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Khandachakra Municipality
Office of Municipal Executive
Kalikot, Karnali Province

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Municipal Transport Master Plan

Khandachakra Municipality

KS Engineering Consultancy PVT. LTD.
BANESHWOR, KATHMANDU

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The study team

ACRONYMS/ABBREVIATIONS

DDC	District Development Committee
DOLI	Department of Local Infrastructure Development
DTMP	District Transport Master Plan
GIS	Geographic Information System
GPS	Global Positioning System
Ha	Hectare
HH	Household
IDPM	Indicative Development Potential Map
Km.	Kilometer
MIM	Municipal Road Inventory Map
Min.	Minute
MoFAGA	Ministry of Federal Affairs and General Administration
MTMP	Municipal Transport Master Plan
MTPP	Municipal Transport Perspective Plan
NMT	Non- Motorized Transport
O-D	Origin and Destination
PCU	Passenger Car Unit
PT	Public Transport
ROW	Right of Way
Sq. km	Square Kilometer
SRN	Strategic Road Network
ToR	Terms of Reference
VDCs	Village Development Committees

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CHAPTER ONE: INTRODUCTION

This chapter briefly explains the background and study area of the study along with the scopes and objectives associated with the preparation of Municipal Transport Master Plan of Khandachakra Municipality.

1.1 Background

Transport, which is simply defined as the movement of people and goods covering some geographical spaces are one of the major components to improve people's access to services. It not only increases the accessibility to the remote places, but also increases the mobility scenario, and hence results in better linkages with market centers/agricultural production pocket areas and other opportunities in the district as well as Municipality.

Adequate roads network in any Municipality can reduce isolation, encourage availing public services and help to transfer technology. Road construction has been seen to bring about notable enthusiasm and visible changes in life. However, in the absence of rational criteria and professional guidelines, road constructions and upgrading are carried out in an ***"ad hoc manner"*** in major places, be it be municipalities or Municipalities.

Municipal Transport Master Plan (MTMP) is primarily a reflection of existing transport infrastructure situation and future potential ones in consistent with the resources available in the Municipality. It offers long term perspective for the planned development of the roads network in the Municipality. The MTMP preparation strongly advocates meaningful participation of all key stakeholders of municipal roads in the planning process, which makes MTMP more acceptable and ensures ownership. A comprehensive Municipal Transport Master Plan (MTMP) is being developed in the Municipality to support investments in transport development with appropriate guideline and criteria for rational and transparent decision-making process. MTMP becomes an authoritative document of the district to negotiate possible grant and loan assistance from donor agencies. Proper planning and sustainability are the key issues for development of municipal transport network.

Ten wards Khandachakra Municipality, after being designated as a Municipal area, it will attract more population along with high investment on infrastructure development. Thus, proper Municipal Transport Master Plan (MTMP) is must for assessing the present road and transport infrastructures and facilities within the Municipality and the surrounding Municipalities' to ensure proper accessibility and mobility by various means of transportation. It also helps to define other policies too, such as: comprehensive land use and city development plan.

1.2 Objectives

The prime objective of this study is the preparation of Municipal Transport Master Plan (MTMP). The planning approach is participatory and bottom-up from the settlement level. It includes a constructive plan to incorporate all present and tomorrow's transportation needs. The specific objectives of the MTMP covered during the study with reference to ToR are mentioned below:

1. Preparation of the Municipality Road Inventory Map (MIM) of all road networks.

2. Identification of the major road networks linking the Municipality with the surrounding areas.

3. Analysis of the present mobility and accessibility situation.

4. Identification and prioritization of the interventions based on mobility and accessibility situation.

5. Development of scoring criteria and its approval from Municipality.

6. Preparation of Municipal Transport Perspective Plan for transport services and facilities

7. Preparation of physical and financial implementation plan of prioritized roads for the MTMP period.

8. Preparation of five years Municipal Transport Master Plan (MTMP).

1.3 Scope of work

The scope of this work is summarized as:

a. Analysis of accessibility and mobility status of the Municipality:

Carrying out various surveys to gain data on accessibility and mobility situation that includes their travel patterns, questionnaire surveys and origin-destination survey.

b. Assessment of public transportation condition:

Data on different public transportation routes and their operation characteristics, which operate within the municipal area and to other adjoining area, is studied.

c. Assessment of safety status and issues:

Road safety status and issues are to be accessed. Possible interventions to make the roads safer are proposed and recommended.

d. Preparation of Municipality Inventory Map (MIM) of existing roads:

MIM linking to strategic road networks and all other roads is prepared. It has included the road names, total length and width, surface type, existing condition, right of way, vehicular traffic and pedestrian traffic flow etc.

e. Collection of demands for New/Upgrading/Rehabilitation transport linkages from Wards/Settlements:

Data regarding the construction, maintenance or rehabilitation of roads according to the existing condition and demand from ward level meeting and actual condition of all the linkages from road inventory survey is noted.

f. Scoring criteria:

Scoring criteria to screen and prioritize all potential interventions for proper allocation of limited budget is developed and approved by the Municipality.

g. Preparation of perspective plan of interventions of services and facilities:

All the identified interventions are screened and rated on the basis of approved criteria and forwarded to Municipality council meetings and finally shown in GIS maps.

h. Preparation of realistic physical and Financial Implementation Plan of Prioritized Roads for the MTMP period:

Information on the resources required for construction/rehabilitation, necessary funding allocation for next five years and appropriate proportion to be spent on ongoing roads and new interventions proposed in next year from Municipality is assessed.

i. Preparation of Municipal Transport Master Plan (MTMP):

MTMP is prepared with due consideration to existing and projected future situation. Base scenario of existing road and transport network based on O-D survey, projected transport infrastructure network and management plan is prepared.

j. Medium term and long-term planning:

The scope of work demands a detailed work plan for five years period (short term). Forecast/estimate of the demand for medium term (10 years) and long term (20 years) is done and recommend a framework to guide future interventions and planning processes.

1.4 Study Area

Khandachakra Municipality lies in Kalikot District in the Karnali Province. The total area of this municipality covers 133.29 (sq.km) including 11 wards and has a population of 22,274 according to census of 2021.

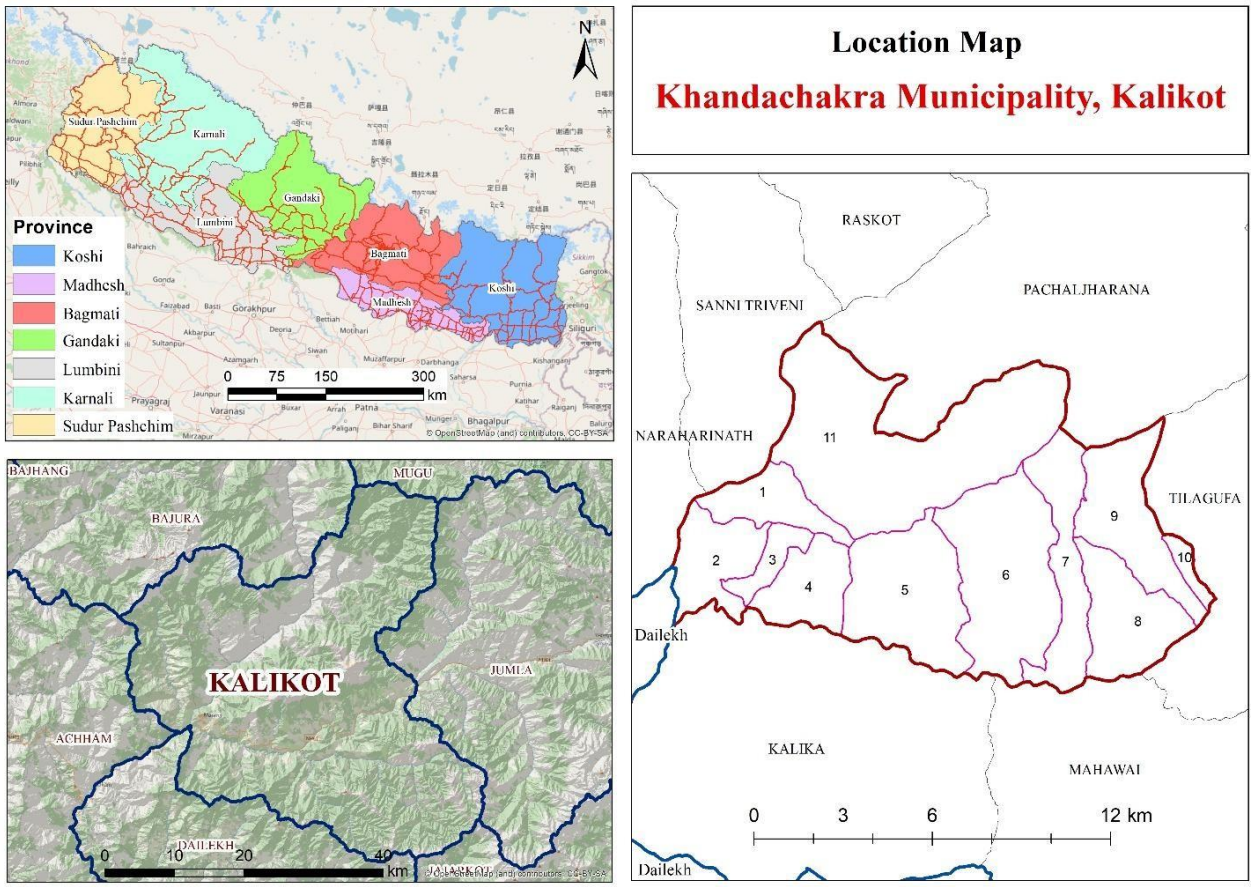

Figure 1: Khandachakra Municipality Map (study area)

There are 11 wards in the municipality, formed by merging Manma, Bharta, Danha, Pankha, and Badalkot VDC. It has been tabulated as below:

Table 1: Formation of Wards of Municipality

SN	Ward No	VDC/Municipality	Population	Area	Population Density
1	1	Manma (5)	3,614	6.31	573
2	2	Manma (1-5), Bharta (8)	3,578	8.19	437
3	3	Manma (8,9)	1,799	2.86	629
4	4	Manma (6,7)	1,784	7.26	246
5	5	Danha (1-3)	2,408	16.13	149
6	6	Danha (4-7)	2,394	20.62	116

SN	Ward No	VDC/Municipality	Population	Area	Population Density
7	7	Danha (8,9)	1,096	10.59	103
8	8	Pankha (1-4)	1,584	10.62	149
9	9	Pankha (5-7)	1,406	12.06	117
10	10	Pankha (8,9)	1,343	1.4	959
11	11	Badalkot (1-3)	1,268	37.25	34
Total			22,274	133.29	167

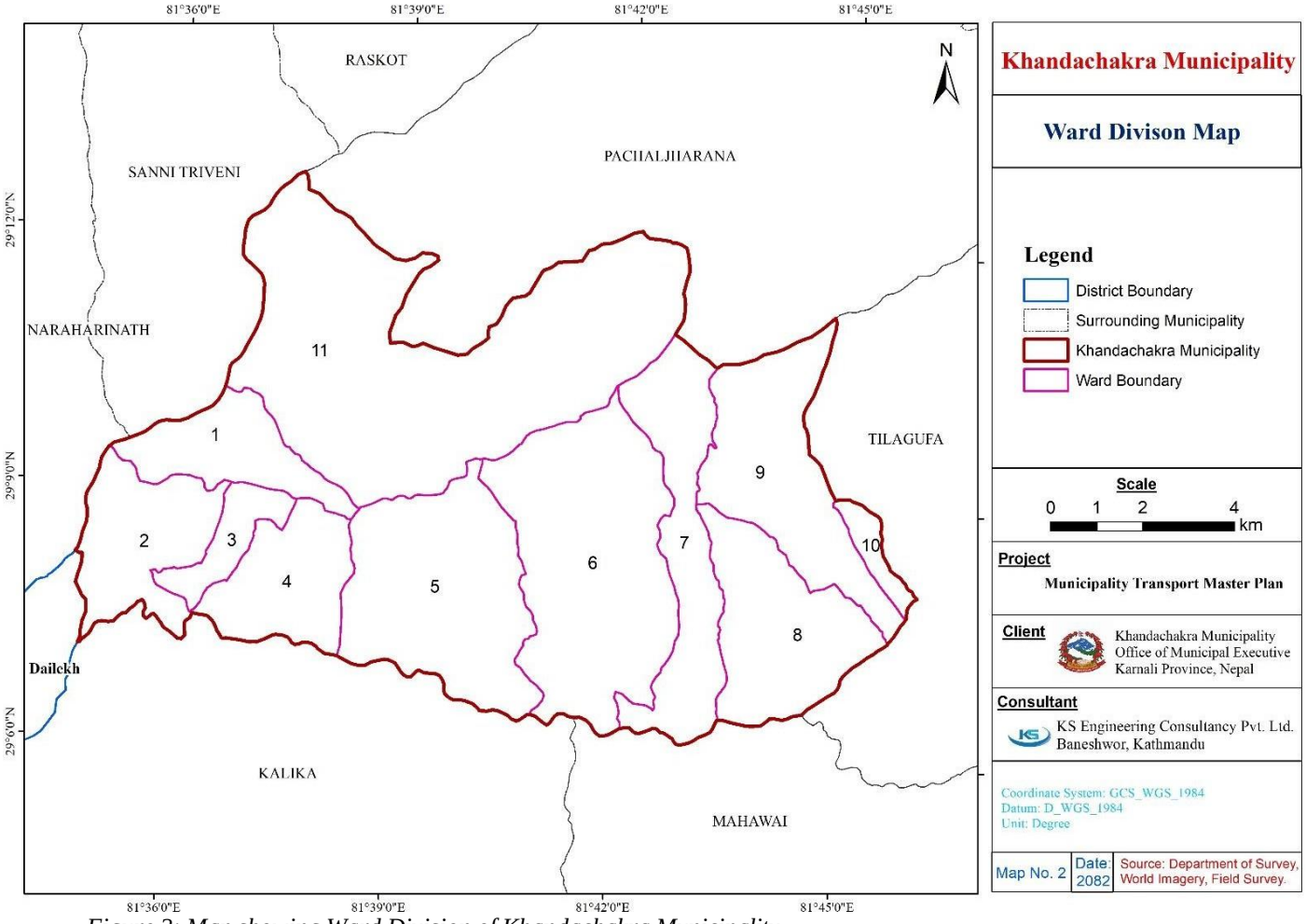

Figure 2: Map showing Ward Division of Khandachakra Municipality

1.5 Limitation of Study

Lack of Comprehensive Town Development Plan, Proper Land Use Policy, and Drainage Network Master Plan, which could have affected the future overall development pattern, and hence future development of these policy need to be based on the proposed MTMP. Bottom - Up Participatory approach along with lack of proper financial policy for land acquisition leads to some difficulty in MTMP planning process.

1.6 Organization of Report

This final report, which is the summarization report of all the work, both field and table work is summarized in eight chapters. Chapter one basically deals with introduction aspect, covering background, scope and objectives along with limitation. Chapter Two deals with the methodology adopted during data collection and data analysis process. Chapter Three covers the existing situation and scenario of the Municipality, which includes the socioeconomic, household and trip characteristics along with road services and facilities within the locality. It also covers how these factors are contributing to the development. Indicative Development Potential of the Municipality has been discussed in Chapter 4. Chapter 5 includes the summary of past MTMP of Khandachakra Municipality. Likewise, Chapter 6 deals with formulation of road hierarchy along with detail of various classes of roads. Chapter 7 deals with Prioritization criteria and prioritized road network. Implementing strategy and financial plan has been discussed in Chapter 7 and finally chapter 8 deals with the conclusion and summary aspects.

CHAPTER TWO: METHODOLOGY

2.1 Approach

MTMP will help to assist the planning of such roads to fulfill the stated objective. Better planning is incomplete without relevant quality data and quality data can only be acquired by use of properly selected survey methods. The chapter deals with the methodological framework adopted for data collection covering all used survey method, sampling techniques, quality and quantity of data along with data processing, analysis and presentation methodology. Municipal Transport Master Plan has been prepared using participatory bottom-up approach and differs from conventional practices of top-down approach. Techno Political interface has been incorporated in the planning process, where active participation from representatives of political parties, line agencies, and Municipality officials is crucial. The Municipality Road Coordination Committee (MRCC) has been constituted as authorized legislative body of Municipality.

2.2 Methodological Framework

The study starts with preliminary planning or desk study where basic background of Municipality is studied with help of secondary data including digital profile of Khandachakra Municipality, census data, GIS data. The study got acceleration with formation of MRCC and inspection report. Various field surveys were carried out with the objective of collecting primary data on transportation network, trip characteristics and service facilities. Along with the primary data, demands for various transportation projects (construction/upgrading/maintenance) were obtained from each ward. Also, potential areas/location for various facilities were also identified based on interaction with local people and MRCC. The scoring criteria for prioritizing road network was identified based on ToR and were approved by Municipality. Then, the hierarchy of roads was proposed, and perspective plans of various interventions were proposed and were analyzed based on available fund and finally physical and financial implementation plan of prioritized roads for MTMP period. After analysis, the study will come up with potential roads that need immediate intervention and roads that need to be given consideration for effective future planning. All the above-mentioned strategies adopted for data collection, processing and analysis is summarized in the following chart.

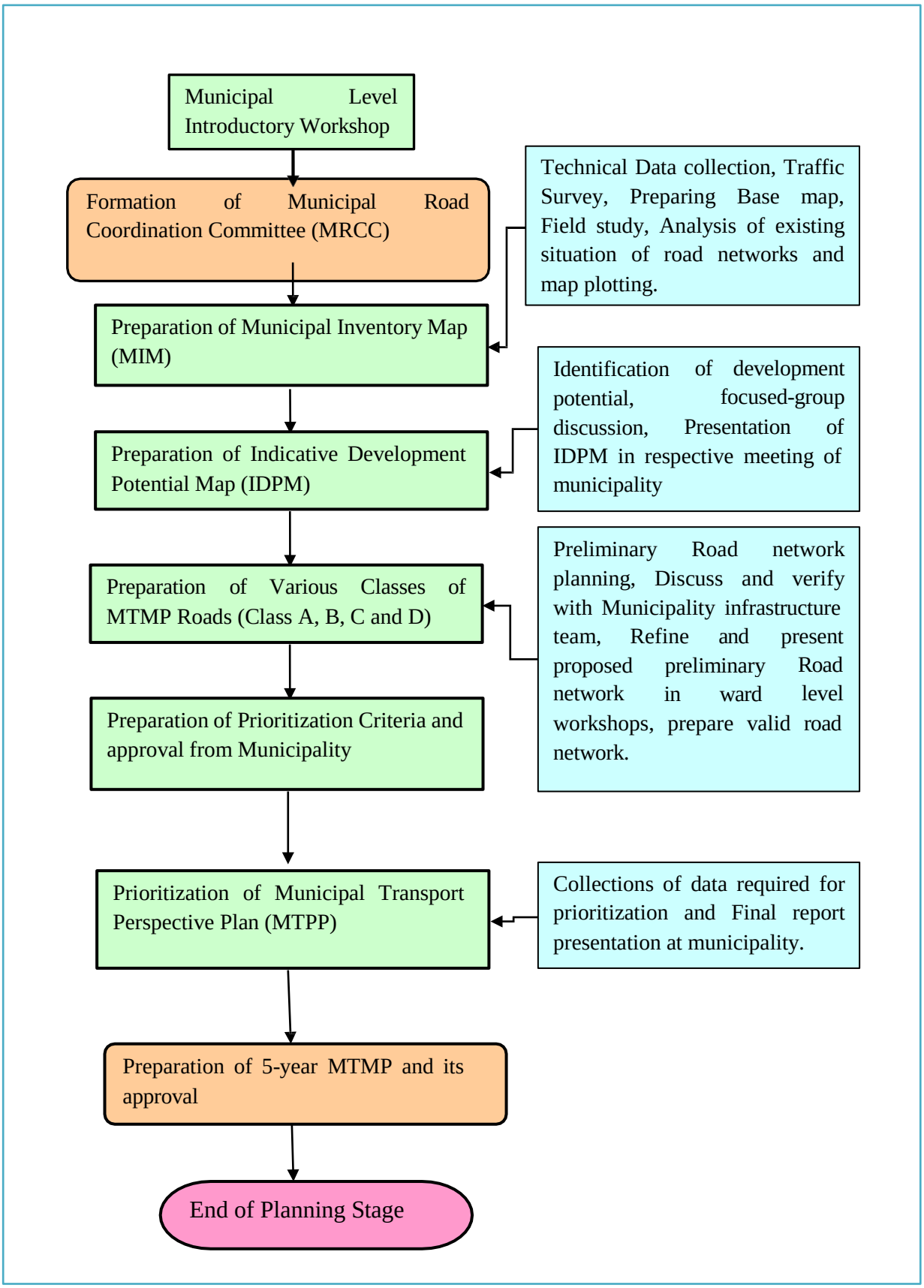

Figure 3 Methodological framework for planning MTMP

2.3 Secondary Data Collection

Any sort of data that was collected from secondary sources are called secondary data. These data were collected from annual report published by district level offices and consultation with various concerned stakeholders. The information about demographic data of Municipality, various maps showing service centers, transport infrastructure inventory, past plans and sector study reports, sector standards and policy targets were collected from the secondary sources, which includes Bureau of Statistics, Survey Department, Local NGOs, line agencies, DCC, Municipality etc. Digitized topographic maps, administrative map of Municipality, strategic road network map prepared by DoR, etc. were some other secondary data that were used during the study.

2.4 Primary Data Collection

Primary information on present household and trip characteristics, traffic characteristics, existing accessibility and mobility level of settlements, prioritized road network required for each ward are obtained via various reliable methods. Tracking of the existing road network along with detail information of its width, surface type and possible intervention required for the effectiveness of services is also carried out. Following primary data collection are adopted for data collection methods.

Road inventory survey was conducted to collect data on its condition of road, road linkage, road safety status and issues that need to be highlighted. It helps in field validation of base maps and assists in preparation of road inventory map, nomenclature and coding of the road linkages and to propose various interventions.

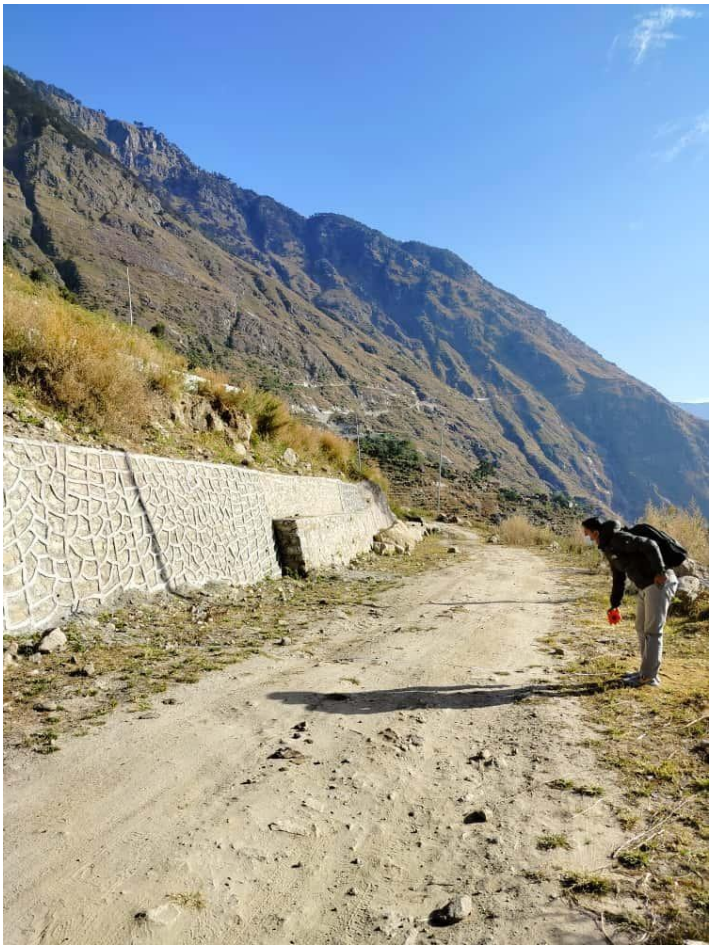

Figure 4 Road Inventory Survey

Road Demand survey comprised of interaction session with the members of ward elected body followed by asking them to fill up demand survey form, which includes demand of new facility or interventions to improve existing roads based on priority.

Figure 5 Meeting with Ward President

Household questionnaire method:

A household (HH) survey, method of Origin and Destination study was conducted in all wards of Khandachakra Municipality, to collect data on socio-economic status, HH characteristics and trip making characteristics. Total 60 samples were collected. The socio-economic details include monthly income, occupation and educational status and vehicle ownership level. Trip characteristics include origin & destination of trip, trip purpose and mode, trip time and accessibility to nearest bus stop.

2.5 Application of GIS for Preparation of Maps

GIS software has been used for the preparation of different maps and database of the municipal roads and other details. GIS maps prepared for Municipal Transport Master Plan (MTMP) can be summarized in the following points.

a. Preparation of map

Shape files for Ward Boundary, Municipal/ Municipal, District Boundary and Development Region Boundary was obtained from Department of Survey. Ward Boundary of each Municipality were also generated in similar manner. Satellite image of the respective Municipality was obtained using Image Capture Software and Google Earth. A ".kml" file was used to obtain an enclosed area for image capture using Google Earth. The image was captured in spatial reference of WGS 1984. After the image was captured, layers for land use, road, buildings, etc. were digitized. Then, WGS 1984 was transformed into Modified Universal Transverse Mercator (MUTM) in three regions namely MUTM 81, MUTM 84 and MUTM 87.

b. Cartography

After field verification, data was entered then map preparation was done. All the maps are prepared in Arc GIS version 10.8. MUTM 84 was used as projected coordinate system. All maps are prepared in a scale in the multiple of 1:25000. Symbols for Road classes have been used as described in Terms of Reference (ToR) provided by MoFAGA. Other symbols are standard and are used so that the whole map expresses what it is intended to.

2.6 Preparation of Visionary City Development and Indicative Development Potential Map (IDPM)

IDPM is basically the indication of the existing and potential market/service centers and high value cash crops, agro-based industries, and tourism-based areas. Similarly, visionary city development plan also governs how the city is planned to be developed in future and is based on the present and foresight vision of the Municipality. The Visionary City development plan is also discussed in front of MRCC and Municipality and the idea of MRCC and Municipality is incorporated in the preparation of IDPM and Visionary City Development Plan.

2.7 Scoring Criteria for Prioritization

A network consists of several links. It is not possible to construct all roads at a time due to resource and time constraint. Therefore, each link in a network needs to be prioritized. After developing a municipal level network, the cost estimate of the road is prepared. Existing population within the zone of influence, present road demand, future potential route, accessibility situation, land use pattern, environmental and social safeguard, proximity to the market/service centers, religious and tourism places were taken as the indicators for prioritization. The scoring criteria is finalized after rigorous study and set in front of Municipality and MRCC for its approval and had been approved with little bit of modification.

2.8 Inception Discussion

During the meeting with municipality's representatives, various agendas regarding the plan were discussed. It was purposed to maintain the ROW for Class A, Class B, Class C and Class D to 14m, 10m, 8 m, and 6 m respectively.

CHAPTER THREE: MUNICIPALITY PROFILE

The chapter deals with the present condition and scenario of the Municipality Socio-economic, trip, land use and road network characteristics within the Municipality. The basic data source of the analysis is the collected primary data.

3.1 Demographic Status

This section shows the details of population size and household availability within the area. The population data is shown in table. Khandachakra Municipality consists of 6 wards and the data are given specifically per each of them.

As of the census of 2021, ward 4 has a total population of 3,865, the largest of the municipality; with ward 2 being least populated with a population of 1602. The maximum population density is of ward 3 with 167 persons per square kilometre and the least of ward 2 with density of 56 persons per square kilometre. The average population density is at 105 persons per square kilometre.

Table 2 Demography table

Ward	Male	Female	Total	Sex Ratio	Population Density
1	1879	1735	3614	1.082997	573
2	1829	1749	3578	1.04574	437
3	871	928	1799	0.938578	629
4	864	920	1784	0.93913	246
5	1197	1211	2408	0.988439	149
6	1193	1201	2394	0.993339	116
7	552	544	1096	1.014706	103
8	809	775	1584	1.043871	149
9	705	701	1406	1.005706	117
10	688	655	1343	1.050382	959
11	625	643	1268	0.972006	34

Based on HH data observed in field, the population have been categorized based on gender, educational status, caste and educational status and been summed up as below.

From the HH survey, out of total populations, males were in less percentage, 49% and females were 51%.

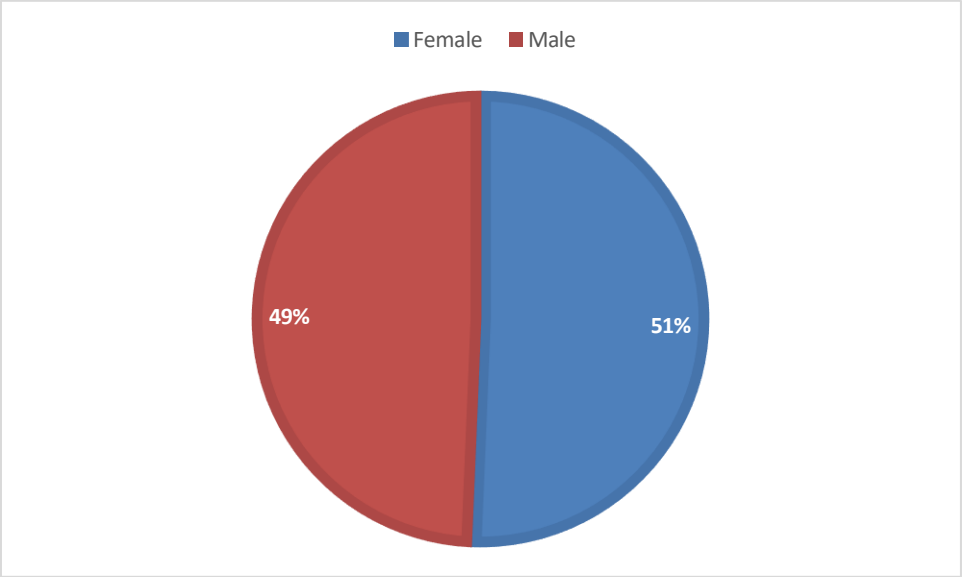

Figure 6 Gender Status in Percentile

3.2 Educational status

The status of the Municipality is governed to large extent by the educational and occupational status. Higher the educational level of the residents, high will be the level of development. Based on survey, 43% of people have completed or are perusing school level education. 25% have completed 10+2 education. Bachelors degree were found to be 3% and 14% were found to be illetrate.

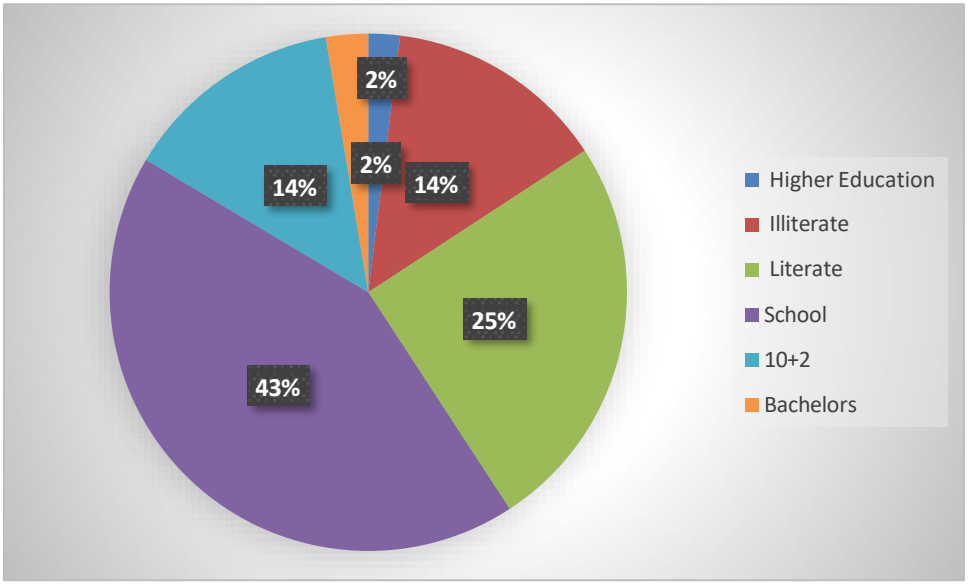

Figure 7: Education Chart

3.3 Origin and Destination Study

A trip, simply called journey is the process of going from one place to another with some purpose. Thus, a trip is characterized by origin (starting point) and destination (ending point). To be more precise, trips are characterized by trip production and trip attraction. Home end is always trip production and the location which attract the produced trips for various causes (job, shopping, and entertainment) are attraction end of trips. Most of the trips are home-based trips with different destination. The major trip destination for the individuals of the Municipality are Ward offices, Surkhet, Manma (district center), Jumla for health checkup, Chuli malika, Pili, Rara.

3.4 Accessibility and Mobility Scenario

Accessibility refers to the ability to reach desired goods, services, activities and destinations. Provision of small trail roads, cycle track, provision of public transportation and proper road network with last mile connectivity help to ensure accessibility. Though walking and buses are dominant mode, better accessibility and mobility is achieved via public transportation network and their frequency.

3.5 Road Inventory

Road network is one the great indicator of development. Various surface types and width of road exists within Municipality, which has a great role to play in development of the Municipality. Road inventory survey was carried out in the Khandachakra Municipality to have proper view of road network. Thus, the concept of both Accessibility as well as Mobility lies within the same Municipality. The road width also varies from 2-3 meter to even up to 8-meter roads.

Different wards have different road network; some has high road network within small area whereas some has low network in large area. Road density is the major parameter that used to reflect the development of road within the considered area. Higher value of which, represent higher level of settlement or high development. Thus, Road density is usually defined in two perspectives, first length of road per square kilometer area and second as length of road per 1000 population.

Table 3 Ward wise Composition of Total Road Surfaces

Ward	Blacktop	Concrete	Earthen	Total
1	0.91	2.04	11.86	14.81
2	11.83	0.44	11.05	23.32
3	4.56	0.76	8.67	13.99
4	3.64	0.70	6.39	10.73
5	7.94	0.25	10.68	18.87
6	5.13	0.11	26.25	31.49
7	2.51	-	9.48	11.99
8	5.07	-	21.36	26.43
9	0.72	-	8.14	8.86
10	0.55	-	1.00	1.55
11	-	-	7.70	7.70
Grand Total	42.87	4.30	122.58	169.74
Percentage	25.3%	2.5%	72.2%	

Referring table 3, we can conclude that within the Municipality around 72% of road was found to be earthen road and Blacktop road was 25%.

Similarly, the composition of road is as shown below:

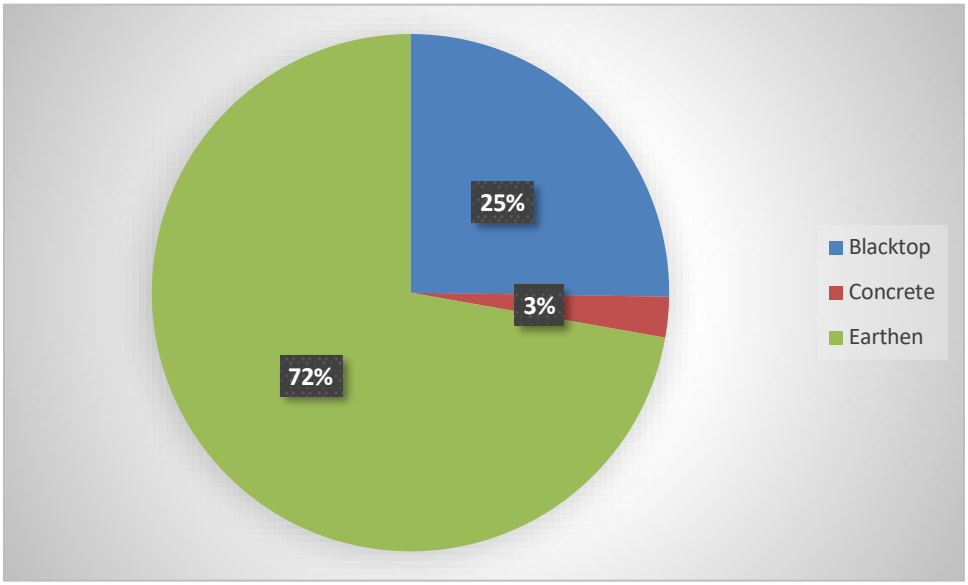

Figure 8: Composition of Road Surface

As seen from the above fig, Khandachakra Municipality consist of road based on surface type as Black top, earthen, gravel, PCC and RCC. We can see that 72% of roads are earthen, 25% are Black topped & 2% are Concrete roads.

Table below shows the road details based on width.

Table 4: Ward wise Road width detail

Ward	less than 4m	4-6m	greater than 6m	Total
1	-	13.89	0.91	14.81
2	-	11.49	11.83	23.32
3	-	9.43	4.56	13.99
4	1.06	6.02	3.64	10.73
5	-	10.93	7.94	18.87
6	1.96	24.40	5.13	31.49
7	-	3.42	8.57	11.99

8	-	13.68	12.75	26.43
9	0.88	4.44	3.54	8.86
10	0.11	0.28	1.17	1.55
11	-	7.70	-	7.70
Grand Total	4.01	105.69	60.04	169.74

3.6 Road Density

Different wards have different road network, some has high road network within small area whereas some has low network in large area. Road density is the major parameter that used to reflect the development of road within the considered area. Higher value of which, represent higher level of road development. Thus, Road density is usually defined in two perspectives, first length of road per 1000 population, whereas second as length of road per total area in square kilometre. But road is possible only in usable area excluding forest area plus Road density of each ward is expressed in the table below.

Table 5 Road Density

Ward No	*Population*	*Area*	*Length of Road*	*Road Density per 1000 population*	*Road Density per sq km*
1	3614	6.31	14.81	4.10	2.35
2	3578	8.19	23.32	6.52	2.85
3	1799	2.86	13.99	7.78	4.89
4	1784	7.26	10.73	6.01	1.48
5	2408	16.13	18.87	7.84	1.17
6	2394	20.62	31.49	13.15	1.53

Ward No	*Population*	*Area*	*Length of Road*	*Road Density per 1000 population*	*Road Density per sq km*
7	1096	10.59	11.99	10.94	1.13
8	1584	10.62	26.43	16.69	2.49
9	1406	12.06	8.86	6.30	0.73
10	1343	1.4	1.55	1.15	1.11
11	1268	37.25	7.70	6.07	0.21

From the table, It can be concluded that Ward 8 has high road density in terms of per 1000 population and Ward 3 has the higher road density in terms of per Sq. Km. Whereas, Ward 11 has lower road density per Sq. Km, which suggests that the road network in these areas of ward need to be increased.

3.7 Road Demand

Demand form was asked to be filled up by each ward for the priority of road demanded. They were asked to rank top five road in their wards or vicinity so as to ensure betterment of the ward. Most of the roads were demanded for periodic maintenance and upgrading as summarized in table below and form of maps in ANNEX A.

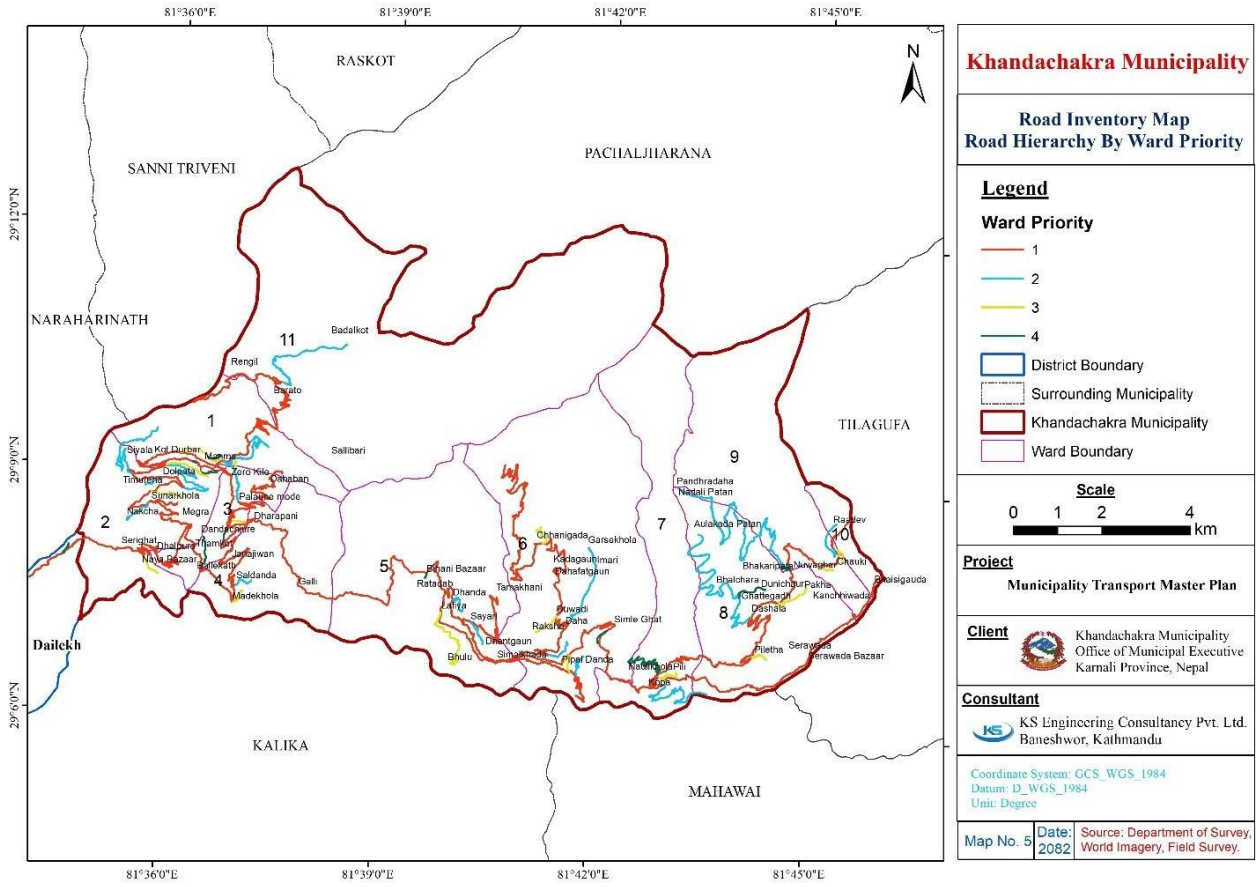

Figure 9: Map showing demand road from ward level

3.8 Road Safety Status

Road accident is one of the critical issues in Nepal and they are the seen most critical issue. They are not addressed properly. Significant traffic and pedestrian volume, improper and inadequately maintained road condition, lack of traffic control measures is further accelerating the road safety status within the Municipality. There is not any provision of separate footpath for pedestrian within the Municipality and hence, pedestrian is forced to share the same road space with other vehicle. Sharp curves and gradient exist within the roads and they need to be maintained.

The main cause of road crash in Khandachakra Municipality is condition of road. Muddy earthen roads, sharp bends in steep slopes, lack of safety barriers are some of the major reasons of crash involving single vehicle. Besides that, some crashes also occur due to mechanical failures in vehicle. Crashes involving two vehicles seldom occur as very limited means of transport are currently in use.

With roads being upgraded and new tracks being made in rapid manner, crashes can be expected to grow in days to come. Khandachakra Municipality should consider road safety and value of human life as governing factor in road design. Haphazard opening of new tracks without technical assessment can cause many lives. Along with road upgradation, rehabilitation, and maintenance, budget should also be allocated in safety measures.

3.9 Public Transportation

From the general survey conducted during site visit, the average time to reach the nearest bus stop is about 5 minutes. The time varies between few minutes to an hour. The variation clearly shows lack of proper public transport network. The average time and the maximum time as perceived by the locals varies significantly. This is because of the fact that there are no formal bus stops and the service is also seasonal.

CHAPTER FOUR: VISIONARY CITY DEVELOPMENT PLAN

The development of the Municipality is basically depended on the features of the individual wards and the vision of the Municipality. This chapter basically covers the indicative development potential and visionary city development plan of the Municipality.

4.1 Indicative Development Potential

Indicative Development Potential (IDP) refers to the assessment of areas with the potential for development, such as market centers, agro-based industries, and tourism. It includes identifying areas with high-value crops, tourism attractions, and important service centers like hospitals, post offices, and schools. The IDP also takes into consideration significant historical and religious sites, as well as areas with large settlements and security offices.

Manma is a town in Kalikot District that is important for its history, culture, religion, economy, and politics. People have been living there since ancient times. In the past, there were fewer people and it was easier to provide services for them. But now, as the population grows, there is a risk of uncontrolled growth and urbanization. Therefore, it is important to have a clear plan for the long-term development of Khandachakra.

The Municipality has higher potential for cash crops & other kinds as the soil is fertile and areas are still vacant and has less occupied by human residence. This can be the center for vegetable and fruits production as most of the population of this portion of Municipality is engaged in agriculture. However, few primary, secondary, and higher secondary schools are granting good education.

Hence higher-level educational center can be established within the Municipality. There are some medical facilities, health posts and pharmacy within this municipality. However, other hospitals need to be established or the health post located at the center of the Municipality should be upgraded to the hospital. These facilities can be upgraded for the betterment of the services and thus, it can be upgraded as the major medical center of the entire Municipality. The main potential of socio-economic development of Khandachakra Municipality is Agriculture and services.

4.2 Visionary City Development

Visionary city development plan ensures safe, responsible, sustainable development of city. According to Kevin Lynch's "A Theory of Good City Form" (Cambridge, MA, MIT Press, 1981), several basic concepts underlie urban and regional economic analysis. First, cities cannot grow if their residents simply provide services for one another. The city must create products which can be sold to an external purchaser, bringing in money which can be reinvested in new

production facilities and raw materials. This "economic base" of production for external markets is crucial. Without it, the economic engine of the city grinds to a halt. Once the economic base is established, an elaborate internal market can evolve. This market includes the production of goods and services for businesses and residents within the city. Obviously, a large part of the city's physical plant is devoted to facilities for internal transactions: retail stores, restaurants, and local professional services such as home stay for tourists, and so on. Modern cities are increasingly engaged in competition for economic resources such as industrial plants, high-technology firms, development of tourism centers, government facilities etc. Various potential areas of development and future oriented planning of Municipality were discussed and finalized with Municipality and is summarized in the following subheading. Tourism can be a good source of opportunity for the municipality. All the wards have their own Tourism significance. Various historical and religious places are scattered throughout the municipality. Similarly, Khandachakra Municipality is a hub for agriculture. Agricultural development could be another breakthrough in improving the economy of the locals.

CHAPTER FIVE: ROAD HIERARCHY DEVELOPMENT

5.1 Road Hierarchy:

Road networks serve for direct access to the particular land-use by the provision of pedestrian footpaths, bicycle tracks, bus and vehicle routes and cater through traffic that is not related to immediate land uses. Functional provisions of passenger and goods movement mainly define the hierarchy of roads and their classification. On the basis of this concept, roads are classified as per their function. Road class is related to the technical standard and functional requirements. Therefore, road classification should be based on its functional hierarchy. It is important to distinguish roads in different class or type based on various criteria. A road hierarchy is a means of defining each roadway in terms of its function such that appropriate objectives for that roadway can be set and appropriate design criteria can be implemented. It is an important instrument of road network and land use planning.

There are restrictions of direct linkage between various kinds of road-hierarchy. In other words, direct connections between certain types of road links should be reduced, for example residential streets and arterial roads. Connections between similar order streets should be made (e.g. arterial to arterial) or between street types that are separated by one level in the hierarchy (e.g. arterial to highway and collector to arterial.). This conceptual framework can be seen from Figure 9 and 10, These hierarchical distinctions of road types becomes clearer when considering the recommended design specifications for the number of through lanes, design speed, intersection spacing and driveway access.

Figure 10 Road Network Hierarchy

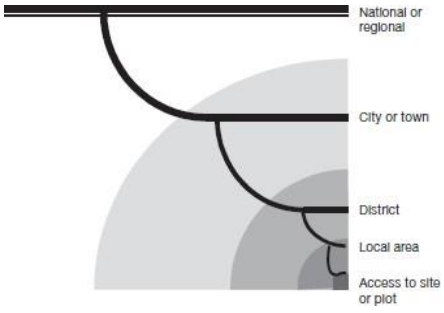

Figure 11 Urban Road Hierarchy

A well-formed road hierarchy increases the performance and efficiency of the particular type of road as well as of the entire road network. Furthermore, it reduces overall impact of traffic by concentrating longer distance flow onto routes in less sensitive locations, ensuring land uses and

activities that are incompatible with traffic flow are restricted from routes where traffic movement should predominate and preserving areas where through traffic is discouraged.

5.1.1 Formulation of Road Hierarchy

Roads under jurisdiction of Municipal authority are referred as urban roads. The classification practices of urban roads basically are guided by the functional hierarchy of roads. Municipality has a complete road network hierarchy consisting of National Highways, Feeder Roads, District Roads and Urban Roads of all four classes. The concept of road hierarchy assists in planning of overall road network and its transport services. Different hierarchy of road has different effect in surrounding areas and other roadways. Hierarchy of roads enable urban design principles such as accessibility, connectivity, efficiency, amenity and safety. Further, it also identifies treatments such as barriers, buffers and landscaping to preserve amenity for adjacent land uses. Thus, a proper plan should accommodate all users of the urban streets in planning, designing and construction of the road infrastructure and furniture. Municipality road network can be conceptualized by considering the functional hierarchy as arterial, sub-arterial and urban roads of various categories such as Class A, Class B, Class C and Class D.

Table 6 : Proposed width for various types of roads within urban area

City	Criteria	Expressway	Arterial	Sub arterial	Collector	Local
Sub city	10,000 -40,000	-	-	30m	20m	10m
City	40,000 -100,000	-	50m	30m	20m	10m
Sub Metro City	100,000 -300,000	50m	30m	20m	10m	10m

Source: Planning Norms and Standard 2015, GoN, DUDBC

The various standard documents on Nepal, which includes Nepal Road Standard (NRS 2070), Nepal Rural Road Standard (NRRS 2071) and Nepal Urban Road Standard 2068 Final suggest the need of footpath and the total right of way is adopted as per ToR provided by MoFAGA and is as follows:

Table 7 : Classification of Municipal Roads

Road Type	Road Class	Right of way (RoW)
Main Collector Road	Class A	14 m
Other Collector Road	Class B	10 m
Tole Road	Class C	8 m
Other Road	Class D	6 m

5.2 High Hierarchical Road Network

Road is classified based on its importance and its area served. Basically, higher hierarchical road network within the Municipality comprises of Strategic Road Network (National Highway and Feeder Roads) and then the local road network, consisting of District Road Core Network (DRCN).

5.2.1 Strategic Road Network (SRN):

There are a Strategic Road Network within the Municipality, both of them being Feeder Road. With Department of Roads had taken 80 National Highways these roads may or may not falls under Provincial highway (Province is drafting PTMP to identify provincial roads). The total Right of way of these roads is 30m.

Table 8 List of strategic Road Networks

Road Code	Name	Length
NH-61	Karnali Highway	42.85
	Total	42.85

5.2.2 District Road Core Network (DRCN):

Based on District Transport Master Plan (DTMP) report prepared by Department of Local Infrastructure (DoLI) there are one DRCN roads within the Municipality which passes through various wards and are of total right of way of 20m. As provincial transport Master Plan is yet to be finalized, it is not clear whether they are included in Provincial roads or will falls under jurisdiction of municipality

Table 9: List of DRCN

Road Code	Name	Length
64DR006	Manma-Badalkot-Ramnakot	3.01
64DR009	Pakha-Chapre-Jubhitha	13.90
	Total	16.91

5.3 Municipal Roads

Different road within the Municipality serves different function, some basically serves the function of access and some serves function of high-quality mobility. Hence road need to be categorized so as to ensure effective and efficient transportation planning process. As described earlier, this MTMP had formulated four level road hierarchy namely Class A, B, C and D, and are described in subsequent heading. The function of Class C and D is basically to provide access, while Class A and B provides mobility and accessibility to higher services which includes linkage to SRN and DRCN roads as well as provides linkage to nearby Municipality.

There is fundamental difference between various class of roads and have been summed up in the form of table 15 as:

Table 10 Comparison of various hierarchy of roads

Criteria	Class A	Class B	Class C	Class D
Purpose	Mobility	Mobility and control access	Access and mobility	Access
Function	Through and long-distance movement	Connect Class A and C; provide alternative connection routes between Class A	Connects higher order roads & mobility to local trips.	Connect local trips to higher level roads.
	High network coverage	Support through movement of traffic	Access to property	direct access to property
	Segregated NMT facilities and Bus laybys	Segregated NMT facilities and Bus laybys	Segregated NMT facilities	Local NMT movement
Maintenance Responsibility	Municipality	Municipality	Municipality& Community	Community
Design Speed (Kmph)	40	30	20	20
Radius (m)	30	20	15	15
Minimum Row (m)	14	10	8	6

Criteria	Class A	Class B	Class C	Class D
Setback distance (m)	2	2	1.5	1.5
Access Control	Applicable based on locality	Not Applicable	Not Applicable	Not Applicable
Public transport services	Public Transportation	Local Public transport	Small form of public transport	No public transportation

5.3.1 Class A Roads

Class A roads serve as the major collector roads. These roads start either from the Arterial or Sub- Arterial Road. These roads are of relatively long distance which connect big market or settlement areas or two or more wards centers within the Municipality. They provide linkage to SRN & DRCN roads as well as to the nearby Municipality.

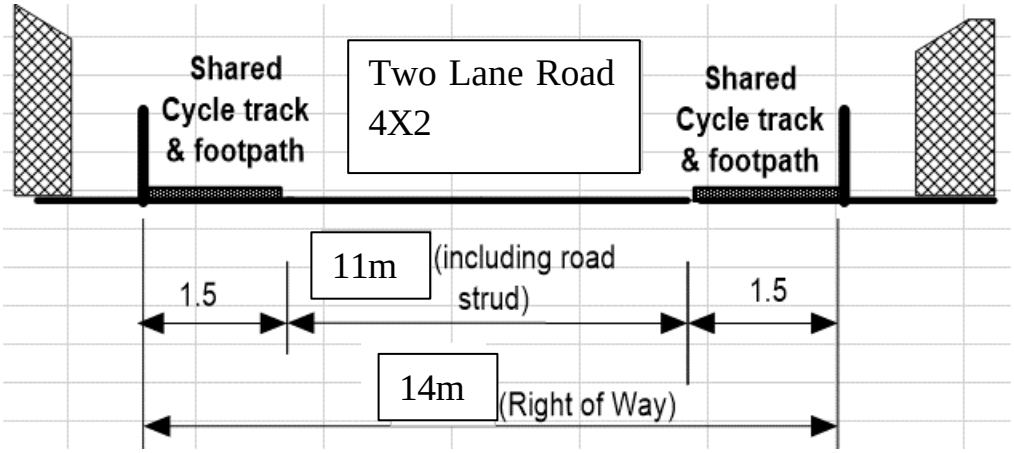

Figure 12: Typical cross section for Class A roads

Table 11 Class A road Classification

Code	Name	Length
A001	Dharapari-Janajiwan-Saldanda-Megrekhola Sadak	8.25
A002	Electricity office-Kot darbar-Manma - Badalkot -Bajura Sadak	7.57
	Total	15.82

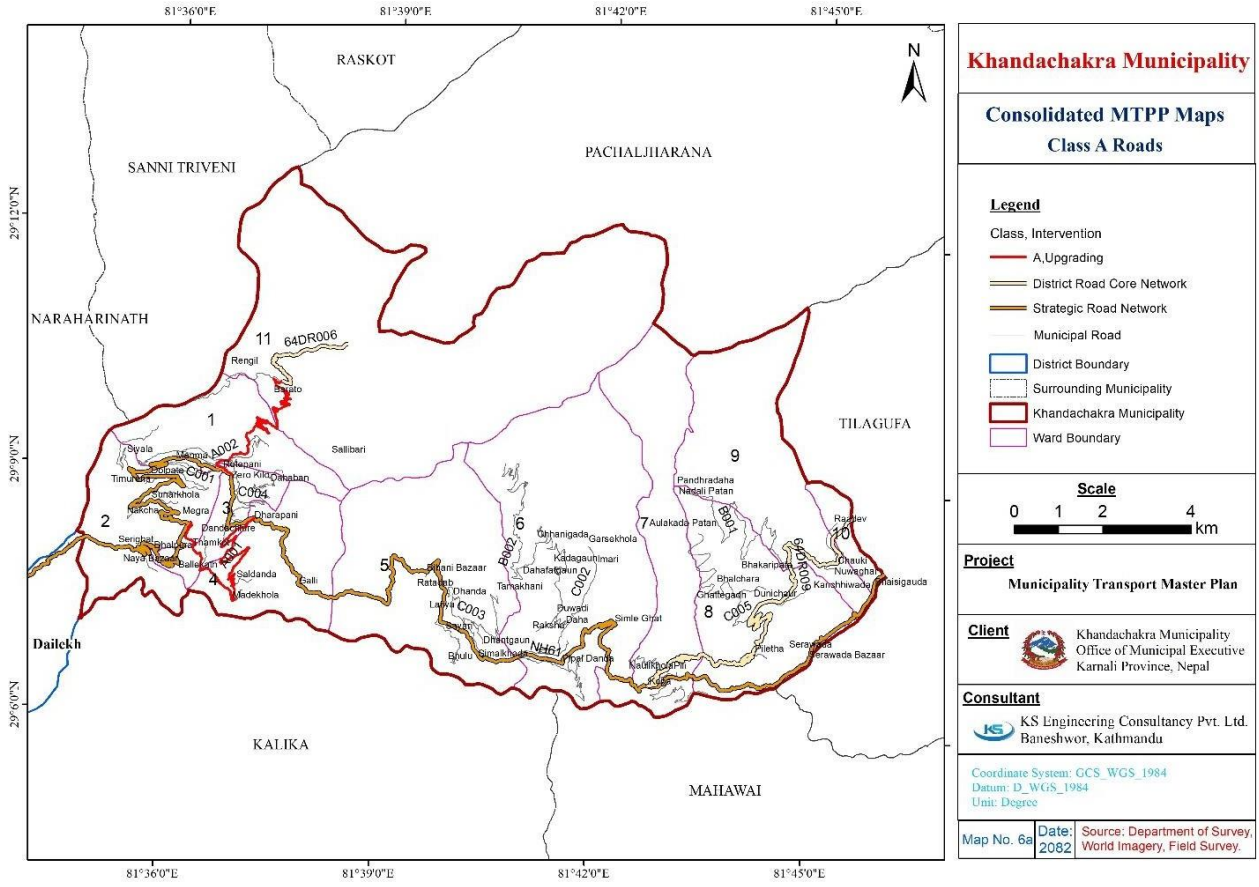

Figure 13: Map of Class A roads

5.3.2 Class B Roads

These roads serve as a second level of road with total right of way more than 12m and can be considered as Feeder roads of Municipality. These roads connect major road network and other roads of similar hierarchy with either major growth center or provide access between Class A and class C road. Mobility is the main concern for these roads and it need to be equipped with at least facilities for non-motorized travel. The typical cross section for Class B roads is as:

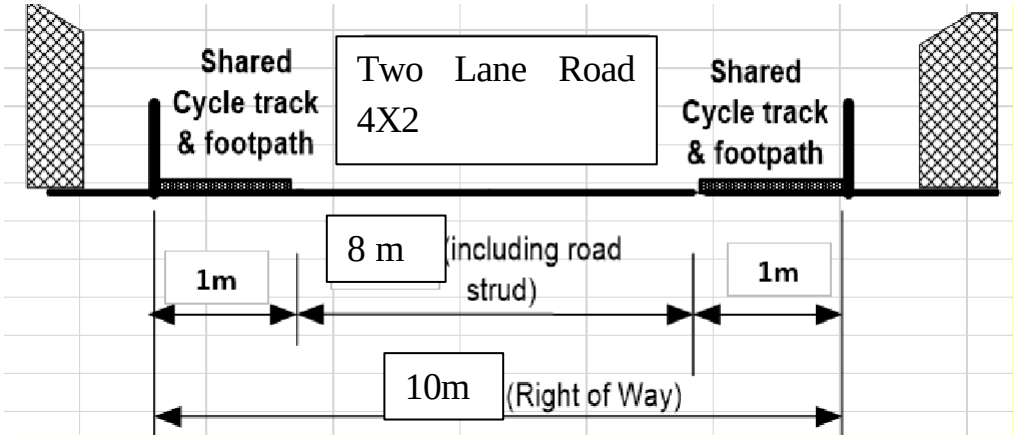

Figure 14: Typical cross section for Class B roads

Table 12 Class B Road Classification

Code	Name	Length
B001	Pakha-Chuli- Paryatakiya Sadak	8.37
B002	Molpha-Daha-Chuli Sadak	16.30
	Total	24.67

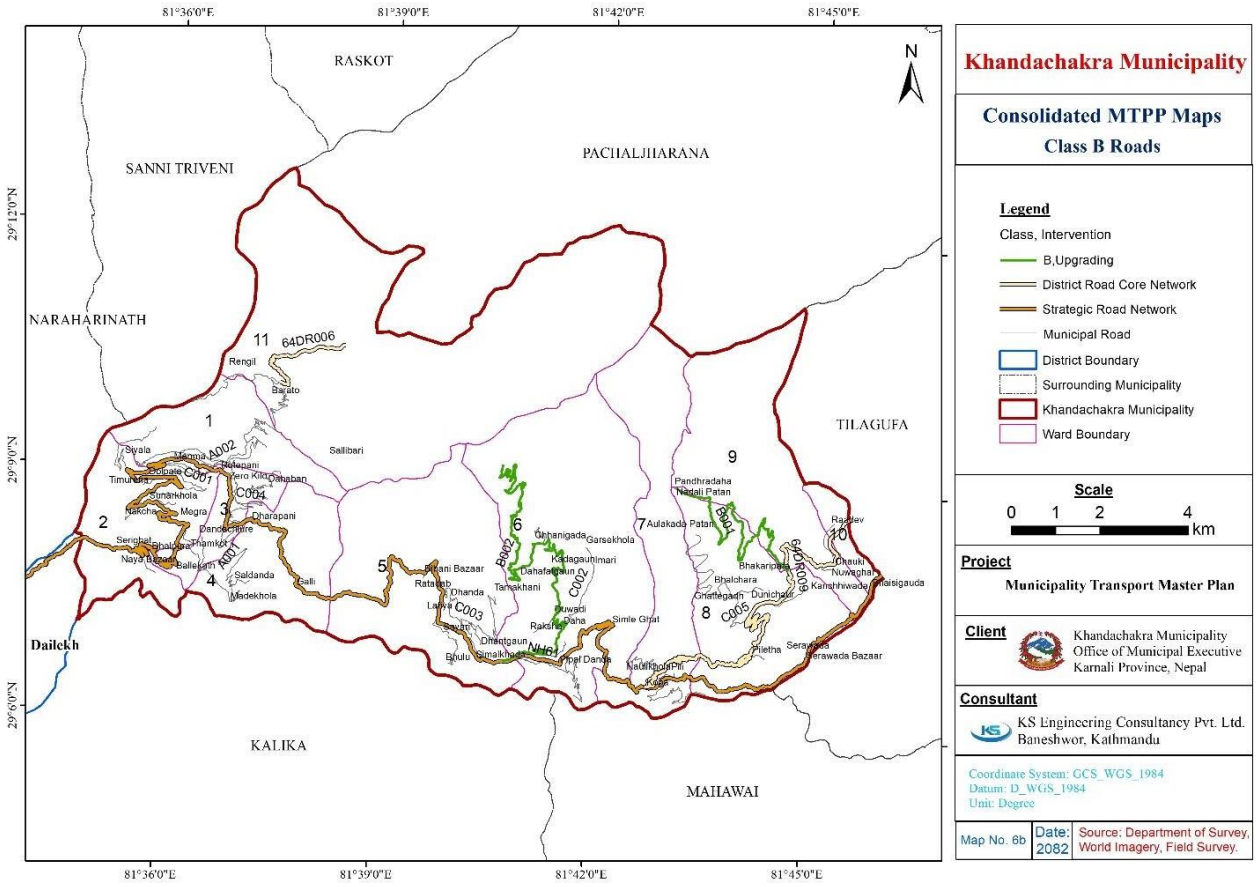

Figure 15: Map of Class B Roads

5.3.3 Class C Roads

Class C roads basically serves the function of access to greater extent and mobility to some extent. These are third hierarchy of roads and these provide access to Class D roads. The right of way for these are recommended to be more than 8m wider roads. Class C roads are residential street and they provide access to the private property and small industrial or public place. These roads provide connection to higher order roads or with agricultural roads which connect a farm with a mini-market center or an agro-based production center. These roads serve mainly for small/light vehicular movement for low volume intensity.

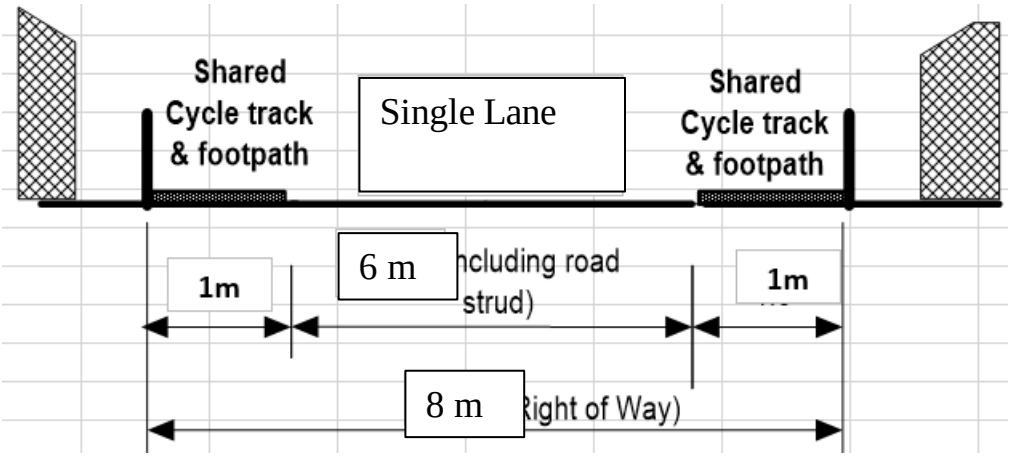

Figure 16: Typical cross section for Class C roads

Table 13: Class C Road Classification

Code	Name	Length
C001	Tharabanna- Ghadasanna -Rali khola-Nainakunja Sadak	3.03
C002	Sundar Khola-Imari-Khada Panchamul Sadak	2.07
C003	Ratadab_Tamakhani Sadak	4.82
C004	Tadi Buspark-Campus-Dahaban-Chuli Sadak	5.34
C005	Dasala Chuli Sadak	6.50
	Total	21.76

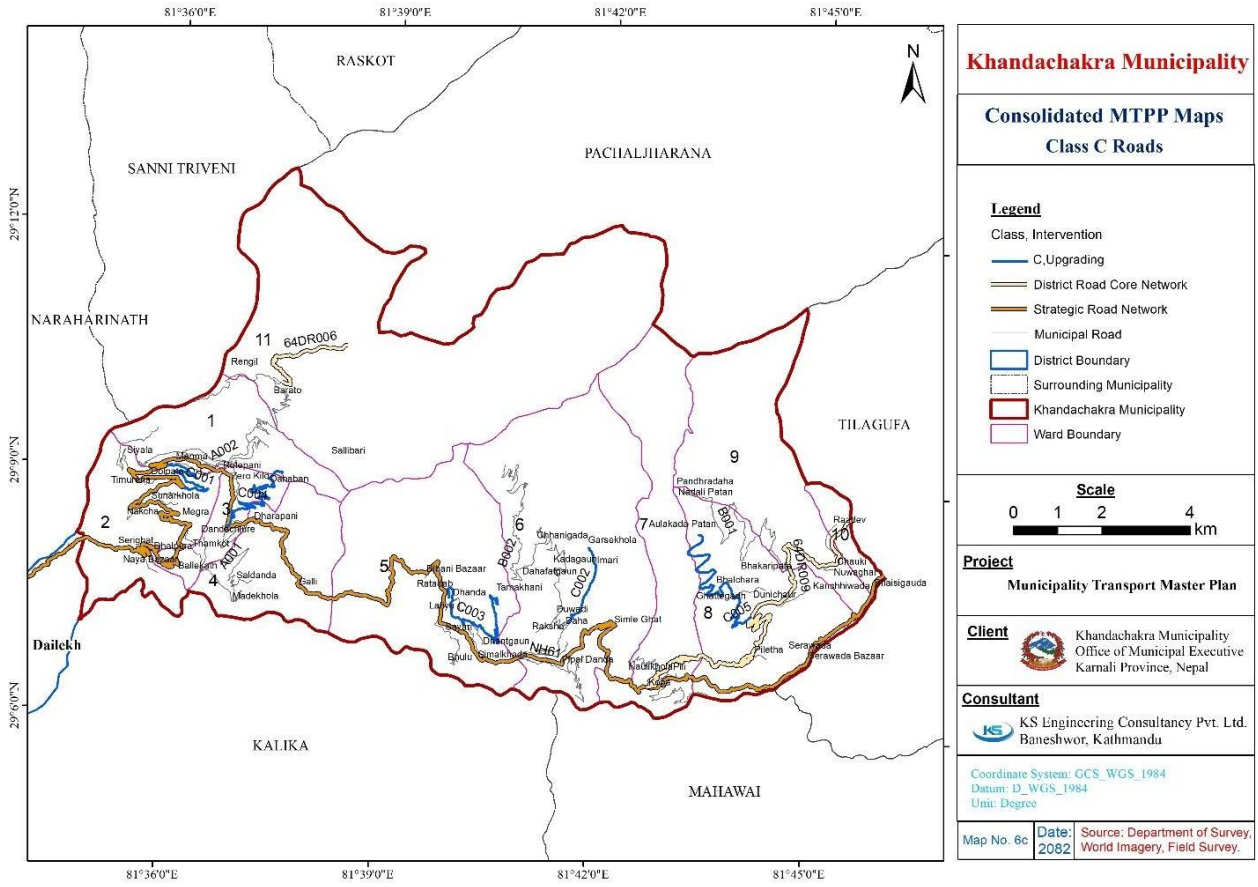

Figure 17: Map of Class C Roads

5.3.4 Class D Roads

Class 'D' roads are all other minor roads which gives access to public property. All other roads that fulfil the minimum requirement set by the Municipality and that doesn't fall under above classes, automatically falls under Class D roads. The cross section can be decided from local level with approval from MRCC, but ensuring all road users are given sufficient rights of sharing the roadway. The community level participation is must for completion of these roads. The Municipality-community share can go from 40% - 60% to 60% - 40% for effectiveness of construction and maintaining the roads. This criteria of investment from local sector depend on Municipality policy. The total length of class D roads is 287.32 Km with 6m RoW.

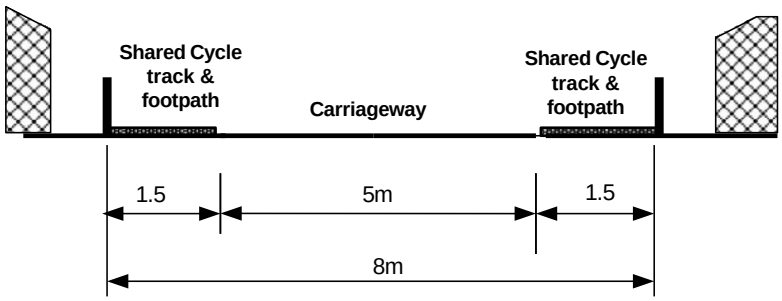

Figure 18: Typical cross section for Class D roads

5.4 Ward Specific Hierarchy of Road

Various hierarchy of road have different functions and characteristics. Based on equity at least each ward needs to be connected by higher hierarchical road network. As highlight in the table below, all the wards are touch by DRCN roads. Later each ward is touched by either of Class A, B or C roads.

Table 14 Ward specific hierarchy of road network

Ward	A	B	C	D	DRCN	SRN
1	3.80	-	0.26	9.84	-	0.91
2	1.00	-	3.03	7.47	-	11.83
3	2.58	-	4.21	2.64	-	4.56
4	5.15	-	0.87	1.06	-	3.64
5	-	0.29	4.82	5.82	-	7.94
6	-	16.01	2.07	8.28	-	5.13
7	-	-	0.33	6.02	3.14	2.51
8		5.07	6.18		7.33	5.06

	-			2.76		
9	-	3.30	-	2.02	2.82	0.72
10	-	-	-	0.38	0.62	0.55
11	3.31	-	-	1.39	3.01	-
Grand Total	15.83	24.67	21.76	47.69	16.91	42.85

Table 15 Ward Pass of the roads

Code	1	2	3	4	5	6	7	8	9	10	11
64DR006											X
64DR009							X	X	X	X	
A001		X	X	X							
A002	X	X	X								X
B001								X	X		
B002					X	X					
C001		X									
C002						X					
C003					X						
C004	X		X	X							
C005							X	X			
NH61	X	X	X	X	X	X	X	X	X	X	

CHAPTER SIX: PRIORITIZATION CRITERIA

6.1 Concept of Prioritization

Each road is of importance in some aspect, some serve large population, whereas some serve the purpose of access, while some link the ward with market or service facilities and some link acts as connectors between two wards or Municipality. It is not possible to construct/maintain or upgrade all roads at a time due to various constraints such as: time, resources and cost constraint. Looking at the importance of road, some road need intervention immediately and some can be done later on. Thus, each link in a network needs to be prioritized and various intervention need to be taken based on the prioritization. In simple words, rank of each road network needs to be assessed based on its importance and the intervention is taken based on the rank. The scoring criteria and their weightage/score remains the same for all road links as well as for all type of intervention.

6.2 Weightage Scoring Criteria

After rigorous study (literature around the world and past experience) and ToR, following prioritization criteria is published. Six ranking/prioritization indicator is proposed as prioritization indicator, which includes following:

Table 16 Proposed Scoring Criteria with score for prioritization

S.N	Scoring Criteria	Scoring Unit	Score
1	Demand Priority of wards		15
2	Total existing width	Meter	15
3	Population served		20
4	Road network benefit (access to service centers, recreational center, agricultural center and market)		20
5	Link to other road network (SRN, District roads, Airport)		10
6	Road Surface		10
7	IDP		10

A. Demand priority of wards:

It is the one of the major criteria for prioritization. Each ward has provided intervention in prioritized order during filling demand form from priority order one to five. This priority is based on actual present ward resident need, i.e., the intervention which is at number 1 priority need to be done first. Higher the priority of intervention, it should get highest score. If certain intervention got highest priority i.e., number 1 priority in certain ward level, then it needs to get full marks. Road with first priority will get full marks and the score will reduced by 20 % for each lower-level priority; i.e., second priority road will get 80% score. Lowest priority (5th priority) link intervention will get twenty percent of total score. And all other roads will get 10% of the total score. The road link with different priority from different wards will get the average score.

B. Existing Width of Road:

Existing width is also the next governing factor for prioritization. The present width of the road is the indicator of the importance. The road which is wider among many roads within the Municipality carries slightly more importance than other roads. Thus, widest road is given highest priority and thus full score. As the new proposed road doesn't have width at present day giving them Zero score will not be realistic and thus new proposed road is given 25% of the total score. Road width within zero and maximum width is given score based on relative scoring. The score for road with variable width will be based on weightage width.

C. Population Served

Population coverage by the road linkage is one of the important indicators of prioritization. Higher the population served by the road, higher will be its necessity or importance and it need to be constructed/upgraded/maintained first. Thus, high score is assigned for the road link serving high population and all other score is based on the relative marking wit. Now the question arises which population can be considered as high population and thus relative score is provided. Among all roads within the Municipality, road serving maximum population is given full marks and the other roads are provided score accordingly. Thus, the score for road based on population served lies within zero to full score.

D. Road Network Benefit (RAMS)

It is one of the main governing prioritization indicators. The road link may provide access to recreational (picnic spot, historical place, park, cinema hall, playground), agricultural land, market center and service center (schools, health post, governmental offices, etc.). A single road link can serve just a single function to all above four functions. Simply more the services road

link offers more will be the importance of the road link/network. The proposed road intervention which serves all four facilities is regarded as the major intervention which need immediate attention and thus it is provided with highest full marks. If the road link only serve any three function/purpose, the score is reduced to 80% of the total final marks. Similarly, link serving any of the two function is provided with 60% and the road which serve only a single function is provided with 40%.

E. Link to other road network

It is one of the main governing prioritization indicators. The proposed road intervention which joins SRN, Feeder Road, and District Road is regarded as the major intervention which need immediate attention and thus it is provided with highest full marks. If the road link only serves any two function/purpose, the score is reduced to 80% of the total final marks. Similarly, link serving any of the one function is provided with 60% and the road which serve from class A road is provided with 40%.

F. Existing Road Surface

Road surface type also governs the scoring and prioritization of the road. There are two principles behind which type of road to prioritize first, one principle says the objective need to be access first, i.e., first make the road motor-able so that it can be operated in all for all weather road. Another approach says the road importance is dependent on surface type, the road which is bituminous at presents has great importance and need to be maintained first compared to upgrading earthen road. Both aspect has significant impact on overall prioritization. Basically, road which has bituminous or metaled road surface serve large population and has significant width and thus it will get high marks in those criteria. Hence, this study gives highest priority to earthen surface as we are mainly concern with accessibility first. Earthen surface road acquires full marks, gravel road surface acquires 80% of total and bituminous/metaled road gets 60% of total score. If a single road has different surface at different section, then the weightage average based on length is taken and score is provided accordingly.

6.3 Prioritized Road Network

The road intervention is based on the budget available as well as the importance of the road and based on above prioritization criteria all roads have been prioritized and then the MTMP plan had been proposed based on the prioritized road network. The prioritized score for various roads has been summed up in the form of table as:

Table 17: Prioritized Major Municipal Road Network

CHAPTER SEVEN: MUNICIPAL TRANSPORT MASTER PLAN

This chapter deals with the strategic framework associated with Municipal Transport Master Plan. Alongside, it also covers perspective plan and implementing strategies necessary to achieve the plan followed by budget expenditure plan.

7.1 Perspective Plan of Municipal Road Network

The prospective plan of Municipal Road network includes the maintenance of the access and collector roads and development of higher hierarchy road corridors supporting mobility of the roads. The first five years should focus on development of existing access roads and their maintenance. It also incorporates construction of new road linkages to provide basic access to the settlements. During this period formulated road hierarchy will be implemented in terms of policy and enforcement of bylaws. Within 2 years other complementary plans of land use and city development will be developed. In the third year, the MTMP and its perspective plan should be revised in coordination with the other plans formulated and changes captured during this period.

Medium term planning will implement the higher hierarchy roads in stages of clearing of the required ROW and infrastructure facilitation. Proper development stages of roads should be planned (construction of Class "A" roads to the standards of Class "C", then gradually upgrading to Class "B" and to Class "A"). Other implementation strategies should be developed and finalized at the end of this period. The road network developed during this period shall complete construction of Class "C" roads. Gradual upgrading of the higher hierarchy road networks during years ten to twenty will be justified by the traffic generated and level of mobility demanded to support the emerging economy. Land development and management should go parallel with clearance of RoW of higher classes of road. Road corridor development projects should be introduced for acquisition of land required to clear RoW for various classes of road.

7.2 Financial Institutions and Capital Investment Plan

The construction work in each year depends on the probable budget. Firstly, the total budget for the current or last financial year needs to be determined. Firstly, the municipal Annual Budget Book is studied for revenues sources as well as expenditure plan on road. Planning of the investment is essential to support local government in developing good and best practice in construction, upgrading, overall asset management and especially operation and maintenance of the road project. The grass root level involvement in the development of the road sector helps to create an informed and responsible citizen in society. Thus, it is important to have local people's participation in the construction works of the local access roads. A majority (if not all) of the local access roads should be constructed by the local people in coordination with the

Municipality. People's participation can be achieved in plantation alongside of the roads, cleaning of the road area and other activities.

Municipality has the responsibility of preparing the necessary framework and implementing policies and strategies for the planned development of the municipal roads and thus the Municipality as a whole. Major share of the municipal budget should be used to maintain the roads and construction of wider roads to meet the planned class and ROW. The annual program should address the local need and the need of emergency and specific maintenance.

Municipality has a major role in developing the roads. It has the responsibility of preparing the necessary framework and implementing policies and strategies for the planned development of the municipal roads and thus the Municipality as a whole. Major share of the municipal budget should be used to maintain the roads and construction of wider roads to meet the planned class and ROW. The annual program should address the local need and the need of emergency and specific maintenance. Specific roads should be constructed as a whole and not in parts for longer period of time. Other institutions are district and division line agencies such as DoR, DoLI. These institutions are responsible for the development of road corridors that are important to the district or a larger area as a whole. Their contribution may or may not invest in the roads within the Municipality, but wider roads of the Municipality that extends to the boundary to other VDC/districts may draw investment beyond the municipal boundary. This will ultimately help in the development of the local municipal market center.

7.3 Five Year Budget Expenditure

Provision of annual budget expenditure for proposed intervention (new construction, upgrading, maintenance and rehabilitation) is one of the final outcomes of the study. The budget plan is based on realistic approach and takes consideration of annual allocated budget of Municipality. Intervention that can't be completed in preceding year should be the next priority in coming year. If a certain road, which was targeted to complete in first year could not be finished in first year, need to be given first priority in next year expenditure plan. If there occurs deficit in annual expenditure, Municipality need to incorporate that particular heading in next year at any cost. They can look for grant, assistance from district or even central level or they can incorporate them by shifting budget from less importance item/heading. Budgeting of roads has been divided according to interventions:

- **Construction and upgrading (70%)**
- **Maintenance (30%)**

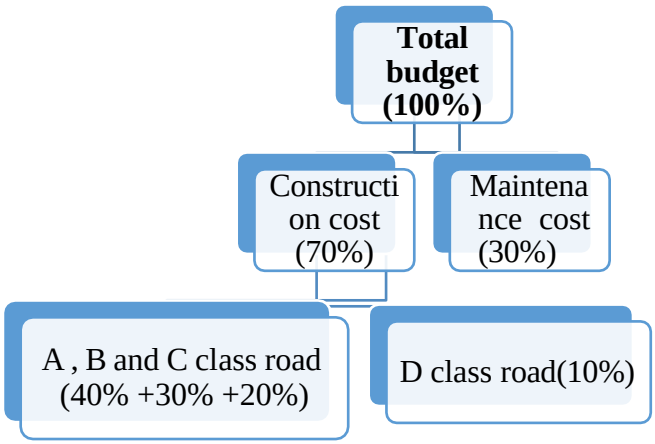

Figure 19: Expenditure Breakdown based on to MTMP Guidelines "A" .

Budgeting of municipal road has been calculated based on present budget and certain growth rate. The capacity enhancement of the Municipality is assumed by 10% increment each year. Maintenance cost has been allocated 30% of fund available for municipal road. Yearly maintenance plans according to need based assessment of required maintenance has to be prepared and cost allocation needs to be done through this plan. In absence of specific fund granted for special project, all other fund available to Municipality for construction of road should come through one window system collected in under single basket and allocated to the roads based on ranking of roads.

The cost of construction and upgrading of road of class "D" is subjected to 10% of total cost of construction and upgrading. Class A road owes 40%, Class B 30% and Class C 20% according to MTMP Guidelines "A" annex 5.

This budget needs to be increased to provide intervention to all road network, if it is to be designed to desired level of full Right of way and hence, they are constructed to acceptable level in next five years and is dealt in next subheading. The projected financial plan for next five years is tabulated below:

Table 18 Projected Financial Plan

Year	Budget	Cumulative Budget	For Class "A" Roads (40 %)	For Class "B" Roads (30 %)	For Class "C" Roads (20 %)	For Class "D" Roads (10%)	Total for Construction & Upgrading-70%	Maintenance (30%)
Base Year	305	305	85	64	43	21	214	92
Year I	336	641	94	70	47	23	235	101
Year II	369	1,010	103	78	52	26	258	111
Year III	406	1,416	114	85	57	28	284	122
Year IV	447	1,862	125	94	63	31	313	134
Year V	491	2,353	138	103	69	34	344	147

*Note: All amount is in Lakhs.

7.4 Five-year implementation plan

Provision of annual budget expenditure for proposed intervention (new construction, upgrading, maintenance and rehabilitation) is one of the final outcomes of the study. The budget plan is based on realistic approach and takes consideration of annual allocated budget of Municipality. Intervention that can't be completed in preceding year should be the next priority in coming year. If a certain road, which was targeted to complete in first year could not be finished in first year, need to be given first priority in next year expenditure plan.

For the preparation of implementation plan one intervention for each road was considered to be intervening. However, if budget remains, then it shall be used for the preparation of second level of interventions considering the same priority. For example, if a road is earthen at present, it will first be upgraded to gravel road and then the next ranked road is provided with intervention and if the budget remains only then it will be upgraded to bituminous/metalled road. At short run all the Class A and B roads will be upgraded to two lane roads, whereas Class C and D roads to single lane roads

In case of graveling within MTMP period (i.e., 5 years), **Single Lane for Class A, Class B, Class C Class D Roads** has been taken under considerations. The difference of RoW and existing width was taken for determining the cost for widening. In each of these calculations, the

rate given in guideline was for single lane and the necessary multiplication was made for respective number of lanes. Drainage calculation was made for both side drains as well as cross drains. Cross drain was considered at every 1000-meterinterval. Most often double side drain was considered within the city area.

Based on the budget projection of the Municipality for next five year and budget allocation for various class of roads and surface type, the implementation strategy for the major hierarchical road network has been proposed. Budget has been allocated for total road length of about km. Table below shows the allocated budget for various classes of roads for Five Years. In municipality, most of the roads have existing road condition earthen and they will be upgraded to gravel roads.

Table 19: Five Year Budget Plan

CHAPTER EIGHT: CONCLUSION

8.1 Conclusion

Municipal Transport Master Plan has been prepared for Khandachakra Municipality. A series surveys for data collection, series of different level interaction with the locals and various authorities was conducted. The study has identified all the roads of the Municipality, their status and interventions required. The map of IDPM, MIM, MTPP and other maps are prepared.

The study has formulated hierarchy of roads which is necessary for long term rapid development of the Municipality area. The study has shown increased trend of motorized vehicle. This is necessary to be implemented as the developed cities are having trouble to address the demand of active mode user friendly urban road infrastructures. As the implementation strategy suggests, the Municipality needs to develop proper framework and policies for the implementation of the perspective plans, built the capacity of the Municipality and the local organizations and committees and proper stages of development of the roads.

Transport and land use along with nodal development cannot be disintegrated. Preparation of Municipal Transport Master Plan is the first step in the planned development of the municipal area. MTMP alone cannot circumscribe the potential development of the municipal area. Comprehensive city development plan, land use plan, drainage master plan, etc. are some other plans that needs to be prepared and integrated with Municipal Transport Master Plan. For future nodal development and transport development, land use master plan and comprehensive city development plan should also be prepared. MTMP should then be revised based on those plans.

The Municipality is linked with high network of DRCN but proper materialization of the planned road network seems missing. Most of the roads are not of adequate width and hence they need to be upgraded. Most of the roads are found to be earthen so, upgrading them to Gravel or Blacktopped or PCC/RCC help in the development of Municipality.

8.2 Recommendation

Proper structured public transport routes are vital for sustainable transport development. As the demand increases, before well-structured and formal transport is justified economically, the local government should introduce City Bus to ply at least within the Municipality.

A proper hierarchy of settlement should be developed to segregate the commercial and business centers from settlement areas and industrial area. A hierarchy of the market centers should be developed as main market

Better provision of ***Road and road side infrastructure*** is must for effectiveness of planning. Due to very high active users, proper networks of pedestrian way and cycle tracks should fit in the

basic road width. Proper bus lay bys are necessary elements for proper public transport system. Adequate lighting system along with proper connected pedestrian ways and zebra crossings is another major road infrastructure.

Integrated service planning is a very important factor for damage minimization during construction and expansion of various facilities. As the road follows, settlement also expands which demands other facilities such as electricity, drainage and drinking water. All these facilities are provided along with road infrastructure, mostly within the ROW of road. Proper integration of these services with road planning is necessary to minimize multiple investment in the individual infrastructure and the damage to other infrastructure during maintenance and/or expansion.

The proposed roads cannot be directly implemented at a glance. ***Proper phases of developmen***t of roads of all hierarchy should be envisaged and planned.

Land acquisition should go parallel with development phase of roads and possibly concept of land polling can be adopted for land acquisition.

Proper Land Use Plan and Comprehensive city development plan is must for better effectiveness of this MTMP and these three need to be correlated with each other.

It is recommended to adopt ***Labor based environmentally friendly and Participatory (LEP)*** approach popularly known as Green Roads construction method. Green Road approach aims at reducing scarring by minimizing the amount of cut necessary and by balancing the amount of material cut with the amount of fill required.

Revised Scoring criteria and Mid Period Review is must to ensure the MTMP is in accordance with the future developed polices on Land Use and Comprehensive City Development Plan.

GLOSSARY:

Accessibility: Ability to reach opportunities/facilities that is beneficial and not the movement.

Base map: A map depicting background reference information such as landforms, roads, landmarks, and political boundaries, onto which other thematic information is placed. A base map is used for locational reference and often includes a geodetic control network as part of its structure.

Capacity: The maximum number of vehicles that can pass over a given section of a lane or roadway in one direction (or in both directions for a two-lane or three-lane highway) during conditions.

Collector road: These roads provide both access and movement within residential, commercial and industrial areas. They are typically discontinuous between residential areas, so as to avoid traffic infiltration through neighborhoods. Lower density developments and community land uses such as schools and convenience retail are often located on collector streets.

Destination: Location where trips are attracted or ended.

Emergency maintenance: Maintenance works that are to be carried out due to unexpected and sudden blockage of roads that stop vehicular movement due to natural disaster

Household: Those who dwell under the same roof, compose a family and eat at the same kitchen

Land Use: Land use highlight on what purpose the land is being used

Local road: These roads provide direct property access in residential, industrial, commercial and downtown areas. With local streets connecting primarily to collector roads, travel distances are short, speeds are relatively low and volumes are modest, as their primary function of accommodating traffic from adjacent lands.

Maintenance: The process of preserving the original condition or function of an asset

Mobility: Efficient and effective movement of people and goods

MTMP: The MTMP is a strategic planning document designed to identify and address the Municipality's needs to the year 2020 and beyond. The MTMP is the document that identify, classify and prioritize the municipal roads; identify possible sources of funds and materials for the construction of the prioritized roads according to their respective standards and scientific mobilization of the available resource.

Network: Set of nodes and connecting links that represent transportation facilities in an area.

New construction: The work of building

Origin: The location of the beginning of a trip or the zone in which a trip begins.

Passenger Car Unit (PCU): Factor used to convert various type of vehicle to car equivalent in context of heterogeneous traffic

Periodic maintenance: Maintenance works to be carried out in intervals of years and of large-scale.

Public Transport: Shared passenger transport service which is available for use by the general public

Recurrent maintenance: Small maintenance works not falling under routine maintenance that are carried out a few times a year in all roads to repair minor damage resulting from traffic and rainfall

Right of Way: A general term denoting land, property of interest therein, usually in a strip, acquired for or devoted to transportation purposes

Routine maintenance: Small maintenance works that are to be carried out in all the seasons on all roads on a regular basis

Specific maintenance: Spot treatments and repairs that do not occur every year or in every road, and which are very specific in nature and location.

Traffic Volume: Number of vehicles passed through the considered section per unit time

Trip: A one-direction movement which begins at the origin at the start time, ends at the destination at the arrival time, and is conducted for a specific purpose.

Upgrading: The process of addition or change that makes something better than it was before

Usable area: The area that can be used for human construction. It includes cultivated and built up area. Environment sensitive area and barren lands are not usable area.

REFERENCES:

Department of Local Infrastructure Development and Agricultural Roads, Access Improvement and Decentralization Project. (2013). *District Transport Master Plan.*Kathmandu District: Government of Nepal, Ministry of Local Development.

Central Bureau of Statistics. (2013). *National Census 2011*. Kathmandu: Government of Nepal, National Planning Commission Secretariat.

Eppell, V. A., Bunker, J., & McClurg, B. (2001). A four level road hierarchy for network planning and management. *Proceedings 20th ARRB Conference.* Melbourne: Jaeger, Vicki, Eds.

Kadiyali, D. L. (2011). Traffic Engineering and Transport planning.

McClurg, B., Bunker , J., & Eppell, V. (2001). A four level road hierarchy for network planning and management. *ARRB.* Melbourne.

Meyer M.D & Miller E.J. Urban Transportation Planning.

National Planning Commission. (2012). *National population and housing census (A national report).* Kathmandu: Central Bureau of Statistics.

Government of Nepal, (2068). Nepal Urban Road Standard 2068 (Final).

Department of Roads, Nepal Road Standard 2070