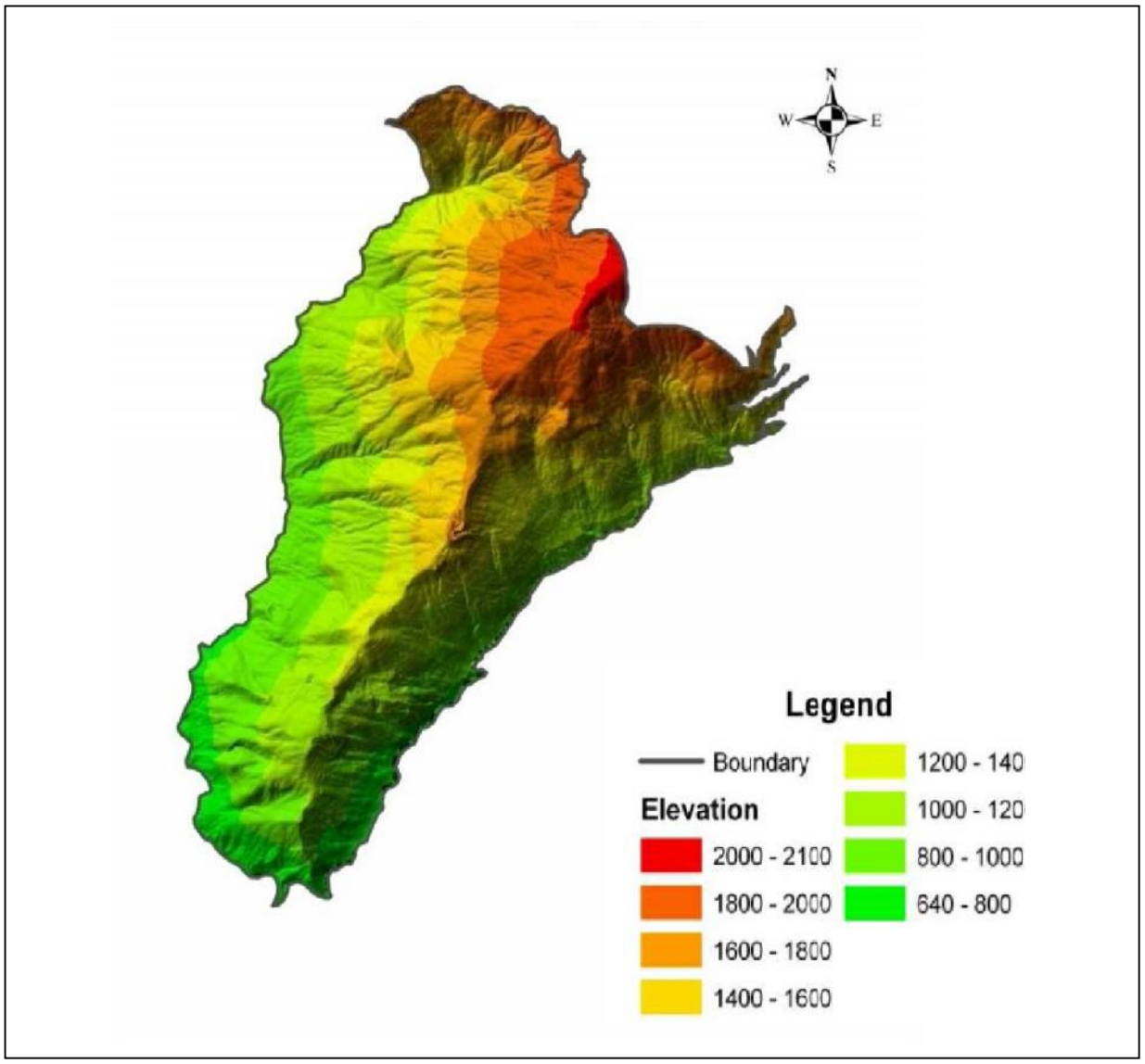


2.2.2. Physiographic Character

Topography

Gangtok is topographically undulating. Topographically Gangtok is situated between the elevations of 1300 M. to 1600 M. Gangtok is located in lesser Himalayas. Gangtok is located on the either side of the ridge with elevation of 1600 M. The ridge is running in the direction of South West to North East. Settlement pattern is affected by the physiographic character of ridge and due to this reason Gangtok is developing as a linear town.

Map 2.3 Physiographic Map of Gangtok



Source: Gangtok Structure Plan: October, 2009

2.2.3. Population

Population of Greater Gangtok area was 1, 06,746 (2000). [1]According to census 2001 population in Gangtok Municipal area was 29,354. Gangtok the capital of Sikkim is a major urban centre. Hence population growth in this particular town is significant than any other hill town in Sikkim. Various economic activities and urbanization acted as catalyst to rural poor to migrate to Gangtok for work opportunities.

[1] RITES Report 1997-98

Table 2.1 Population of Gangtok Muncipal Area

Sr. No.	Year	Population	Decadal Growth
1	1951	2744	
2	1961	6848	149.56
3	1971	13308	94.33
4	1981	36747	176.13
5	1991	25024	-31.90
6	2001	29354	17.30

Source: Census 2001

* From 1981 to 1991 growth rate of Gangtok is negative due to reduction of urban area.

The Municipal area is further divided into 15 wards. The ward-wise population and population and density details are given below.

Table 2.2 Ward Wise Population : Gangtok

S.No.	Ward	Population	Area (in Ha.)	Density (PPH)
1	Deorali	7631	28.20	270.63
2	Daragaon	8370	144.92	57.76
3	Tadong	5715	138.61	41.23
4	Ranipool	5284	108.72	48.60
5	Arithang	8684	34.80	249.53
6	Burtuk	8664	436.21	19.86
7	Chandmari	5484	298.13	18.39
8	Tathangchen syari	8114	239.09	33.94
9	Lower sichey	6377	316.19	20.17
10	Upper sichey	6094	72.22	84.38
11	Development area	7014	73.98	94.80
12	Upper m.g.marg	2855	12.91	221.15
13	Lower m.g.marg	5039	13.41	375.66
14	Tibet road	3726	27.68	134.61
15	Diesel power house	5094	17.52	290.73
Total		**94145**	**1962.60**	**47.97**

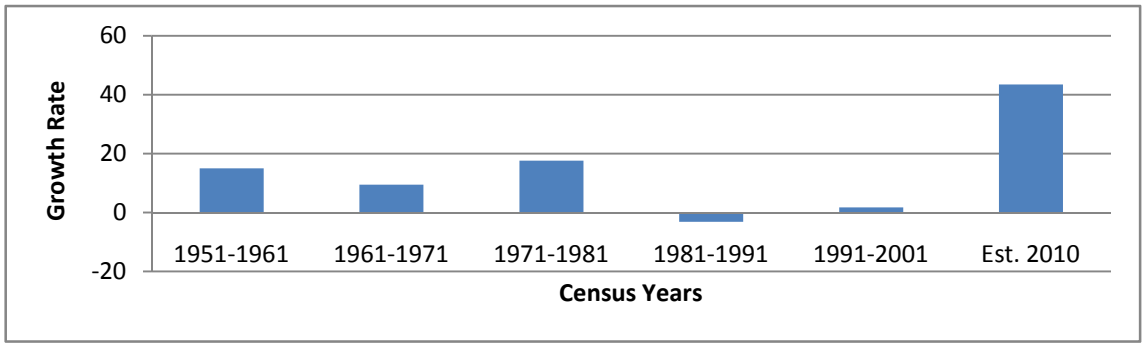
Source: MoUD, Gangtok

As evident from the table, population density of Gangtok is highly uneven. Areas like Diesel Power House, Upper and Lower M.G. Marg, Deorali and Arithang have a greater density compared to most other regions. This can be owed to factors like proximity to market place, health facilities, offices, banks and even bus and taxi stands. Lesser developed and geographically isolated regions show low population density.

2.2.4. Growth Rate

Analysis of the population growth trends over the years shows that the population in the GGPA has been highly inconsistent through the years.

Figure 2.1: Population Growth Trend



During 1951- 1961 the growth rate was 14.96% after that it decreased to 9.430% in the year 1961-1971. This again increased to 17.61% in the next decade but during 1981-1991 it was negative due to the reduction of urban area. The rate of decadal growth was 1.73 in 2001. It is estimated to have a growth rate of 43.49% by 2010.

2.2.5. Economic Base

Sikkim's economy is largely agrarian, based on traditional farming methods, on terraced slopes. The rural populace grows crops such as cardamom, oranges, apples, tea and orchids. Rice is grown on terraced hillsides in the southern reaches. Sikkim has the highest production and largest cultivated area of cardamom in India. Because of the hilly terrain, and lack of reliable transportation infrastructure, there are no large-scale industries. Breweries, distilleries, tanning and watch-making are the main industries. These are located in the southern reaches of the state, primarily in the towns of Melli and Jorethang. The state has an impressive growth rate of 8.3%, which is the second highest in the country after Delhi. In recent years, the government of Sikkim has promoted tourism. Sikkim has a vast tourism potential and by tapping into this the state has grossed an earnings windfall. With the general improvement in infrastructure, tourism is slated to be the mainstay of the Sikkim's economy.

2.2.6. Ecotourism

Now Ecotourism has emerged as an important economic activity in the region which includes trekking, mountaineering, river rafting and other nature oriented activities. The number of Tourist arrival in Gangtok has shown an increasing trend from 1000

visitors in 1980 to 1,16,500 in 1997 and has reached a current level of 2,00,000 per year.

There are many interesting places to visit in and around Gangtok. Some of the sites of tourist interest are listed below:

- The Namgyal Institute of Tibetology. It was built in 1958 and is a research center for Mahayana Buddhism and Tibetan culture. Besides being a museum of traditional and old artifacts, tourists can also buy Buddhist religious books and other objects of craft.
- Flower exhibition centre at White Hall complex and some private orchid sanctuaries around town, which is home to around 500 varieties of orchids.
- Rumtek Monastery; the institute is abode of the head of the Kagyupa order of Tibetan Buddhism as well as a learning centre. Devotees and tourists visit the monastery throughout the year.
- The Tsomgo Lake enroute Nathula pass lies in the northeast direction of Gangtok. Tourists require special permits to visit this picturesque lake.
- Hanuman Tok, Ganeesh Tok and Bulbuley wildlife sanctuary are located on the upper reaches of the city and offer an interesting experience to tourists.
- For the adventure tourist, Gangtok has plenty to offer with adventure activities like trekking, white-water rafting, yak safari, and mountain biking.
- Tour operators in Gangtok offer interesting visits and treks to Pemayangtse, Khechiperi, Yuksam, Tsokha, Dzongri, Thangshing, Zemathang, Chaurigang, Tashiding, Barsey, Yangang, Rabongla, Sang and Sikip.
- The state tourism department of Sikkim has been promoting the adventure tourism potential of Gangtok.

2.2.7. Trade through Nathula Pass

Trade in the Hill State of Sikkim is upbeat on the prospect of Indo China Trade through Nathula. Lhasa the capital city of the Tibet is 431 kms from Nathula and little over 1100 kms from the port of Kolkata. At present the goods are transported to Lhasa through Beijing and Shanghai. As the present route is of considerable distance the trading community is expected to take advantage of the logistics for export of goods from India to Lhasa through Nathula.

Siliguri and Jalpaiguri in West Bengal and the East and South Districts of Sikkim are set to emerge as transhipment points for goods arriving from Kolkata port for Tibet and China. At these two places, the plan is to load goods in smaller containers before they make their way up the hills to Nathula via Gangtok. Besides sending goods for the Indian market, Chinese exports to South-East Asia, Bangladesh and Myanmar can also be routed through Nathula.

Gangtok being located en-route to Nathula and presently being the Administrative and Business Capital of the State has to capture the immense gains that would emerge from the Nathula Trade Route. [2]

2.2.8. Direction of Growth for Physical Development

In the past few years Gangtok has experienced unprecedented spatial expansion. Total area of Gangtok City is approximately 25 sq. Km. but as per the City Development Plan (CDP) area of Greater Gangtok is 76.95 Sq. Km. which includes urban and rural fringe around the Gangtok and population of same area is 93,955 (Census 2001).The total area comprises of the surrounding satellite towns namely Bhusuk, Ranka & Luing, Penlong & Pangthang, Rumtek, Assam Lingzey and Pakyong.

Gangtok exhibits a similar form of development, where growth has been accelerated as a response to increased economic opportunities. The primary growth axis for Gangtok is towards the South and South West direction, along the NH 31A on the Setipul- Ranipul axis. The terrain in this axis is relatively more favorable and accessibility is enabled by NH-31A. Some of the urban fringe areas facing increasing pressure on land development are Deorali, Tandong and Ranipul. There are also several settlements growing along and off the Indira bypass and on the eastern slope from Chandmari to Syari.

The existence of steep slopes, vulnerability to landslides, large forest cover and inadequate access to most areas has been a major impediment to the natural and balanced growth of the city. The existing physical pattern has been dictated primarily by availability of land that is safe with respect to stability. In view of the development constraints like landform, topographical features, watercourses, drains, ecology and

[2] The Hindu

growth propensity, the future direction of growth needs to be spread over a larger area. Under developed areas within the notified city area need to be opened up for development through better accessibility and traffic and transport measures. Areas below Indira Bypass and the surrounding revenue blocks, Siyari, Tahtnagchen and Chandmari, Bojhoghari have potential to absorb some of the growth momentum in Gangtok.

2.3. Study Area Profile

The study Area considered for the preparation of the CMP is the Greater Gangtok Planning Area which comprises of 75 sq. kms including the surrounding areas namely Bhusuk, Ranka, Pakyong, Assam Lingzay, Rumtek, Penlong and Pangthang.

2.3.1. Satellite Colonies in the Greater Gangtok Area

Bhusuk

The Bhusuk hill facing Gangtok is located at a driving distance of 1 hour, i.e. approximately 35 to 40 kms from Gangtok. This area is primarily represented by a fragile eco system and is hence unsuitable for high-density growth. It will be possible to create a habitat centre, interpretation centre, botanical gardens, centre for flora and fauna. It may also be developed as a centre for sporting facilities that do not require heavy infrastructure.

Pakyong

Pakyong is located at a distance of 25-30 kms from Gangtok. It is already notified as one of the 9 urban centres of Sikkim. The proposed airport will be located in Pakyong. There is also a proposal for the creation of an IT city in Pakyong. The surrounding hinterland of Pakyong has the potential to develop as an industrial zone because of its proximity to Bengal.

Assam Lingzay

Assam Lingzay is located around 15 kms from Gangtok within a driving distance of around 30 minutes. Due to the land profile and enabling weather this area should ideally be planned as a residential area. It also has the potential to attract investments for development of institutions such as schools

and colleges so that the residential area can develop in tune with the schools.

Rumtek

The Rumtek hillside is located at a distance of about 20 kms from Gangtok. The main magnet in Rumtek is the presence of Rumtek Monastery and the Lingding Monastery which is located at Ranka but is within a driving distance of 20 minutes from Rumtek. Focus of planning in this area shall have to be tourism oriented. It will be essential to encourage low-density development. Establishment of infrastructure for tourism related commercial activities is essential here to reinforce the idea of decentralizing Gangtok. People of Rumtek can avail of these services locally.

Pangthang, Luing and Ranka

The Pangthang, Luing and Ranka hill facing Gangtok is one continuous stretch and is located within a distance of 10 kms from Gangtok and driving time of 20 minutes. This entire belt may be developed into an institutional as well as a commercial hub. Pangthang / Penlong is already developing as an institutional hub with several educational and Government institutions such as the GB Pant Institute of Himalayan Studies, Taktse International School, proposed five star hotel, Department of Forest research centre, proposed sports centre or 'Khelgaon', and the centre for Buddhist studies already operating in the area.

The establishment of the Nathula trade is expected to further catalyse the growth of Ranka and Luing due to the alternative highway that has been proposed along the existing Ranka Luing Road to cater to the Nathula trade. All urban services, especially transport terminals will have to be planned immediately in Ranka to cater to the growing traffic. The vast area under the city limits of Greater Gangtok emphasises the importance of intra city transportation and regular commuting facilities. Due to the rapid economic growth in its tourism related industries during the last two decades, it is striving to manage the growing transportation requirements.

2.4. Civic Administration

Gangtok is not administered by a municipality but directly by the various departments of Government of Sikkim, particularly the Urban Development and Housing Department (UDHD) and Public Health Engineering Department (PHED). These departments look after the civic functions such as garbage disposal, water supply, tax collection, license allotments, and civic infrastructure. An administrator appointed by the state government heads the UDHD. The Sikkim Municipal Act, 2007 has approved the formation of Gangtok Municipal Corporation which shall take over the administration from the UDHD.

CHAPTER 3

REVIEW OF LAND USE SYSTEM

3 REVIEW OF LAND USE SYSTEM

3.1. Existing Reports and Documents

Gangtok does not have a statutory Master plan as such, and the growth of the city has been mainly along the major transport corridors. The City development plan of Gangtok which was prepared in 2006, gives an overview of the existing landuse pattern.. A Structure Plan has also been prepared in 2009, which discusses the land requirement and proposed landuse in 2040.This structure plan may be translated into a Master plan in near future.

3.2. Landuse Patterns and Development Trends

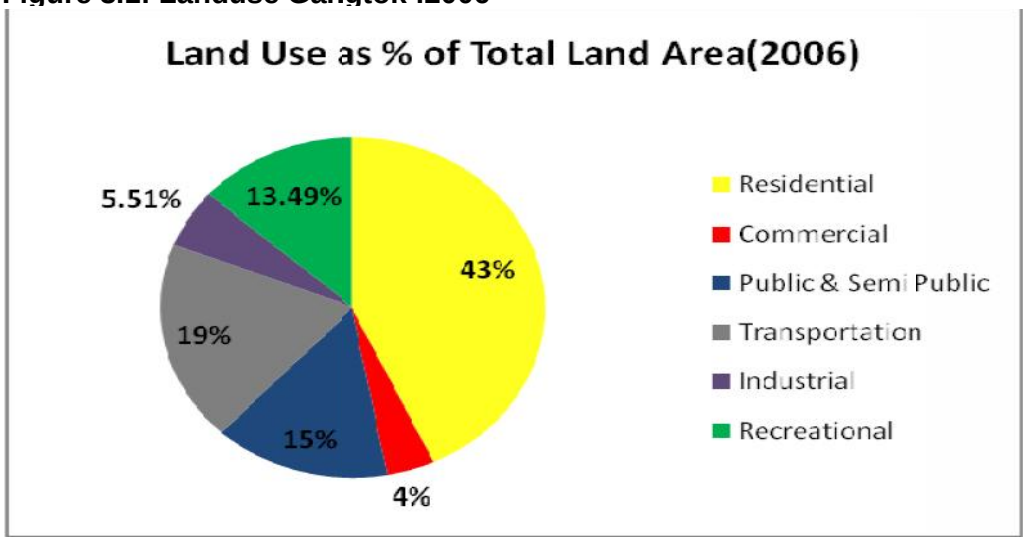
It is observed that the total developed area has been increasing for the past three decades. The highest growth rate has been seen in the industrial sector, which shows a growth rate of 363.41% from 1985-1995, this is mainly due to coming up of new industries along the NH-31A, there has also been considerable increase in the transport and recreational sector, however residential, commercial and public uses have been growing at a slower pace.

Table 3.1 Landuse

Sr. No.	Landuse	% to total Land Area			
		1975	1985	1995	2006
1	Residential	65.48	54.82	49.56	43
2	Commercial	6.85	6.35	4.63	4
3	Public and Semi public	0.55	1.70	4.19	15
4	Transportation	13.42	12.21	10.57	19
5	Industrial	1.10	7.27	9.03	5.51
6	Recreational	12.60	17.65	22.03	13.49

Source: NEURDP, ADB Report, 2006

Figure 3.1: Landuse Gangtok :2006



Earlier Gangtok had an organic growth. Mixed landuse is prominent feature of this City. The guiding factor for the development was accessibility and availability of suitable land.

The landuse distribution of 1995 and 2006 shows decline in percentage share in the residential area. However, there is considerable increase in public semipublic landuse share. It was due to new institutions and other public buildings came into being. There has also been increase in the share of industrial landuse.

3.3. Land Use of Some Specific Area

Pani house

Located along the National Highway, this area is characterized by steep slopes. This locality is primarily a residential area having the presence of a large number of hotels that have sprung up along the National Highway. Through traffic is a problem on this route.

Arithang

This area is a suburb of Gangtok. Due to its close proximity to the core urban area, a large number of commercial buildings are emerging especially along the roads. Primarily, the area is residential in nature. There are slums located in Arithang and the buildings types are characterized by a mixed type comprising mostly of RCC buildings as well as semi pucca types. Large number of traffic is generated from all over Gangtok to this area.

City Area

It is the most developed area. There are residential, commercial, public and semi public use buildings. Banks, offices of FCI, NEDFI, PHED, PWD, Schools, Hostel, Center for blind, clinic and Himalayan Nursery are just few to name. The existing buildings have an average of 4-5 floors and maximum number goes up to 7. It generates large traffic volume and needs organized parking sites

Enchey Area

This area is located in the upper reaches of Gangtok and is mainly an institutional area. It is characterised by the presence of Enchey School and the oldest monastery in Gangtok, Enchey Gumpa. Hostels, monastic hostel, schools, water supply substation, water supply tanks and some residential buildings are situated in this area. A large number of pilgrims congregate in this monastery on a daily basis. Due to the presence of VIP colony nearby, this entire belt generates a large volume of traffic and requires immediate intervention for creating a parking lot for the VIP colony and monastery bound traffic.

Balwakhani

This area comprises of residential, public, semi public and commercial use buildings. Offices of CPWD, LIC, Forest Department, Metrological, State Lottery, Telecom and State legal offices are located in this area. There is a power substation and generator room. It also generates large volume of traffic to and from these centers.

Tathangchen

This area is ecologically fragile. The area comprises of buildings of mix use, residential buildings being the predominant type. There are schools, offices such as District Institute of Education and Training, Gram Panchayat, Administration center, Green Houses, Power Station and water storage tank in this area. Traffic pressure is not much in this area.

India Press

Residential, Industrial work sheds, offices, Press office, Guest house and public utility buildings as water tanks and generator house are situated in this area. Traffic is moderate in this area.

Chandmari

There are building of various uses such as residential, public and semi public in this area. Green houses, Schools, ICDS School, monastery, BSNL office are some of the public facilities available in Chandmari. Traffic is moderate in this area

M.G. Marg and Tibet Road and Kazi Road

This area is the core business district of Gangtok NTA. This is a major hub for the tourists and most employment is in the service area are buildings for residential, commercial, public and semi public use. Several office buildings such as Birth & Death Registration Office, CA office DIC, Education center, Health Center, LIC office, Police Station, State Excise office, tourism office, vigilance office and banks are located in this locality. The buildings are pucca and semi pucca in nature. A large volume of traffic is generated to and from this area. Parking is the main problem.

Deorali

Deorali is fast emerging to be a commercial and institutional hub of Gangtok. There are many business enterprises apart from institutional buildings. The Deorali Girls Senior Secondary School, private schools, private Colleges, Clinics, Office of the Forest Department, State Trading Corporation of Sikkim Office, Geological Survey of India Office, Health center Water Storage tank, Post Office, SITCO Office, Banks, Telephone Exchange, Office of the Auditor General, Office of the Divisional Engineer (Sewer) PHED, are also situated at Deorali. There are a number of upcoming hotels, restaurants and commercial centers that indicate the potential of this hub becoming a major commercial centre in the future. This hub generates a large number of traffic in the city.

Namnang

This area is essentially a commercial hub. It is also an upcoming hospitality hub with a large number of hotels in the locality because of its location. The scenery of the surrounding hills from Namnang is exemplary and its proximity to the market centre, schools, offices, Tibetan Tantric study institute, Chintan Bhawan and the State Assembly have made it a place of demand for the tourists. During function in Chintan Bhawan and State Assembly, traffic is generated in large

volumes. A separate parking facility needs to be created in Namnang. There is the Tibetan Health care centre which also brings in a large number of people. There are commercial units emerging in Namnang, alongside the existence of schools, Press Club office.

Ridge Park

This area sits along the ridge and is one of the most beautiful locations in the city. It is one of the main recreation centres of Gangtok, with the buildings such as the White Hall Complex, an officers' club and the Samman Bhawan dominating the landscape. The Chief Minister's residence, Mintokgang stands on one end of the ridge while the Palace stands on the other end. During function in Mintokgang and Samman Bhawan, traffic is generated in large volumes. A separate parking facility needs to be creating in Ridge Park area. It is the favourite destination for joggers and morning walkers, Tae kwondo, badminton and sports enthusiasts etc. The Flower Festival Pavilion located in this area exhibits flowers of Sikkim all year through while holding flower festivals during spring and autumn. The areas surrounding the Ridge is a notified Green Belt, hence building density along this location is low. The view of the mountains is spectacular from the Ridge Park. Tourists flock this area all round the year.

Tibet Road

Located off MG Marg, Tibet Road derived its name from the earlier trade route to Tibet. It was the road where mules transported goods to Tibet. It is now the second most important commercial centre of Gangtok. This area is one of the most densely developed, comprising of buildings of residential use, offices, public facilities & having a large concentration of hotels. The prominent buildings are Health Care Center, High Court, Telephone Exchange office, and Nurses Training Institute. It is a vibrant transportation route of the Gangtok.

TNA area

The dominant land mark in this area is the premier school of the State, Tahsi Namgyal Academy or TNA. This area adjoins the Ridge Park area and is an extension of the beautiful vast green landscape of the city. Since the surrounding areas have been notified as green belt area, the area is not densely inhabited.

The buildings are of mixed type. There are offices such as the Akashwani, Department of Sports and Youth affairs, and a few Government quarters. Moderate traffic is generated from this area.

SNT Area

This area's landmark is the bus terminal of the Sikkim Nationalised Transport, and its office. It has also over the years emerged as a institutional hub with Schools like the Holy Cross Missionary School, St. Thomas School, District Consumer Office, Fire office, Central Post Office, Tibetan Welfare Office, UDHD, Power Sub Station, Most Backward Class Office, Banks, Industrial Work Sheds, Computer Training Institute, St. Thomas Church and reputed hotels of Gangtok. Large traffic volume is generated from this area.

Upper and Lower Sichey

Upper Sichay is predominantly a residential area, with a few hotel buildings, the Paljor Stadium, Department of Fisheries office, health care center, District Courts, District Collectorate Office, Zilla Panchayat office, IRB office, Power Grid Corporation Office, Orchid nursery, Special Bureau Office, Motor Training Institute. There are a few private schools and one Government School in the area. It also generates huge traffic volume.

Tadong (Upper and Lower)

The growth trend of Gangtok suggests development along the South and South Westerly axis wherein Tadong and Fifth Mile area is situated. This area is Gangtok's fast emerging commercial and institutional hub. All along the National Highway, commercial establishments of various kinds have come up. There are a number of private and Government Schools in this area while the major institutional buildings present here are the Krishi Bhawan, Animal Husbandry Department, BSNL office, Central Water Commission, Census Office, Sikkim Milk Union, Holy Cross Senior Secondary School, Baha'I School, Sikkim Government College, College Auditorium, Horticulture nurseries, Central Referral 500 bedded Hospital, NBCC Office and Banks. Trade activities along the roads such as motor car showrooms, workshops etc. are common in this entire belt. A large volume of traffic is generated from this area.

3.4. Direction of Growth for Physical Development

In the past few years Gangtok has experienced unprecedented spatial expansion. Total area of Gangtok City is approximately 25 sq. Km. but as per the City Development Plan (CDP) area of Greater Gangtok is 76.95 Sq. Km. which includes urban and rural fringe around the Gangtok and population of same area is 93,955 (Census 2001).The total area comprises of the surrounding satellite towns namely Bhusuk, Ranka & Luing, Penlong & Pangthang, Rumtek, Assam Lingzey and Pakyong.

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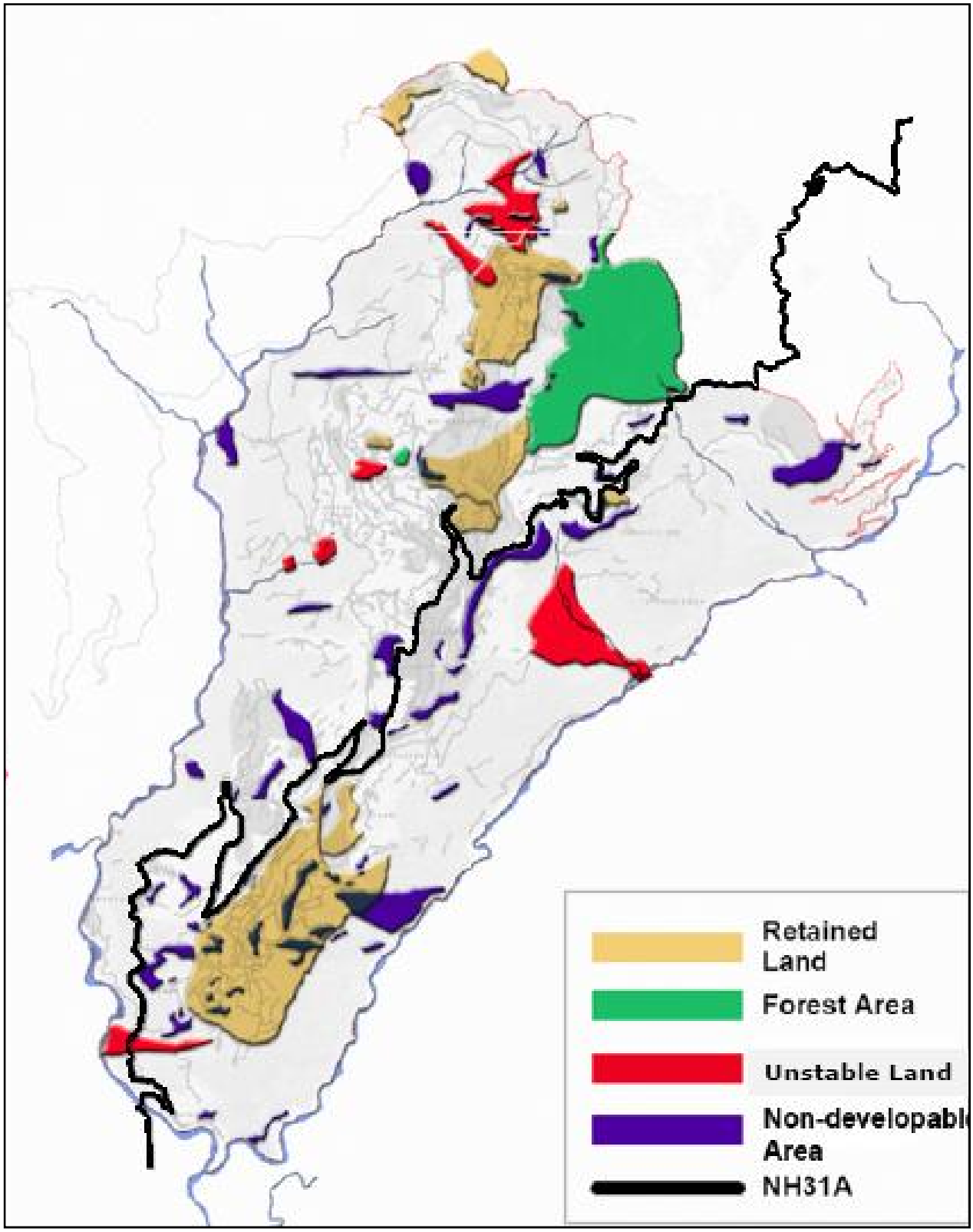
3.5. Physical Growth Constraints

The 4 aspects of constraints, when put together, give a very clear idea all physical constraints affecting the Gangtok Municipal area. Following Map 3.1 gives constraints plan would provide guideline for landuse planning in future. After deducting the land under physical constraint total developable land will be 80% of total land.

Map 3.1 Land under Physical Constraints



3.6. Landuse Development Policies and Strategies

Since Gangtok does not have an approved Master Plan, there are no definite land development policies. As per the Gangtok Structure plan, to enable better sector planning for local facilities, it is proposed for the GPA to be divided into 7 planning communities. Sector planning will ensure a balanced catchment of facility users within each community, while still adopting the user ratio stipulated in the Indian Standards.

Table 3.2 Landuse Breakdown in GPA in 2040

S.No.	Land Use	Site Area (Ha)	Percentage
1.	Residential	935	35.4%
2.	Commercial	150	5.6%
3.	Institutional	132	5.0%
4.	Industrial	55	2.1%
5.	Sports and Recreation	14	0.5%
6.	Special Use	279	10.6%
7.	Public Green	139	5.3%
8.	Open Spaces	936	35.5%
Total		2,640	100.0%

3.5.1. Summary of attributes:

- Population – 163, 346
- Population Density – about 6000 persons/km
- Residential Units (Households) – 32, 175
- Commercial Space – 2.8 million sqm

The total projected population for the Gangtok city in 2010 is about 1.6 Lakh. The proposed municipal area has been increased from 19.6 Sq Km to 25 Sq Km. About 35.6% of the land is allotted for residential use, thus bringing down the total percentage of land under residential use from present 43%.The land area under commercial landuse has been increased to 150 Ha, which amounts for 5.6% of the total area. Landuse under transport will be in between 15% to 20%. Taking it on higher side the total land will be about 500 Hectares. This may be deducted from open spaces, public green and special areas. 132 ha have been dedicated to institutional landuse, taking into consideration the fact that Gangtok has a large number of schools and other institutions. Only 2% of the land area has been allotted for industrial uses, which include small and medium scale industries.14 Ha of land or

0.5% have been allocated for sports and other recreational facilities and 279 Ha has been reserved for special use. Considering the fact that Gangtok falls in ecologically fragile zone, almost 41% of the area have been kept open, out of which 139 ha have been reserved for public green and remaining 936 Ha are open spaces, which include steep slopes and other inaccessible areas.

The structure plan is silent about landuse under transport activity, whereas transport is an important landuse, which actively contribute towards economic development. Earlier CDP has given 19% of land under transport. In future this share will remain between 15%-20% of the total land area. (Map 3.2)

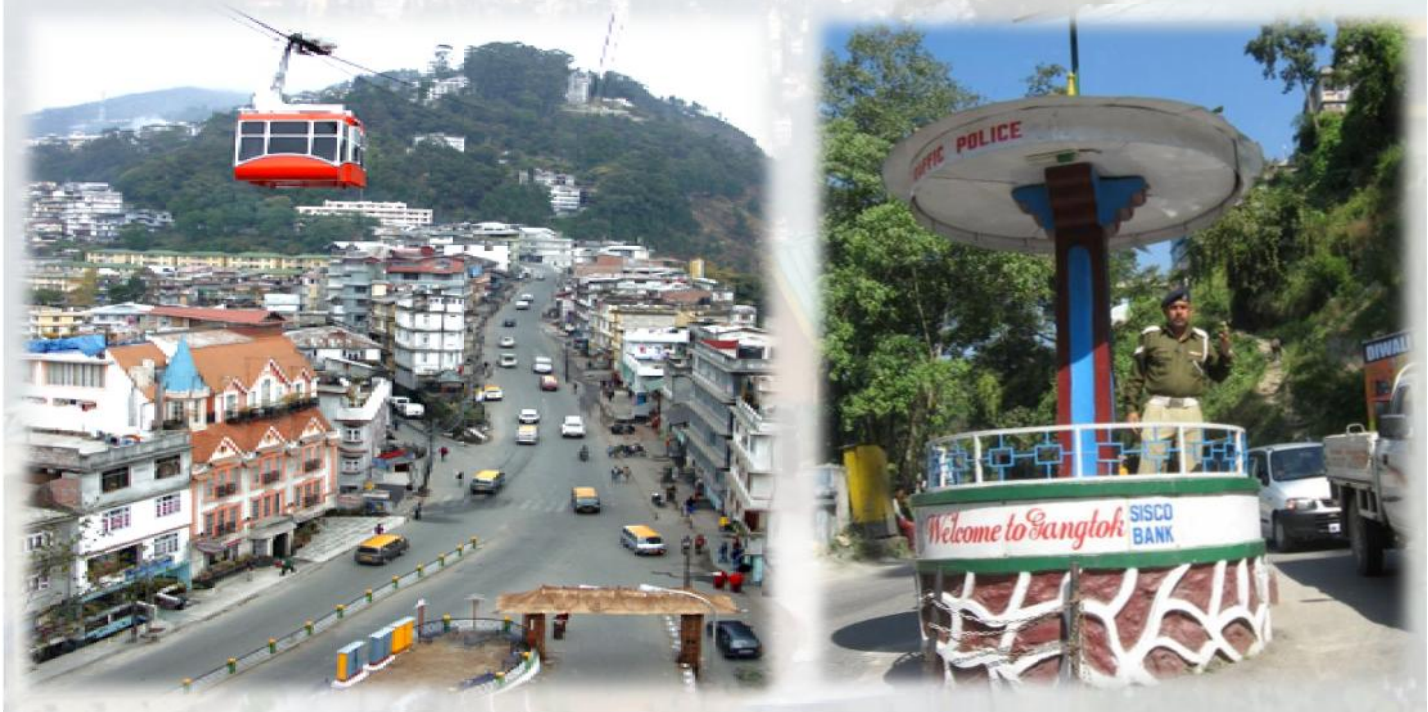
3.7. Issues

Most of the areas are characterized by dense building forms along the roads and in areas that are situated close to arterial roads. Due to inaccessibility, commercial activities are concentrated only along roads.

- Most of these areas have poor approach and internal roads are located on steep slopes, do not have proper footpaths.
- Drainage and landslide issues need to be addressed holistically for all the areas.
- Organized open space is required for most of these areas.
- Commercial units need to be earmarked for an organized growth pattern as there is no proper land use pattern in Gangtok.
- Parking of cars is concentrated on the roads thus adding to the congestion. Creation of localized parking lots for private cars and taxis is very important.
- Landuses are not properly defined hence transport network need to be suggested on felt need basis

CHAPTER 4

EXISTING TRANSPORT SYSTEM



4 EXISTING TRANSPORT SYSTEM

4.1. Existing Studies, Reports and Proposals

Various Transport surveys and studies were conducted from time to time those are:

- City Development Plan (2006),
- Transport Study by Center for Indian Road Transport (2005),
- Performance improvement Measures for SNT by CIRT, Pune,(2008)
- Structure Plan by Surbana (2009)
- Transport Study by Wilbur Smith Consultants (2008),
- Transport Study by RITES,

All these studies were considered to understand transport related problems and their appropriate solutions.

4.1.1. City Development Plan (CDP)

City development plan for Gangtok is prepared by Shristi Urban Infrastructure Development Ltd. Major findings of CDP are as follows.

The major roads are

- National Highway No.31A (Gangtok-Siliguri),
- North Sikkim Highway connecting Gangtok with the North District
- Jawaharlal Nehru Road, (the trade route link between China and India).

- Full establishment of Nathula pass will also strengthen the road network in future. The same route will be developed as fright corridor for international trade and import export of goods.

- Gangtok is linear city and topographically also it has great difference in highest and lowest altitude. Topography acts as a barrier to road alignment. Most of the roads in Gangtok are two lane, undivided and footpath on one side and drain on the other side. Roads in Gangtok are narrow in width. Gradient of roads are also slightly high.
- Some areas in Gangtok are not accessible through vehicles.There are no designated terminal facilities for goods vehicles and goods are transported to

the local sites in smaller vehicles.90% of the traffic is intra-city and only 10% traffic is interstate traffic.

Congestion are recorded on following junctions

I. Metro-MG Marg Junction
II. Hospital junction
III. Community Hall Junction
IV. Lall Bazar junction
V. Deorali Junction
VI. Tadong (Daragaon) Bazar
VII. Sikkim Govt. College entrance-exit point
VIII. M P Golai
IX. Zero point junction

- Under traffic management measures 4 roads are used for one way traffic flow those roads are Sadar Thana Road, DPH Church Road, Portion of Tibet Road and Kazi Road.

- Journey speeds vary from 11 kmph to 27 kmph. The traffic volume data recorded at various locations bring to light that out of ten locations, six locations experience a gush of more than 10,000 PCU, during the day. The analysis of volume/capacity ratios (VCR) reveal that the maximum VCR is along the primary spine of the city as well as on the roads near the core commercial area of the city. Thus, on an average day the peak volume varies from nearly 350 to 590 PCUs.
- The pedestrian traffic volume survey at 4 locations show high pedestrian volumes mainly on MG Road, Indira Bypass and Deorali Bazar Road.
- The land use pattern around the area is typically mixed, comprising of residential/semi-public/commercial buildings.
- A survey for on-street and off-street parking 80% of the parking is of short-term duration, with a high turnover.
- The acute traffic problems that Gangtok faces presently are in the areas of Metro-MG Marg Junction, Hospital junction, Community Hall Junction, Lall

Bazar junction, Deorali Junction, Tadong (Daragaon) Bazar, Sikkim Govt. College entrance-exit point and Zero point Junction. A special effort has to be undertaken to provide interconnecting road links between major arteries of the city.

Table 4.1: Identified Projects in "CDP, Gangtok: 2006"

Sl. No.	Type Of Project	Total No's
1	Improvement of Selected Urban Roads	12
2	Improvement of Major Intersections	6
3	Parking	9
D	Truck /BusTerminal	2
E	Pedestrian foot over bridge	7
F	Improvements of footpaths	10

Source: CDP Gangtok, 2006

4.1.2. CIRT Study

A study on the traffic situation of Gangtok was carried out by CIRT, Pune in the year 2005. The findings of the study are

The highest daily traffic in Gangtok is observed at Deorali i.e. 35,758 cars, followed by Hospital junction i.e. 32,296 cars and at Denzong Junction i.e. 30,484 cars.

Table 4.2: Traffic at intersections / mid blocks

Sl. No.	Intersection	Total volume of vehicles
1	GICI	12,809
2	Hospital	32,296
3	Metro	22,792
4	Denzong	30,484
5	Deorali	35,758
6	Indira bye-pass	26,224

Source: CIRT, Pune, 2005

The maximum hourly traffic volume was observed at Hospital junction of 4277 vehicles per hour. The other two important intersections at Denzong and Deorali recorded a volume of more than 3000 vehicles per hour.

Table 4.3: Peak Hour pedestrian flows (along the road)

Sl. No.	Location	Peak Hour flow
1	Police Head Quarters	1,830
2	Bansi Lal Petrol pump	2,022
3	Deorali Five ways junction	678
4	PS Road (Near Post Office)	927
5	Orthopaedic Hospital Junction	1,321
6	Tadong School Crossing	236

Source: CIRT, Pune, 2005

The share of personalized vehicles and taxis combined was observed at 98% of the total vehicles in Gangtok, which is very high.

Table 4.4: Peak Hour pedestrian flows (along the road)

Sl. No.	Location	Two wheelers	Car/Jeep/Taxi	Bus	Goods Vehicles
1	GICI	8.0	89.5	0.6	1.9
2	Hospital	7.7	91.5	0.4	0.4
3	Metro	10.6	88.7	0.4	0.3

Source: CIRT, Pune, 2005

The higher percentage of the private vehicles and taxi is evident from the survey findings as among the taxi users 16% were tourist and 84% are local residents in which 36% are the daily commuters and 64% are occasional.

Keeping view the environmental, regional and tourism importance of the town need of mass public transport is felt. When asked during the survey 92% of persons interviewed were in the favour of the minibus services to be introduced with higher frequency.

Key Issues and Challenges

- Inadequate Road Infrastructure – narrow carriageways, junctions, signage and traffic management, etc.
- Integration of landuse plan and transportation planning.
- Streamlining the heavy cargo transport.
- Low Share of Public Transport resulting in traffic menace and environmental degradation.
- Safety Institutional accountability Lack of awareness and non-compliance of

the commuters to traffic regulations.

- CMP may also select few more areas other than above referred colonies and townships.
- CMP will also suggest connectivity pattern of these colonies with Gangtok and also among these colonies for better movement pattern.
- CMP will finalize projects after analyzing primary survey data/information collected as per formats given in annexure.
- CMP will also suggest phasing in implementation of projects based on their priority of urgency.

4.1.3. Performance Improvement Measures for SNT by CIRT

This particular report is prepared by CIRT Pune in December 2008. This report discuss about how SNT established and what is its present status. Earllier in 1951-52 SNT was established for fright services and presently it is also looking after passenger transport in Sikkim State. The support from State government to SNT was limited this caused inability to replace or augment its fleet on time to improve the quality of its services.

Major objective of this study

- % increase in per Km charges for passenger tickets and fright charges per Km. per ton.
- Optimal utilization of existing fleet and manpower.
- Measures to be adopted for plugging the leakage in revenue.
- Measures to be adopted to reduce turnaround time for fright operation
- Ways and means to be adopted for route rationalization
- Measures to tackle the private operations in passenger and freight vehicles
- Recommendations or suggestions to improve passenger service and ratio of staff
- Optimal utilization of workshop facility

New technologies introduced to reduce waiting time and increase efficiency of existing fleet. Separate majors are suggested for Fright operations, passenger transport services, basic infrastructure development, Fleet replacement and

Augmentation and maintenance management.

4.1.4. Gangtok Structure Plan: Surbana

Gangtok structure Plan was prepared in the year 2009. It was prepared for a span of 30 years, i.e. upto 2040.The structure plan has discussed about the existing linkages by roads in Gangtok. This included study of existing road network and also the existing ropeway system. The study concluded –

- The NH 31 A acts as the spinal cord of the city, and it is highly overloaded and congested.
- Road Widening not possible due to steep terrain and space constraint.
- New Road Schemes to be explored
- The ropeway service is commonly used by residents working within the CBD area, as it avoids road congestion and has shorter traveling time to work.
- In Proposed landuse of Structure Plan area under circulation and transportation was not discussed or covered, which is important part of any landuse plan.

The structure plan has also proposed a new road structure-

- New inner and outer Ring road has been proposed
- A new link in the west to connect the to-be-implemented new State highway.
- A new junction in the south to link the outer ring road with a route to Pakyong Airport.
- New Collector roads added as connectors between the ring roads and the national highway to enhance overall traffic circulation.
- New road hierarchy is proposed with 6 levels.

4.1.5. Wilbur Smith Associates in 2008

In a recent study conducted by Wilbur Smith Associates in 2008, Gangtok was given a ranking of 1.1 on a scale of 5, meaning that pedestrian facilities are quite inadequate and there is scope for much improvement.

4.1.6. Transport Study by RITES

RITES had prepared the Gangtok Masterplan in 1997.The major contribution of the study is population projection for the year 2010 and 2020.Transport survey of Gangtok has been conducted by RITES and as an outcome of the survey proposal

for pedestrian footover bridges were suggested and built on following locations

- Hospital Junction
- Metro Junction 2 pedestrian cross over bridges were constructed
- Lal Market Junction

4.1.7. NEURDP Study:

This study discusses about the change in landuse in Gangtok for last 4 decades.. As per the study, it is evident that the city area has consistently increased since 1975. Thereby the percentage for each landuse has decreased, even though the population and density has increased over the years.

4.1.8. Gangtok Integrated Development Plan 2000 Study:

This study was prepared in 1987 for the year 2000 and it was for an area of 725 Ha out of the 725 Ha 70% area is already covered, while the remaining area comprises of vacant land, agricultural land, Jhoras and area under tree cover..

4.2. Existing Transport Infrastructure

4.2.1. Connectivity

Gangtok is connected mainly by road with rest of the regions. The National Highway, NH-31A is the major connector of Gangtok to Siliguri, Darjeeling and Kalimpong. Regionally Gangtok is developing on the East, West and South direction due to good connectivity by road. Nearest Railway station to Gangtok is Siliguri which is 120 Km away from Gangtok. Nearest airport to Gangtok is Baghdogra. At city level, major traffic generating nodes are work centers, commercial centers, recreational centers and transportation terminals. Inter-state and intra-state buses are available on the same terminuses which are located at Paljor Stadium Road and at the private taxi stand near the Police Headquarter. As both these terminals are located very much in the core city area they are causing traffic congestion.

The major roads are:

- National Highway No.31A (Gangtok-Siliguri),
- North Sikkim Highway connecting Gangtok with the North District
- Jawaharlal Nehru Road, (the trade route link between China and India).
- Full establishment of Nathula pass is likely to strengthen the road network in

future. The same route will be developed as fright corridor for international trade and import export of goods.

The only other alternative connectivity to Gangtok is by helicopter service provided by Pawan Hans Helicopters Ltd. The service is quite unreliable and susceptible to bad weather.

4.2.2. Road Network

Gangtok is a linear city that has developed along the arterial roads, especially National Highway 31A. The length of the city is about 25 km. The NH-31A, North Sikkim Highway, Indira bypass and JN Road act as the major regional roads converging at or passing through the city. Apart from these, the other major city roads are Tibet Road, M.G. Marg, Kazi Road, Paljor Stadium Road, Indira by-pass and Namnang Road, that connects to the National Highway. In addition to these, there are several other roads in the city that provide internal accessibility.

Table 4.7: Road Profile Gangtok

Two Way	One Way	Junction
· Nam Nang · Tibet Road · Development Area Road · Arithang Road · Sichey Road · J.N. Road · Syari Road · By-Pass Road	· Sadar Thana Road · DPH Church Road · Portion of Tibet Road · Kazi Road (Feeder)	· Metro-MG Marg Junction · Hospital junction · Community Hall Junction · Lall Bazar junction · Deorali Junction · Tadong (Daragaon) Bazar · Sikkim Govt. College entrance-exit point · M P Golai · Zero point junction

Most of the road length in Gangtok, is of two lane undivided carriageway with foot path on one side of the road and drain on the other. The steep gradient of the different road stretches coupled with spiral road configuration act as a constraint for smooth flow of vehicular as well as pedestrian traffic. About 75% of the primary road network has a carriageway ranging from 6-8m. Another 25% of the road length has carriageway ranging between 8-10m. There is no road apart from MG Marg, which has divided carriageway in Gangtok. The bypass road (Indira By Pass) has a total length of 11.2 km. The National Highway 31A has a footpath running along its entire length from Ridge Park, Zero Point up to Ranipul. The width of the footpath is 1.2 m

inclusive of the railing and appears inadequate given the high pedestrian volume. The Right of Way (ROW) of NH 31A for 69% of its length in Gangtok NTA is 5-10 meters wide. The average Carriageway Width (CW) of other roads of Gangtok is 5.5 to 7.0m wide. The existing roads of Gangtok are essentially narrow to accommodate the high volume of traffic, and the road geometry inappropriate.

4.2.3. Congestion are recorded on following junctions

- Metro-MG Marg Junction
- Hospital junction
- Community Hall Junction
- Lall Bazar junction
- Deorali Junction
- Tadong (Daragaon) Bazar
- Sikkim Govt. College entrance-exit point
- M P Golai
- Zero point junction

The gradient of roads is also moderately high in certain lengths, to the tune of 1:10 gradient, especially along Kazi Road, Tibet Road, Namnang Road, Sichay Road and Paljor Stadium Road owing to the terrain.

4.2.4. Terminals

Gangtok has two bus terminals serving both interstate as well as intra state buses at P.S. Road and Police Head Quarters. These consist of 7 bus bays. Another 7 are expected to come up in the second phase of construction. These terminals are presently being used by the local taxi and private vehicle owners also.

4.2.5. Pedestrian Facilities and NMT Profile

In Gangtok, footpaths are constructed along the National Highway only and foot over bridges have been constructed at only a few junctions. The width of the footpath is 1.2 m inclusive of the railing and appears inadequate given the high pedestrian volume. With no pedestrian facilities on other roads, commuters are unsafe while walking along and across the roads.

In a recent study conducted by Wilbur Smith Associates in 2008, Gangtok was given a ranking of 1.1 on a scale of 5, meaning that pedestrian facilities are quite inadequate and there is scope for much improvement.

4.2.6. Ropeways

A one km long cable car with three stops connects lower Gangtok suburbs with Sikkim Legislative Assembly in central Gangtok and the upper suburbs. Due to their higher costs, these are not as popular with local commuters as they are with tourists owing to the aerial view of the whole city that they provide.

There are no designated terminal facilities for goods vehicles and goods are transported to the local sites in smaller vehicles.

90% of the traffic is intra-city and only 10% traffic is interstate traffic. Average trip length is 8 to 10 Km. this also depicts that regionally this area is developing very well. Purpose of trip is also mixed type.

Gangtok is acting as centre for many commercial activities. This has been supported by goods traffic desire pattern.

Private mode of transport is influenced by tourists almost 50% of the trips of private taxis generated by tourists for sightseeing and shopping.

4.2.7. System Inadequacy

An inventory of the major road network was undertaken for about 18 km length indicated that the road condition is fair and some roads need immediate resurfacing. The right of way (ROW) varied from 5m to 12m, while indicating that there is no scope for further widening of these roads. Barring M.G. Marg, which is 4-laned and divided; the average carriageway of other roads including the NH-31A and Indira Bye-pass is 5.5m on an average. Only 12% of the road network in Gangtok has pedestrian sidewalk i.e. mainly along the National Highway. Cross drainage and longitudinal drains provided across and along these roads are not maintained adequately and lack in regular/periodic maintenance. The land use pattern around the area is typically mixed, comprising of residential/semi-public/commercial buildings.

Speed profiles on the primary road network in Gangtok reveal that journey speeds

vary from 11 kmph to 27 kmph. The traffic volume data recorded at various locations bring to light that out of ten locations, six locations experience a gush of more than 10,000 PCU, during the day. The analysis of volume/capacity ratios (VCR) reveal that the maximum VCR is along the primary spine of the city as well as on the roads near the core commercial area of the city. Thus, on an average day the peak volume varies from nearly 350 to 590 PCUs.

The pedestrian traffic volume survey at 4 locations show high pedestrian volumes mainly on MG Road, Indira Bypass and Deorali Bazar Road. This high volume of pedestrian traffic is due to commercial activities in these areas. Footpaths are present on all the major roads but their width is not adequate to carry the present load of pedestrians. M.G. Marg, the main shopping street is closed to vehicular traffic and records the highest volume of pedestrians from 5-9 pm.

4.3. Public Transport System

Sikkim Nationalized Transport (SNT) provides public transport service to the people of Sikkim. The entire bus passenger transport service is the state is nationalized with no private bus operators. Currently, SNT has a fleet of 75 buses and 83 truck/tankers. SNT operates on routes from Gangtok to Siliguri, Mangan, Jortang and Rangli. It presently employs 900 people and has 35 bus routes throughout the state. There are 3 depots at Gangtok, Jorthang and Rangpu.

The operation of the public transport system provided by SNT is currently on a decline with reduction in its fleet size over the past years. The total number of SNT buses in 2008 was 75. During the last decade, the bus fleet has declined by 48.28% and the truck /tanker fleet has reduced by 45.75%.

SNT has about 10 buses catering purely to school trips, 5 catering to city service Gangtok by the name of Red Panda City Runner. The city buses run on 5 routes with one bus on each route, a frequency of 1 hour and 4 round trips between 7am and 6pm. The city buses run with an average fuel efficiency of 4.08 kmpl, an EPKM of around Rs. 18.45 at Rs. 1.20 as the average fare per km. Gangtok has been sanctioned 25 buses under the bus funding scheme of JNNURM, Ministry of Urban Development, which are yet to be operational. These are expected to bring about a major change in the public transport outlook of Gangtok. The existing routes of SNT city services are given in the following table.

Table 4.8 : Existing routes of SNT city services

Origin	Destination	Seating Capacity	EPKM (Rs.)	Route Length (Kms)	Fare (Rs.)	Fare/Km (Rs.)
Gangtok	Penlong	28	17.5	12	11	0.92
Gangtok	Setipool	33	16.1	11	16	1.45
Gangtok	Jalipool	33	16.8	15	15	1.00
Gangtok	Rumtek	28	16.3	NA	NA	NA
Gangtok	Marchak	28	14.4	NA	NA	NA

Source: DPR for procurement of buses, Gangtok.

Para transit mode of travel is an intermediary facility falling in between traditional public transport and the personalized automobiles. It is also referred to as Intermediary Public Transport (IPT). IPT has a potential to overplay its role and rather than being useful can become a nuisance as seen in the case of Gangtok.

Taxis are the most widely available public transport within Gangtok. Most of the residents stay within a few kms of the town center and many have their own vehicles such as two wheelers and cars. The share of personal vehicles and taxis combined is 98% of Gangtok's total vehicles. City buses have a share of less than 1%. Those travelling longer distances generally make use of share-jeeps which is a kind of public taxi.

Existing fare structure of Taxis is as given below:

- Rs. 9.85/- per km upto 50 kms.
- Rs. 7.88/- per km from 51 to 100 kms.
- Rs. 6.90/- per km from 101 kms. onwards

4.4. Urban Goods Movement

The share of goods traffic varies from 1.4% to 5.7% and the average is about 3.7%.There are no designated terminal facilities for goods vehicles from where goods are transported to the local sites in smaller vehicles.

In gangtok the freight transport services are provided both by Sikkim Nationalised Transport (SNT) and private operators. However, the operation of private trucks is monitored by SNT through collection of supervision charges from trucks entering Sikkim. To study the freight operations in Gangtok, the DDFPCL team has done a

reconnaissance survey to assess the ground reality besides having discussions at check post, terminal and head office with officers and staff including drivers.

The survey and discussions has revealed that SNT is providing point to point service as and when informed by the consignee. Further, in order to meet excess demand, SNT is hiring the services of private operators. The regular consigners of SNT include Armed force, FCI and Govt of Sikkim. The Govt of Sikkim has made it compulsory that the transportation of goods meant for government purpose are carried by SNT or under arrangement authorized by SNT. The armed forces have been continuously hiring the services of SNT on yearly renewable contract basis. Siliguri in West Bengal is an important place especially from operational point of view as it is an important loading point (i.e. NGP, Bangdupi and TCP). Most of the trucks and tankers movement takes place from Siliguri to various destinations in Sikkim.

All trucks and tankers enter Sikkkim through either Malli Check post or Rangpo Check post where SNT have their counters. Majority of freight movement is passing through Rangpo check post. At these counters, SNT is collecting supervision charges from private operators besides details like Origin, Destination, quantity of materials carried etc. Private trucks and tankers carrying essential commodities like rice, milk etc are exempted from supervision charges.

FREIGHT OPERATIONS IN SNT

The movement of goods across Gangtok comprises of Bricks, Cement indicating development activities in the city.

Table 4.9: Composition of Goods Traffic

Sr No	Name of Location		Truck	Lcv	Others	Total goods
1	Lal Market Intersection Volume Count	**Nos**	101	81	87	**269**
2	0' Point Intersection Volume Count	**Nos**	113	105	47	**265**
3	Amdo Golai (Indira Byepass) Intersection Volume Count	**Nos**	361	240	140	**741**
4	Ridge Road & NH 31 A Volume Count at Intersection	**Nos**	140	247	119	**506**
5	2rd Mile Ganesh Tok Intersection	**Nos**	243	276	188	**707**
6	Power Station Road Junction	**Nos**	324	238	127	**689**

Source: DDF Primary Surveys –

The other types of goods comprises of manufactured items and transport goods. The

challenges that are faced by SNT are not only internal but also external. The internal problems include operation of old fleet, reducing fleet size, and lacunae in system of coordination of freight movement while external problems include narrow roads with many bends, land slide prone areas, excessive fog in particular seasons and altitude effect causing breathing problems etc.

From the analysis of OD of freight movement in the city it was found out that Siliguri-Gangtok-Siliguri is a major freight corridor with about 25% of the trips falling in this category. Considering the likely pattern of freight movement as far as essential commodities are concerned, the major freight corridors would comprise of Siliguri to district headquarters since the distribution of commodities would take place from the district headquarters to remote areas. In future it is likely that Rangpo will develop in to a major warehousing center and goods movement to all major areas would take place from Rangpo.

Strategies to Reduce Turnaround Times

A turnaround time is defined as the average time elapsed between the truck's arrival at your facility and it is departure after completing the necessary work and loading processes. This has a significant impact on profit only when loading and paper work handling is carried out in same premises. Truck's waiting time for loading and unloading, 0at F.C.I the loading time allotted is 7 hrs and unloading time is 2 hrs. but the actual time taken for loading/unloading is more than what has been specified. It is evident that the delay is from consignee's side. SNT may consider making financial provisions to employ contract labour for loading/unloading of goods to reduce turnaround times.

To increase the utilization of trucks it is recommended that SNT should focus on setting up of a systematic information data base. The information system should have details like arrival of truck on return to origin after unloading, fitness/preparedness of truck to take up next trip etc. it will help SNT to use their resources optimally and monitor the movement of vehicles. Further, it is recommended that a vehicle tracking system may be installed on all vehicles.

4.1. Traffic Safety and Enforcement

At present the RTO and Gangtok Traffic police are regulating the traffic in Gangtok city. The enforcement of all traffic rules is as per the National Motor Vehicle act, 1988. There are no signalized junctions in the city and the traffic is managed manually. For pedestrian safety, guarded footpath exists along the national highway, but not on any internal roads. There are 3 footover bridges at Arithang Junction near

Lal Market, Hospital Junction and M.G. Bazar Road Junction. These are highly inadequate keeping in view the heavy vehicular flow in the internal roads.

4.2. Legal Framework and Standards

At present the RTO and Gangtok Traffic police are regulating the traffic in Gangtok city. The enforcement of all traffic rules is as per the National Motor Vehicle act, 1988.

4.3. Institutional and Financial Situation

Efficient Institutional set up has direct and immediate effect on the quality of life of the city. The improvement in governance has a visible impact in the city as successfully witnessed in some of the cities of India. The proactive leadership and a committed administration are the underlying reasons of these successes. This section outlines the present governance structure and institutional framework related to infrastructure development especially transport sector of Gangtok. Provision of facility and service is the basic function of Urban Development and Housing Department. With the implementation of the statues in accordance with the 74th amendment, it is imperative to have a local body and the functions of local body to be carried out by it.

The institutional framework for Gangtok is at two levels. The UD&HD has the administrative and legal jurisdiction along with the responsibility to develop the city infrastructure and provision of services to its citizens. At the other levels the other Government agencies of the PHED and PWD, Power, Transport have an independent charge of the operations relating to their agencies and there is adequate coordination between the Departments to address emerging issues. Generally it is the Municipality that looks into the functions of the local departments. In case of Gangtok, the Municipal Corporation Act was passed in 1975, though it was never fully implemented. The city administration was formed and placed under an Administrator. In 1985 the Act was repealed and the functions of urban local body were transferred to the state government. The Sikkim Municipal Bill 2006 is in the process of finalization, which is in accordance with 74th constitutional amendment.

According to the Notification of Government of Sikkim dated 03.03.2004 the functions and statutory rules for the UD&HD include:

- Public Service-Statutory Rules of the service regarding transportation issues, with which the Department is concerned, are the Byelaws of Passenger Aerial Ropeway in Sikkim.

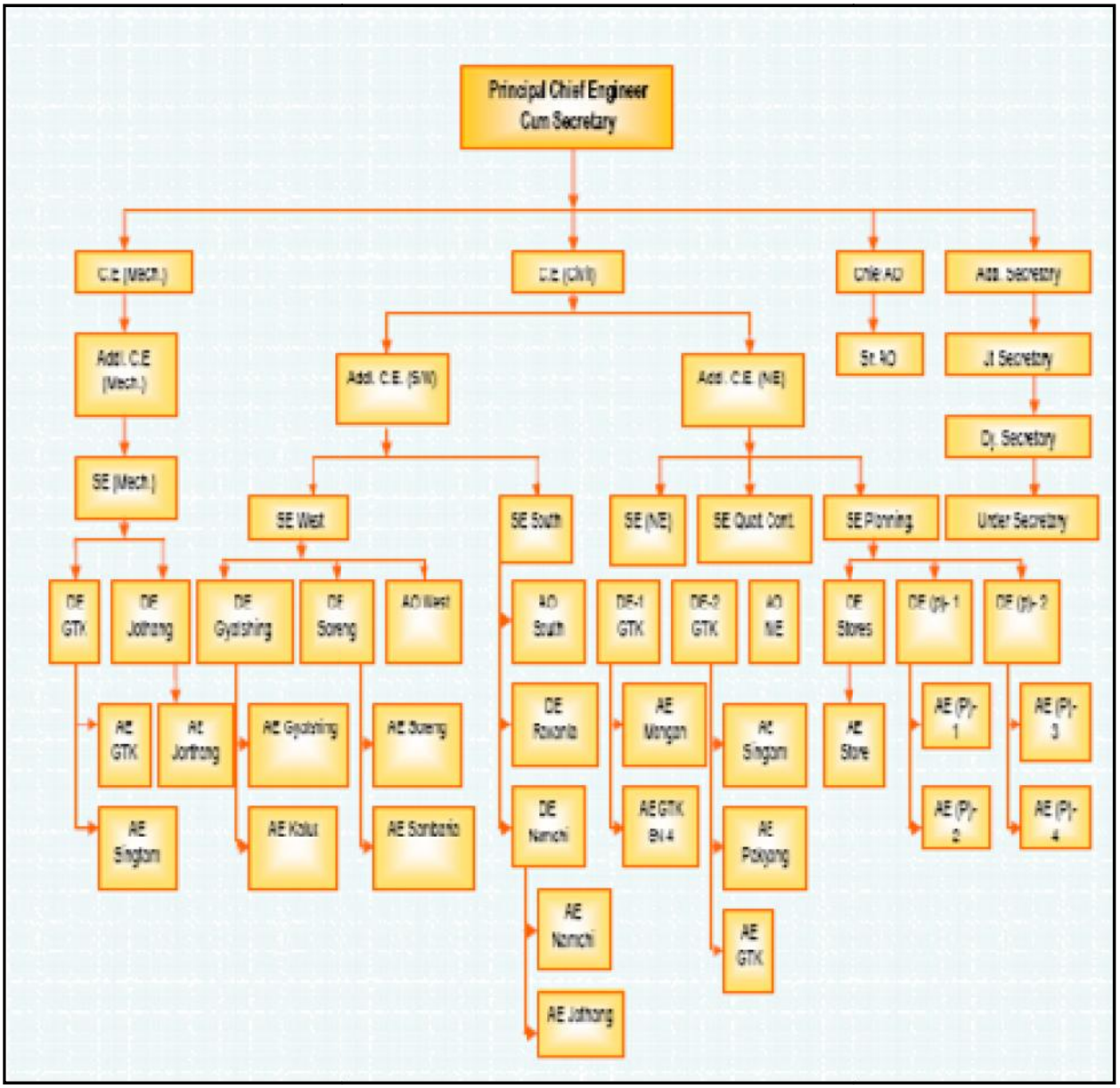
4.7.1. Public Works Department (PWD)

The Public Works Department is responsible for construction and management of roads and buildings. The broad functions can be listed as:

- To plan and execute highways in the state
- To execute works related to various state government projects, including buildings
- Managing and supervising the deposit work
- Control of roads
- Restriction on traffic
- Land use control for areas affecting public road

The administrative setup of PWD is given in Figure 4.1

Figure 4.1 : Administrative Setup of PWD department.



Prevailing Issues in transportation sector to be addressed through Institutional reform

- Several road stretches within the city is vulnerable to floods.
- Ribbon development along the primary road network – a major constraint towards capacity improvement of road networks. Capacity of roads is further limited by on-street parking and commercial establishments.
- Need for provision of parking facilities, development of truck/ bus terminals etc.

- Traffic safety and law enforcement.
- Road safety, road design, management and operations.

4.4. Environmental and Social Conditions

It needs to be ensured that, the state shall endeavor to protect and improve the environment and to safeguard the forests and wildlife and to protect and improve the natural environment including forests, lakes and rivers and wildlife and to have compassion for the living beings. In Resolution No. 3-1/86-FP dated the 7th December 1988, the Government of India, Ministry of environment and Forests, enunciated National Forest Policy to be followed in the management of state forests in the country. However, over the years, the environment, forests and land in the state of Sikkim have come under serious pressure due to the fact that more than 80% of the land resources of the state are under the management of the Department of Forests, Environment & Wildlife. Due to the increase in human population and cattle population and increase in development activities in the state, the pressure on the environment, forest and land is increasing at a very fast pace. Due to increase in human population, there is increase in demand for land for house construction, agriculture, road construction, projects and other developmental activities.

Transportation sector/Traffic of Gangtok is one the most important contributor to environment degradation of the town.

4.8.1. Vehicular Pollution

Petrol Driven Vehicles

Altogether 83.72% of the petrol driven vehicles were meeting the specified standards and 16.27% of the petrol driven vehicles were not meeting the stipulated standards.

Table 4.10: Petrol driven vehicles monitored for CO%

Sl. No.	Type of Vehicle	Total Vehicles Monitored	Co	
			Total Vehicles Complying the Standards	Total Vehicles Not Complying the Standards
1	Two Wheeler	54	48	06
2	Four Wheeler	161	132	29
Total		**215**	**180**	**35**

Source: State of Environment Pollution Report 2004

Diesel Driven Vehicles

A total number of 90 diesel driven vehicles were monitored which included Buses, Lorries, Mini Lorries, Commander jeeps etc., of different makes at peak hour in commercial and traffic area. It was observed that 78 vehicles (86.66%) were meeting the standards. However, 12 vehicles (13.33%) failed to meet the standards. Details of the above data are shown in the table below.

Table 4.11: Diesel driven vehicles monitored for Smoke density in HSU.

Type of Vehicle	Total Vehicle Monitored	Smoke Density (HSU) Total Vehicle Complying the Standards	Total Vehicle Not-complying the Standards
Four wheeler	90	78 (86.66%)	12 (13.33%)

Source: State of Environment Pollution Report 2004

4.8.2. Vehicular Exhaust Monitoring

Commercial, tourist and day to day activities has caused an exponential growth of vehicle population in Gangtok. Motor vehicle registration department shows that till 2003 there were 20807 vehicles registered with them. Out of this figure 4617 were two wheelers, 8846 Pvt. Govt. vehicles and 2214 Goods carrier.

All new Vehicles complying with the emission standards notified by Govt. of India, under motor vehicle Act, 1988. Gangtok has two automobile smoke testing centers, one for petrol vehicles at Deorali and the other for diesel vehicles at SNT complex, Gangtok.

The state pollution control Board has procured a instrument (gas check 2000) to monitor the emission of petrol under the Central Government Sponsored scheme, “Strengthening of State Pollution Control Board”.

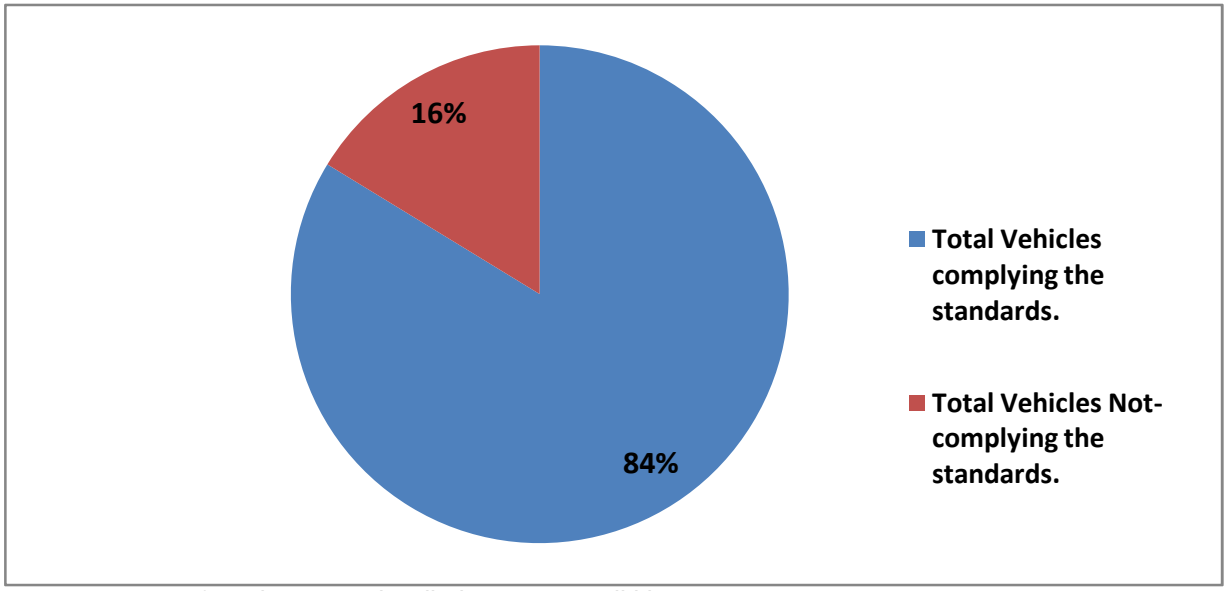
The state pollution control Board, Sikkim has been carrying out vehicular emission checks to access the percentage of vehicle complying with the standards. A sample check in year 2004 of result has been provided.

Table 4.12: Petrol Driven Vehicles Monitored for CO% in 2004

Sl. No.	Type of Vehicle	Total Vehicles Monitored	CO	
			Total Vehicles Complying the standards.	Total Vehicles Not-complying the standards.
1	Two Wheeler	54	48	06
2	Four Wheeler	161	132	29
Total		215	180	35

Source: State of Environmental Pollution Report; Sikkim. 2004

Figure 4.2: Petrol Driven Vehicles Monitored for CO% in 2004

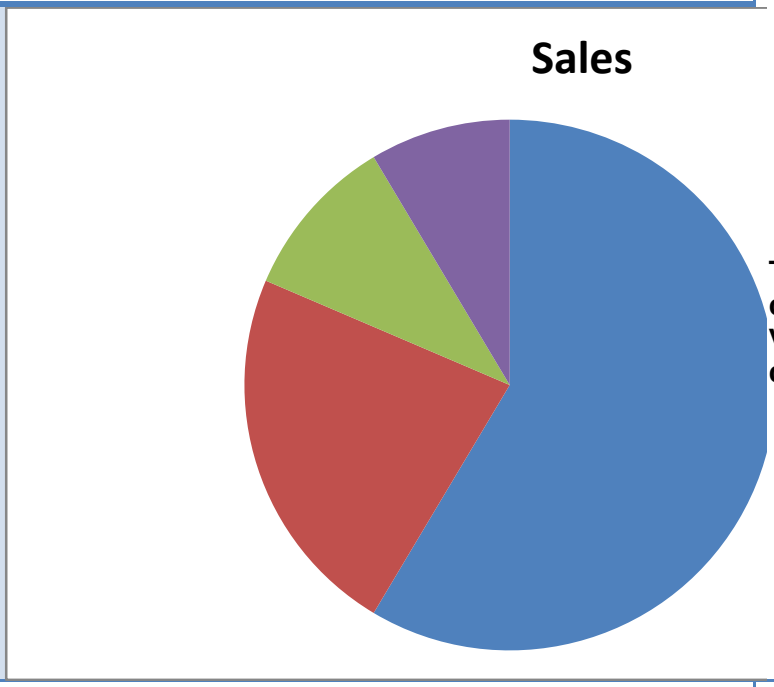


Source: State of Environmental Pollution Report; Sikkim. 2004

Altogether 83.72% of the petrol driven vehicles were meeting the specified standards and 16.27% of the petrol driven vehicles were not meeting the stipulated standards. Total 90 Diesel driven vehicles were monitored which included Buses, Lorries, Mini Lorries & Commander Jeeps etc. of different makes at peak hour in commercial and traffic area. It was observed that 78 vehicles (86.66%) were meeting the standards. However, 12 vehicles (13.33%) failed to meet the standards.

Table 4.13: Diesel Driven Vehicles Monitored for CO% in 2004

Sl. No.	Type of Vehicle	Total Vehicles Monitored	CO	
			Total Vehicles Complying the standards.	Total Vehicles Not-complying the standards.
2	Four Wheeler	90	78	12
Total		90	78	12



Source: State of Environmental Pollution Report; Sikkim. 2004

4.8.3. Noise Pollution Monitoring

Noise has rapidly become a source of environmental pollution with increase in industrialization, urbanization and the rapid expansion of the means of transportation. The ambient noise level termed as the total noise associated within a given environment and usually comprise of sounds from many sources both near and far.

Noise Monitoring Locations in Gangtok

The measurement of ambient noise level is being using sound level meter 2031 A (Cygnet). The measurements were taken for seven consecutive days in each sites

were in three slots i.e. morning 8:00 a.m. – 10:00a.m., afternoon 14:00 p.m. – 16:00 p.m. and night 18:00-20:00 p.m. the average measurements are as follows.

Table 4.14 : Average Ambient Noise level at Various Places in Gangtok.

Sl. No.	Place	Day Average leg. In dB (A)	Night Average leg in dB (A)
Silence Zone			
1.	Hospital Junction	62	63
2.	District Court	50	44
Residential Zone			
1.	Tadong	61	58
2.	Deorali Govt. Quarter	61	57
3.	Development Area	66	51
Commercial Zone			
1.	M.G. Marg	70	62
2.	Indira Bye-Pass	73	69

Source; SPCB, Government of Sikkim, 2004.

The study finds that the commercial place like Metro Point, Zero point and Hospital Point are the places where the level of pollution is high hence decongestion of traffic is required at these places.

4.5. Other Relevant Issues

- Most of the areas are characterized by dense building forms along the roads and in areas that are situated close to arterial roads. Due to inaccessibility, commercial activities are concentrated only along roads.
- Most of these areas have poor approach and internal roads are located on steep slopes, do not have proper footpaths.
- Road safety in terms of drainage and landslide issues needs to be addressed holistically for all the areas.
- Organized open space is required for most of these areas.
- Commercial units need to be earmarked for an organized growth pattern as there is no proper land use pattern in Gangtok.
- Parking of cars is concentrated on the roads thus adding to the congestion. Creation of localized parking lots for private cars and taxis is very important.
- Land uses are not properly defined hence transport network need to be suggested on felt need basis.

- Disintegration of landuse and transport network.
- Absence of mass transportation system for the Gangtok Planning Area.
- Unorganized institutional setup and legal reforms

CHAPTER 5

ANALYSIS OF EXISTING TRAFFIC/TRANSPORT

5 ANALYSIS OF EXISTING TRAFFIC/TRANSPORT SITUATION

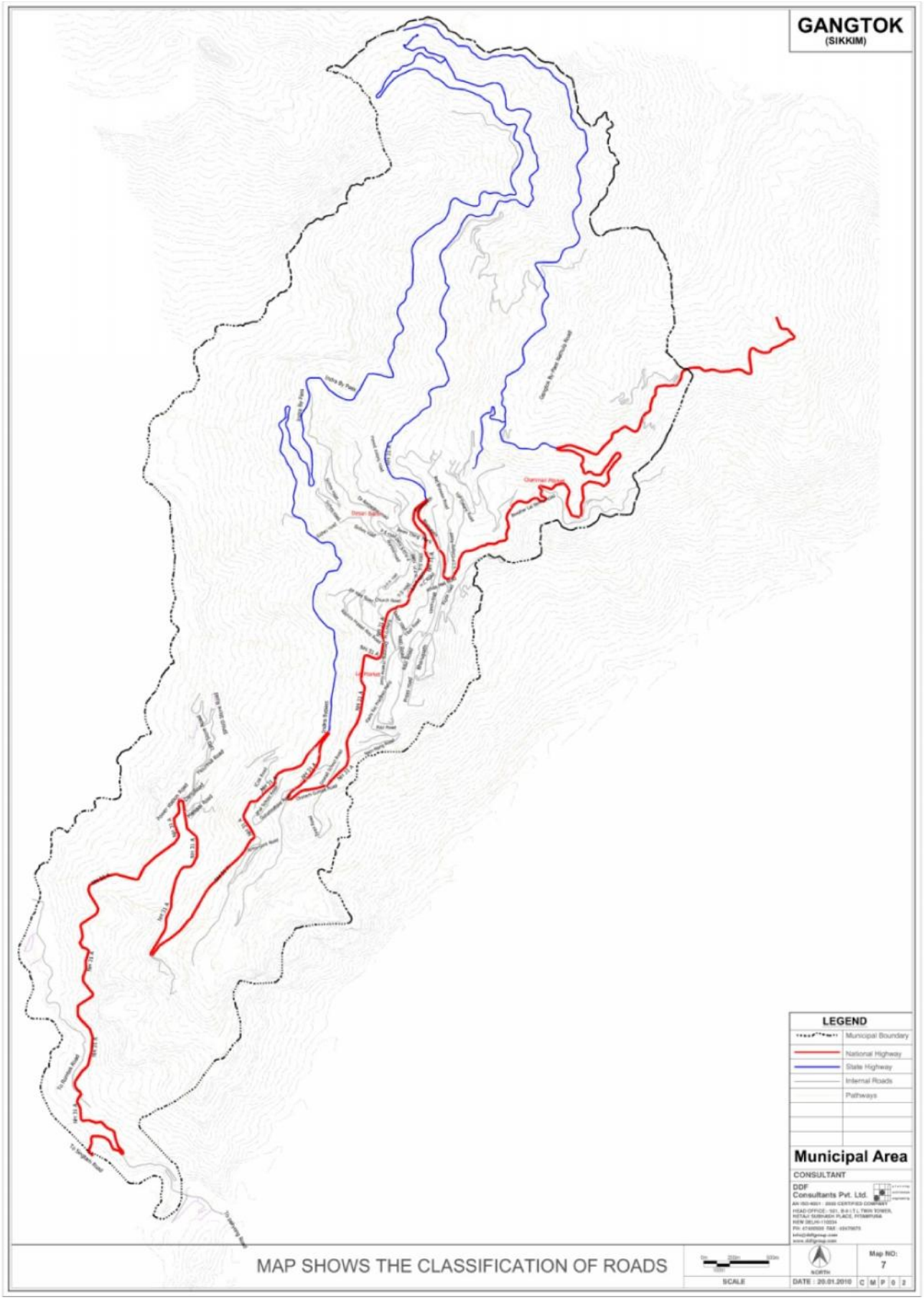
5.1. Background

The physical characteristics of the road network of Gangtok are quite typical of a hill town. It is mostly characterized by narrow roads with high steep gradients and a number of acute bends and curves. The road intersections too are characterized by poor road geometrics in terms of angles and gradients. These physical characteristics are responsible for low capacity and speeds on the networks.

At the city level the network is characterized by its convergence to central areas of the city. Almost all roads coming from any direction converge to the city center. This may be one of the main causes of congestion in central areas during peak period. Although, there is a lot of redundancy in the network in form of parallel sections of roads at various places, these mostly join back in or near the central areas and are very poor on geometrics. There is no real alternative, for traffic plying from one end of the city to the other, to actually bypass the central areas.

Another significant character of Gangtok road network is a clear lack of road hierarchy, which is essential for smooth functioning of road based transportation system. All the roads, whether major or minor allow direct access to abutting properties irrespective of the nature of traffic they carry. Further, this results in slowing down of traffic and disruptions due to parking and pedestrian related conflicts with the traffic. The figure given below shows the primary road network of Gangtok.

Map 5.1: Primary road network of Gangtok



5.1.1. Road Network Characteristics

Different surveys were conducted to identify road network characteristics. The primary surveys included road network inventory, speed and delay survey, capacity estimation was done for all the major roads. The total length of road network is 88.22 Km with average link length of 0.39 Km. For Gangtok, the surveys were carried out on 52.01 km of road network consisting of National Highway, Major Roads and other roads. Road network inventory survey was conducted on all the major roads of the city which gives a broad idea about the network characteristics like road length, width, condition and footpath conditions. (Map 5.2)

A) Classification of Roads

The major classification of roads is given as National Highway, State Highway, Major Roads and Other Roads. Out of the total road network National Highway constitutes to be about 20.6%, State Highway is about 24.6% and Major Roads and Other Roads together constitutes to about 54.6%. The classification is described in

Table 5.1: Distribution of Total Road Length in Gangtok Municipal Area by Classification of Roads

Classification of Roads		Road Length in kms	Percentage
National Highway (NH 31A)	NH	18.24	20.68
State Highway	SH	21.78	24.69
Major Roads	MR	32.1	36.39
Other Roads	OR	16.1	18.25
Total		**88.22**	**100**

The total road network surveyed is about 52.01 kms which is about 50% of the total road network. The classification of the roads surveyed is also detailed below in

Table 5-2: Distribution of surveyed Road Length by Classification of Roads

Classification of Roads		Road Length in kms	Percentage
National Highway (NH 31A)	NH	10.2	19.61
State Highway	SH	8.9	17.11
Major Roads	MR	19.8	38.07
Other Roads	OR	13.11	25.21
Total		52.01	**100**

B) Right of Way (ROW)

About 48% of the surveyed road length has ROW between 6.0 to 10.0 m, 28% has ROW between 12.0 to 14.0 m and 22% has ROW less than 12.0 m indicated in Table 5.3. This indicates the limitation of widening of roads for many of the roads. (Map 5.3)

Table 5.3: Distribution of Road Length by Right of Way

Right Of Way (mts)	Road Length (in km)	Percentage (%)
<6	0.87	1.67
6--8	12.01	23.09
8--10	13.11	25.21
10--12	11.48	22.07
12--14	14.54	27.96
Total	**52.01**	**100**

Source: DDF Primary Surveys – 2009-10

C) Carriageway Width

It has been observed that about 18% of roads are with CW less than 6 Mts. 40% of the roads are with carriage way between 6 to 8 Mts. 31% roads are with 8 to 10 Mts carriage way. Only 12% roads are with carriage way more than 10 Mts. (Map 5.4)

Table 5.4: Distribution of Road Network as per Carriageway Width

Carriageway (mts)	Road Length (in km)	Percentage (%)
<6	9.43	18.13
6--8	20.54	39.49
8--10	15.92	30.61
10--12	5.78	11.11
12--14	0.34	0.65
Total	**52.01**	**100**

Source: DDF Primary Surveys – 2009-10

D) Availability of pedestrian facility: Footpath

Only 20% (8.5 Km) of road has footpath on one side. Rest 80% of road network does not have this facility. Maximum length of footpath is available on NH-31A from P.S road to Gurudwara (2.1 Km) followed by road between C.M. House to P.S. Road (Table 5.5)

Table 5.5: Road stretches with footpath.

S.No.	Name of the Road	Road Length in KM	% of Road	Left Foot-path	Right Foot-Path
1	Chagola Road to Vajra Cinema Road	0.8	9	Yes	No
2	Grudwara to Idira Bye pass Intersection	0.7	7	Yes	No
3	National Highway to Vajra Cinema Road	1.1	15	Yes	No
4	Vajra Cinema Road	0.9	11	Yes	No
5	White Hall to C M House	0.4	5	Yes	No
6	CM House to PS Road	1.8	21	No	Yes
7	NH31A (PS Road to Gurudwara)	2.1	25	No	Yes
8	P.S. Road (Hospital- SNT)	0.7	7	No	Yes

Source: Primary Survey by DDF Consultants Pvt. Ltd., Nov 2009

Table 5.6: Detailed road Network Inventory Road Section Wise.

S.No	Name of the Road	Rd. Lt. (Km)	ROW (Mts)	Total C/W (Mts)	Median	Left Foot-path	Right Foot-Path	Light		Rd. Surf. Type	Rd. Surf. Qlty.
								Type	Location		
1	Arithang (OR)	0.8	6.0	4.5	No	No	No	No	No	Bitumen	Poor
2	Arithang to Indira Bye pass (MR)	0.4	8.0	4.5	No	No	No	Sodium	One Side	Bitumen	Fair
3	Bhanupath (MR)	1.5	9.0	7.0	No	No	No	Sodium	One Side	Bitumen	Fair
4	Bhojogari to Tashi (MR)	1.9	12.0	9.0	No	No	No	No	No	Bitumen	Fair
5	Chagola Road to Vajra Cinema Road (MR)	0.8	14.0	12.0	No	Yes	No	Sodium	One Side	Bitumen	Good
6	CM House to PS Road (NH-31A)	1.8	12.5	10.5	No	No	Yes	Sodium	One Side	Bitumen	Good
7	White Hall (OR)	0.1	9.0	7.0	No	No	No	Sodium	One Side	Bitumen	Fair
8	Forest Check Post to White hall road (J. Nehru Road) (NH-31A)	1.2	7.5	6.0	No	No	No	Sodium	One Side	Bitumen	Poor

S.No	Name of the Road	Rd.	ROW	Total	Median	Left	Right	Light		Rd.	Rd.
9	Grudwara to Idira Bye pass Intersection (NH-31A)	0.7	9.0	7.5	No	Yes	No	Sodium	One Side	Bitumen	Good
10	IInd Miles to Forest Checkpost (NH-31A)	2.0	9.0	6.0	No	No	No	No	No	Bitumen	Fair
11	Iind Miles to IIIrd mile checkpost (NH)	1.3	7.5	5.0	No	No	No	No	No	Bitumen	Poor
12	Indira Byepass to Ranka 0 (MR)	2.8	12.5	6.0	No	No	No	Sodium	One Side	Bitumen	Fair
13	Kazi Road (OR)	1.1	6.0	4.5	No	No	No	Sodium	One Side	Bitumen	Fair
14	L. Bhurtuk to Luing (MR)	6.2	9.0	6.0	No	No	No	Sodium	One Side	Bitumen	Fair
15	Lower Arithang (OR)	1.3	5.5	4.5	No	No	No	No t	No t	Bitumen	Poor
16	Luing to Middle Bhojoghari (MR)	5.4	9.0	6.0	No	No	No	No	No	Bitumen	Poor
17	NH to Vajra Cinema Road (NH-31A)	1.1	9.0	7.0	No	Yes	No	Sodium	One Side	Bitumen	Good
18	PS Road to gurudwara (NH-31A)	2.1	12.0	9.0	No	No	Yes	Sodium	One Side	Bitumen	Good

S.No	Name of the Road	Rd.	ROW	Total	Median	Left	Right	Light		Rd.	Rd.
19	P.S. Road (Hospital-SNT) (MR)	0.7	11.0	9.0	No	No	Yes	Sodium	One Side	Bitumen	Good
20	Ranka 0 to Lower Bhurtuk (MR)	3.6	9.0	6.0	No	No	No	Sodium	One Side	Bitumen	Fair
21	Tashi to Ganesh Tok (MR)	4.9	10.0	8.0	No	No	No	No	No	Bitumen	Good
22	Tibet Road (OR)	0.8	7.0	6.5	No	No	No	Sodium	One Side	Bitumen	Fair
23	Vajra Cinema Road (MR)	0.9	11.0	9.0	No	Yes	No	Sodium	One Side	Bitumen	Good
24	White Hall to C M House (NH-31A)	0.4	12.5	10.5	No	Yes	No	Sodium	One Side	Bitumen	Good

Source: Primary Survey by DDF Consultants Pvt. Ltd. Nov. 2009

5.1.2. Speed and Delay Characteristics

The study of the speed and delay characteristics of the study area reveal fairly low journey speeds on an average of about 20 km per hour, which could fall as below as 8 km per hour during peak hour in certain stretches.

It is seen that along the Study Area, about 8.4% of the road length has journey speed less than 10 kmph, 42% of the road length has journey speed between 10-20 kmph, 48% of the road length has journey speed between 20-30 kmph, about 1.3% lies between 30-40 kmph in the peak period. During the off-peak period, 32% of the road length has journey speed between 10-20 kmph, 43% of the road length has journey speed between 20-30 kmph, while about 26% lies between 30-40 kmph

Apart from the central areas low journey speeds were observed on stretches in peripheral areas too, owing to poor road conditions and geometrics. The table given below shows the speed and delay characteristics on surveyed road network.

Table 5.7: Speed and Delay Characteristics, Gangtok.

	PEAK HOUR JOURNEY DETAILS FOR PVT MODE					OFF PEAK HOUR JOURNEY DETAILS FOR PVT MODE			
Name of the Road	Journey Distance	Journey Speed	Journey Time	Delay Time	Running Speed	Journey Time	Delay Time	Journey Speed	Running Speed
	Kms	(Kms/Hr)	(Sec)	(Sec)	(Km/hr)	(Sec)	(Sec)	(Km/Hr)	(Km/hr)
E	F	G	I		J	M	N	O	P
NH-31 A	0.4	18.9	76	17	25	44		32.7	50
NH-31 A	0.6	19.8	109	12	25	80		27.0	40
NH-31 A	3.1	29.7	376	34	30	333		33.5	50
NH-31 A	1.3	25.4	184	24	25	137		34.2	40
NH-31 A	1.0	16.4	220	15	20	205	7	17.6	35
NH-31 A	0.6	13.7	158	17	25	113		19.1	40
NH-31 A	0.7	14.2	178	21	25	131	19	19.2	40

NH-31 A	0.6	16.6	130	18	20	96		22.5	35
NH-31 A	0.3	8.9	122	36	15	49		22.0	30
NH-31 A	0.3	14.8	73	8	20	63		17.1	35
Nam-nang Road	0.8	16.4	176	24	20	167		17.2	25
NH-31 A	1.0	8.4	431	121	10	143		25.2	35
NH-31 A	0.3	16.6	65	12	10	53		20.4	40
Sadar Thana Road	0.2	11.6	62	8	10	56		12.9	25
NH-31 A	0.2	12.0	60	15	15	49	4	14.7	30
NH-31 A	0.4	24.0	60	5	25	46		31.3	40
NH-31 A	0.4	21.8	66	0	30	52		27.7	60
NH-31 A	0.7	40.0	63	8	25	28		90.0	40
NH-31 A	0.1	18.0	20	2	20	14		25.7	40
NH-31 A	0.8	16.5	175	5	25	128		22.5	40
NH-31 A	0.5	21.2	85	3	15	74		24.3	20
NH-31 A	1.9	17.5	390	5	20	282	6	24.3	30
NH-31 A	1.3	25.6	183	8	30	152		30.8	40
Vajra Cinema (Balwakhani)	0.4	16.6	87	13	15	36		40.0	30
State Highway	0.3	14.2	76	19	15	46		23.5	30
State Highway	0.7	19.8	127	5	20	79		31.9	35

State Highway	1.1	21.0	189	7	30	118		33.6	40
State Highway	2.5	22.3	403	10	30	365		24.7	40
Indira Bye-pass	2.5	26.5	340	7	40	296		30.4	55
Bhanupath	0.2	20.0	36	5	20	23		31.3	35
Bhanupath	0.6	22.0	98	3	20	69		31.3	35
Kazi Road	1.1	20.4	194	5	15	155	1	25.5	30
P.S. Road	0.3	12.6	86	13	15	57		18.9	30
P.S. Road	0.3	13.7	79	9	15	47		23.0	30
Indira Bye-pass	1.0	19.6	184	5	25	145		24.8	45
Indira Bye-pass	0.8	20.4	141	2	25	103		28.0	45
Indira Bye-pass	0.7	21.4	118	11	30	108		23.3	50
Indira Bye-pass	1.9	22.0	311	3	45	277	13	24.7	75
Indira Bye-pass	3.3	27.6	431	15	35	399		29.8	45
Tibet Road	0.6	14.5	149	16	15	114		18.9	30

Source: Primary Survey DDF Consultants Pvt. Ltd. Nov 2009

Based on the analysis of the physical network and speed and delay characteristics of the network in Gangtok the average capacities of various road configurations were derived and have been presented in the table given below. (Maps- 5.5, 5.6, 5.7, 5.8)

Table 5.8: Lane Details

Sno	Lane Configuration	Divided/Undivided	Traffic Management	Capacity(PCU/hr/lane)
1	1/1.5 Lane	Undivided	One Way	900
2	2 Lane	Undivided	Two Way	750
3	1.5 Lane	Undivided	Two Way	450
4	1 Lane	Undivided	Two Way	300

5.1.3. Traffic Volume Characteristics

It is seen that about 10,000 vehicles enter or leave Gangtok Municipal Area on a typical working day. It is observed that the traffic at different locations varies from 670 PCU's (563 Vehicles) at Assam Lingsay Road to 4485 PCU's (3747 Vehicle) at Ranipool throughout a normal fair weather working day. The table given below shows the traffic volume counts both in terms of numbers of vehicles and passenger car units (PCUs) have been computed for the total daily (16 hour) traffic at various outer cordon locations

Table 5.9: Traffic Volume at Cordon Points

Sr. No.	Location name	Grand Total (Nos.)	Grand Total (PCU's)
1	Ranipool	3747	4485
2	Assam Lingsay	563	670
3	Setipool	905	1084
4	Tashi View Point	1457	1756
5	Rumtek	1200	1257
6	IIIrd Mile	712	1025
7	Rumtek- Sang	660	686

Source: DDF Primary Surveys – 2009-10

The morning peak hour volume varies from 68.5 PCUs (60 vehicles) at Assam Lingsay Road to 520 PCUs (462 vehicles) at Ranipool. Evening peak hour volume varies from 65 PCUs (71 vehicles) at Rumtek Sang Road to 368.5 PCU's (324 vehicles) at Ranipool. Peak hour factor is observed to be 6.7% to 14.3% at various locations. At most places peak hour factor is 9% to 11%.

The daily traffic composition at outer cordon locations exhibits predominance of fast moving passenger traffic varying from 77% to 94%. The traffic at cordons location of the study area consists of about 77% of light fast moving passenger vehicles. The share of

slow moving vehicles varies from 6% to 23% with the average of about 13%. The share of bus traffic is as low as 1% at Rumtek Road, IIIrd Mile and Rumtek Sang Road and as high as 3% at Tashi View Point Road with an average of about 1%. The fast passenger vehicles predominantly consist of two wheelers, cars and taxis while the movement of slow vehicles is almost negligible. Share of cars in total traffic is maximum at Rumtek Road (41%), Ranipool Road (34%) and Setipool Road (32%). The share of taxi's in total traffic is maximum at IIIrd Mile Road (58%), Rumtek Sang Road (52%) and Assam Lingsay Road (44%). The share of bus traffic in peak hour is as high as 3.3% at Setipool road. Average peak hour composition for bus is about 1.63%. Goods traffic varies from 23% at IIIrd Mile Point to 4% at Rumtek at peak periods. Average peak hour share of goods traffic is about 11.31%. The share of fast moving vehicular traffic varies from 94% at Rumtek Road to 74% at IIIrd Mile with an average of about 87%. Peak hour varies from 9000 Hrs to 1100 Hrs (Morning) and 1600 Hrs to 1800 Hrs (Evening).

Bus occupancy varies from 13.5 to 28 and averages out at 20.7. Average occupancy for cars, two wheelers and Taxi, is found to be 2.5, 1.4, and 5.2 respectively. The mini buses have an average occupancy of 11.2.

Table 5.10 Average Occupancy of Fast Passenger Vehicles at Outer Cordon Locations

Sr. No.	Name of Locations	Car/ jeep	2 WH	TAXI	Bus	Mini Bus
1	**Ranipool**	2.3	1.3	7.0	16.7	0.0
2	**Setipool**	2.3	1.5	6.2	24.6	0.0
3	**Tashi View Point**	3.6	1.5	5.8	15.3	0.0
4	**Rumtek**	2.3	1.3	4.5	26.4	12.4
5	**IIIrd Mile**	2.3	1.7	3.0	28.0	13.5
6	**Rumtek- Sang Road**	2.5	1.4	4.5	13.5	7.8

Source- DDF Primary Surveys- 2009-2010

Table 5.11 shows daily passenger trips at cordon locations. It is observed that the

daily passenger trips at different locations vary from 260 trips at IIIrd road to 15369 trips at Ranipool Road throughout the normal fair weather working day. More than 25,500 passengers trips cross study area daily (bothways) on a typical working day. 60% of total trips are by taxis. Cars account for 21% of the total trips. This reflects the need of good public transport system for the study area, upto atleast the outer cordons points at Ranipool, Setipool and Rumtek which will inter-alia include other intermediate towns enroute.

Table 5.11: Vehicle trips at Outer cordon points

Sr. No	Name of Location	CAR/ JEEP	2 WH	TAXI	BUS	MINI BUS	TOTAL
1	Ranipool	2935	476	10689	1269	0	15369
2	Setipool	345	128	1519	320	0	2311
3	Tashi View Point	95	23	252	35	0	405
4	Rumtek	660	164	1611	370	12	2817
5	IIIrd Mile	72	25	119	43	1	260
6	Rumtek- Sang Road	965	309	2691	311	78	4354

Source: DDF Primary Surveys – 2009-10

It is observed that the peak hour passenger trip varies from 271 trips at IIIrd Mile road to 2020 trips at Ranipool throughout the fair weather normal working day. (Table 5.12)

Table 5.12 Peak Hour Passenger Trips at Outer Cordon Locations

Sr. No.	Name of Location	Car/ jeep	2 wh	Taxi	Bus	Mini bus	Total
1	Ranipool	338	56	1526	100	0	2020
3	Setipool	98	26	254	98	0	476
4	Tashi View Point	191	53	412	61	0	716
5	Rumtek	152	26	225	26	12	442
6	IIIrd Mile	25	7	183	56	0	271
7	Rumtek- Sang Road	45	34	180	14	0	272

Source: DDF Primary Surveys – 2009-10

The traffic volume counts both in terms of numbers of vehicles and passenger car units (PCUs) have been computed for the total daily (16 hour) traffic at various intersection locations in Gangtok Municpal Area is presented in **Table 5.13.** It is observed that the traffic at different locations varies from13227 PCU's (12366 Vehicles) at 2nd Mile Ganesh Tok Intersection to 19769 PCU's (19759 Vehicles) at Lal Market Intersection throughout a normal fair weather working day. Other locations which exhibit high traffic volumes (more than 15,000 PCU's) are Amdo Golai (Indira Byepass) Intersection, 0' Point Intersection and Lal Market Intersection.

Table 5.13 Daily Traffic Volume (16 Hours) At Intersections

Sr. No.	Location name	Grand Total (Nos.)	Grand Total (PCU's)
1	Lal Market Intersection Volume Count	19759	19769
2	'0' Point Intersection Volume Count	16616	16518.5
3	Amdo Golai (Indira Byepass) Intersection Volume Count	15418	16340
4	Ridge Road & NH 31 A Volume Count at Intersection	13437	13641.5
5	2rd Mile Ganesh Tok Intersection	12366	13227
6	Power Station Road Junction	13777	14639.5

Source: DDF Primary Surveys – 2009-10

The morning peak hour volume varies from 1177.5 PCUs (1145 vehicles) at Ridge Road & NH 31 A Intersection to 2120 PCU's (2135 vehicles) at Lal Market Intersection. Peak hour factor is observed to be 8.6% to 10.7% at various locations. The evening peak hour volume varies from 1110 PCUs (1095 vehicles) at Ridge Road & NH 31 A Intersection to 1883 PCU's (1913 vehicles) at Lal Market Intersection. Peak hour factor is observed to be 8.14% to 9.53% at various locations.

The daily traffic composition at intersection locations exhibits predominance of fast moving passenger traffic varying from 94.3% to 98.6%. The traffic at intersection locations of the study area consists of about 95% of light fast moving passenger vehicles. The share of slow moving vehicles is absolutely nil as such type of terrains reduces the usage of cycles and cycle rickshaws due to extra human effort required in its operation. The share of bus traffic is as low as 0.3% at Ridge Road & NH 31A

Intersection and as high as 1.2% at Power station Road intersection with an average of about 0.8%. The fast passenger vehicles predominantly consist of cars and taxis. The share of cars in total traffic is maximum at Ridge Road & NH 31A Intersection (35.1%). The share of goods traffic varies from 1.4% to 5.7% and the average is about 3.7%.

The share of bus traffic in peak hour is as high as 1.56% at Power station Road intersection. Average peak hour composition for bus is about 1.04%. Goods traffic varies from 0.65% at Lal Market Intersection to 8.49% at 2nd Mile Ganesh Tok Intersection at peak periods. Average peak hour share of goods traffic is about 3.18%. The share of fast moving passenger traffic varies from 90.42% at 2nd Mile Ganesh Tok Intersection to 98.58% at Lal Market Intersection with an average of about 95.76%. Peak hour varies from 0900 Hrs to 1100 Hrs (Morning) and 1615 Hrs to 1815 Hrs (Evening).

5.1.4. Origin Destination Characteristics

The major generation and attraction zones are given as follows:

Table 5.14 : Major Generation and Attraction Zones : Gangtok

	Major Originating Zone	% Share in total trips	Major Destination Zone	% Share in total trips
1	Lower MG Marg	17.7	Chandmari	9.91
2	Lower Sichey	8.7	Deorali	8.8
3	Ranipool	8.2	Lower MG Marg	12.9

Source: DDF Primary Surveys – 2009-10

Given above are the major originating attracting zones accounting for more than 55% of vehicular trips. Access to and dispersal from these zones will be of prime importance in the scenario building process.

Mode wise average occupancy have been worked out which will be further utilized to ascertain person trips from vehicular trips.

Table 5.15 : Mode wise Average Occupancy

S.No	O-D Survey Location	Car	Taxi	2W	Bus
1	III Mile	2.26	3.05	1.71	28
2	Ranipool	2.3	7	1.3	16.7
3	Rumtek	2.3	4.5	1.25	26.4
4	Sang Rumtek	2.55	4.49	1.39	13.5
5	Setipool	2.33	6.2	1.52	24.6
6	Tashi Viewpoint	3.6	5.84	1.5	15.25

Source: DDF Primary Surveys – 2009-10

5.1.5. Distribution of Trips by mode of travels

It has been found that walk trips is at any time higher than the motorized trips i.e. 42.57%. The next bigger share of mode trips is occupied by the taxis (36.2%) operation in the absence of an organized public and intermediate public transport system. The private vehicular trips take up the share of 20%. This is shared by the car (17.51%) and two wheeler (2.36%) respectively. Bus mode trips are scanty (0.77%) shared by city buses (0.71%) and school buses (0.06%). Trips by trucks are least (10.47%) especially for goods both civil and defense purpose. Table 5.16

Table 5.16: Modal Split 2009 (Including walk Trips)

S.No.	Modes	Trips/days	Percentage
1	Car	15827	17.51
2	Taxi	32827	36.32
3	Two-Whlr	2132	2.36
4	Bus	639	0.71
5	School Bus	53	0.06
7	Walk	38475	42.57
8	Truck	426	0.47
	Total	90379	

Source: - Primary Survey, DDF Consultants Pvt. Ltd.

5.1.6. Modal Split 2009- Motorized Trips:

Among motorized trips taxis have the biggest share i.e. 63.25% followed by cars 30.49%, two wheelers 4.11%, Buses 1.32% and Trucks 0.82%. It indicates high dependency on Taxis as there is highly insufficient public transport system.

Table 5.17: Modal Split 2009 (Excluding Walk Trips – Motorized Trips)

S.No.	Modes	Trips/days	Percentage
1	Car	15827	30.49
2	Taxi	32720	63.04
3	Two-Whlr	2132	4.11
4	Bus	639	1.23
5	School Bus	53	0.10
6	Train	107	0.21
7	Truck	426	0.82
	Total	51904	

Source: - Primary Survey, DDF Consultants Pvt. Ltd.

PCTR refers to the number of inter zonal trips made by an individual per day. Accordingly, PCTR has been calculated for the city Municipal limit and the same is presented in Table 12.10 below.

Table 5.18: Per - Capita Trip Rates

S. N	Trip Purpose	Trips	PCTR
1	Total no. of trips inclusive of walk trips	90379	0.96
2	Total no. of trips exclusive of walk trips	51904	0.55

Source: - Primary Survey, DDF Consultants Pvt. Ltd.

5.1.7. Pedestrian Flow Characteristics

Peak hour pedestrian volume is calculated to establish the demand to be catered. The peak hour demand at the all survey locations and the identified peak hour is given below

Table 5.19 Directional Distribution of daily traffic (16 hrs) at Intersection Locations

S. No.	Location	Peak Hour	Peak Hour Demand
1	Sikkim Government College	1700 to 1800 hrs	2610
2	P.S.Road	0800 to 0900 hrs	1043
3	Jeevan Theeg Marg	0800 to 0900 hrs	1959
4	Bhanupath	1700 to 1800 hrs	1837

Source: DDF Primary Surveys – 2009-10

To decide upon the character of the facility to be provided, a comparative of pedestrian and motorized traffic volume ratios is considered. Table below shows the max PV^2 values at 04 critical junctions in study area. It is observed that the all the location has observed PV^2 more than 2 X 10^8.

Table 5.20 Directional Distribution of daily traffic (16 hrs) at Intersection Locations

Sr. No.	Location	PV^2
1	Sikkim Government College	2.26E+12
2	P.S.Road	7.12E+11
3	Jeevan Theeg Marg	2.26E+12
4	Bhanupath	2.26E+12

Source: DDF Primary Surveys – 2009-10

The above chart explains that at most of the places, the Pedestrian vs Motorised Traffic Volume is more than 2x10^8 which according to the IRC standards, demands dedicated pedestrian facilities to be provided as subways, foot over bridges etc. Further, the detail design of the facility to be provided will depend upon the peak hour demands and required discharge rate.

5.1.8. Parking Characteristics

Parking Accumulation is a significant parameter for appreciating parking characteristics at the Parking site. Parking Accumulation shows the number of vehicles parked at any given point of time. Peak hour parking accumulation at various locations is given in table below.

Table- 5.21 Peak hour parking accumulation at various locations

S. No.	Location	Peak Accumulation				
		Duration	Car	2 Wheel	Mini Bus	ECS
1	Namnang	9-10 a.m.	62			62.0
2	Siliguri G. Floor	9-10 a.m.	138			138.0
3	Siliguri F. Floor	9-10 a.m.	125			125.0
4	Rankastand	10-11 a.m.	46	5	1	50.0
5	Below Govt. College	10-11 a.m.	56	9		61
6	Op Sardar Thana G. Floor	9-10 a.m.	121			121.0
7	Op Sardar Thana F. Floor	9-10 a.m.	16	9		21

Source:- Primary Survey, DDF Consultants Pvt. Ltd.

Table below gives the parking duration of various modes at parking survey locations selected across the study area. At most locations short term parking (up to 4 hrs) is significant due to shopping areas. Long term parking is observed mainly at parking lots near offices, banks and hotels. This is mainly due to fact that employees park their vehicles in the morning and go to their work place and pick them up in the evening at the time of return.

Table- 5.22 Parking Duration & Various Modes.

Location		Duration (Hours)						Total
		Short Term		Medium Term		Long Term		
	Mode	0-2	2-4	4-6	6-8	8-10	10-12	
Namnang	Car	82	21	11	2	1	0	117
	%	70%	18%	9%	2%	1%	0%	100%
	2 Wheeler	0	1	0	0	0	0	1
	%	0%	100%	0%	0%	0%	0%	100%
Siliguri Gr. Floor	Car	213	9	6	0	0	0	228
	%	93%	4%	3%	0%	0%	0%	100%
	2 Wheeler	0	0	0	0	0	0	0
	%	-	-	-	-	-	-	-
Siliguri F. Floor	Car	160	13	1	0	0	0	174
	%	92%	7%	1%	0%	0%	0%	100%
	2 Wheeler	0	0	0	0	0	0	0
	%	-	-	-	-	-	-	-
Ranka Stand	Car	77	42	26	0	0	0	145
	%	53%	29%	18%	0%	0%	0%	100%
	2 Wheeler	1	4	27	0	0	0	32
	%	3%	13%	84%	0%	0%	0%	100%
Below Govt. College	Car	94	25	26	0	0	0	145
	%	65%	17%	18%	0%	0%	0%	100%
	2 Wheeler	13	9	9	0	0	0	31
	%	42%	29%	29%	0%	0%	0%	100%
Opp. Sardar Thana – G. Floor	Car	144	3	0	0	0	0	147
	%	98%	2%	0%	0%	0%	0%	100%
	2 Wheeler	0	0	0	0	0	0	0
	%	-	-	-	-	-	-	-
Opp. Sardar Thana – F. Floor	Car	22	16	5	6	2	10	61
	%	36%	26%	8%	10%	3%	16%	100%
	2 Wheeler	13	8	0	7	0	6	34
	%	38%	24%	0%	21%	0%	18%	100%

Source:- Primary Survey, DDF Consultants Pvt. Ltd.

Parking demand at a location is the number of vehicles parked over a period at time while supply is the accommodation capacity of parking lot.

Table- 5.23 Parking D emand & Supply

Location	Total Accumula -tion Vehicles	Total Accumula -tion-ECS	Peak Hour	Peak Accumula -tion (in ECS)	Supply (area in sq mts)	Supply (ECS)	Inde x	Turn over
Namnan g	118	118	09_10	62	2950	128	0.48	1.90
Siliguri G. Floor	228	228	09_10	138	6840	297	0.46	1.65
Siliguri F. Floor	174	174	09_10	125	6840	297	0.42	1.39
Ranka stand	187	214	09_10	46	15980	695	0.07	4.65
Below Govt. College	176	161	09_10	56	4025	175	0.32	2.88
Op Sardar Thana G. Floor	147	147	09_10	121	4410	192	0.63	1.21
Op Sardar Thana F. Floor	95	78	09_10	16	4410	192	0.08	4.88

Source:- Primary Survey, DDF Consultants Pvt. Ltd.

Parking Index is the ratio of peak hour parking accumulation to parking supply of spaces. The Parking Index at various locations is given in table below.

Table- 5.24 Parking Accumulation and Index

Location	Peak Accumulation (in ECS)	Supply (ECS)	Index
Namnang	62	128	**0.48**
Siliguri G. Floor	138	297	**0.46**
Siliguri F. Floor	125	297	**0.42**
Ranka stand	46	695	**0.07**
Below Govt. College	56	175	**0.32**
Op Sardar Thana G. Floor	121	192	**0.63**
Op Sardar Thana F. Floor	16	192	0.08

Source:- Primary Survey, DDF Consultants Pvt. Ltd.

Parking Turnover is the number of times a parking space is used during a day. At locations where parking is long term, parking turnover is less while at locations where parking turnover is high, indicates short term parking duration. The Survey shows that highest turnover is at locations where parking turnover is high, indicates short term parking duration.

Table- 5.25 Parking Accumulation and Index (* For details, refer to table 10.4)

Location	Peak Accumulation (in ECS)	Index	Turnover
Namnang	62	0.48	1.90
Siliguri G. Floor	138	0.46	1.65
Siliguri F. Floor	125	0.42	1.39
Ranka stand	46	0.07	4.65
Below Govt. College	56	0.32	2.88
Op Sardar Thana G. Floor	121	0.63	1.21
Op Sardar Thana F. Floor	16	0.08	4.88

Source:- Primary Survey, DDF Consultants Pvt. Ltd.

5.2. Development of Base Year Transport Demand Model

5.2.1. Introduction

The Transport Planning Process is a sub system responding to the social and economic forces that exist in an urban area. In Urban Transport Planning, the input magnitudes and the behaviour of the system is estimated normally through the use of a four phase process of travel demand forecasting. The major components of travel behaviour are:

- The decision to travel for a given purpose - Trip Generation
- The choice of destination – Trip Distribution
- The choice of travel mode – Modal Split
- The choice of Route – Trip Assignment

In this process, the outputs of each step become inputs to the following step, which also takes relevant inputs from the land use and socio economic projections. One of the principle components in the transport planning process is modelling the relationship between travel demand and land use and socio-economic parameters. Conventionally a four stage urban transport planning system (UTPS) approach is widely used in transport planning studies. In the present study an advanced transport planning software – TRIPS has been used to carry out the travel demand modelling exercise. The four stages of UTPS are:-

I. Trip Generation
II. Trip Distribution
III. Modal Split
IV. Trip Assignment

The database for the modelling process comprised information obtained from household survey, roadside interview, traffic counts & travel demand data along with land use and socio-economic data aggregated at zonal level.

5.2.2. Trip

A trip is a one-way person movement by a mechanized mode of transport, having two trip ends, an origin (the start of the trip and a destination (the end of the trip).

Trip Generation

Trip Generation is the first stage of the travel demand estimation process. It is a general term used in the Transportation Planning Process to cover the field of calculating the number of trip ends in a given area. The objective of the trip generation stage is to understand the reasons behind the trip making behaviour and to produce mathematical relationships to synthesis' the trip-making pattern on the basis of observed trips, land-use data and household characteristics.

Factors Affecting Trip Generation

Prior to the application of the trip generation model, it must be calibrated using observations from the base year by means of a variety of traffic surveys. The total number of person trips generated constitutes the dependent variable of the model. The independent or the explanatory variables bear a relationship with trip making behaviour. A large number of explanatory variables have been employed in previous studies to estimate Trip Generations in an urban area. These variables can be categorized into:

- Land Use Factors: Population, Indicators of Intensity of Residential Activity, Intensity of Employment Opportunities, Land Values etc.
- House Hold Factors: Household Income, Vehicle Ownership, Family Size, Family Structure etc.
- Urbanisation Factors: Degree of Urbanisation, Distance form CBD, Accessibility etc

Trip Purpose

Trips are usually divided into two types:-

- home-based
- non home based

Home-based trips are those having one end of the trip either origin or destination at home, of the persons making the trip,

Non home based trips are those having neither end at home of the person making the trip.

Different transportation studies have adopted different classification systems for trip purpose depending upon the planning issues involved and the size of the city. The idea has been to develop independent trip generation models for each trip purpose separately. As the observed home based trips in the study area were insignificant and due to non availability of the needed data; the trip generation for non home based trips was not attempted for the study. The home based trips were classified into the following three categories:-

- Work: - home based trips with one end as home and the other end as the work place was classified as work trips
- Education: - trips performed by the students with one end of the trip as home and the other end as the educational institution was termed as an education trip.
- Other trips: - other trips included social, shopping, recreation etc.

Another important aspect considered while developing the trip production equation is taking into account the walk trips. Walk trips in medium sized cities play an important role in elucidating the travel characteristics. Though walk trips were not considered while assigning trips on the network; they were taken into account for working out the total travel demand for the study area.

Modeling Trip Generation

The process of modelling trip generation is fairly well developed, at least with respect to ordinary trips. It proceeds through a series of logical steps t hat make up the aggregate trip generation model.

The two components of Trip Generation modelling are:

- **Trip Production** - Trip production is used for trips generated by traffic zones and is associated with trips generated at home end. Variables such as population, income, vehicle ownership, land use characteristics, accessibility etc affect trip production.
- **Trip Attraction** - Trip attraction is associated with trips at non-home end like work places, shopping area etc. Variables such as employment, land use, floor space, and distance from CBD etc. affect trip attraction.

Trip generation models are generally developed using regression analysis wherein a zonal trip production and attraction model is developed a multiple linear regression.

Multiple Linear Regression Analysis

For fitting mathematical relationship between dependent and independent variable, multiple regression analysis is used.

Dependent variable: the number of trips

Independent variable: various measurable factors influencing trip generation as land use, socio economic characteristics etc.

$$\mathbf{Y = a_1X_1 + a_2X_2 + a_3X_3 + ... a_nX_n + U}$$

Where

Y = number of trips for specified purpose

$\mathbf{X_1\ X_2}$, $\mathbf{X_3}$**.....** $\mathbf{X_n}$ = Independent variables as land use, socio economic factors etc.

$\mathbf{a_1}$ **,** $\mathbf{a_2}$ **,** $\mathbf{a_3}$ **,.....** $\mathbf{a_n}$ = dependent variables of the independent variables X_1 , X_2 , X_3 ,..... X_n obtained by linear regression analysis.

U = disturbance term, constant describing that portion of value of Y not explained by independent variables

Selection of Variables

The prerequisites for the selection of independent variables are

- To ensure that there is casual basis to the apparent dependency between variables
- To include only those independent variables that can be forecasted with a reasonable degree of accuracy.

The independent variables studied for the Jodhpur study area are as follows:

Population- Population was taken as an indicator of trip production. This is the most widely used variable and is the most easily forecast able.

Employment opportunities- The employment opportunities and its classification into commercial and educational employment opportunities serve as important variables for developing trip attraction equations.

Model Qualities

- Quality of simplicity
- Quality of usefulness
- Valid ability
- Suitability
- Accuracy
- Economy
- Sensitivity

Assumptions in Multiple Linear Regression Analysis and their validity in Trip generation Studies

- All the variables are independent of each other
- All the variables are normally distributed
- All the variables are continuous
- A linear relation exists between the dependent and independent variable
- Influence of independent variable is additive i.e. the inclusion of each variable in the equation contributes a distinct portion of the trip numbers.

5.2.2.1. Trip Generation Model

Trip End Model

Trip end models were developed for intra-city trips while all other trips i.e. internal – external, external – internal, and external – external were modelled using growth factor method.

Table 5.26: Trip End Model for the Base Year 2009

Zone No	Production	Attraction
1	4867	3464
2	5477	5309
3	5230	7023
4	5101	4619
5	6741	7179
6	6897	6647
7	4970	4136
8	8516	7641
9	5903	5671
10	6801	3590
11	4978	7058
12	3173	5237
13	3694	3307

Zone No	Production	Attraction
14	3608	4776
15	3412	3711
	79368	79368

5.2.2.2. Trip Production

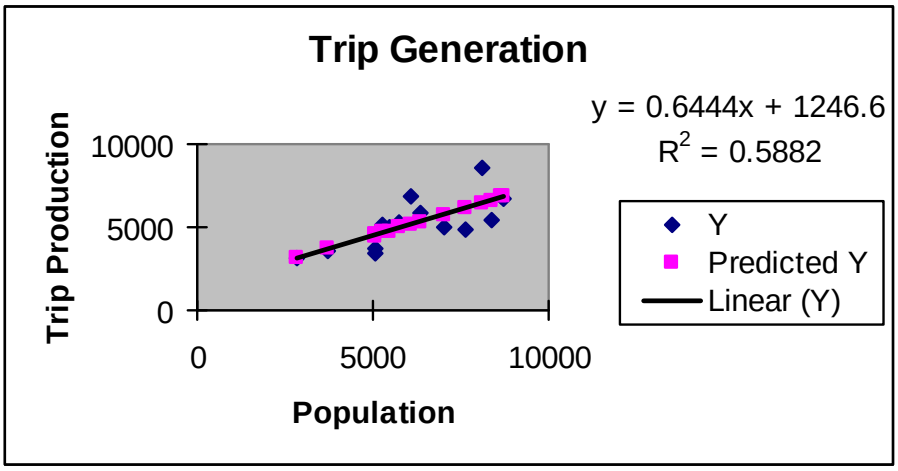
The best fit equation obtained for trip production taking zonal population as independent variable is:

Trip Production =0.6444 *** (Population)** + 1246.6

R^2 = 0.5882

The overall equation was observed to be statistically significant.

Figure 5.1 Scatter Diagram of Trip Production Vs Population



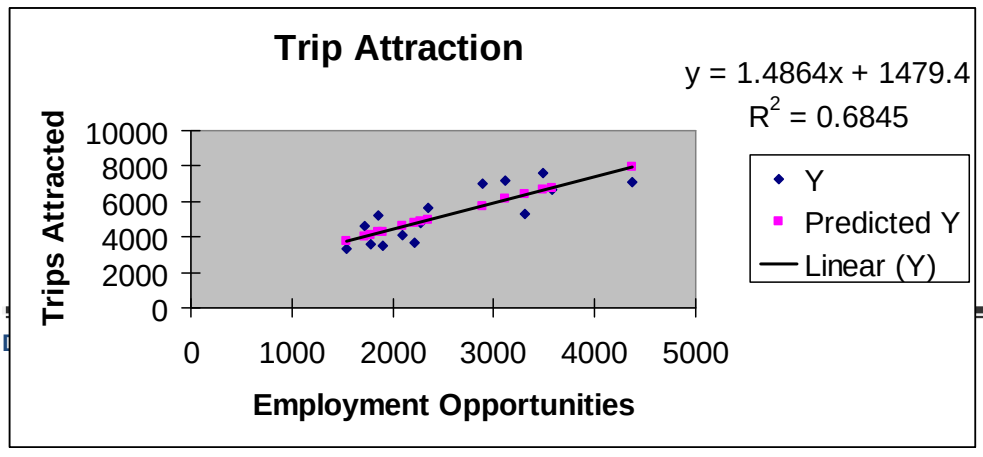
5.2.2.3. Trip Attraction

The best fit equation for trip attraction taking zonal employment as independent variable was

Trip Attraction = 1.4864*** (Employment)** +1479 **R^2** = 0.6845

The overall equation was observed to be statistically significant.

Figure 5.2: Scatter Diagram of Trip Attraction vs. Employment



A zonal regression model was used in which the study area is divided into a number of zones and each traffic zone is treated as one observation. The "regression" model assumes that zonal trip ends are dependent on some independent variables (representing the zone) and thus respond to changes in them. The following were kept into view while developing the equations:

- Not to use coefficient of determination as the only criterion of statistical validity of the equations.
- Not to use collinear independent variables in the equation.
- Size of regression intercept in relation to the mean dependent variable is to be small.
- Signs in the equation must be logical.

5.2.2.4. Trip Distribution Model

Background

This is the second stage of four stage travel demand modelling process. The purpose of this stage is to simulate the travel pattern in the city by distributing the production and attraction end of trips, into different traffic zones based on some deterrence function. A number of methods are available which explain and predict distribution of trips. These can be broadly classified into following:

- Growth Factor Models
- Gravity Models
- Opportunity Models
- Stochastic Behavioural Models

Method and Description

Of the above four types of models developed for trip distribution stage of travel demand modelling, Gravity model has been most widely used in previous studies and suits the present study most due to data availability and its better applicability in future.

Gravity models are adopted from the Law of Gravity, which explains the attractive force between the two masses.

$$F_{12} = \frac{G. M_1. M_2}{D_{12}}$$

Where F_{12} =the gravitational force between two masses

M_1 & M_2 =Masses of bodies 1 & 2

D_{12} =Distance between bodies 1 & 2

G =Constant

The more recent trip models have the least resemblance with this original version, but the generic name still continues. The basic philosophy is to relate productions and attractions of different zones with quantum of trip modelling between individual zone pairs.

In the present study a Gravity Model has been used with a typical functional form as:

$$\mathbf{T_{ij} = R_i C_j P_i A_j f(W_{ij})}$$

Where:

T_{ij} = Trips between zone i & j

P_i = Trips Production at zone i

A_j = Trips Attraction at zone j

R_i, C_j = Constants of Proportionality

$f(W_{ij})$ = Deterrence function between zone i & j

$= e^{-\alpha tij} (tij)^{-\beta}$

Where Wij = travel time between zone i & j

α β = Parameters to be calibrated

Model Types

Gravity models can be run with and without constraints

- Unconstrained
- Production Constrained (Singly Constrained)
- Attraction Constrained (Singly Constrained)
- Fully Constrained (Doubly Constrained)

The variations in the Gravity models mentioned above are the result of variations in satisfying these production and attraction equations.

5.2.2.5. Un Constrained Gravity Model

This takes the following shape

$$T_{ij} = K\, P_i\, A_j\, f(W_{ij})$$

Where, K is the constant of proportionality which ensures that the total number of trips from the model output equals to the total number of trips in the survey matrix. But there is no guarantee that the sums of the rows and columns of the matrix will balance individually with the total of survey.

5.2.2.6. Production Constrained Gravity Model

The model is of the form

$$T_{ij} = \frac{P_i\, A_j\, f(W_{ij})}{\sum A_j .\, f(W_{ij})}$$

This ensures when trips of the modelled T_{ij} matrix are summed across the rows, their total (zonal trip origins) equals the corresponding observed trip totals.

5.2.2.7. Attraction Constrained Gravity Model

The model is of the form

$$T_{ij} = \frac{P_i\, A_j\, f(W_{ij})}{\sum A_j .\, f(W_{ij})}$$

Here the constant of proportionality guarantees that when the trips of the modelled T_{ij} matrix are summed down the columns their total (zonal trip destinations) equal the corresponding observed trip destination total.

5.2.2.8. Fully Constrained Gravity Model

The model takes the form

$$T_{ij} = R_i\, C_j\, P_i\, A_j\, f(W_{ij})$$

$$R_i = \frac{1}{\sum R_i\, P_i\, f(W_{ij})}$$

The constant of proportionality now becomes the joint product of R_i and C_j. It is known as balancing or normalising factor. This ensures that the row and column totals (productions and attractions) of the observed T_{ij} matrix.

Model Selection - Development & Calibration

Fort the practical purpose of gravity model application in the study area and distribution of the observed Tij for other zone pairs where zero trips were observed in sample matrix, fully constrained gravity model was chosen. Again function f(tij), that separates zones I and j, can be explained by various forms as follows.

Power function $f(T_{ij}) = \frac{1}{T_{ij}^{\alpha}}$

Where ά = Deterrence Function

Gausian function $f(T_{ij}) = \frac{1}{\exp(T_{ij}^{\alpha})}$

Exponential function $f(T_{ij}) = \frac{1}{\exp(T_{ij} \times \alpha)}$

Tanner's function $f(T_{ij}) = \frac{Tij}{\exp(T_{ij} \times \alpha)}$

The Tij itself can be assumed to be any or a combination of the following Distance, Time & Cost.

In this exercise, as experienced in the earlier studies (literature review), time being the most reliable parameter for using the path on the network by the road user, has been taken to estimate separation index for each pair of zones through TRIPS software. After getting the zonal time matrix from the shortest path method, the observed trip matrices were synthesized using the tanner's function explained earlier.

O-D Matrix was calibrated taking all modes together since there are no regular bus based trips and the Para transit trips use the entire primary network.

Table 5.27: Results of Model Calibration

Mode	**Calibration**	
	~	
All modes	**0.986**	**-0.0021**

Figure 5.3: Trip distribution

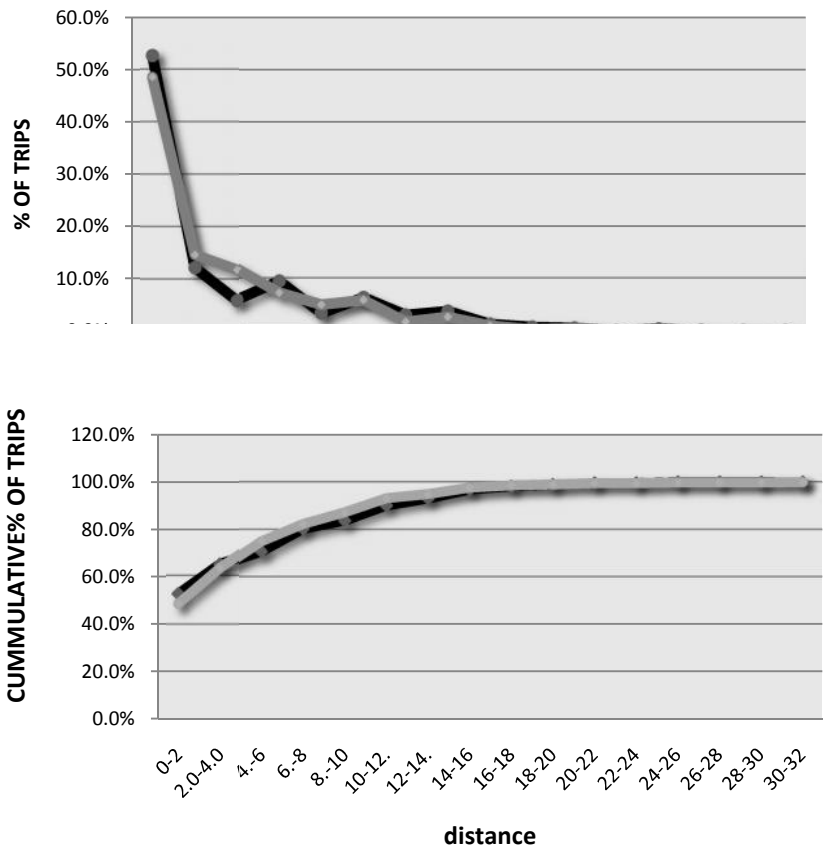


Figure 5.4: Cumulative Trip distribution

Modal Split

Modal split stage is the third stage used to distribute the total travel demand in two or more categories. The purpose of Modal Split analysis in general is to identify the various modes of private and public transportation services and partition the total trip matrix into public and private transport trips.

The experience in developing modal split models has not been very successful, primarily due to limitation of data. It however suggests that modal share is primarily dependent on socio-economic characteristics of urban area residents, the type of public transport system available, its efficiency and its cost etc. In the context of Indian cities, particularly non-metro cities, the users are largely captive to certain modes of travel and travel choices do not really exist in the absence of adequate public transport supply in these cities. Hence a normative based approach for estimating modal share is generally

preferred and adopted. For the present study a modal share of 35% has been adopted for the city in horizon year 2023 based on recommendations of Study Group on Alternative Systems of Urban Transport, GOI (1987)

Traffic Assignment

The trip assignment procedure determines the route choice of trip maker to whole or part of the network is the fourth of travel demand modelling process where the inter zonal modal trips are assigned to the various links of the network. There are at least four factors that lead people to choose one route over another. They are travel time, generalized travel cost, travel distance and level of service. The most common factor in studies in India employed is the travel time. Travel cost may be more appropriate when route choice modelling is done. Taking a single parameter to determine the shortest path between each zone pair assumes that there is only one preferred path between each origin and destination. The purpose of this stage is to simulate the flows on the links based on the trips between origin and destination pairs in the entire network.

5.2.2.9. Techniques

The assignment itself can be of various types like “All or Nothing Assignment”, “Capacity Restraint Assignment”, “Multi path Assignments.

Out of the three assignments technique mentioned above “All or Nothing Assignment” have been applied in study to see the actual desire of the trips. The technique is based on the assumption that the path taken by vehicles travelling from zone of origin to zone of destination will be one with least travel resistance i.e. time. The basic procedure adopted is as follows:

- Determine the minimum path trees from each zone to all other zones
- And assignment of all trips from each zone to every other zone by the appropriate minimum path, and the aggregation of total flow on each link in the defined network.

5.2.2.10. Validation of the Assignment

To validate the assignment stage of the process, traffic volume counts at eight screen lines points had been conducted. The comparison between the observed link volumes

and modelled link volume were done.

Table 5.28: Shows the validation of the Assignment Technique

Location	Survey	Trips	Diff
Lal Market Intersection Volume Count	2120	2567	447
0' Point Intersection Volume Count	1673	1718	45
Amdo Golai (Indira Byepass) Intersection Volume Count	1712	1680	-32
Ridge Road & NH 31 A Volume Count at Intersection	1177	1090	-87
2rd Mile Ganesh Tok Intersection	1282	1180	-102
Power Station Road Junction	1513	1483	-30

5.2.3. Issues

A number of issues, pertaining to the transportation system of Gangtok, emerged from interaction the PWD officials, the analysis of information from site visits and primary survey data. Most of the issues point to problems and constraints, but a few also point to the potentials and possibilities for the city transportation system.

- The urban services are under pressure, intensified by the lack of availability of suitable land for infrastructure development. Gangtok exhibits a development, where growth has been accelerated as a response to increased economic opportunities. The primary growth axis for Gangtok is towards the South and South west direction, along the NH 31A on the Selep-Ranipul axis. The terrain in this axis is relatively more favorable; and accessibility is enabled by the NH 31A. The urban fringe areas like Deorali, Tadong and Ranipul are the areas facing increasing pressure on land development. There are also several settlements growing along and off the Indira bypass and on the eastern slope from Chandmari to Syari. The existence of steep slopes, vulnerability to landslides, large forest cover and inadequate access to most areas has been a major impediment to the natural and balanced growth of the city.
- The existing physical pattern has been dictated primarily by availability of land that is safe with respect to stability. Intervention in planning at this stage is required to reverse this trend and not allow concentration towards south and

southwest directions alone. Keeping in view, the development constraints like landform, topographical features, watercourses, drains, ecology and growth propensity, the future direction of growth needs to be spread over a larger area. Under developed areas within the notified city area need to be opened up for development so that the pressure in these densely populated areas is alleviated. Areas below Indira Bypass and the surrounding revenue blocks, Siyari, Tahtnagchen and Chandmari, Bojhoghari are areas that have a potential to absorb some of the growth momentum in Gangtok.

- There are very high density developments in the core areas of the city, which are not only unsafe and unhealthy but also attract the major share of trips resulting in high levels of congestion. Limiting type and intensity of land use is essential as a policy instrument and planning measure for achieving a sustainable transportation system. Major activities like establishments, institutions and offices at city centers are attracting more trips to CBD area and creating more traffic problems.
- Most of the road length in Gangtok, is of two lane undivided carriageway with foot path on one side of the road and drain on the other. The steep gradient of the different road stretches coupled with spiral road configuration act as a constraint for smooth flow of vehicular as well as pedestrian traffic. There is no road apart from MG Marg, which has divided carriageway in Gangtok. The bypass road (Indira By Pass) has a total length of 11.2 km. The National Highway 31A has a footpath running along its entire length from Ridge Park, Zero Point up to Ranipul. The width of the footpath is 1.2 m inclusive of the railing and appears inadequate given the high pedestrian volume. The Right of Way (ROW) of NH 31A for 69% of its length in Gangtok NTA is 5-10 meters wide. The average Carriageway Width (CW) of other roads of Gangtok is 5.5 to 7.0m wide. The gradient of roads is also moderately high in certain lengths, to the tune of 1:10 gradient, especially along Kazi Road, Tibet Road, Namnang Road, Sichay Road and Paljor Stadium Road owing to the terrain. The vehicular accessibility to

various areas is limited and no organized public transport is under operation. The poor public transportation system in the city doesn't help the situation forcing the people to u

- The road network is limited in its capacity to carry traffic and potential for improvement or capacity expansion. This along with rapid increase in private vehicle ownership has resulted in extreme levels of congestion during peak hours and safety issues. An integrated approach of promoting balanced land use development, infrastructure expansion, public transport promotion and traffic management is essential to build a safe, efficient and convenient transportation system for the city.
- Typical terrain and network conditions are the constraints for expanding the road widths and further the road conditions restricting the capacity of lanes. The steep slopes and curves further limit the road capacity and safety. Major delays and long queues are observed at many intersections during peak and sometimes during off peak hours owing to poor intersection geometrics.
- The National Highway (NH-31A) is the only connectivity with the outside world, connecting Gangtok with Siliguri, Darjeeling and Kalimpong. The nearest airport (Bagdogra) and rail head (Siliguri) are 120 km from Gangtok. Gangtok's regional influence mainly extends towards the South, the East and West Districts and less towards the North District. This is generally because of good linkages throughout the East, West and South districts. It is expected that Gangtok will play a major role in the regional dynamics once trade with Nathula is fully established and the road linkages is further strengthened.
- The city is often cut-off from the national road network in wake of heavy monsoon and such natural calamities like landslides etc. Further, the city lies in an active seismic zone categorized as zone v and prone to earth quakes. It is essential to build a reliable road network to ensure year round access to city from the national highway network. Further, it is desirable to build in sufficient alternatives or redundancy in the network to ensure accessibility during times of natural calamities or disasters for relief and rescue work. Unreliable connectivity also has

a negative impact on the economic growth and development of the city and in attracting potential tourist traffic or industrial/ commercial investment.

- Pedestrian traffic constitutes almost half the total travel demand in the city. Walk is an essential and sustainable mode in any transport system, especially so in context of Gangtok. It is essential and desirable to maintain and upgrade pedestrian facilities such that the people are encouraged to walk at least for shorter distances and the mode share of walk trips is maintained.
- The pedestrian traffic volume is high mainly on MG Road, Indira Bypass and Deorali Bazar Road. This high volume of pedestrian traffic is due to commercial activities in these areas. Footpaths are present on all the major roads but their width is not adequate to carry the present load of pedestrians. M.G. Marg, the main shopping street is closed to vehicular traffic and records the highest volume of pedestrians from 5-9 pm.
- Typical vehicle parking characteristics of households on roadside during day and night time occupying one side of the road.
- There are no organised facilities available for intercity travel in terms of bus or taxi terminals, thereby causing inconvenience to tourist and other city-travellers. Most intercity taxi operations are scattered in the city center. This mixing of inter and intra city traffic further causes problems of conflict and congestion.
- Bus and taxi terminals, cater to both inter-state and intra-state traffic. These terminals are located at Paljor Stadium Road and at the private taxi stand near the Police Headquarters. Being within the city core, a high volume of traffic is generated in these areas. However, there is also a high traffic volume between M G Marg and zero point area because of the location of work centres, commercial establishments etc. and easy access to the commercial hub of MG Marg, Tibet Road and Namnang. Due to the absence of other forms of transportation such as rail or air traffic, passengers and goods are transported by road. The major roads are the National Highway No.31A (Gangtok-Siliguri), North Sikkim Highway connecting Gangtok with the North District and Jawaharlal Nehru Road, which is the trade route link between China and India.

- There are non organised facilities available for Commercial goods traffic, though a truck terminal is under construction at present. Goods vehicles mix with passenger traffic resulting in problems of safety and congestion. There is a need to restrict intra-city goods movement timings and reorganisation of bulk goods handling activities towards the peripheral areas.

CHAPTER 6

DEVELOPMENT OF VISION AND GOALS STRATEGY FOR TRANSPORT DEVELOPMENT

6 Development of Vision and Goals Strategy for Transport Development

6.1. Need for Transport Strategy

Urban Transport Strategy can play an important role in tackling urban problems, traffic congestion constraints and business efficiency which degrades the quality of life. Urban Transport projects can reduce journey times and their unpredictability yielding large savings of travel time and vehicle operating costs and thus release city's economic and social potential.

The urban transport problem may be described as fundamentally an economic problem of matching supply and demand with social, energy and environmental aspects and funding, institutional and political constraints. Urban Transport Strategy should be based on a rigorous definition of problems. Urban Transport problems of Gangtok Municipal area have been analyzed in the context of city-wide problems and transport strategy evolved. This strategy will achieve efficiency in transport sector and provide better and safe transportation to the people of Gangtok Municipal area

6.2. National Urban Transport Policy

The Government of India has evolved a policy to overcome the problem of poor mobility which dampens the economic growth and deterioration in the quality of life. The approach is to deal with this rapidly growing problem as also it can offer a clear direction and a framework for future action.

The vision of this policy is:

- To recognize that people occupy center-stage in our cities and all plans would be for their common benefit and well being
- To make our cities the most livable in the world and enable them to become the "engines of economic growth" that power India's development in the 21st century
- To allow our cities to evolve into an urban form that is best suited for the

unique geography of their locations and is best placed to support the main social and economic activities that take place in the city.

The objective of this policy is to ensure safe, affordable, quick, comfortable, reliable and sustainable access for the growing number of city residents to jobs, education, recreation and such other needs within our cities. This is sought to be achieved by:

- Incorporating urban transportation as an important parameter at the urban planning stage rather than being a consequential requirement
- Encouraging integrated land use and transport planning in all cities so that travel distances are minimized and access to livelihoods, education, and other social needs, especially for the marginal segments of the urban population is improved
- Improving access of business to markets and the various factors of production
- Bringing about a more equitable allocation of road space with people, rather than vehicles, as its main focus
- Encourage greater use of public transport and non- motorized modes by offering Central financial assistance for this purpose
- Enabling the establishment of quality focused multi-modal public transport systems that are well integrated, providing seamless travel across modes
- Establishing effective regulatory and enforcement mechanisms that allow a level playing field for all operators of transport services and enhanced safety for the transport system users
- Establishing institutional mechanisms for enhanced coordination in the planning and management of transport systems
- Introducing Intelligent Transport Systems for traffic management
- Addressing concerns of road safety and trauma response
- Reducing pollution levels through changes in traveling practices, better enforcement, stricter norms, technological improvements, etc.
- Building capacity (institutional and manpower) to plan for sustainable urban transport and establishing knowledge management system that would

service the needs of all urban transport professionals, such as planners, researchers, teachers, students, etc

- Promoting the use of cleaner technologies
- Raising finances, through innovative mechanisms that tap land as a resource, for investments in urban transport infrastructure
- Associating the private sector in activities where their strengths can be beneficially tapped
- Taking up pilot projects that demonstrate the potential of possible best practices in sustainable urban transport

6.3. Vision

With this background, it is desirable to have a vision be developed before considering different alternative strategies. A vision by definition is 'a vivid image produced by the imagination'. A transport planner's vision for the city and metropolitan area is to see 'a well contained city with efficient people-friendly transport system with minimum travel time & maximum safety and comfort'. At the same time the facility provided should be optimally used. The vision as envisaged for comprehensive mobility plan for Gangtok Municipal area is as follows:

1. To improve connectivity and travel throughout the city and its region.
2. To improve mobility within neighborhoods, wards, zones and satellite towns to address inner- and inter-city transportation needs.
3. To achieve efficient arrangement of land use and transport systems to minimize overall travel cost.
4. To offer viable and reliable transportation options that aim at reducing dependence on cars, with widespread use of non-motorised modes and mass rapid transit system.

6.4. Goals of Comprehensive Mobility Plan

Goals for Comprehensive mobility plan for Gangtok Municipal area are as follows

1. 80% of total trips should be made by public transport, with one (or two)

modal changes.

2. 90% of the population should be served by public transport. Trip origins and destination will be within 500m-1000m of public transport terminal and stops. For those who do not have access to public transport within walking distance, safe bicycles lanes should be provided to reach the public transport system, with secure bicycle parking provided.
3. Safe and convenient pedestrian/NMV facilities should be provided throughout the urban area. These facilities exist particularly in residential, commercial and institutional areas.
4. Integrated urban land use and transport system result in efficient and sustainable mobility for everyone and provide greater accessibility to opportunities (e.g employment, education, health, goods, and other services).

6.5. Optimization of Existing Transport Infrastructure

Analysis of existing transport scenario indicates lack of adequate traffic engineering and management measures. It is, therefore, desirable to optimize the capacity of the existing transport network by these measures which cost little and are easy to implement. It will also be desirable to develop an institutionalized capability to achieve these objectives because the existing organizational set up for traffic and transport management lacks this capability.

6.6. Development of Satellite Towns

The Gangtok city is growing fast in east, west and south directions. For the year 2041, it is envisaged that the additional population will be accommodated in the proposed areas as well as the existing ones considering the existing densities and extension of existing urban area. In order to restrict the population of Gangtok to 2 lakh by the year 2041, it is necessary that satellite towns such as Ranka, Luing, Pakyong, Assam Lingsay, Bhusuk, Penlong are to be developed in order to check the immigration to Gangtok.

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6.7. Modal Split

The present modal split in favour of public transport is less than 15 percent. However the maximum trips are catered to by the taxis which ply on Gangtok city roads. This is due to the high growth rate in personalized motor vehicles and taxis, this share is likely to fall more in the absence of effective public transport system. This will result in more traffic on roads. Accordingly, it is suggested that the modal split should be increased to about 80 percent in favour of public transport and Intermediate Public transport (taxis) together by providing a city-wide integrated mass transport system network of buses so that all the areas are within 500m-1000m of mass transport system.

6.8. Planning Options

Transportation system for the city cannot be visualized or developed in isolation of the overall developmental pattern for the city. A transportation system affects the pattern of land use development and in turn itself gets affected by the pattern of development. Land use planning therefore, is an important and effective tool in planning of the transportation system for the city

- **Land use distribution**

Land use and transport have a relationship of mutual inter-dependence. From a travel demand perspective mixed and high density developments result in more efficient transportation systems, provided adequate transport infrastructure can be made available to handle high concentration of demand. However, in existing and old developments, where it is not possible to provide additional transport supply in terms of road space or parking etc, high concentration of activity leads to heavy congestion. In such a scenario it is important to spatially distribute various land uses and connect them through transportation network with adequate capacity to handle the resulting demand.

- **Residential and Commercial use density**

There need to be limits on exploitation of land for commercial or residential purposes as defined by sound planning principles and practice. It is the unregulated use of land that

has resulted in extremely high densities of development leading to traffic and other infrastructural and basic services deficiencies in the core areas of the city. A comprehensive land use plan for the city needs to define residential and commercial use densities for various zones or areas of the city and these limits should be enforced to decongest the existing critical areas and to regulate future development of the city in a sustainable manner.

- **Development Controls**

Development controls shall be designed and enforced for the city in order to promote safe building practices, enforce density and use conditions and promote healthy living environment. Development controls would normally include regulation and restriction on height and dimensions of building, use, structural adequacy, health and safety considerations etc.

6.9. Policy Options

1. **Vehicle Registration Policy/ Taxation**

Aizwal has seen a multi fold increase in vehicle ownership due to improvement of economic status of people coupled with easy availability of credit. This however, was not accompanied by commensurate public expenditure in creation of supporting infrastructure like parking or wide roads etc. this has resulted in extremely congested situation of traffic on city roads. There are thousands of taxis on city roads with little space to move resulting in long queues and waiting time at intersections. A practical registration policy based on appropriate taxation can serve dual purposes of dampening the artificial demand created due to conspicuous consumption patterns while at the same time generating resources to upgrade public facilities such as roads, parking or transit etc. The tax proceeds from such measures should be specifically earmarked and used for the purpose or improving the transport infrastructure and public transport facilities only.

2. **Public Transport policy**

A comprehensive public transport policy needs to be developed for the city in order to

guide and regulate the operations of buses and other modes of public transport. The policy needs to define the system of fiscal incentives, concessions and obligations of public transport operators in the city in order to make the operations feasible and services user friendly in order to promote the use of public transport. A nodal agency shall be responsible for routing and scheduling of services and also, regulating and monitoring operations with respect to planned routes and schedules. This also has to be defined under the policy.

3. Shifting of Work Centers

Significant population of the city is salaried working class with a major proportion of this in government services. With all government offices situated in the city center a lot of travel demand can be shifted if a policy decision regarding shifting of work centers to appropriate locations is taken by the government. It is not only the government employees that will shift due to such policy but also a number of allied or supporting activities that take place in the private sector will also shift. Furthermore, this will also result in shifting of residential locations in relation to the work centers over a medium to long term leading to better traffic and living conditions in the core areas.

4. Adjustment of Work/Activity Timings

It has been observed that a lot of activities are concentrated at specific timings thereby creating a rush of traffic at those particular times. It may be justified to keep government office timings in tune with the standard timings of the rest of the country but school timings should be aligned to local day light cycle as a matter of convenience. As a policy decision the local/state government can adjust and stagger the work and school timings thereby distributing peak demand over different time periods.

5. Expansion of City Limits/New areas of Development

Another policy option that will have an impact on the development pattern and consequently travel demand is opening up of new areas for development or expansion of city limits. As decision is made to develop newer areas for residential or other activities, a coordinated effort needs to be made by various concerned agencies to develop the site and provide basic physical and social infrastructure at these locations,

create or extend roads to such areas to provide accessibility to these sites and promote or guide public transport to these areas in order to provide mobility which will trigger off a self sustaining cycle or development, which will help decongest the core areas.

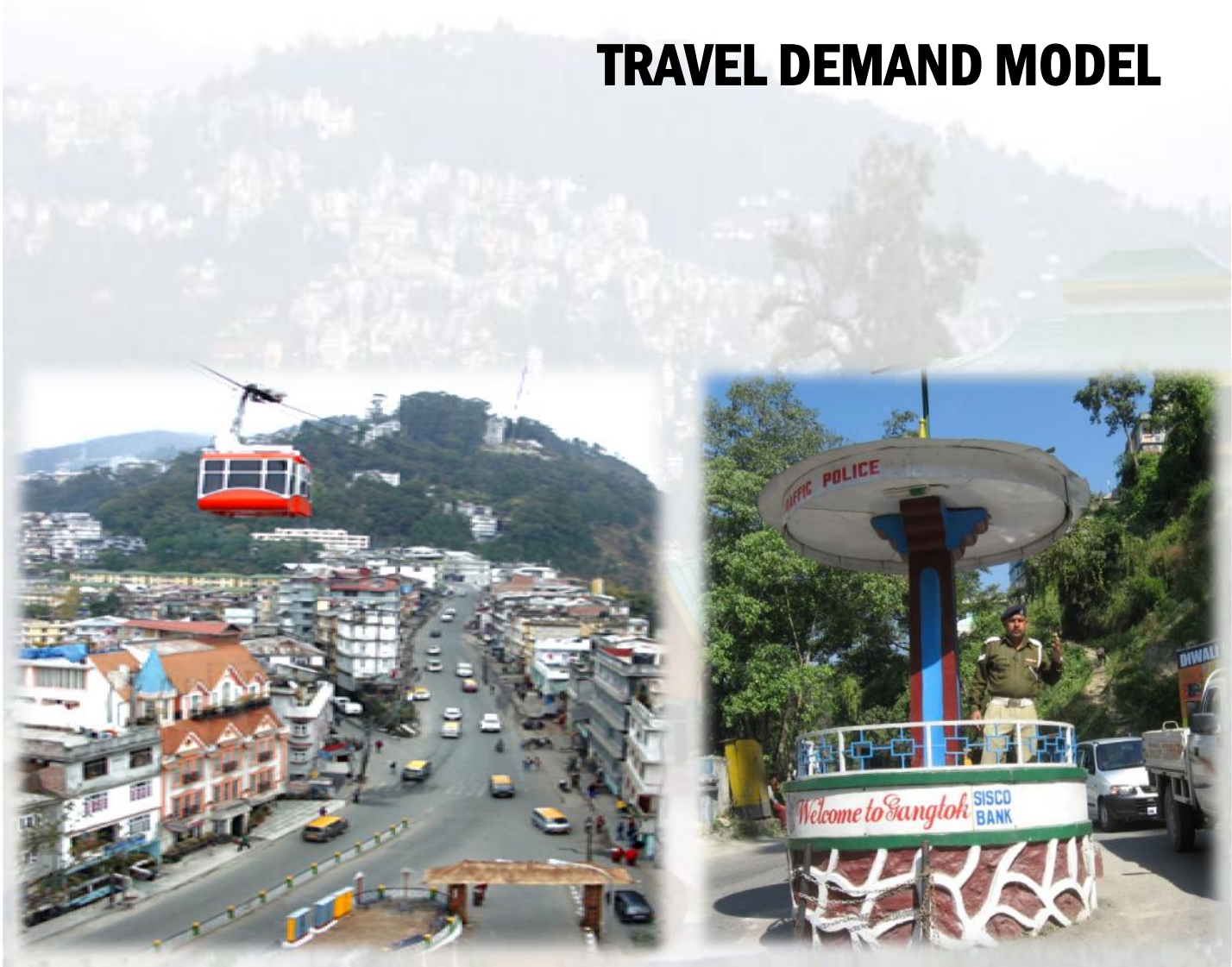
6.10. The Preferred Strategy for Transport Development

In order to prepare the Comprehensive Mobility Plan the following policy measures are required to be taken based on which the mobility plan will be finalized.

1. Mass transport system to provide wide coverage and interchange facilities with other modes of transport.
2. Provide substantially large network of medium level mass transport system such as BRT to cover the areas beyond the Ropeway network and on over loaded corridors.
3. Landuse adjustments and densification of corridors along mass transport (ropeway) corridors where possible.
4. Extension of commuter rail system up to the Lingsay, Bhusuk, and strengthening of Gangtok rail link to act as sub-urban services.
5. Introducing BRT and wherever possible dedicated bus lanes.
6. Rationalization of local bus system and its augmentation.
7. Improvement in traffic management through TSM measures.
8. Special facilities for pedestrians within the entire network especially in the core areas; pedestrianisation of selected shopping streets inside the core area.
9. Diverting through traffic on bypasses. Providing transport hubs at the junctions of bypasses with important radials such as; the National Highways and other heavily loaded roads.
10. Improving Primary, Arterial and other important roads by providing grade separation, junction improvements, adding missing links, widening and other road side facilities wherever necessary.
11. Transport integration of various modes.

CHAPTER 7

TRAVEL DEMAND MODEL

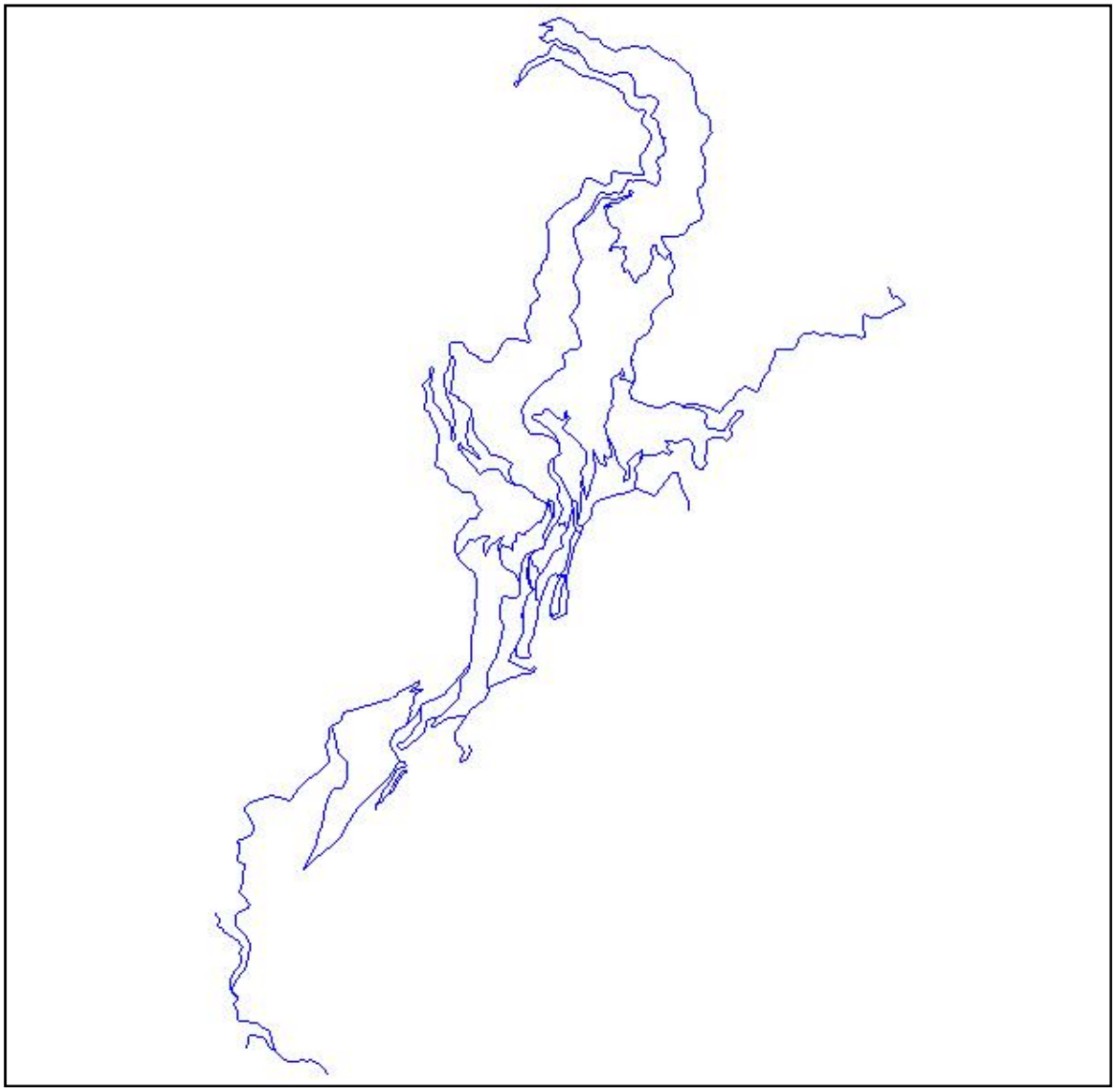


7 Travel Demand Model

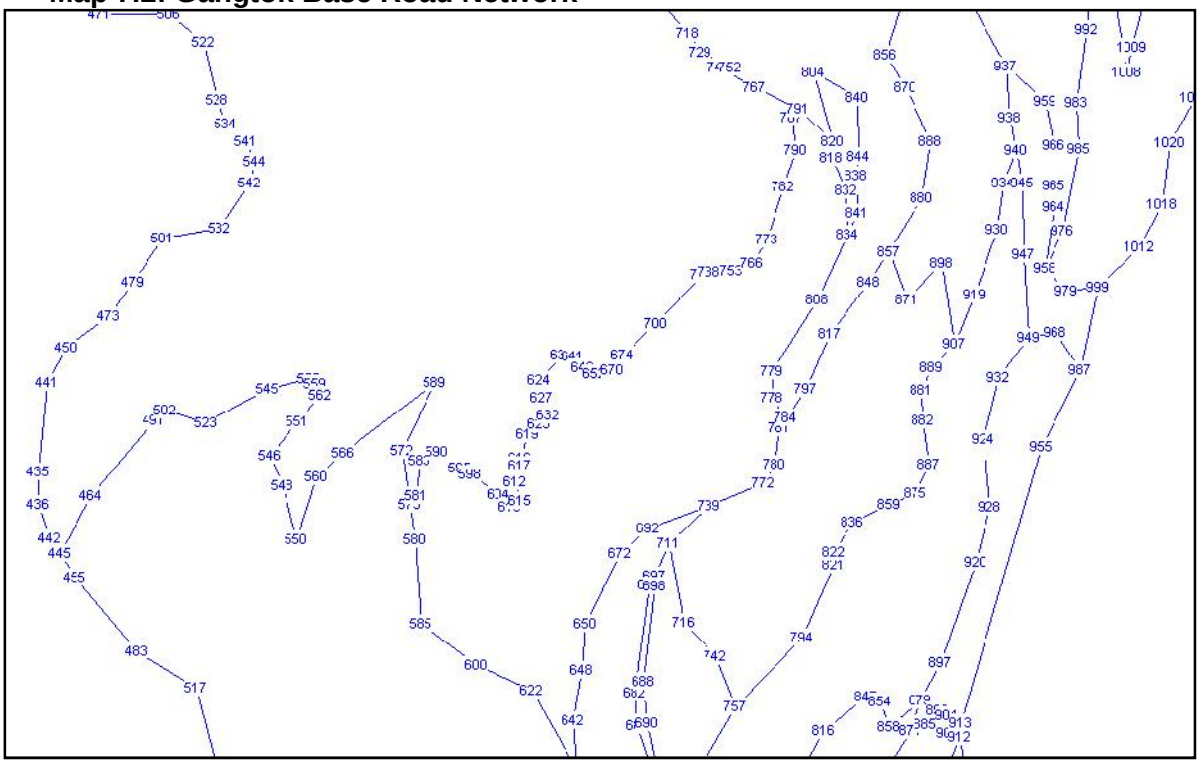
7.1. Base year Network development

The zoning system adopted is in coherence with those adopted by the local planning bodies. The zone system of Gangtok comprised of 15 Internal Zones and 08 External Zones, making it a total of 22 zones. The study area along with the external zones has 1471 nodes with 1576 links and 22 zone centroids Map 7.2

Map 7.1: Existing Road Network Development



Map 7.2: Gangtok Base Road Network

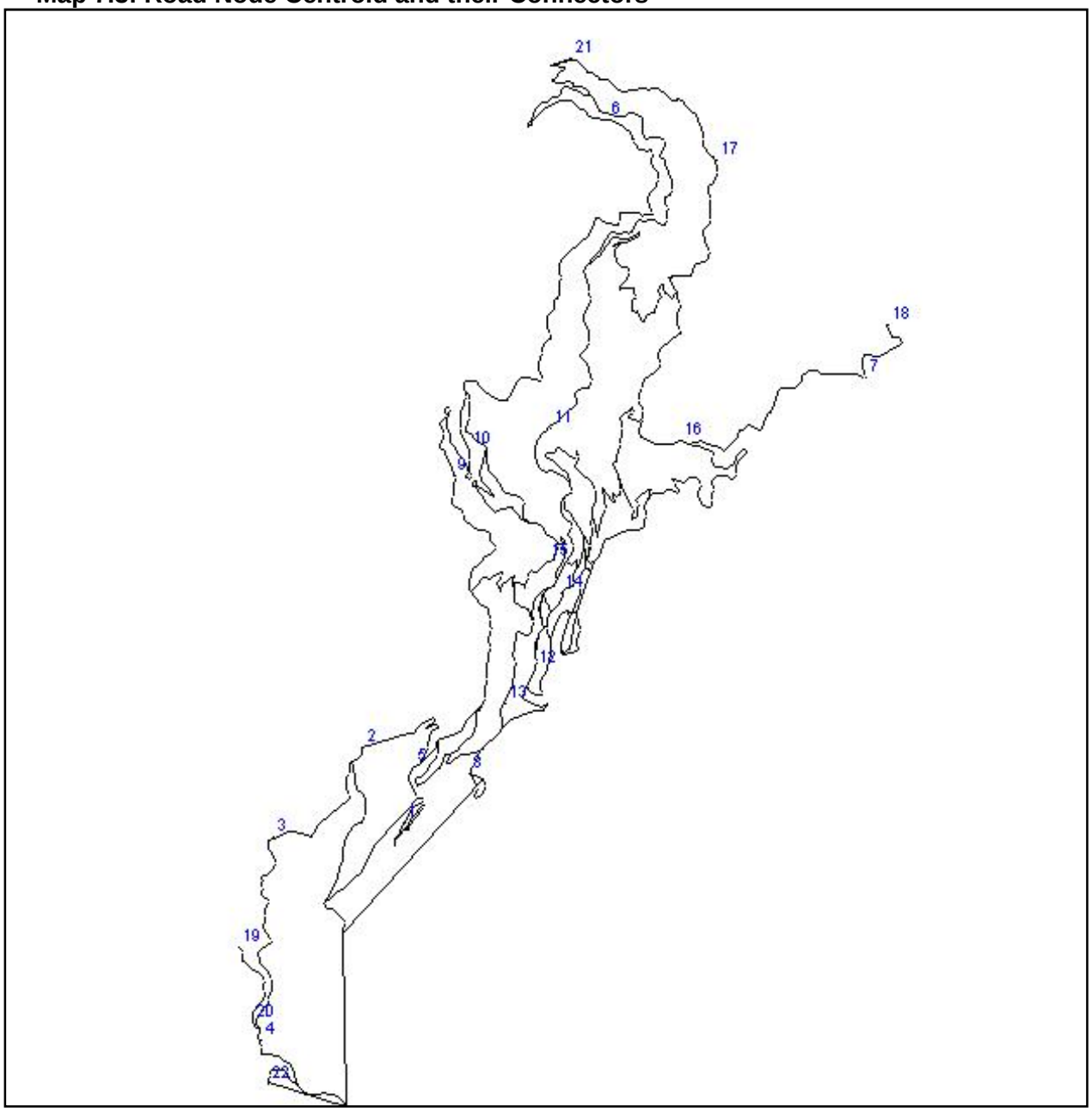


The chosen modeling suite served as a robust network database which will enable validation of traffic flows and scenario testing through cross sectional simulation runs on the overall network and for parts of it (junctions, street tranches, etc.).

7.2. Vehicular Network

The vehicular network for the Gangtok City Corporation Area is defined across the road hierarchy covering arterial, sub arterial (Primary Network) and local and collector streets (secondary network).

Map 7.3: Road Node Centroid and their Connectors



The zone centroid is assumed to serve as a key reference point within a zone. The said centroid will represent the zonal average of trips generated and attracted to a zone in line with the primary network. The base road network, centroid and centroid connectors are as per Map. 7.3. The average journey speeds allotted to the centroid connectors linking zones with nodes were 5 Kmph in the city, 10 Kmph for outer access roads.

The distances between link pairs lengths were ascertained using the key plan and

validated onsite. Each link connect was assigned appropriate journey speed (with delay component) with corresponding flow and capacity parameters.

7.3. Network Validation

The validation exercise demanded random onsite validate of the links pertaining to the primary overlapping network, speed assessments as obtained from Speed and Delay survey versus the one exogenously assigned and the observed flow of traffic across either side of screen lines. Needless to say the sincerity of the model was confirmed when modeled flows (post traffic assignment exercise) were compared with mid-block counts.

7.4. Trip Distribution

7.4.1. Introduction

A trip distribution model was formalized to calibrate travel patterns that reproduce inter-zonal patterns of surveyed traffic under a set of constraints. The calibration is a iterative process, whose function is to fill the nonzero cells of expanded OD matrix and produce TLFD. (observed and estimated) using Gravity Model with given friction values. If all the cells are filled then the TLFD and matrix can be accepted. Otherwise the iterations have to be repeated till the zero cells are filled.

7.4.2. Approach

Calibration of the base matrix has been carried out using the Gravity model. The model specification used is as follows:

$$Tij = \frac{Pi \times Aj \times Fij \times Kij}{\Sigma\, Aj \times Fij \times Kij}$$

Where Tij : Trips between i and j

Pi : Trips produced from i

Aj : Trips attracted to j

Fij : Friction factor

Kij : Balancing Constant

Fij = deterrence function for mode m

= Km e-Bcijm C Jim

Where K = above mentioned constant

C = generalized cost of travel

= Calibration constant – as obtained from the exponential/power deterrence function

The model was calibrated with doubly constraints imposed on the horizontal totals and the vertical totals of the matrix so as to ensure-

Σ Tim = Gi Σ Tim = Aj

7.4.3. Overall Matrix Calibration Statistics

Software Output

The initial input values assumed for the purpose of matrix calibration, a & β were 0.986 and -0.0021 respectively. They were used as the initial seed values for the purpose of undertaking the trip distribution exercise. The final calibration parameters emanating as an output read:-

a = 0.986

β = -0.0021

Figure 7.1: Trip Length Frequency Distribution Based on Distance

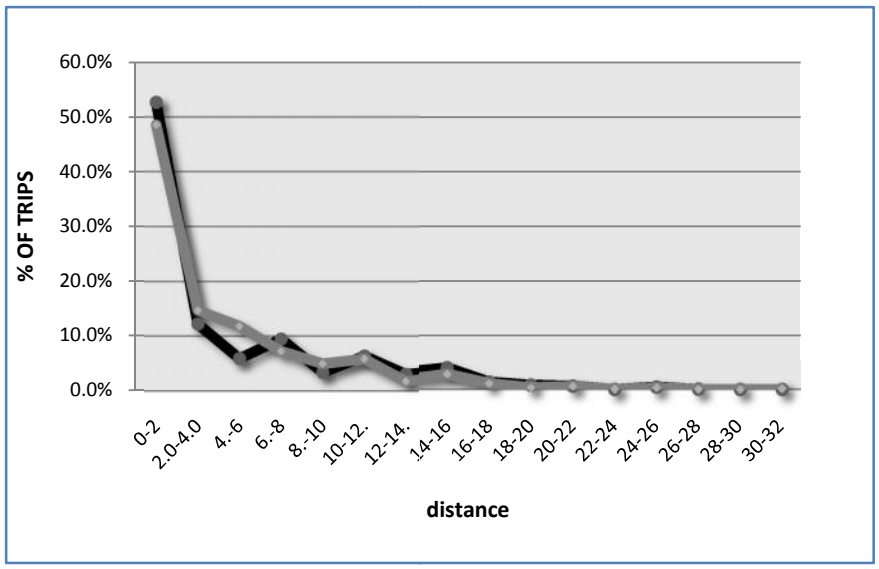
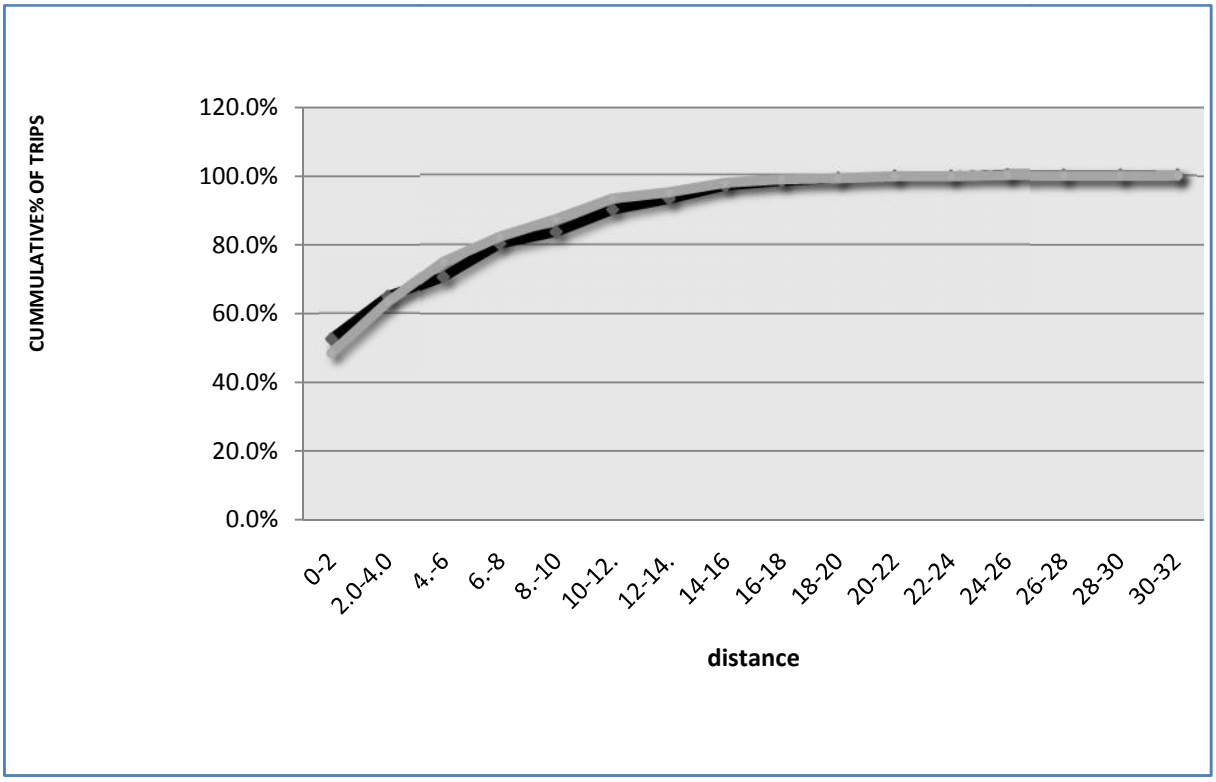


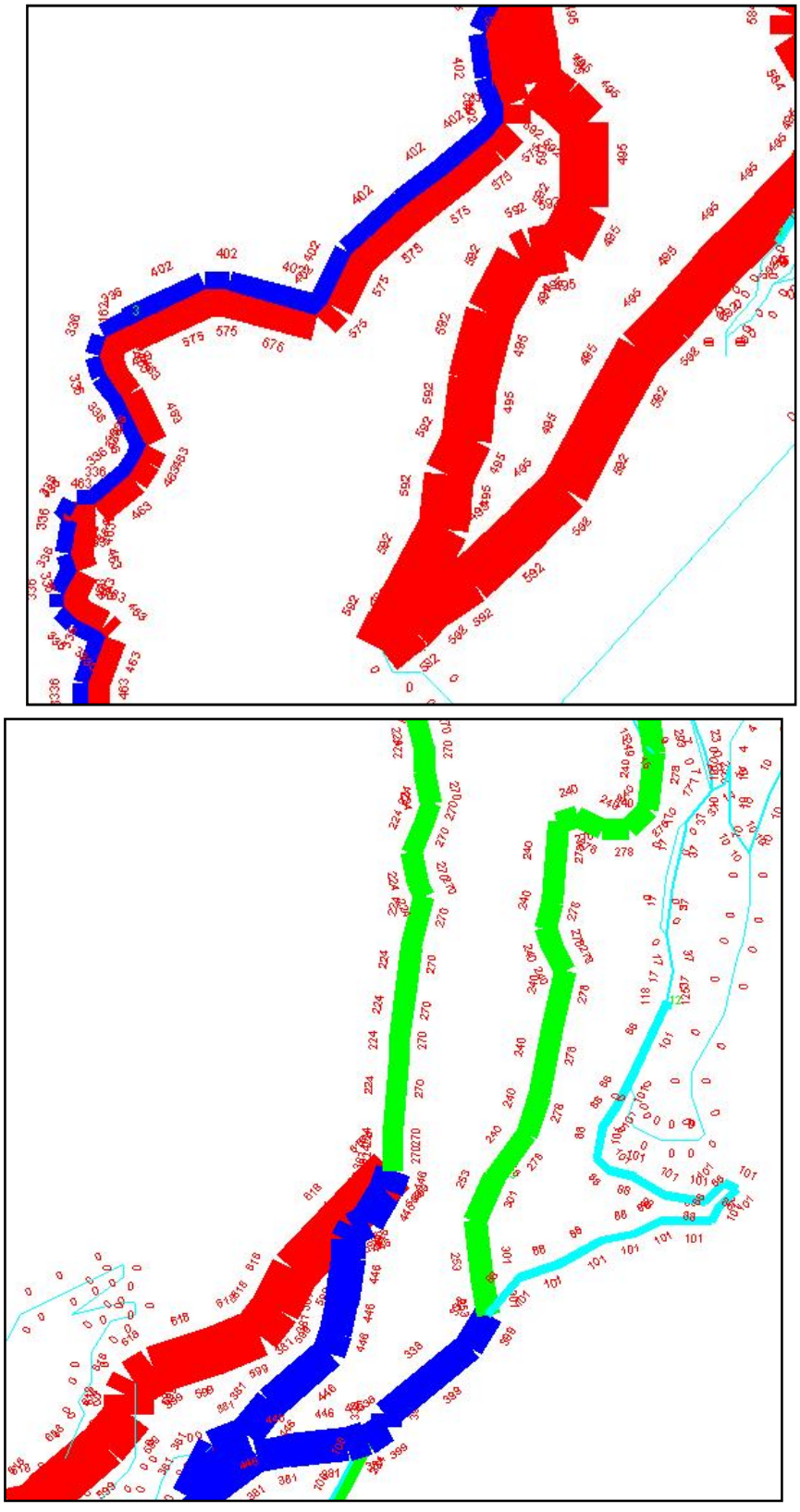
Figure : 7.2 : Cumulative Trip Length Frequency Distribution Based on Distance



7.5. Network Assignment Validation

The travel desire lines for the base year is as per figure.The major corridor of movement can be identified using this assignment. Also, validation of model needs to be done. Map 7.4 shows the assignment results for base year 2009

Figure : 7.3 : Assignment Results (Gross Level)



7.5.1. Validation Statistics post Assignment of the Calibrated Matrices

The validation of results from the traffic assignment was carried out with a consistency check by using screen line traffic flows and at selected mid blocks. The discrepancies observed across the most survey locations were within 8% of the actual counts. Table 7.1 shows comparison of observed and assigned flows across screen line.

Table 7.1 Comparison of Observed and Assigned Flows (Sample Results)

Location	Survey	Trips	Diff
Lal Market Intersection Volume Count	2120	2567	447
0' Point Intersection Volume Count	1673	1718	45
Amdo Golai (Indira Byepass) Intersection Volume Count	1712	1680	-32
Ridge Road & NH 31 A Volume Count at Intersection	1177	1090	-87
2rd Mile Ganesh Tok Intersection	1282	1180	-102
Power Station Road Junction	1513	1483	-30

The difference between the assigned and observed flows should not be more than 10%. As it can be seen, the above difference is within the range of 10%, thus the model developed is acceptable and can be used of future scenario building.

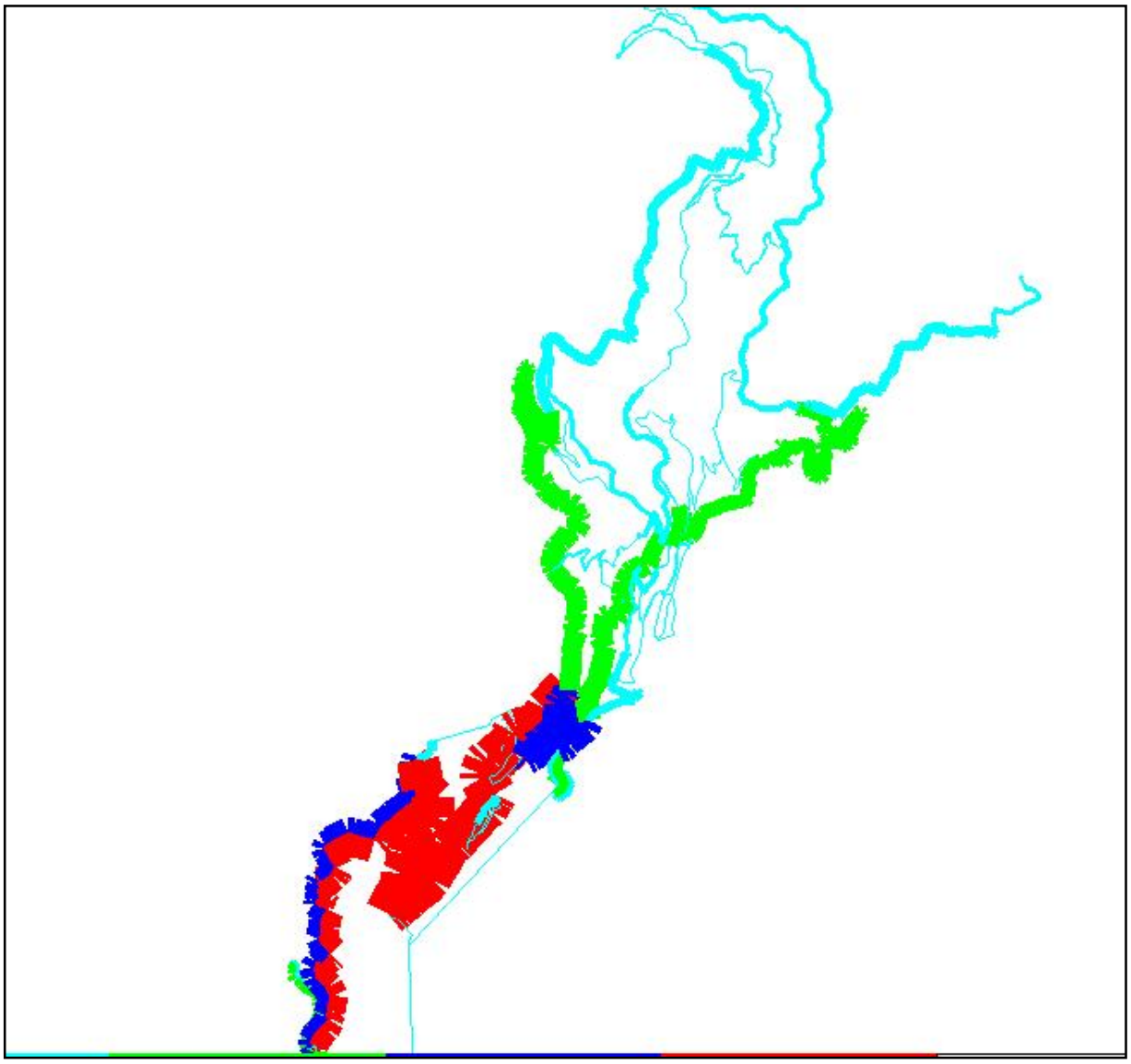
The travel demand model developed for the base year is validated by assigning updated travel trips for both private and public transport to their respective networks. The assigned volume on the network was then compared with the observed volume at screen lines/midblock of study area. The estimated travel under various parameters of the study area in terms of average network speed, total vehicle hours/km, total passenger hours/km etc. is given in 7.2

Table 7.2 Estimated Travel under various parameters - 2009

Vehicular Trips Assigned (Peak Hour)	2492
Vehicular Trips Assigned - Private (Peak Hour)	2462
Vehicular Trips Assigned – PT (Peak Hour)	30
Average Network Speed	26.00 Kmph
Vehicle Km – (Peak Hour)	161419
Vehicle Hour (Peak Hour)	523759

Peak hour assignment for the base year and the major corridors are given in Map 7.5.

Map : 7.5 : Peak Hour Assignment



From the assignment as shown in map 7.5, it is observed that the traffic volume is high on the NH and some major roads leading to city core area.

The list of mobility corridors are as follows:

- NH 31 (near Manipal Hospital)
- NH 31 (near Sikkim Govt. College)
- NH 31 (Meeting point of Tadaong to Zero Point road)

- NH 31 (Near DC office)
- Tadong to zero Point road
- Chandmari road

7.6. Summary

The travel demand model for the study was formalized using the UTPS framework. It is used to validate the estimates of traffic and model the travel pattern as obtained from primary surveys. The following are the key concluding remarks:

- The detailed operational model was able to replicate and validate much of the travel and traffic patterns on the primary/secondary network and across screen-line points
- The validation exercise bought out limited discrepancies with respect to midblock data consistency (when compared to model flows). Such issues have been highlighted in this chapter and will be addressed before the subsequent submission.
- The exercise clearly models the shift in consumer preferences towards alternate mode choice (to be used as an input in subsequent analysis) on account of savings on travel cost and time
- The developed travel demand model is fully operational and can be subjected to scenario and sensitivity testing across horizon years owing to endogenous and exogenous interventions.

CHAPTER 8

FUTURE URBAN GROWTH SCENARIO

8 Future Urban Growth Scenaro

8.1. Future Growth Scenario

For the preparation of the Comprehensive Mobility Plan for Gangtok, the population projection is taken from CDP, Gangtok. The strategic Urban Travel Demand Model developed under this study is used to predict the travel patterns and modal shares for the horizon years i.e. 2021, 2031, 2041 under respective land – use and transport network scenarios.

8.1.1. Horizon Year Strategies

Assuming a growth rate of 6.0% the population has been projected. The projected population for 2021, 2031 and 2041 were used for estimating trip ends in the corresponding years. The population projections are given in Table 8.1 respectively.

Table 8.1 Population/Employment Projections

Name of the Area	Projected Population in the Study Area				
	2009	2015	2021	2031	2041
GCC	94145	141559	200805	359610	644007

The Master Plan – Gangtok has not been prepared. In the absence of the same any change in land-use is difficult to incorporate while predicting trip ends as well as trip distribution. Thus assuming similar kind of land use for the horizon years the analysis has been carried out as presented below.

The forecasted Trip Ends are given in Table 8.2.

Table 8.2 Forecasted Trip Ends

Ward Number	Trips Produced			
	2015	**2021**	**2031**	**2041**
1	7458	10580	18947	33930
2	8181	11604	20781	37216
3	5586	7923	14189	25411
4	5164	7326	13119	23495
5	8487	12040	21561	38612
6	8468	12012	21511	38523
7	5360	7603	13616	24384
8	7930	11249	20146	36078
9	6233	8841	15833	28355
10	5956	8449	15130	27096
11	6855	9724	17415	31187
12	2790	3958	7089	12694
13	4925	6986	12511	22405
14	3642	5166	9251	16567
15	4979	7062	12648	22650
Total	**92014**	**130523**	**233747**	**418605**

8.2. Future Transport Network Scenarios

Information on the transport network improvement proposals was collected from various agencies responsible for implementation of road projects. These improvements could be in form of road widening projects, junction improvement plans, construction of new roads etc. The base year was updated with the same for development of horizon year network. The transport scenarios to meet the travel demand for the horizon year 2015, 2021, 2031 and 2041 is explained in subsequent section.

CHAPTER 9

FUTURE TRANSPORT NETWORK SCENARIO

9 Future Transport Network Scenario

9.1. Strategies

Considering the status of progress in various fronts that have already been initiated in Gangtok, the road to an integrated urban transportation strategy is fraught with difficulties. The cost of not doing the integration is far higher than that of doing it and the resultant situation, if the integration is not done, will be far messier than the process of doing it. Therefore, the following initiatives are recommended.

The above strategy is sought to be implemented through the following broad approaches:

- Developing pedestrian facilities by connecting prominent areas by stairs wherever possible to increase the walkability index of the city thus decreasing motorized trips by increased share of walk
- Pedestrianizing important portions of the core city area and linking them with strategic parking places to encourage people to walk in such areas
- To identify the mobility corridors along which high performance public transport system to be developed on the basis of a technical and economic feasibility and rote rationalization of the existing service
- Improving operations of public transport so that there is significant shift of modal split towards public transport.
- Providing alternative routes for those having to enter the core city area even when their journey does not begin or end in this part of the city. For this purpose, ring corridors have been suggested to enable the core city area to be bypassed.
- Providing bypass routes for long distance commuter and truck traffic so that they do not have to travel through the city roads.
- Policy level intervention that would discourage the use of personal motor vehicles

The following strategies need to be adopted in quest to meet the various goals set for Gangtok.

I. Development of Mobility Corridors
II. Public Transit Improvement Strategy
III. Pedestrianisation strategy
IV. Travel Demand Management Strategy

9.2. Mobility Corridors

Roads can be classified based on their functionality as Arterial, Sub – Arterial, Collector / distributor and local streets. This is important to standardize the design and management of the roadways. Even though the hierarchy of roads exists in Gangtok the roads are not maintained according to the required standards. By designating roads as mobility corridors, these corridors should get priority for increasing the through put as well as to ensure desirable speeds of traffic.

9.3. Public Transit Improvement Strategy

One of the strategies identified as part of the vision is to increase the public transport share to 80%. The existing level is about 2% and in the future if nothing is done it is estimated that the share will deteriorate even further. For this purpose various technology alternatives in public transport are being considered.

The existing modal split in favor of public transport is 2%. To increase the public transport trips to 80% various technology alternatives in public transport are being considered. The alternate scenarios are:

- Do Nothing
- Augment existing operations
- Route Rationalization of existing operations
- Route Rationalization of existing operations + Ring and Radial Corridor development

Do Nothing

This scenario assumes that no major improvements are anticipated. The changes contemplated will be limited to most improvement options such as providing bus shelters etc. The existing urban transport model is used to simulate the traffic

characteristics under this scenario

Assuming, no increase in fleet and subsequent increase in load factor, the number of PT trips the system can sustain over the horizon years.

Table 9.1: Projected Modal Split in Do – Nothing Scenario

	2009	2021	2031	2041
Total Demand	79368	130523	233747	418605
Modal Share	1%	2%	2%	2.5%

Augment Existing Operations

One of the ways of increasing public trips is through the provision of bus fleet augmentation. As part of this scenario, City bus authorities will be required to increase the existing fleet with most likely additional routes as well. The services offered would be through a variety of bus sizes suitable for segments and services without ITS operations.

The bus fleet augmentation should focus on modern buses where choice of bus technology is important, as it will strongly influence the system's performance and commuter perceptions. Vehicles have direct impact on speed, capacity, environmental friendliness and comfort.

BRT Based Public Transport Plan

One of the successful ways of increasing the public transport trips in addition to the fleet augmentation is to increase the speed and capacity of the public transportation system by way of dedicated public transport corridors. A public transport corridor is an alignment mostly on existing transport network system with at grade or grade separated supported by dedicated carriageway to carry public transport trips.

But, as the ROW in Gangtok does not allow proposal of BRT or dedicated lanes, BRT should not be proposed in Gangtok.

Ring and Radial Roads Based Public Transport Plan

Following circumferential and radial corridors are considered for implantation.

- Inner Ring Road (To be Constructed)
- Outer Ring Road (To be Constructed)

9.4. Typical Segregation of NMVs

Footpaths

A significant portion of the trips (43 %) are made completely by walk. Sidewalks and stairs have valuable community benefits. The following is suggested for the installation and maintenance of footpaths:

I. Foot path and stairs are to be constructed on the proposed mobility corridors and also the secondary arterials, as a minimum requirement. It should also be provided in all the residential roads, wherever possible.
II. Encroachments on footpaths to be removed. Any further obstruction like tress etc to be relocated.
III. The footpath design should be comfortable to all class of users. The height should be easily accessible by children, old people, women, etc. Also, it must discourage two wheelers using the footpath.
IV. At signalized intersections, pedestrian zebra crossings must be clearly marked
V. Footpaths at all busy intersections must be provided with handrails to enforce pedestrian cross at zebra crossings.

The different types of pedestrian crossings that can be developed are given below:

I. Zebra Crossing
II. Special Signals consisting of electric lamps or light – emitting diode
III. Skywalks , Subways
IV. Special Signals and Markings for pedestrian movement and to stop vehicles in the way of foot traffic
V. Pedestrian refuges
VI. Pelican Crossings
VII. Pedestrian Crossing as shown in Figure 5.10

9.5. Traffic Management

Traffic Management will include the following:

- Junction Improvements
- Traffic Management Measures
- Safety Measures
- Parking Management Measures

Traffic Management Measures

The inventory of the roads undertaken revealed that road space allocation on some roads do not allow any major restructuring. The ROW range from 6 – 14 meters. In such a situation certain traffic management measures need to be adopted to allow smooth operation of traffic. The areas that need special focus in abating the current situation that they are facing certain traffic management measures may be adopted, after careful analysis/ study of the following areas.

Safety Measures

The major accident causative factors emerging from an analysis of accident data, as well as interaction with various types of road users and police authorities are as under;

- Poor road geometrics
- Insufficient street furniture
- Lack of pedestrians facilities
- Ineffective traffic control measures

Based on preliminary road safety audit of project roads and detailed analysis of road accident data, possible improvement measures for typical black spot sites are as follows;

1. Intersections / Junctions

- Channelisation / Signalisation to reduce conflict points
- Adequate street furniture

- Proper maintenance of road signs and road markings
- Footpaths with guardrails for safe pedestrian movements

2. Road links / mid blocks

- Provision of adequate hard shoulders for traffic segregation
- Lane markings, road edge markings with retro reflective paints
- Provision of adequate street lighting
- Painting parapet walls / railings by retro reflective paintings at frequent intervals
- Raised footpaths

3. Sharp curves

- Realignment of curves by improving the radii
- Provision of adequate super elevation and extra widening

6. Urban areas

- Provision of pedestrian footpath with guardrails
- Provision of pelican signals and raised pedestrian crossings
- Provision of adequate off-street parking to avoid on-street parking
- Provision of bus bays
- Provision of adequate street lighting

7. Traffic control and management measures

- Installation of adequate retro-reflective traffic signs and markings
- Provision of object / obstruction markings and delineators with reflectors
- Provision of bypasses at major settlements
- Traffic control, regulation and management devices

8. Enforcement measures

- Training for enforcement personnel for efficient enforcement
- Speed control by road signs, traffic calming measures and enforcement measures
- Helmets for two wheelers to be made mandatory to avoid casualties

- Seat belts for cars to be made mandatory to avoid casualties
- Parking control on streets to retain capacity for traffic movement
- Driving under the influence of alcohol and drugs should be strictly controlled

Parking Management Plan

As part of the principles upon which the CMP is being developed it is envisaged that strategic parking lots would be developed and integrated with the CMP elements. The parking structures, either isolated or integrated with the public transport terminals, should meet some or all of the following requirements before implementation:

I. The parking must facilitate public transport
II. The parking must facilitate non – motorized transport
III. The parking lots should improve off – set removal of on – street parking

A parking policy needs to be devised for long term vehicle parking. Measures like car pooling, public transport connectivity in peak hours to be used to reduce usage of private vehicles.

CHAPTER 10

TRAVEL DEMAND FORECAST

10 TRAVEL DEMAND FORECAST

10.1. Short Term Improvement Plan

The conventional approach is to prepare a short term improvement plan to take care of the priority areas in the city. Long term improvement plans will be included in the scenarios to be discussed in coming chapters.

'Do Nothing' scenario with respect to the development of transport facility and assess what the problems would emerge with the expected growth of population and along with future travel demand towards horizon years 2021, 2031, 2041. In Do Nothing Scenario will be available by the horizon years therefore would be a 'Do minimum' situation with some of the spot improvement plans and traffic management plans to be carried out. The Do-minimum assignment was carried out for the horizon years to identify the bottlenecks, over capacity links etc. With this it is possible to identify the major constraints in the network. Once the constraints are identified it is easy to formulate schemes to overcome the problems. New infrastructure, traffic management plans, and policy controls can be worked out with the help of identified schemes.

In the Do – Nothing Scenario, any fleet augmentation or route rationalization is not expected. The only assumption that is made is that the existing fleet is used attain its maximum load factor.

There would be an increase in traffic volume on most of the road network beyond its capacity. Peak hour traffic assignment on the road network for the year 2021, 2031, 2041 is shown in Table 10.1.

Table 10.1 Modal Split – Present and Forecasted – Do Nothing Scenario

Modes	Modal Split (incl. walk)	
	Base Year Scenario - 2009	
	Daily Person Trips (Lakhs)	%age
Private	12297	56%
Bus	29	1%
Horizon Year Scenario – 2021		
Private	73093	56%
Bus	2610	2%
Horizon Year Scenario – 2031		
Private	128561	55%
Bus	4675	2%
Horizon Year Scenario – 2041		
Private	228140	54.5%
Bus	10465	2.5%

The traffic characteristics of the study area extracted from the model in terms of average network, speed, vehicle distance traveled, total passenger hours etc is given in Table 9.1 for the horizon years. There would be an increase in traffic volume on most of the road network beyond its capacity. The V/C ratio for the entire network for the horizon years 2021, 2031 and 2041 is given in Map 10.1, Map 10.2 and Map 10.3 respectively.

By 2021, as it is seen in Map 10.1, by 2021, that links emerging out of the city would be clogged except at the top most end the town. The Volume by Capacity ratio on NH 31 would also be nearing capacity saturation. The city core would continue to remain congested.

By 2031, the number of roads with volume by capacity ratio greater than 0.5 would increase further. Parts of arterial would also be congested.

It is observed from the figure that the traffic movements would be heavy on the arterial leading to the city core along with some major roads connecting CBD area leading to reduction in travel speeds and increase in V/C ratio.

The V/C is exorbitantly high and indicates jamming conditions in the horizon years. Thus there is a requirement to augment capacity as well as to make significant changes in travel patterns for smooth operations of the traffic. The Estimated Travel under various parameters of the Do Nothing Scenario is given in Table 10.2.

Table 10.2: Estimated Travel under various parameters – Do Nothing

Estimated Travel under various parameters	2021	2031	2041
Trips Assigned (Peak Hour)	2975	4665	7663
Average Network Speed	31	28	23
Vehicle Km – (Peak Hour)	177273	255181	393885
Vehicle Hour (Peak Hour)	575655	829670	1282491

As it can be seen from the above analysis, the traffic and travel situation without any significant improvement would be difficult to manage and result in absolute chaos. This would affect the growth potential and tourism of the city. Thus to develop the city into a world class tourist and IT city, various strategies have to be initiated. Therefore, the combination of various strategies designed to improve the quality of traffic operation has been envisaged emerging as Scenario 2.

10.2. Scenario

Considering the evaluation of the above scenario, the most important issue to reduce traffic will be to increase the share of trips by public / mass transport. This will mean providing public transport services on all corridors. The various strategies to be developed in Scenario 2 are given below.

I. Development of Tourist Centers
II. Development of Mobility Corridors
III. Missing Links to increase walkability index
IV. Bus Augmentation / Route Rationalization

V. Integrated Public Transit Network Planning
VI. Access to the public transit network that includes integration with auto rickshaws, taxis and NMT modes
VII. Safety Measures for NMT at junctions
VIII. Restricted delivery times in CBD
IX. Junction Improvements
X. Blackspot Identification and eleimination of Traffic
XI. Road Maintenance & Management Plan
XII. Encroachers / Hawker Management
XIII. Parking Control

Strategy I Network Improvement Plan

The base year network was updated by including identified and committed road and additional public transport routes to form the forecast the network which includes base year network with proposed link speeds. With the proposal of removal of on street parking from almost all over the city, improvement of link speeds is anticipated.

Based on the assignment for the horizon year it is observed that there are certain stretch of roads which will be overloaded and will not be able to accommodate the future traffic. The list of roads that are congested are given below in Table 10.3.

Table 10.3: Estimated Travel under various parameters – Do Nothing

Road Name
NH 31 (near Manipal hospital)
NH 31 (near Sikkim Govt. College)
NH 31 (at meeting point of Tadong to Zero point road)
Tadang to Zero Point road (Forest Secretariate)
Tadong to Zero Point road (Police Station)
NH 31 (DC OFICE)
Bhanu Path

Strategy II Improvement of Public Transport System

Considering the present modal split, the most important issue to reduce road traffic will be to increase the share of trips by public/mass transport. This will mean augmenting the public transport operations. The alternate scenarios considered are:

I. Enhance Bus System, including Route Rationalization
II. Bus System + Introducing Ropeway as a Public Transport mode

This scenario aims at improved traffic transportation by enhancing the bus system including route rationalization.

Once the evaluation of above scenario is made, the crucial issue emerging out is reduction of private vehicular trips i.e. to increase the share of public transport. For this scenario, it is proposed to increase the modal split for the horizon years. The targeted modal split for the horizon year is given below in Table10.4.

Table 10.4: Targeted Modal Split

Year	Targeted Modal Split
2021	20%
2031	30%
2041	40%

The improved public transportation and associated improvements to the study area would substantially shift the travel patterns of the study area. Results from the travel demand model indicate that after implementing the public corridors and the other necessary proposals public transport share of the trips would increase to approximately 35% – 40% of the motorized trips. To further increase in public transport modal shares additional demand management interventions are necessary:

- Corridor densification
- Limited availability of parking as well as high parking fees
- Congestion charges

Parking Management Plan

Presently most of the roads in Gangtok have on street parking. Parking control is important for many considerations including the following:

- Control the personalized vehicles plying in the system

- Potential to augment and facilitate the public transport corridor ridership
- Loss in the throughput of the adjacent street due to parking interface
- Consolidation of the on – street parking
- Gain / loss of the business of the commercial uses on the street
- Revenue generation potential through parking charges
- Facilitate pedestrianisation policy

Strategy III: Development of Mobility Corridors

Functional classification of the urban roads is an important step wherein design and management of the roadway would be standardized. Functionally, urban roads are classified as Arterial, Sub – arterial, Collector / Distributor and Local Streets. In Gangtok, even though the hierarch of roads exist the roads are not maintained according to the required standards. By designating certain roads as mobility corridors, these corridors get priority for increasing the throughput as well as operating level of service. Therefore for a mobility corridor increasing the throughput as well as speeds would then be focused and appropriate solutions have been proposed.

Peak hour traffic assignment on the road network for this scenario for the horizon years 2021, 2031 and 2041 is shown in Map 10.4, Map10.5 and Map10.6.

It is observed that there is significant reduction in traffic volume on many roads with increase in passenger trips on mass transport network. The daily trips assigned in the proposed network for horizon years are given below in Table 10.5.

Strategy IV: Non Motorized Plan

The Non – Motorized Plans are summarized below:

- Install Footpaths
- Install Pedestrian Grade Separated Facilities
- Encourage and Designate Pedestrianisation in Core Area

The Table 10.5 presents the public and private trip distribution for the horizon years 2021, 2031 and 2041. This improvement is expected with increase in the modal split in

favor of public transport system.

Table 10.5: Modal Split – Base and Horizon Year – Scenario 2

Modes	Modal Split (incl. walk)	
	Base Year Scenario - 2009	
	Daily Trips	**%age**
Private	12297	56%
Bus	29	1%
Horizon Year Scenario – 2021		
Private	39157	30%
Bus	26105	20%
Horizon Year Scenario – 2031		
Private	44412	19%
Bus	70124	30%
Horizon Year Scenario – 2041		
Private	41860	10%
Bus	167442	40%

Public transport network has been upgraded by adding new buses in the fleet.

As the above frequencies calculations suggest large fleet size, it is difficult to sustain the same in a city like Gangtok. Given the limitation of ROW in Gangtok, it is essential to plan a system with greater throughput which can help achieve the targeted modal split.

The desire line diagram for this scenario for different years is shown in Map 10.7, Map 10.8 and Map 10.9. It is observed that there is significant reduction in traffic volume on many roads with increase in passenger trips on mass transport network. The daily trips assigned for horizon years are given below in Table 10.5

As the share of public transport increases traffic loading on the network reduces which is reflected in the improved V/C ratio as given in Table 10.5 below:

Table 10.5: v/c Ratio

S.No	Name of the Road	V / C ratio		
		2021	**2031**	**2041**
1	NH 31 (near Manipal hospital)	1.22	1.48	1.40
2	NH 31 (near Sikkim Govt. College)	1.36	1.70	1.68
3	NH 31 (at meeting point of Tadong to Zero point road)	1.52	2.00	2.10
4	Tadang to Zero Point road (Forest Secretariate)	0.52	1.38	1.44
5	Tadong to Zero Point road (Police Station)	0.64	0.84	0.90
6	NH 31 (DC OFICE)	0.44	0.50	0.66
7	Bhanu Path	0.40	0.60	0.70
8	Chandmari	0.58	0.72	0.84

The change in modal split changes the major corridors of movement. Thus it is important to understand the Desire Line of Travel and any emerging mobility corridors for private as well as public vehicles. The Map 10.7, Map 10.8, Map 10.9 gives the desire line for 2021, 2031 and 2041 for private as well as public vehicles.

Desire line diagram for 2021 gives clear idea about maximum trips will generate/starts from Deorali, Development Area, Lower MG Marg, Ranipool ward and also from siliguri road outer corden point.These all areas are mostly residential or mixed landuse areas.
Most of the trips will end at Chandmari, Deorali, Lower M G Road, Ranipool. These all areas are either commercial or institutional. Out of seven cordon points 2 are predominantly seen as major destination those are Setipool Road connecting Gangtok to Pakyong and Ranipool outer cordon point connecting to Silliguri/ Kalingpong/ Darjeeling. Details of this is shown in Map 10.7

Desireline Diagram for 2021:

Table 10.6: Matrix of trip generation and distribution for the year 2021.

ZONES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Total
1	12	0	3	0	7	5	3	7	3	0	0	5	9	17	0	0	0	0	4	1	1	8	85
2	0	27	5	0	4	8	5	11	3	1	3	1	5	5	1	0	0	10	5	2	12	10	118
3	0	1	5	4	6	19	0	7	8	0	1	0	0	1	0	0	0	8	6	2	1	11	80
4	0	0	6	6	5	2	3	7	3	9	0	8	0	1	1	0	0	0	7	1	2	9	70
5	3	1	6	5	7	11	6	26	5	1	1	5	1	1	4	0	0	1	9	2	9	47	151
6	1	3	29	1	10	14	3	8	1	3	0	3	0	5	1	0	0	0	11	2	3	7	105
7	1	3	0	2	5	2	25	3	2	1	2	2	1	2	2	1	0	0	6	2	5	15	82
8	3	3	5	3	9	3	1	28	5	3	2	9	0	4	0	0	0	0	3	4	1	15	101
9	0	0	8	3	3	0	2	9	24	2	0	6	2	1	1	0	0	0	5	1	4	8	79
10	0	0	0	5	0	1	1	7	2	37	0	2	0	0	0	5	0	0	51	18	3	15	147
11	0	1	14	0	2	2	5	13	0	0	19	5	5	1	2	0	0	0	3	3	1	1	77
12	1	0	0	3	3	1	1	10	5	1	0	1	0	0	1	0	0	0	16	5	7	39	94
13	3	3	5	1	2	0	2	1	3	0	4	2	19	3	2	0	0	0	3	0	3	7	63
14	4	1	1	0	1	3	2	5	0	0	2	2	5	9	0	0	0	0	3	0	2	5	45
15	0	1	0	1	8	0	1	1	4	2	1	3	0	2	24	0	0	0	3	0	4	7	62
16	0	0	0	0	0	0	0	1	0	4	0	0	0	0	0	0	0	0	0	1	0	2	8
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	4	5	3	3	7	4	5	6	6	1	3	2	2	2	1	0	0	0	0	0	0	2	56
19	3	3	3	2	3	4	4	4	3	10	1	1	1	1	1	0	0	3	8	0	3	4	62
20	0	2	1	1	3	1	2	3	3	14	0	4	1	0	2	1	0	0	9	3	3	12	65
21	2	9	2	3	4	1	2	2	3	2	0	2	1	0	2	0	0	0	2	0	7	1	45
22	5	4	7	6	30	7	10	22	6	13	3	18	4	3	3	1	0	2	17	7	7	1	176
Total	42	67	103	49	119	88	83	181	89	104	42	81	56	58	48	8	0	24	171	54	78	226	1771

Future projections for 2031 shows that maximum trips will generate from Deorali, Bhurtuk, Developemnt Area, Lower M. G. Marg and Ranipool wards and outer cordon point i.e. Ranipool connecting Gangtok to Siliguri/ Darjeeling. Except M.G. Road which is commercial area rest all wards are mixed as weel as residential areas.

Destination of maximum trip will be Chandmari (Institutional+Residential), Deorali (Institutional+ Commercial+Residential), Development area (Office+ Residential) and Lower M. G. Marg (Commercial Area). Outer corden points will be Rumtek satellite town of Gangtok and Ranipool connecting Gangtok to Siliguri. Details of this desire line are shown in Map 10.8

Desireline Diagram for 2031:

Table 10.7 : Matrix of trip generation and distribution for the year 2031.

ZONES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Total
1	19	0	6	0	12	9	6	12	6	0	0	9	16	31	0	0	0	0	5	1	1	9	142
2	0	48	10	0	7	14	10	19	5	2	5	2	10	10	2	0	0	10	6	2	13	11	186
3	1	3	9	7	10	35	1	13	14	0	3	1	0	2	1	0	0	9	6	2	1	12	130
4	0	0	11	11	10	3	6	13	6	15	0	14	0	1	1	0	0	0	7	1	2	10	111
5	5	1	11	9	13	20	11	47	9	3	1	9	1	3	6	0	0	1	10	3	9	49	221
6	2	6	51	2	18	26	5	15	1	5	0	6	0	9	1	0	0	0	12	2	3	7	171
7	2	5	0	4	8	4	44	5	3	2	4	4	1	4	3	1	0	0	6	3	5	15	123
8	5	6	8	5	15	5	1	51	9	6	3	16	0	6	0	0	0	0	4	4	1	15	160
9	1	1	13	4	4	1	3	16	43	4	0	11	3	2	2	0	0	0	5	1	4	8	126
10	0	1	1	8	1	3	3	12	4	67	0	4	0	0	1	5	0	1	53	19	3	16	202
11	0	1	26	0	3	3	9	23	0	0	34	8	9	1	3	0	0	0	3	3	2	1	129
12	1	1	0	5	5	3	2	18	9	3	0	2	0	0	1	0	0	0	17	5	7	40	119
13	5	5	9	1	3	0	4	1	5	0	7	3	34	5	3	0	0	0	3	0	3	7	98
14	7	1	2	1	2	5	3	9	1	0	3	4	8	17	1	0	0	0	3	0	2	6	75
15	0	2	0	2	14	0	2	2	8	4	2	6	0	4	43	0	0	0	3	0	4	8	104
16	0	0	0	0	0	0	0	1	0	4	0	0	0	0	0	0	0	0	0	1	0	2	8
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	4	5	3	3	7	4	6	6	6	1	3	2	2	2	1	0	0	0	0	0	0	2	57
19	3	4	3	2	3	4	4	4	3	10	1	1	1	1	1	0	0	3	9	0	3	4	64
20	0	2	2	1	3	1	2	3	3	15	1	4	1	0	3	1	0	0	9	3	3	13	70
21	3	10	2	3	4	2	2	2	3	2	0	3	1	1	2	0	0	0	2	0	8	1	51
22	5	5	7	6	31	8	10	23	6	14	3	18	5	4	3	1	0	2	18	7	7	2	185
Total	63	107	174	74	173	150	134	295	144	157	70	127	92	103	78	8	0	26	181	57	81	238	2532

Desire line matrix gives clear idea for year 2041. In future maximum trip will be generated from following wards. Bhurtuk (Residential), Deorali (Mixed), Ranipool (Mixed) and outer cordon point will be Ranipool.

In future maximum trip will be destined to following wards.Chandmari (Institutional+Residential), Deorali (Mixed), Lower M. G. Marg(Commercial) and Ranipool outer cordon point.Deside line for 2041 is shown in Map 10.9.

These assignments reveal that there are certain stretches of roads in the core area that are still overloaded as they are being used by both private vehicles and PT. Hence it is required to augment capacity of roads or introduce Ropeways in order to accommodate traffic.

The Estimated Travel under various parameters of Scenario 2 is given in Table 10.8

Desireline Diagram for 2041:

Table 10.8: Matrix of trip generation and distribution for the year 2041

ZONES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Total
1	24	0	7	0	14	10	7	14	7	0	0	10	17	34	0	0	0	0	5	1	1	9	160
2	0	53	11	0	8	16	11	21	5	3	5	3	11	11	3	0	0	10	6	2	13	11	203
3	1	3	10	7	11	38	1	14	16	0	3	1	0	2	1	1	0	9	6	2	1	12	139
4	0	0	12	12	11	3	6	14	6	17	0	15	0	2	2	0	0	0	7	1	2	10	120
5	6	1	13	10	14	22	13	52	10	3	1	10	1	3	7	0	0	1	10	3	9	51	240
6	3	7	57	3	20	28	5	16	1	5	0	7	0	9	1	0	0	0	12	2	3	7	186
7	2	6	0	4	9	4	49	6	3	2	4	4	1	4	3	1	0	0	6	3	6	16	133
8	5	7	9	5	17	6	2	56	10	7	3	17	1	7	1	0	0	0	4	4	1	16	178
9	1	1	15	5	5	1	3	18	47	4	0	12	3	2	2	0	0	0	5	2	4	9	139
10	0	1	1	9	1	3	3	13	5	74	0	5	0	0	1	6	0	1	55	20	3	17	218
11	0	1	28	0	3	3	10	25	0	0	37	9	10	1	3	0	0	0	4	3	2	1	140
12	1	1	0	6	5	3	2	20	10	3	0	2	0	0	1	0	0	0	17	5	8	42	126
13	6	6	10	1	3	0	4	1	6	0	7	3	37	6	3	0	0	0	3	1	4	8	109
14	8	2	2	1	2	5	3	10	1	0	4	5	9	19	1	0	0	0	4	0	2	6	84
15	0	2	0	2	15	0	2	2	9	4	2	6	0	4	47	0	0	0	3	0	4	8	110
16	0	0	0	0	0	1	0	1	0	4	0	1	0	0	0	0	0	0	0	2	0	2	11
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	4	5	3	3	8	4	6	6	7	1	3	2	2	2	1	0	0	0	0	0	0	2	59
19	3	4	3	2	3	4	4	4	3	11	1	2	1	1	1	0	0	3	9	0	3	4	66
20	0	2	2	1	4	2	2	3	3	15	1	5	1	0	3	1	0	0	9	3	3	13	73
21	3	10	3	3	4	2	3	2	4	2	0	3	1	1	3	0	0	0	2	0	8	1	55
22	6	5	8	6	33	8	11	24	7	15	3	19	5	4	4	1	0	2	19	8	7	2	197
Total	73	117	194	80	190	163	147	322	160	170	74	141	100	112	88	10	0	26	186	62	84	247	**2746**

Table 10.9: Estimated Travel under various parameters – Scenario 2

Estimated Travel under various parameters	2021	2031	2041
Trips Assigned (Peak Hour)	2185	3245	3120
Average Network Speed	35.20	27.23	32.26
Vehicle Km – (Peak Hour)	143514	193947	190593
Vehicle Hour (Peak Hour)	379123	516463	506589

10.3. Scenario 3: Introduction of Mass Transport System and network up gradation with inner and outer ring road.

Considering that many of the road corridors will still be overloaded in Scenario 2, the ropeway transport network and road network has to be introduced on certain network. The basic premise of the Transport Plan in terms of the National Urban Transport Policy is to create an efficient, cost effective and extensive network of public transport which could provide comfortable, convenient and affordable means of transport to the maximum number of commuters. In this direction a number of schemes are already under implementation and quite a few on board. Keeping in view these plans, there exists a large requirement for additional facilities in respect of public / mass transport system.

The network improvement as suggested in Scenario 2 remains same in Scenario 3. In addition, the inner ring road is also proposed to be widened. The details of the same are given in Section 3.2.

As many of the road corridors will still be overloaded in Scenario 2, the public/mass transport will be extended on the following corridors in scenario 3:

1. Mass Transport Network and Major Road Network as in Scenario 2
2. Additional Ropeway Transport Corridors which have emerged due to targeted modal split and change in travel patterns

Ropeway is one of the most cost effective public transport modes where the given condition can be met:

- Limitations regarding Right of Way along the corridor to provide for exclusive

carriageways for higher grade of PT as BRT

The land-use and transport strategy, developing of mobility corridors, Freight management Strategy, Public Transport Terminal Plans, Traffic engineering measures are the same as Scenario 2. The public transport facilities and integration of the same with pedestrian facilities enhancements strategies would be incorporated in Scenario 3.

Expected modal split for Scenario 3 for horizons year 2021, 2031 and 2041 is shown in Table 10.11. As the share of person trips for public/mass transport is targeted to increase to 80% by 2041 as it is desirable for Gangtok city. The increase in modal split is attributed to the expected shift of people from private to public due to the improved public transport system.

The willingness of the people opting to shift is calculated based on the data given below in Table 10.10.

Table 10.10: Willingness to Shift

Stakeholders/ Experts Opinion	%
Cars	20%
Taxi	80%

This translates to 24.4 % of the users of other modes shifting to the use of buses. At a conservative year on year growth this is targeted to result in a modal split of 60% for 2041, 70% for 2031 and 80% for 2041.

The modal split for scenario 3 is given below in Table 10.11.

Table 10.11: Modal Split – Base and Horizon

Modes	Modal Split (excl. walk)	
	Base Year Scenario – 2009	
	Daily Trips (Lakhs)	**%age**
Private	12297	56%
Bus	29	1%
Horizon Year Scenario – 2021		
Private	26105	40%
Bus	39157	60%
Horizon Year Scenario – 2031		
Private	35062	30%
Bus	81811	70%
Horizon Year Scenario – 2041		
Private	41860	20%
Bus	167442	80%

As it can be seen from the Table 10.12 (given below), certain stretches still have unacceptable values of V/ C ratios. In such a case it is necessary to find alternatives to control private vehicular movement on such stretches. Some measures that can be adopted are as follows:

- One way schemes
- Banning of Private Vehicles during peak hours
- Operating the battery operated medium capacity buses to reach the city core.

Estimated Travel under various parameters – Scenario 3

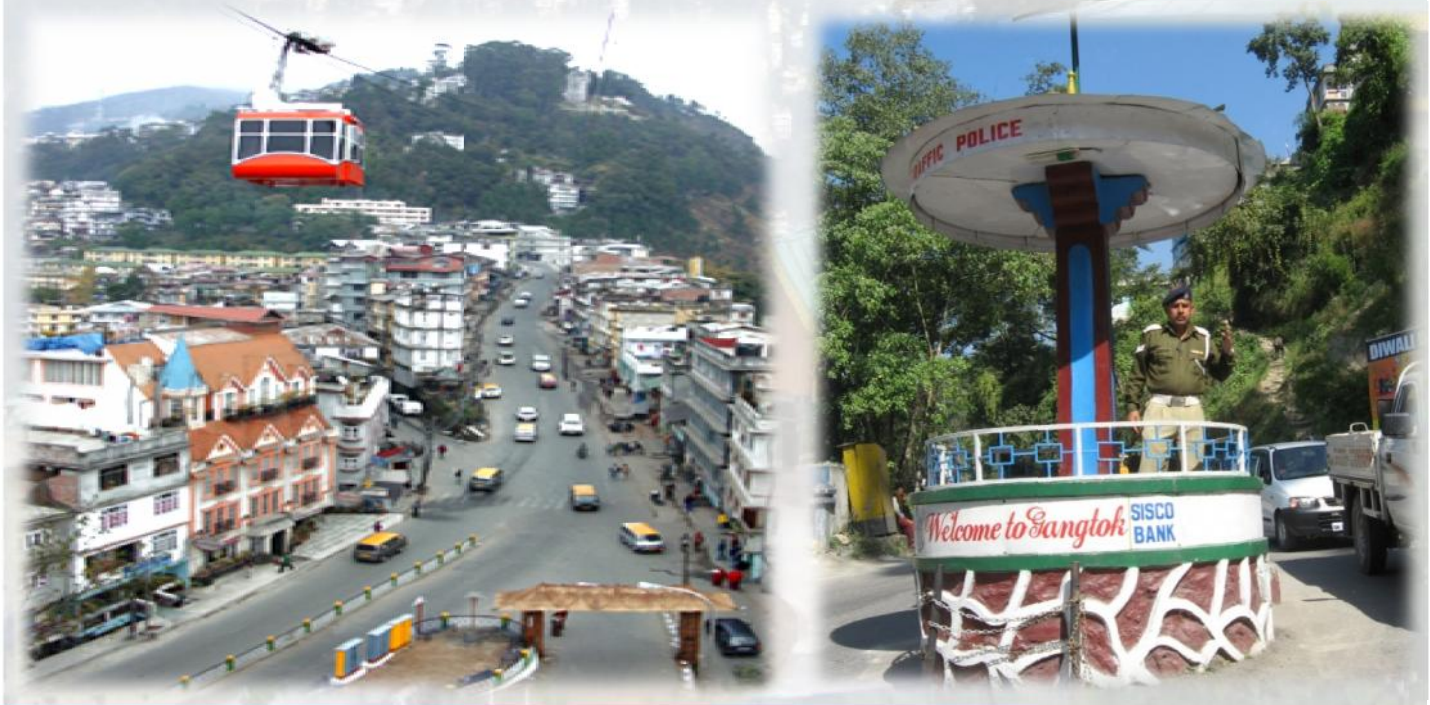
The Estimated Travel under various parameters for Scenario 3 is given in Table 10.12.(Map 10.10, 10.11,10.12)

Table 10.12: Traffic Characteristic

Estimated Travel under various parameters	2021	2031	2041
Trips Assigned (Peak Hour)	3574	5067	5492
Average Network Speed	35	37	3634
Vehicle Km – (Peak Hour)	113093	147773	159393
Vehicle Hour (Peak Hour)	278421	367974	397058

CHAPTER 11

EVOLUTION OF SCENARIOS



11 Evolution of Scenarios

Different scenarios have been developed for the city to cater the expected growth in terms of traffic and travel demand. All the scenarios are formulated with a holistic view of reducing the resistance to travel thus lowering the time and effort to be input for commuting thus reducing not only the direct costs but also the social costs involved with the same. Also, consultants aim to enhance the mobility index of the city by incorporating efficient public transport strategies.

All the scenarios developed are evaluated in comparison to each other in the given table below. The scenario best suited for the city of Gangtok can be shortlisted from this comparative picture as given in Table 11.1.

Table 11.1: Best Scenario Selection

S.No	Travel Characteristics	Base Case – 2009	Scenario 1 – Do Nothing 2041	Scenario 2 - 2041	Scenario 3 - 2041
1	Vehicle Kms	1,61,491	3,93,885	1,90,593	1,59,393
2	Vehicle Hours	5,23,759	1,28,2491	5,06,589	3,97,058
3	Average Network Speed	26.00	21.00	25.26	36.00

11.1. Recommended Scenario

Consultant's approach is to create an urban transport scenario with least resistance and enhanced mobility. The transport scenario should be such that transport continues to be an induced demand and does not changes into an activity itself i.e. the role of transport systems should be of facilitating connectivity and not resisting it consuming indefinite passenger hours leading to lower productivity and high social costs.

All the scenarios discussed above have their own set of pros and cons. Still, scenario 3 where consultants propose a high modal split for public transport and support the modal share assumption by proposing a Rapid Transit System i.e. BRTS, is considered to be the best scenario achieved.

The reasoning behind considering the scenario 3 to be of high utility value is

- Higher modal split in favor of PT
- Provision of Ropeway System to stimulate modal shift from private to public
- Proposal of capacity augmentation on critical road sections
- Proposal of ring road to by pass through traffic

CHAPTER 12

PUBLIC TRANSPORT IMPROVEMENT PLAN

12 PUBLIC TRANSPORT IMPROVEMENT PLAN

12.1. Public Transport Characteristics

12.1.1. Existing Scenario

SNT is basically responsible to provide public transport service to the people of Sikkim. Interestingly, the entire bus passenger transport in the state is nationalized and no private bus operators are seen. Currently, SNT has a fleet of 75 buses and 83 trucks/tankers. SNT operates throughout the state on major arterial roads v.i.z NH-31 Gangtok to Siliguri, Gangtok to Mangan, Gangtok to Jorethang and Gangtok to Rangli towards east. Total manpower in SNT is about 900. SNT operates with 35 bus routes throughout the state. There are 3 depots at Gangtok, Jorethang and Rangpo. The share of public transport system on Indian roads is declining with Sikkim being no exception. The operation of the public transport system being provided by Sikkim Nationalised Transport is currently on a decline with reduction in the size of its fleet over the past years. Total number of buses with SNT was 75 as on 31st March 2008. During the last decade, the bus fleet has declined by 48.28% and the truck/tanker fleet has reduced by 45.75%. It is observed that post 1998; the fleet size of SNT has reduced considerably. The city bus service of SNT runs from 7 a.m. to 6 pm in the evening. SNT has about 10 buses attached purely for catering of school trips.

Currently, about 5 buses are catering to the city services in Gangtok by the name of Red Panda City Runner. The city buses run on five routes with one bus on each route, a frequency of one hour and four round trips during 0700 hrs and 1800 hrs. The city buses run with an average fuel efficiency of 4.08 kmpl, an EPKM of around Rs. 18.45 and Rs. 1.20 as the average fare per kilomter.

Details of Existing Routes

Details of the existing routes of SNT city services are given in Table 12.1.

Table 12.1: Details of Existing Routes of SNT City Services

Sl. No.	Origin	Destination	Seating Capacity	EPKM (Rs.)	Route Length (km)	Fare (Rs.)	Fare per kilomter (Rs.)
1	Gangtok	Penlong	28	17.5	12	11	0.92
2	Gangtok	Setipool	33	16.1	11	16	1.45
3	Gangtok	Jalipool	33	16.8	15	15	1.00
4	Gangtok	Rumtek	28	16.3			
5	Gangtok	Marchak	28	14.4			

12.1.2. Present Bus Station and Bus Stops

Bus terminals serving both the interstate as well as intra state buses exist at P.S. Road and Police Head Quarters. The bus terminal consists of seven bus bays. It is proposed to come up with the second phase of the bus terminal constituting of another seven bays in the same location. But the area is presently also being used by the local taxi and private vehicle owners.

12.1.3. Public Transport Plan

The Need:

Currently, SNT is running five buses with low frequency in Gangtok. These buses face severe competition from the local taxi operators owing to their frequency inspite of high fares. SNT is unable to improve the operating conditions of buses for want of funds and are forced to limit them with what they do. Also, there appears to be a very big potential for tourism in Gangtok since this has a very good traditional culture. The Tourism Development department informed that there are a number of enquiries every day regarding the availability of departmental buses for going in and around Gangtok. Hence, there is urgency for the Government to encourage the bus transport service for overall development of Gangtok city. This is a vital lifeline for common man. A modern urban bus transport service with reliable and frequent services in Gangtok is necessary to improve the socio economic conditions of the people at large and induce more people to travel by bus.

After the sanction of 25 buses under JnNURM, SNT has carried out a study for identification of routes for operation of 30 buses (25 JnNURM+5 existing). A scientific analysis was done by SNT for identifying the potential routes for operation of buses based on financial performance, network analysis, routes frequently preferred by

daily commuters and physical constraints. Further, SNT has also carried out the study to find out the best possible way of providing services with intention to reduce the cost of operation, improve the frequency of service and eliminate overlapping of routes with modification in route structure.

Table 12.2: Details of Routes Finaliszed For Opeartion Of City Services

Sno	Origin	Destination	Route Length(km)	Total no of buses proposed	Frequency
1	Gangtok	Lingdok	35	5	60
2	Gangtok	Saramsa	15	6	23
3	Gangtok	Adampool	35	5	60
4	Gangtok Sichey	Luing	20	4	45
5	Gangtok Tashiling Secretariat	Kanchenjunga National Park	25	5	44
6	Gangtok	Bhusuk	15	2	70
TOTAL				27	

Assumptions

Average speed of bus	15.0 Km ph
Layover time at each end	10 minutes
Total working time (6am to 8pm)	12 hrs

In addition to this an additional fleet of 10 buses are required to serve the entire population residing in Gangtok town.

Table 12.3: Detail of Routes

Sl. No.	Origin	Destination	Route Length (km)	Proposed Frequency (minutes)	Buses Required
1	Gangtok Deorali	Central School via Deorali	15	30	5

Route Details

Route: Gangtok to Lingdok

This route is in the North of Gangtok and passes through Balwa Khani, Swastik, Upper Burtuk, Bhojo Garhi, Tashi View Point and Penlong. The length of this route is

approximately 35 kms and it is proposed to operate 5 buses with 60 minutes frequency.

Route: Gangtok to Adampool

The route has a length of 35 kms starting from Gangtok and ending at Adampool. The route passes through important areas like Indira bye pass, Linding, Sang Pong, Resithang, Lingdum Monastery, Ranka, Sazong before reaching Adampool. The estimated total journey time is about 150 minutes. The route is one of the links to areas in west of Gangtok.

Route: Gangtok Sichey to Luing

Gangtok Sichey to Luing route has 20 kms of route length. The estimated journey time is 90 minutes. The route connects various areas like Tamang Gumpa, Sichey Busti, District Administration Centre, Zakri Fall Road bifurcating at DAC, Lower Burtuk, Helipad, Thami Dara and Luing.

Route: Gangtok to Saramsa

This route is one of the potential routes connecting Gangtok and Saramsa with route length of 15 kms passing through various ares like Deorali, Biralu Dwar, Tadong Bazaar, Manipal Referral Hospital, Ranipool, Jalipool and Setipool.

Route: Gangtok Tashiling Secretariat to Kanchenjunga National Park

This route is originating from Tashiling Secretariat and terminates at Kanchenjunga National Park passing through Tathangchen, Chandmari, Enchey Monastery, Decheling, 2nd Mile, Hanuman Tok (route bifurcates near Luksha) and Ganesh Tok. This route is in th eastern direction of Gangtok. This is one of the major routes comprising of tourist spots and most of the government offices are also located along this route.

Route: Gangtok to Bhusuk

Gangtok to Bhusuk route has 15 kms of route length. The route connects various areas like Bhanupath, Tashiling Secretariat, Thadangchen, Chandmari and Rongek.

12.2. Efficiency Improvement Measures Taken up by SNT

For the purpose of city operation, scheduling has been changed to 3 shift pattern viz. morning, evening and general shift. In morning and evening shift approximately 40% of the schedules will depart and in general shift 60% of the schedules will depart. The reason for adopting this kind of a scenario is that in early morning and late evening trips the passenger demand is less and accordingly service level shall be less. During peak hour, the passenger demand also increases and to cater to this buses in general shift will be added to the existing buses.

12.2.1. Details of the institutional measures being put in place for introduction/improvement of the public transport system;

All bus services in the state are provided departmentally through SNT. There is no ULB. SNT will act as the SPV for running the Gangtok Urban Transport service. A dedicated cell has been set up within SNT vide Government Order No. 833/T, dated 07.10.09 with Deputy General Manager as the head. The Deputy General Manager will also be one of the members of the coordination committee.

An officer from Monitoring and Evaluation cell, all officers and staff in Traffic Information and Management control Center at Gangtok bus stand and all officers and staff in Gangtok depot responsible for maintenance and operation of city bus service will be under him.

The Deputy General Manager will be broadly responsible for

- Maintenance of buses
- Planning and operation of City Services
- Implementing the decisions taken by the coordination committee especially related to operation of buses in Gangtok like rerouting, extension, curtailment etc.
- Keeping track of past and present performance through on line revenue information system.
- Scientific amendment in routes as per the requirement; based on field

conditions, periodic study and assessment of travel pattern done by M&E cell.

12.2.2. Infrastructure Arrangements

Presently, SNT has got four depots located all around Sikkim. At Gangtok, the depot and terminal are adjoining with only one way to enter and exit. The depot has some basic infrastructure like maintenance shed to park about four buses at a time, a washing ramp located in the same maintenance shed due to inadequate space. About 10 – 15 buses can be parked inside the depot area. In the same area, there is an old shed that has been formally used as a reconditioning unit with a small machine shop. This shed isn't being utilized fully except it houses maintenance supervisor's room with old machinery now not in use.

12.2.3. Setting up of Modern Vehicle Service Centre

SNT has sizable lot of prime land in Gangtok where the bus terminus, the branch workshop and vehicle service centres are located. This centre has been in operation for many years and it is time, this centre is converted into modern servicing centre with capacity to provide every aspect of servicing facility for all types of vehicles. It is proposed to take up the modernization of the vehicle service centre not only to provide excellent service to commercial vehicles of the transport department but also with a view to cater to the servicing requirements of all non functional vehicles of government departments.

There is a bus terminal adjoining this depot with seven bus bays for parking, loading and unloading of passengers. This has other amenities required for passengers like waiting hall, drinking water, few shops with a canteen in the basement. In addition to this, it has provisions for housing a timekeeper, railway reservation counter, booking counter exclusively for city and mofussil services etc., in the ground floor. The upper floors house the transportation officials and other traffic-inspecting officials.

A portion of this terminal is being used by the RTO's office thereby the entire passenger waiting area, the seven bus bays and the gangway are occupied by the private vehicles and taxis coming up for registration, accident attention, seeking driving licenses etc., denying the legitimate entry of the SNT buses.

A proposal has already been prepared by CIRT in the early 1990s wherein two parts of the bus terminal each for housing seven buses had been planned. Out of these two phases, Phase I has already been executed and completed in full. Phase II for additional facilities is yet to be initiated due to paucity of funds. But a diesel-dispensing pump has been erected and functioning in the location where originally Phase II should have been executed. But during the course of discussions with the officials, they had agreed to shift the existing fuel station to the opposite location within the same campus where there had been a petrol dispensing pump which has been functioning before and now abandoned as there are no more petrol vehicles with SNT. The total extent of the land is only 2.5 acres, the present diesel-dispensing pump is necessarily to be shifted. Hence, we had to built one more stretch of bus bay with an additional seven bays.

As the depot is also very much cramped and inadequate to accommodate the new fleet of about 40 buses, it is necessary to expand the present depot by dismantling the old shed wherein a new maintenance shed can be build for a better facility.

12.3. ITS Facilities Application:

Details of the ITS facilities regarding fare collection system: operation and maintenance system proposed to be put in place.

- The fare collection at present is of manual type in which the conductors carry many denomination tickets in their hands for issue to the passengers. The conductors also have to write in the Trips sheets, the denomination wise closing number of tickets, issued by them to the passengers, at every stage of the route
- However in this JnNURM project for purchase of buses to be operated in Gangtok city, the system of fare collection is changed by including the supply of Electronic Ticketing machine(ETM) per bus by the manufacturer as per the JnNURM guidelines with adequate spares. The manufacturer will be giving training to the conductors for operating the ETM.
- Digital Route Display system is essential especially for the city services in

Gangtok because of the following reasons:

- Vast Informative Capability
- Guides the people to recognize the bus information easily
- Uniformity in the style and design of destination boards
- Commuter benefit especially after sunset

- SNT has decided to upload the information of all the routes operated by Gangtok depot through suitable programme into the processor of digital display board of all the buses operated within the city. The bus driver will have to just select the particular route to be displayed before taking the bus on route and the processor will automatically show the display.
- The facilities like smart card, real time passenger information system and vehicle tracking system are proposed to be implemented in the near future.

12.3.1. Mechanism for information of passenger information system and management; scientific management control/management information system

- In Gangtok, SNT has a depot cum bus station. At the bus station SNT has already has a passenger Information System in place with a centrally located enquiry counter. Following information is given by the depot to the PIS counter
  - Schedule Cancellation
  - Trip Cancellation
  - Late Arrival
  - Break down of bus
- The information of local and interstate arrivals/departure is available with PIS counter because all the schedules have Gangtok bus station as Origin/destination. The scheduled arrival/departure is prominently displayed at the bus station. In case of city operation at major locations SNT has planned manned nodes; the staff deployed at these nodes shall be trained with multi disciplinary skill which includes handling passenger information system,

sharing information with other bus station or nodes etc.

Integration of the services with other public transport system

- SNT buses are the only public transport mode presently running and operating in and around Gangtok. SNT has taken following initiatives as a part of development of transport system in Gangtok
- INTEGRATION WIITH THE INTERSTATE BUS OPERATION: NBSTC is operating its service from Siliguri to Gantok and vice versa; at Gangtok their buses are allowed to come in the central bus station, Gangtok. In addition SNT's own buses from various destinations to Gangtok are terminating at the same place. While planning of city services, SNT has given due consideration to integration with these services.
- INTEGRATION WITH IPT: in gangtok city there are 2 IPT terminus located along the NH31A comprising of terminus for interstate and district transport service located at Paljor Stadium Road for the passengers going from Gangtok to Siliguri, Jorethang etc. and terminus for local transport service located near the Police Headquarters for carrying the passengers within the Gangtok city. SNT has designated bus stop along the route on which these terminus are present.
- COMMITEMENT FOR THE MULTIMODAL INETGRATION OF FUTURESNT would extend its support for multimodal integration for improving efficiency of public transport system as a whole and to contribute significantly in development of Gangtok Urban Area.

12.4. Institutional Mechanism

Institutional Mechanism for periodic studies and assessment of travel pattern

- The objective behind carrying out periodic studies and assessing the travel pattern is to maintain the pace between the ever growing passenger demands with supply of services in a scientific way.
- The team formulated will carry out the scientific planning and operation of buses which includes identification of number of buses required on each route based on desire lines, trip generation and attraction data that is obtained from

the electronic ticketing machines and periodic route survey. In addition scheduling exercises will also be done to analyse new area developments and new route demands, possibility for optimization of routes recommending curtailment, extensions, cut-trips, committed trip requirement, evolving policies for rote planning and operation etc.

Institutional mechanism of periodic revision of fares, but not only city bus service but also other modes of public transport and intermediate public transport.

- In the changing urban scenario, the policy of government should be attract more passengers towards using the public transport and for this it is essential to find the bus fares that are capable of matching the operating expenditure on one hand and be affordable and attractive to the common man on the other
- In Sikkim, the State Transport Authority under the transport department is the permanent regulatory authority for fixing of fares of taxies and other intermediate modes of transport. The fixation of fares of buses and periodic revision is done by the Sikkim Nationalised Transport after approval from Government of Sikkim. Further, it is easier for SNT to keep a close watch on the escalating cost and to identify the stage where it will become inevitable for the SNT to propose for fare increase. Hence the existing mechanism for fares to ensure the financial viability for SNT is adequate for the present.

Self Effective System For Training Of Drivers And Conductors

- The success of the public transport operation depends very much on the skill, competence and aptitude of the people who run and/or work in the operation of buses; there is no denying the fact that skill, competence, and aptitude comes from proper training. Hence the need for training and capacity building cannot be underrated. However, the training to be imparted to the drivers and conductors in city operations needs a customised touch because the problems in urban operations are slightly different than those of non urban operations.
- In the present scenario where SNT is expanding its urban operation in a major

way with latest technology buses equipped with ETM's digital route display boards etc, it is essential to impart training for drivers and conductors. SNT has decided that M/s Tata Motors will train the drivers and conductors for operating new buses fitted with latest technology equipment. Further, SNT has been sending Driver Instructors on regular basis to National Training Organisations and vehicle manufacturers for advanced training programmes.

CHAPTER 13

REGULATORY AND INSTITUTIONAL MEASURES

13 REGULATORY AND INSTITUTIONAL MEASURES

13.1. Introduction

Traffic is generally defined as the movement of people, goods or vehicles between spatially separated points, and thus includes pedestrians and all types of vehicles mechanized, motorized or non-motorized.

Traffic management is the application of sound management principles and practices to optimize the use of the existing road network with a view to improving traffic flow and road safety without impairing environmental quality.

Provision of new urban transport infrastructure is both long term and capital intensive; resources are simply not available at scale that matches the escalating demand.

The only resources open to the traffic management, therefore is the option of optimizing existing facilities to provide improved accessibility and mobility at a satisfactory level of safety and comfort to most of the road users. This can be achieved after studying and evaluating the problems in the light of sound and tested traffic management techniques which are essentially low cost, easily implementable and flexible. These are short term solutions, primarily intended to reduce the intensity of inconvenience caused by congestion and the multiplicity of the modes of transport conflictingly trying for the same space. They may not offer a permanent solution, yet they lend themselves to sometime earning relief up to a point where the administration may launch a long term solution. It is, of course, absolutely imperative to integrate the long term and short term planning. The objectives of the short term solutions should be within the perspective, and be compatible with the goals set out in the long term plans.

The traffic Management Techniques have been listed below under seven main categories:

13.1.1. Regulatory Techniques:

- One-way Street
- Reversible streets

- Reversible lanes
- Turning movement restrictions
- Closing side streets

13.1.2. Traffic Control Devices:

- Traffic signs
- Road markings
- Traffic signals
- Computerized signal control system
- Traffic cones and drums
- Barricades
- Speed-barkers
- Traffic lighted bollards
- Central refuges
- Intersection channelization

13.1.3. Traffic Segregation Techniques

- Pedestrian grade-separators
- Pedestrian malls
- Sidewalks
- Central dividers
- Footpath and central railings
- Creation of storage lanes at turning points
- Bus bays
- Bicycle lanes
- Off-street loading/ unloading facilities

13.1.4. Demand management Techniques

- Parking restrictions
- Parking supply reduction
- Parking pricing
- Preferential parking for high- occupancy vehicles

- Preferential lanes for high- occupancy vehicles
- Road and bridge tolls
- Supplementary licensing
- Area tolls
- Vehicle ownership taxation
- General fare reduction on public transport

13.1.5. Bus priority Techniques

- Priority maneuvers
- Bus lanes
- Bus precincts
- Bus priority single systems
- Bus operations management

13.1.6. Self enforcing Techniques

- Dividers
- Railings
- Channelizes
- Queue channels
- Parking notches
- Sleeping policeman
- Bus bays
- Sharing of taxis
- Fixed taxi tariff system

13.1.7. Police public interaction techniques

- Education to bring about traffic awareness
- System-condition broadcasts
- Traffic booths for and of road users

13.2. Unified Metropolitan Transport Authority (UMTA)

The National Urban Transport Policy (NUTP) 2006 has recommended setting up of

UMTA for all million plus cities. Although the population of Gangtok is very less, but, because of its importance as a capital city, it would be advantageous if UMTA or a separate Traffic and Transportation Cell is set up which takes care of the following functions.

13.2.1. Objective and Functions

With a view to coordinate all urban transport activities in the city of Gangtok, a proposal is being moved to set up a Unified Metropolitan Transport Authority (UMTA)/ Traffic and Transportation Cell that would have following functions:

- Undertake overall planning with regard to public transport in Gangtok, covering all modes such as road, rail and air transport systems.
- Recommend fares for the use of public transport as well as para-transit to the appropriate fare fixation authority prescribed under the MV Act and also fix fees, if any, for the use of depots, terminals and all such infrastructure that may be provided by one agency but used by another.
- Undertake network/route design for all public transport services.
- Determine, prescribe, monitor and direct the enforcement of performance parameters and quality of service standards for all modes of public transport, including standards relating to safety of operations that are outside the purview of the STA or the Commissioner of Railway Safety
- Allocate routes amongst different operators through a transparent process
- Evolve policies for private sector involvement in public transport in the city
- Procure public bus services for different routes by any method such as contracting, concessioning, etc. as it may deem fit.
- Monitor and enforce contracts
- Ensure compliance of terms and conditions of license;
- Recommend revocation of license for non-compliance of terms and conditions of the license;
- Carry out surveys and manage a database for scientific planning of public transport requirements
- Co-ordinate fare integration among different bus operators and also between different modes of public transport as well as determine the principles for

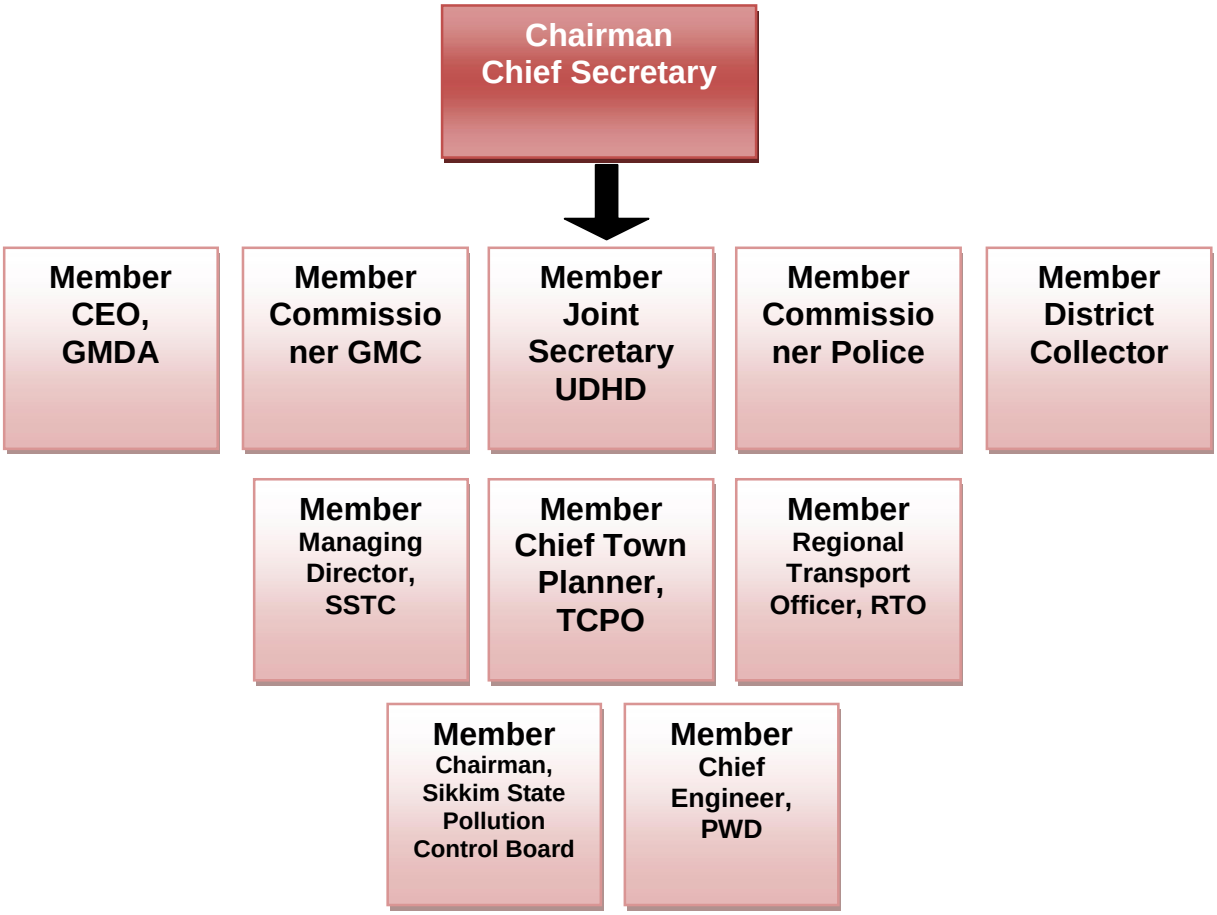
sharing of revenues earned from common tickets or passes.

- Operate a scheme of passes for the use of public transport and channelize subsidies to operators for any concessions that are offered in accordance with government policy.
- Regulate the arrangement amongst operators for the sharing of their revenue derived from the use of passes.
- Facilitate competition and promote efficiency in the operation of public transport services;
- Protect the interest of the consumers of public transport services.
- Settle disputes between different operators and between operators and infrastructure providers.
- Render advice to the State Government in the matters relating to the development of vehicle technology and any other matter relating the public transport industry in general, including the provision of special facilities for the physically challenged, senior citizens, women and children.
- Levy fees and other charges at such rates and in respect of such services as may be determined by regulations;
- Perform such other functions including such administrative and financial functions as may be entrusted to it by the State Government or as may be necessary to carry out the provisions of this Act.

13.2.2. Composition

The organization chart would be as given below:

Figure 13.1 : Proposed Organizational Setup of UMTA



It is also proposed to give legislative backing to the UMTA/ Traffic and Transportation Cell, to enable it to have the requisite authority to discharge its functions.

13.2.3. Manpower Requirements and Staffing Plan

While the UMTA/ Traffic and Transportation Cell will be the high level body, as mentioned above, it would need to have a technical secretariat with the requisite professional skills to carry out its functions. Its manpower profile would be as follows:

Table 13.1: Manpower Requirements and Staffing Plan

S. No.	Specialization/Designation	Background/Experience
1	Executive Director	At least 15 years experience in the public services out of which at least 5 years experience in the urban planning or urban transport sectors. Relevant academic qualifications would be desirable.
2	Urban Transport Specialist	Educational qualifications in urban transport planning with relevant experience of at least 7 years
3	Public Transport Specialist	Educational qualifications in Mechanical or Civil Engineering or Public Administration) over a period of 7 years, with relevant experience in a public transport operating company for at least 10 years
4	Financial Specialist	Educational qualifications in Finance with relevant experience in financial modelling of infrastructure projects, financial appraisal, infrastructure project finance for a period of at least 7 years.
5	Statistic and Data Management Specialist	Educational qualifications in Statistics, Economics, or a similar discipline, with relevant experience in Data management and operating an MIS system over a period of 7 years
6	Transport Engineer	Educational qualifications in Transport engineering with relevant experience of at least 7 years
7	IT Expert	Educational qualifications in IT systems, with relevant experience of at least 7 years
8	Support Staff	Secretary (2), Office Assistant (2), Messenger (1)

13.2.4. Funding

It is being proposed that the UMTA/ Traffic and Transportation Cell be the custodian of the urban transport fund. It would also be the custodian of any other fund sanctioned for the development of urban transport. It would also earn fee from the following:

1. Additional tax on petrol sold in the city
2. Additional registration tax, if any, levied in the city
3. Advertising revenue from buses, bus stops
4. Land development cess
5. Any other fee that may be levied

13.3. Urban Transport Fund

13.3.1. Purpose for setting up the fund

It is recognized that huge investments would be required in creating infrastructure as well as enhanced services for urban mobility. In order to meet this cost and have a ready pool of resources for such investments, it is being proposed that some special levies/taxes be put in place and credited to an “urban transport fund”. The amount in this fund can be utilized for such investments.

13.3.2. Sources of Funding

Possible avenues for raising resources for the fund would be the following:

- Taxes - property tax, sales tax on fuel, advertisement tax
- Portion of parking fees
- Collections from congestion tax, as and when introduced
- Additional fee on PUC certificate
- Collections from traffic violation fines
- Additional registration fee on vehicles – this could be graded depending on the size of the vehicle
- Proceeds from a “Land Value Tax” or “Betterment Levy”
- Any other fee/tax that may be decided to be used exclusively for investments in improving urban transport infrastructure and services

13.3.3. Management of the Fund

It would be important to have a professional fund manager so that the balances in this fund can earn appropriate returns, in accordance with prevailing market potential. The UMTA would appoint a professional fund manager for this purpose who ensures that a smooth flow is maintained for the disbursement of funds for each of the member municipalities.

13.3.4. Eligible claims/ appraisal and approval mechanism from the fund

Any investment proposal that would require funding / part funding from the Local Govt. / State Government could be posed to the urban transport fund for financial support. Approval would be given by the UMTA/ Traffic and Transportation Cell, after

due appraisal by the secretariat. Once approved, appropriate instructions /sanctions would be conveyed of the Fund Manager for disbursement. The Fund Manager would be responsible for suitable disbursement, accounting, recovery (wherever necessary) and asset management.

Detailed guidelines on the different claims that can be made as well as the appraisal criteria will be developed once the setting up of the funds is approved by the Government.

13.4. Institutional setup of SPV

In the recent past the city did not have any public transport. Under the JnNURM scheme of bus funding, Government of India has sanctioned 25 mini buses to be plied on Gangtok roads. Therefore it would be necessary to organize these through a corporate body. Through experiences it has been suggested world over that an SPV incorporated by the government appears desirable.

The SPV would be responsible for development of transit infrastructure and plan and manage transit operations through private participation. It will be company run by GMC as an SPV to develop and manage the city bus system under the companies ACT of 1956. ITS resources will comprise of revenue from ticketing and passes issues, advertisement revenue, and revenue from route bidding and commercial exploitation of space available in the terminals and parking charges at the terminals.

13.4.1. Functions of SPV

- Planning, regulation and operational control, services planning and scheduling, setting service quality, standard, monitoring and control of services,
- Data acquisition and processing – contracting of services for acquisition, communication, warehousing and processing of data for planning besides monitoring and control of services.
- Contracting of fleet operators in a transparent manner.
- Contracting of station management and revenue collection services.
- Human resource management, legal and company affairs, administration, grievance handling, etc.
- Any other function necessary for the City bus service operations.

13.4.2. Organizational Structure

The four proposed divisions are:

1. Administrative division

- Human resource
- Internal accounts
- External audit and legal service
- Other administrative functions

2. Financial and Marketing division

- Acts as fund manager for payments to operators and other support services
- Interfaces with Planning division in fare structure planning
- Marketing
- Non Fare box revenue collection

3. Operations division

- Central Control Center - Monitors real time operations
- Fare collection
- Monitors quality of rolling stock of operators
- Principal interface between SPV and operators
- Infrastructure maintenance

4. Planning division

- Plans routing and frequency on a regular basis
- Plans future expansion of the system
- Interfaces with external consultants for planning and design
- Deals with public works department and other government bodies
- Monitors infrastructure development

The Board of Directors of the SPV will consist of the representatives of the government agencies and chaired by the Municipal Commissioner, Gangtok Municipal Corporation.

Board of SPV

Commissioner GMC	Chairperson
Dy. Commissioner	Member
Rep. of Secretary UD&HD (GoS)	Member
Rep. of Secretary Finance (GoS)	Member
Rep. of Boarder Road Organization	Member
Rep. of Urban Development Department	Member
RTO	Member
Rep. of PWD Sikkim	Member
Municipal Councilors (1)	Member
Technical Experts (1)	Members
Eminent citizens (1)	Members
CEO, SPV	Member

The CEO, who will be responsible for bus operations, will be sourced from the market.

As stated already, an SPV established by the local government with participation from Government of Sikkim and GMC would manage the public transport services. The SPV will have overall responsibility for system management and quality control. Private sector will be invited to deliver all other aspects of the system including fare collection and bus operations.

- Buses will be procured and operated on a kilometer scheme under the overall control of the SPV.
- Land for depots will be provided by GMC. As at present GMC is not yet established the UDHD, GoS will take care of this. Civil works will be carried out through private participation. Land value would be captured through commercial development of land.
- Fare collection will be through electronic system.

The SPV will have the authority to decide route allocation and the frequency on each route. SPV may allow route extensions/alterations based on the need subject to other operating conditions. Frequency will be based on the standards set in terms of

occupancy level.

The business structure defines the selection process and operating conditions including compensation for services. Long term sustainability of the system is the main objective.

Advertisement Policy

In the current scenario, there is potential for marketing of various consumer products and other commodities. Hence the advertisement campaigns with many innovative features have assumed importance. The objective of an advertisement policy would be to raise resources to part finance investments in urban transport infrastructure without compromising with the aesthetic appeal of the city. It seeks to allow advertising rights and channel the proceeds from advertizing to be used for investments in urban transport infrastructure and services.

The advertising policy must give careful and high consideration to the ambience of an area, the architectural character of the area or building in particular and to issues of road safety. This would require the policy to consider location, size, design, and type of sign, where the potential for creation of visual clutter and conflicts with traffic safety is minimal.

The objective of an advertising policy is to seek the enhancement of physical character and visual appearance of a city. Permissions to an advertising hoarding should be permitted based on the following criteria:

a) If they support the commercial viability of a significant building tenant.
b) If they advertise a civic/ community event involving the city.
c) If they can be considered as a public art.
d) If the cumulative impact of the sign does not give rise to visual clutter.

In case of Public Transport global experience reveals that the revenue generated from ticket sales alone cannot meet the operation cost of any urban public transport. In bus transit, the transport organizations should earn through other sources and exploit alternative potentials for revenue. One such source of revenue is through advertisements on the bus and bus stops; since the buses are being operated through the length and breadth of the city throughout the year.

The advertising agencies would be invited for erection of shelters at various bus

stops and awarded rights to display advertisements. The following sources of advertising revenue will be considered for the city bus services provided in Gangtok.

a) Advertisement on the
- Inside and outside of the bus
- Rear side windscreen glass (one side view)
- Passenger view glass (one side view)
- Behind driver seat.
- Behind passenger seats
- Passenger grab handles
- Inside the bus buses, behind driver cabin and on the sole bars
- Inside the bus above the passenger view glass along with route map
- At the backside of thermal paper rolls issued through ticketing rule
- Grab rails

b) Advertisement on the top of bus stop shelters

c) Advertisement on the glow sign boards inside terminals, on the fascia of the shelter in terminals

d) Advertisement in terminals with adequate up keeping and security arrangements in terminals

e) Bill boards along the transit route

There is further scope of providing FM radio in buses which, in addition to the advertisement, will provide passenger information regarding traffic details such as traffic jam and route diversions. We can also resort to advertisement in the straps that are hung from the grab rails to help the standee passengers. The added advantage here is that the advertising agency will ensure that the straps are kept secure in place and they will be maintained properly. The electronic route display board is an added area for displaying advertisement to earn additional non-traffic revenue. It is estimated that the city bus service in Gangtok would be able to generate revenue of around Rs. 17.5 Lakhs from advertisement on buses.

Guiding Principles for Advertisement Policy

The guiding principles for outdoor advertisement policy should not be driven by revenue, but by the city development imperatives. The policy should be so designed that it does not compromise on road safety, it should ensure that outdoor advertising is not hazardous to road and pedestrian traffic.

a) Revenues from advertisement on elevated walkways should be used for the maintenance and upkeep of the walkway, especially in keeping it safe and usable.
b) Revenues from advertisements on public transport vehicles and public transport stations, depots, terminals, etc should be used entirely for part financing the public transport system.
c) Advertisements on auto-rickshaws, taxis and cycle rickshaws should be used for financing a mechanism for the scientific management of such vehicles that also ensures the health and well being of the drivers/pullers.
d) New areas for allowing advertisement rights to be explored and allowed so that it adds to revenues for investments in urban transport. However, such new areas should not lead to undue clutter.
e) Size and type of the advertisements should depend upon the use of land
f) The Policy should explicitly work to discourage visual clutter.

13.5. Parking Policy

Gangtok has witnessed a very rapid growth in the number of personal motor vehicles resulting in increased pressure on the availability of space for parking. Inadequate parking spaces have resulted in the existing right-of-way being used for parking, thereby creating higher levels of congestion. The city of Gangtok shall prepare a plan for the effective management of parking facilities with comprehensive parking policy supported by parking standards for different land uses. Suitable agencies shall be identified to administer the parking policy evolved at the local body level.

13.5.1. Objectives of Parking Policy

The demand for parking space in a particular location depends largely on the land use and the type of traffic control measures adopted in that location.

The proposed parking policy will be formulated with the following objectives:

a) Initiate necessary actions to have a substantial Parking Management System in Gangtok by devising and implementing appropriate actions in essential areas
b) Curb of on-road parking through command and control policy to ease traffic flow in congested areas
c) Arrange for off-street parking with proper management supported by sustainable parking standards and integrated parking management systems
d) To realize the true value of the land occupied for parking and recover economic costs accordingly
e) To promote public transport ridership and discourage travel by personal vehicles to congested areas

Currently, two multi level parking lots exist which are used by inter and intra state taxis only, which is inadequate to accommodate the existing number of taxis. Requirement of a parking policy is thus considered necessary for Gangtok so as to formalize parking in designated parking spaces.

Accordingly, a Parking Policy would be developed which would, inter alia, have the following components:

a) A parking tariff structure which would reflect the cost of the land occupied and would vary depending on the period for which the facility has been used
b) Provide for lower tariffs if located convenient to mass transit stations, so that it can function as an effective feeder to the BRT system
c) Making amendments to the existing byelaws requiring that every residential/commercial property provides for adequate parking within its premises before the building plans are approved
d) Provide for parking to be a supplement to pedestrianization initiatives so that crowded parts of the city can be made vehicle free and there is greater encouragement of NMT.

13.5.2. Heavy Vehicle Parking

Overnight parking of buses, trucks, omni-buses, tourist buses, vans, water tankers, and container Lorries, etc. along major roads will be discouraged under the proposed parking policy

a) Specific off-street parking facilities will be made available by the owners/operators of the vehicle for night-time parking or when the vehicles are not in use. Such vehicles will be discouraged from occupying the road space of the major roads for long-stay parking
b) Overnight parking of private vehicles shall be allowed on inner streets. However, over-night parking of commercial vehicles such as taxis, light commercial vehicles, buses, trucks, etc. in the residential area will be discouraged considering the possible nuisance due to noise disturbances and safety hazards, associated with such parking
c) Long stay overnight parking will be avoided
d) Vehicle Parking Certificate (VPC) will be mandatory for all heavy vehicles and in the future.

13.5.3. Parking at bus terminals/inter-modal change points

Convenient inter-modal transfer facilities at transport terminals would be developed to bring down the use of private vehicles. Commuter parking will be provided at the bus terminals and ropeway stations by the respective authorities to facilitate the commuters to adopt the park and ride concept. This will help obtain maximum utilization of all available transit modes, relieve congestion and help curb pollution.

13.5.4. Mechanism to Enforce the Parking Policy and to Control Demand

Considering the existing road network and the growth trend in the private vehicle population, it is necessary to bring down the demand on parking spaces, both on-street and off-street. Introduction of fiscal incentives for reducing overall parking demand, command and control system for prevention of on-street parking of vehicles are the important measures proposed to be enforced in Gangtok. Necessary actions to bring down the growth rate of the vehicles in Gangtok such as introduction of efficient city wide public transport, limiting taxi permits, increase in road tax and registration tax on private vehicles, etc. are already being implemented.

13.5.5. Traffic Restraint Measure

Areas restricted for entry of personalized vehicles may be identified and notified. Traffic resistant measures will be adopted with a focus on the concept of reducing the number of vehicles entering an area where they may cause traffic congestion. This is proposed to be achieved by adopting one or more of the following strategies – including area licensing scheme where the vehicles other than public transport are charged for entry into the area, levying higher parking charges and lowering parking space availability within the designated area.

13.5.6. Parking Pricing

Pricing of parking would be judiciously devised to manage parking demand. It could help for efficient use of parking facilities and ensure that parking is available for intended users and it will help manage the cost of maintaining parking associated facilities. Parking pricing can have significant transportation impact. Even modest parking fees can affect vehicle travel patterns. Variable parking prices would be adopted with higher rates during peak period and lower rates during off-peak periods and would reflect the cost of land. Parking pricing would create revenue that can be used to recover the cost of maintaining the related facilities and funds for other areas. Efficient fee collection techniques would be developed and used to minimize delay and inconvenience to drivers.

13.5.7. Transit Oriented Development

Concept

Transit Oriented Development is a moderate to high density development located within an easy walk of a major transit stop/station, generally with a mix of residential, employment and shopping opportunities designed for pedestrians without excluding the personal modes of transportation. This focus is required in the current scenarios to ensure a cost effective transit, increase affordable housing, employment and service choices within the exiting communities, re-develop vacant or under-utilized industrial and commercial sites, create vibrant and livable communities and preserve the regional space creating specific areas that integrate transit into neighborhood thereby improving the effectiveness of transit. A TOD strategic plan needs to be prepared by the city in order to prioritize the planning and implementation activities of the city related to transit planning and transit oriented development. It may be used for defining priorities where the city's resources can be used in the short, medium and long term, identifying

implementation strategy and ensure close co-ordination against different departments of the city. Normally, a bus system lacks magnitude and performance for a successful TOD. However, medium to small density development is definitely possible where buses operate. Transit Oriented Development should benefit the local community. Through consultation with local communities, TOD should provide a wide range of supporting benefits for local communities, including increased uses and services, a variety of housing, increased transportation options, and a more workable environment and community amenities.

Objectives of TOD

a) To identify market based TOD development scenarios
b) To assess the ability of existing regulations to respond to market realities
c) To change the perception of general public and bring about a suitable community reaction to market-based TOD development scenarios
d) To make a proper development assessment of market-based TOD development scenarios.
e) To identify funding/financial gaps for addressing through public-private partnership
f) To ensure land uses around Transit Stations to support ridership by generating high levels of transit use and provide a mixed-use activity node for the local community and city-wide transportation network benefits
g) To increase density around all stations to support high quality service and provide a base for a variety of housing, employment, local services and amenities that support vibrant station area community
h) To create convenient, comfortable, direct and safe pedestrian linkages to and from all Transit Stations in order to support a walkable station area and promote the use of bus transit
i) To accommodate Transit bus and private automobile circulation and parking needs, while creating a comfortable pedestrian environment.

TOD Policy

a) Identifying and concentrating activities at and around transit stations and major bus corridors and transfer points in view to develop station areas as activity centers that consist of residential, office, retail, commercial and sufficient green space. Promote high-density development in the intermediate

vicinity of the transit station up to 500m followed by a medium density development up to 1km of the transit station.

b) Meaningfully engaging citizens in planning and developments proposed in their neighborhoods
c) Protecting existing neighborhood residents and businesses while attracting and providing for new residents and activities
d) Maximizing transit access, usage and convenience to encourage transit, mainly walking as the preferred mode
e) Providing a mix of uses for diversity of activities, goods and services easily accessible by transit
f) Providing quality urban design that increases pedestrian safety, amenities and enjoyment
g) Supporting the expansion and enhancement of the bus transit system to link neighborhood centers and provide efficient and reliable connections across the region
h) Formulating suitable economic development strategies to attract large employers for station areas depending upon market surveys along the corridors to determine the appropriate scale, mix and location of retail activity
i) Formulating assistance programmes to relocating business that may be impacted due to the construction of stations
j) Managing parking, bus and vehicular traffic effectively
k) Planning in context to the local communities by making each station area a unique place with the local fervor

Location of various urban activities and introduction of transport links has significant impact on the current urban form of the city. The urban form of Gangtok has been dictated by the developments along the major roads growing in Gangtok. The planning of transport infrastructure would incorporate direction oriented travel. The hills and forests in the south along with the land conservation laws restrict the growth of the city in the southern direction. New locations which can be focused for transit-oriented development are Ranipool, Rumtek and Jalipool.

CHAPTER 14

SOCIAL AND ENVIRONMENTAL CONSIDERATIONS

14 Social & Environmental Considerations

14.1. National Level Policy and Legal Framework

All projects and activities are broadly categorized into two categories 'A' category projects are those having potential impacts on human health and natural and manmade resources. These projects require prior environmental clearance from the central government in the Ministry of Environment and Forests (MoEF).

'B' category projects require prior environmental clearance from the State Environment Impact Assessment Authority (SEIAA). The SEIAA's decisions are based on the recommendations of a State level Expert Appraisal Committee (SEAC) as to be constituted for in this notification. Environmental Impact Assessment (EIA) Notification S.O. 1533 dated 14th September 2006; under section 3 the Central Government forms a State Level Environment Impact Assessment Authority. Categories of projects mentioned in the notification are not included in the CMP Gangtok and hence, none of the project interventions as part of the CMP trigger the environmental impact assessment / screening requirements as per the GoI regulations. However, for ready reference, the categories of sub-projects as per the notification are included in the Annex – 8. If any of these categories of sub-projects are included in CMP, the stages of prior environmental clearance as per the MoEF EIA Notification of September 2006 and as indicated in Annex – 8 will be adhered to.

Government of India also include following environmental related legislations, these are briefly described in the Annex-9.

1) Forest (Conservation) Act, 1980 as amended in 1988
2) Wild Life Protection Act, 1972
3) Water (Prevention and Control of Pollution) Act, 1974 as amended in 1978 and 1988
4) Noise Pollution (Regulation and Control) Rules, 2000
5) The Environment (Protection) Act, 1986

14.2. Land Acquisition Act, 1894

The Act ensures that no person is deprived of land except under the Act and entitles Affected Persons to a hearing before acquisition. The Land Acquisition Act provides a framework for facilitating land acquisition within the Country. This Act enables the State to acquire private lands for public purposes. The main elements of the Act are given in Table 17-1.

Table14.1: Land Acquisition Act

Section	Aspect	Provision
Section 4	Notification of land	Notification of land identified for the purpose of public welfare. Objections must be made within 50 days to the DC (highest administrative officer of the concerned district. No further sales or transfers are allowed.
Section 6	Intention to acquire land	DC is directed to take steps for the acquisition, and the land is placed under Section 9. Interested parties are then invited to state their interest in the land and the price.
Section 11	Enquiry and award by Collector.	DC shall make an award within one year of the date of publication of the declarations. Otherwise, the acquisition proceedings shall lapse.
Section 12	Award of Collector when to be final.	Award shall be filed in the Collector's office and shall, except as hereinafter provided, be final and conclusive evidence, as between the Collector and the persons interested, whether they have respectively appeared before the Collector or not, of the true area and value of the land, and the appointment of the compensation among the persons interested.
Section 18	**Reference to Court.**	In case of disagreement on the price awarded, within 6 weeks of the award the parties (under Section 18) can request the DC to refer the matter to the Courts to make a final ruling on the amount of compensation. Compensation for land and improvements (such as houses, wells, trees, etc.) is paid in cash by the project authorities to the State government, which in turn compensates landowners. The price to be paid for the acquisition of agricultural land is based on sale prices recorded in the District Registrar's office averaged over the three years preceding notification under Section 4. The compensation is paid after the area is acquired, actual payment by the State taking about two or three years. An additional 30 percent is added to the award as well as an escalation of 12 percent per year from the date of notification to the final placement under Section 9. For delayed payments, after placement under Section 9, an additional 9 percent per annum is paid for the first year and 15 percent for subsequent years.

14.3. Implications for Gangtok

In case of Gangtok, land acquisition may be involved for construction of inner and outer ring road and improvement of the regional network. Besides this all the projects in the city would not require prior environmental clearance from the State / Central Environmental Appraisal Committee as the infrastructure projects discussed do not fall under any of the requirements suggested as per the Schedule for the MoEF Notification on Environmental Impact Assessment dated 14th September 2006. Provisions of Air and Water Act would be applicable for activities involving civil works.

14.4. Environmental and social Screening

Environmental and social screening is intended to provide inputs into identification of potential impacts with the implementation identified projects of the CMP. Screening is conducted by identifying the interaction of environmental components on the project activities for various projects. Identified projects and respective impacts are presented in the table given 17-2.

Table 14.2: Environmental Impact of Identified Projects

Broad Project Category	Activities / Sub-components	Impacts
Pedestrian / NMT Infrastructure Improvement	Reconstruction of footpaths	a. Temporary interruption to traffic and increase of emissions from vehicles due to higher idling times
		b. Temporary increase of noise levels due to idling and traffic snarls
		c. Removal of encroachers from the footpaths causing livelihood losses – even though they are illegal
		d. Loss of shelter for temporary shops and encroachers
		e. Contamination of runoff from road with construction material as sand / cement / silt from stacked excavated earth
	Pedestrian Prioritization	a. Increase in signal time for red causing increase in idling and emissions from vehicles / noise

Broad Project Category	Activities / Sub-components	Impacts
	measures through traffic signals, pelican lights, road marking etc.	b. Improvement in safety of pedestrians due to measures proposed
	Construction of new footpaths	a. Acquisition of land for footpaths causing resettlement impacts and loss of livelihood
		b. Relocation of road appurtenances and utility lines
		c. Temporary interruption to traffic causing air and noise pollution
		d. Loss of adequate frontage to commercial / residential establishments
		e. Contamination of runoff from road with construction material as sand / cement / silt from stacked excavated earth
	Paving and Delineation of areas as pedestrian friendly precincts	a. Contamination of runoff from paving areas with construction material as sand / cement / silt from stacked excavated earth
		b. Improvement in pedestrian safety
	Peripheral Vehicular Parking	a. Increased safety of pedestrians
		b. Improvement of air / noise quality in the core areas of cities
		c. Increased land requirement for parking – causes removal of squatters and encroachments and loss of livelihood / shelter
		d. Land acquisition causing R&R issues – loss of livelihood, loss of shelter, severance of community / social links
		e. Increase in traffic – noise and air pollution in the periphery of core city areas
	Street Furniture-Lighting, Bollards etc	a. Minor construction issues only. Improves safety of precincts with introduction of bollards and adequate street lighting
	Bus-Stops, Signage etc	a. Improvement in safety of pedestrians
Public	Demarcated	

Broad Project Category	Activities / Sub-components	Impacts
Transport Infrastructure	public transport network	a. Use of existing pavement width for demarcated bus lanes will cause removal of squatters and encroachments from roadsides causing loss of livelihood and loss of shelter
		b. Construction / reconstruction / improvement of bus lanes will be causing construction issues as:
		1) Generation of noxious gases during construction – increasing air pollution
		2) Temporary increase in noise pollution during construction
		3) Contamination of road runoff with construction material stacked on road side
		4) Traffic safety during construction
		5) Traffic diversions causing lengthening of routes increasing air emissions and exposing previously unexposed neighbourhood's to noise
		c. Reduction of additional lane width for other traffic
		e. Reduction in private vehicles causing reduction in air / noise pollution
	Terminals/Depots/Commuter Amenity Centers	a. Acquisition of land for the facilities causes – R&R issues as loss of livelihood, loss of shelter, severance of community & social ties
		b. Increase of noise and air pollution in the areas of terminals and depots
		c. Improvement in approaches to the terminals and depots causing impacts on adjacent landuses and land acquisition
		d. Additional land acquisition, if any for the approach road improvement will lead to R&R issues along the roads and cause impacts on livelihood and shelter
		e. Construction stage impacts include the increase in air and noise pollution
		f. Contamination of road runoff with stacked construction materials
		g. Improvement of traffic conditions during operation stage causing reduction in air and noise pollution
	Bus-Stops and sky, walkways, Foot over bridges	a. Temporary interruption to traffic and increase of emissions from vehicles due to higher idling times
		b. Temporary increase of noise levels due to idling and traffic snarls

Broad Project Category	Activities / Sub-components	Impacts
		c. Alternate traffic diversion routes increasing route length and consequently emissions
		d. Alternate traffic diversion routes exposing previously low traffic routes to higher urban traffic and increasing air / noise pollution
		e. Removal of squatters and encroachers from the footpaths causing livelihood losses at approaches to the sub-ways / FOBs
		f. Loss of shelter for temporary shops / residences for squatters and encroachers at approaches to the sub-ways / FOBs
		g. Contamination of runoff from road with construction material as sand / cement / silt from stacked excavated earth
	Ropeways	a. Temporary interruption to traffic and increase of emissions from vehicles due to higher idling times
		b. Temporary increase of noise levels due to idling and traffic snarls
		c. Alternate traffic diversion routes increasing route length and consequently emissions
		d. Alternate traffic diversion routes exposing previously low traffic routes to higher urban traffic and increasing air / noise pollution
		e. Removal of squatters and encroachers from the footpaths causing livelihood losses at approaches to the sub-ways / FOBs
		f. Loss of shelter for temporary shops / residences for squatters and encroachers at approaches to the sub-ways / FOBs
		g. Contamination of runoff from road with construction material as sand / cement / silt from stacked excavated earth0
	Procurement of Bus Fleet	a. Improvement in urban air quality
	Traffic Signal Prioritization	a. Pedestrian safety issues from reduction of signal times for pedestrians
ITS application to	Traffic Signal Improvements	a. Improvement in traffic flow and reduction of air / noise emissions

Broad Project Category	Activities / Sub-components	Impacts
Public Transport	Public Information System- Plasma Screens, Display boards at bus stops etc	a. No impacts anticipated
	Control Rooms	a. Acquisition of land for construction of control rooms may cause R&R issues
Others-Road Infrastructure	Junction/Rotary Improvements	a. Additional land requirement for junction improvements will cause R&R impacts as loss of livelihood and loss of shelter
		b. May cause removal / displacement of squatters & encroachers
		c. Air and noise pollution from construction impacts
		d. Contamination of runoff from road with construction material as sand / cement / silt from stacked excavated earth

14.5. Location Impacts

The location Impacts being analysed are associated with site selection and project location on environment and resettlement or livelihood related impacts on communities. Some of the generic impacts associated with location of project facilities that involves construction activities either by acquiring additional land and / or public land encroached by residents are as below:

- Major environmental features as lake fronts, parks etc., in the urban areas would generally be avoided and hence environmental impacts on these areas would be minimal to absent
- Projects do not have any major environmental features that are sensitive to acquisition of land as it is nominal in case of the conceived projects
- Removal of encroachments and squatters leading to loss of livelihood and / or shelter
- Vulnerable PAP within the encroachers would be further impacted by the pressure of relocation as well as loss of income and their removal
- Breakup of established social fabric and cause severance of established relationships amongst the community
- Temporary loss of services provided by the encroaching PAPs due to their

removal

Some of the specific impacts associated with construction of foot over bridges and Ropeway stations involves disruption to existing traffic flow, especially, if located in the congested urban stretches. These would also involve land acquisition (either temporary or permanent) and would also impact the squatters and encroachers affecting residences and / or livelihood.

They would cause traffic congestion and delays and may also involve changes in the project design and alternatives. Project interventions as ITS application, improvement in public transport infrastructure would only improve the environment rather than causing pollution though resettlement impacts would be present to a limited extent.

14.6. Design Impacts

Designs generally are intended to provide optimum environmental benefits but would also involve environmental and social impacts due to the project. Specific environmental and resettlement impacts associated with the project designs are presented in the paragraphs below. Design impacts arise due to the intrinsic nature of project design, including the technology used, scale of operations, discharge standards etc. Design impacts in case of the project interventions are usually positive in nature causing reduction of air and noise emissions leading to general improvement in the environment.

Design impacts on environment and resettlement aspects are anticipated in case of active measures as construction of new footpaths, provision of parking facilities, and construction of stairs. The impacts would mostly be limited to unavoidable impacts as increased traffic movements in the areas surrounding the parking facilities causing emissions and elevated noise levels. Due to general lack of adequate space in urban precincts, it is conceived to allocate designated parking spaces to avoid congestion in the whole area. This would involve relocation of few PAPS who are otherwise continuing with their livelihood or residential activities.

Positive design impacts are anticipated on the environment with NMT infrastructure developments as reconstruction of footpaths, stairs, paving / delineation of areas as pedestrian friendly precincts, street furniture and lighting. Similar positive impacts are

anticipated in case of provision of low emission vehicles, ITS and provision of bus stops. Limited or positive design impacts on environment are likely from the improvements in public transport fleet or reorganization of cycle rickshaw etc.

Planning for terminals, minor road improvements and junction / rotary improvements would involve design impacts as any of these activities would require land and consequently environment and resettlement impacts are likely. Some of the typical design impacts due to such project interventions are:

- Speculation of land prices, more specifically in case of terminals and road improvements is an identified impact which is both beneficial as well as harmful – induced impacts is an intrinsic benefit of the development projects however, speculation of land prices causes undue rise in project costs if land is to be acquired and hence a harmful affect
- Environmental impacts from design of the project components would mainly be due to design inconsistencies, if any as the proposed project designs would consider optimal environmental solutions to environmental impacts. Design optimization towards cost and environment would mostly involve minor impacts on environmental resources of the project areas
- Psychological distress to potential PAPs is considered a major impact during or due to design. This is especially due to the ground works as undertaking surveys and investigations while PAPs are not fully equipped to assimilate the ongoing improvement programme.

14.7. Construction Impacts

Impacts resulting from pre-construction and construction activities including site clearance, earthworks, civil works, etc are identified in this section. Pre-construction and construction impacts arise due to dismantling of existing facilities, use of heavy construction machinery, spillage / disposal of construction debris, runoff from construction site, inadequate or inappropriate drainage of the construction site, inadequate safety measures etc. These are some of the direct impacts of construction in the project area.

In addition to the above, there are few indirect impacts or impacts that result from construction activities though not causing the impacts, support to cause the impacts. Some of these impacts include, generation of vectors and vector borne diseases,

spread of Sexually Transmitted Disease (STD) / Human Immunodeficiency Virus (HIV) amongst the construction workers and within the community in the vicinity of construction activities etc. The above environmental impacts are generic in nature occurring along all the project activities where civil works are involved. Impacts that are specific to the construction activities in a project intervention are presented below.

- Construction activities in case of reconstruction of footpaths or construction of new foot paths would cause temporary interruption to traffic and increase of emissions from vehicles due to higher idling times apart from temporary increase of noise levels due to idling and traffic snarls
- Loss of adequate frontage in few cases of foot path construction or provision of additional lanes
- Relocation of utilities in the pre-construction stage causing temporary disruption to services.
- Safety of pedestrians and traffic in the area is likely to be affected due to the progress of construction activities
- Contamination of runoff from road with construction material as sand / cement / silt from stacked excavated earth
- Construction activities elevate the air pollution and noise pollution in the project area temporarily. Air pollution is due to generation of noxious gases emanating from asphalt plants, construction equipment, crushers etc., while noise pollution is due to operation of various types of construction equipment
- Stacking of construction waste causing interruption to traffic and pedestrian movements
- Runoff from staked construction waste entering the water bodies and existing drainage systems causing clogging of drain outlets as well as the drains themselves

Project interventions as procurement of low emission vehicle fleets, traffic signal prioritization, ITS, provision of signage etc., involve minimal construction activities and hence, environmental and social benefits from these activities will outweigh any minimal impacts that may occur.

14.8. Operation Impacts

These are the Impacts associated with the operation and maintenance of the infrastructure built in the project. The project interventions are conceived to provide

maximum benefits to the community with the implementation of the project. The project interventions as could be judged from the discussion so far involve environmental and resettlement impacts during pre-construction and construction stages of the project and appropriate mitigation and management measures would be undertaken to avoid the same.

Negative environmental / social impacts in the operation stage would mostly be limited to air and noise pollution along the improved road infrastructure as well as the parking areas. While there would be loss of usual transport routes for provision of pedestrian routes, overall improvement in environmental quality is anticipated in the operation stage.

While in previously polluted and congested core city areas / heritage areas would be experiencing better environmental quality than before the project implementation due to pedestrianisation. Pedestrian safety would also be improved with the implementation of the project. Implementation of ITS and traffic signal prioritization interventions would also aid in better management of traffic leading to improvements in air and noise quality.

14.9. Environmental Management

Environmental and social impacts identified through screening and impact analysis are to be mitigated and / managed to reduce their impacts. Generic management measures applicable to the impacts discussed in the preceding section are presented in the sections below. The Environmental Management Framework for implementation of the management measures discussed below indicating the timing and applicability for various projects where applicable is indicated in the Annex - 10. This framework institutionalizes the measures discussed below through assigning implementation responsibilities and contractualizes the measures through formulation of contract clauses for incorporation into contract documents.

14.10. Involuntary Resettlement

Location of facilities has to be planned so as to have least impact on the community. If a particular location is suitable for all factors except for limited resettlement, necessary compensatory measures as per the resettlement framework needs to be worked out. Resettlement impacts due to these interventions would be managed through appropriate compensation and rehabilitation measures as per the

entitlements of the PAP. A resettlement action plan to this effect would be prepared to address the impacts. Compensation and rehabilitation measures will be carried out in accordance with the entitlement framework for the project.

It needs to be ensured that all R&R activities are to be completed before the construction activity starts, on any sub-section of project roads. If any resettlement is required for project interventions, resettlement sites required are to be taken up for construction prior to the contractor mobilization at site. Suitable locations for resettlement sites are to be identified in consultation with the PAPs to be relocated.

The entitlement matrix needs to be adapted to the project initiatives to arrive at appropriate entitlements for identified impacts. These entitlements should have special privilege to vulnerable people affected by the project.

14.10.1. Cultural Property Resources

All utilities and common property resources likely to be affected due to the project will be relocated with prior approval of the concerned agencies before start of construction. Similarly, cultural properties within the CoI, whose structure is likely to get affected, will be relocated at suitable locations, as desired by the community before construction starts. Local community need to be contacted to discuss relocation aspects, seating as well as their maintenance.

All necessary and adequate care shall be taken to minimize impact on cultural properties (which includes cultural sites and remains, places of worship including temples, mosques, churches and shrines, etc., graveyards, monuments and any other important structures as identified during design and all properties/sites/remains notified under the Ancient Sites and Remains Act). No work shall spillover to these properties, premises and precincts.