DHAMDARA & KABRAYTAR

LAP Revision and Infrastructure Design

Planning and Transportation

December,2020

PHUENTSHOLING THROMDE

Royal Government of Bhutan
Chukha, Bhutan
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OVERVIEW

1. INTRODUCTION

Phuentsholing is a vibrant border town of Bhutan with a booming economy and future potential. It is correctly connoted as the economic and financial capital of Bhutan. After Bhutan opened to modernization starting with the five-year plans in early 60's, Phuentsholing was considered to be more developed and a happening place than the capital city Thimphu, due to its commercial viability. However, Phuentsholing has its own set of problems and issues, which could be attributed to its setback in development to grow into its true potential. The most important factor can be attributed to availability of land and the physical barrier that impeded its growth and development. Towards the north lies the geologically unstable terrain, whereas the India-Bhutan border lies towards south. The Toorsa River is another physical barrier towards the west and some good initiatives are being taken to reclaim land for development by channelizing the river. Therefore, the Phuentsholing Thromde's proposal to expand towards north and east was inevitable and a timely decision as outlined in the Phuentsholing Urban Development Plan 2002-2018 (PUDP) and Phuentsholing Structure Plan 2013- 2028 (PSP). Such planning intervention is long overdue if PT wants to grow into its full potential and live up to its name as the Commercial Capital of Bhutan.

Planning is the process of addressing complex issues (economic, social, environmental, political, and ideological) which affect the policy decision that ultimately shape the urban development patterns through its various planning tools. It is concerned with the design and layout of the physical environment that is based on an arguable analytical decision-making process which again is based on evidence and current trends. Though it is argued that planning should be flexible, pragmatic and even incremental (even if their goals and objective changes), it involves a commitment to achieve a perceived goal and objective. Planning is considered to advocate a generic model of thought style in governance that is based on scientific understanding rather than material interest, expediency or political ideology.

Planning is a continuously evolving process which requires constant evaluation and revision.

The most recent local area plans (LAPs) for Dhamdara and Kabraytar were prepared in 2014 by Phuentsholing Throm with the aim to meet the objectives and goals of the PUDP and PSP at the local levels. Proper land use planning and subdivision of lands using land pooling techniques and provision of infrastructure were identified in the LAPs.

However, during the preliminary field survey by the MoWHS officials in 2016, it was found that major part of the LAPs in Thromde has slope instability owing to steep topography with fragile geological conditions and climate. The DGM report of 2010 also states that, the area is an active tectonically uplifted compounded with fragile geologic conditions and geomorphological processes.

1.1. BACKGROUND

The first Development Plan for Phuentsholing was prepared in 1987 with its horizon year as 2001. It covered an area of 186 hectares. Dhamdara and Kabraytar were excluded from the plan. Figure 1.1 shows the Thromde boundary of 1987 plan and 2002 plan. Next strategic plan, PUDP was prepared in 2002. Again, the PUDP covered in detail only the Town Core and Built-up areas of Phuentsholing Town. However, Dhamdara and Kabraytar (including Rinchending, Pasakha, area between Rinchending and Pasakha, Ammo Chhu reclamation area) were included in the Phuentsholing Urban Area (PUA) as extended areas and it outlined the need for preparation of LAPs for all the extended areas. PUDP covered a total area of 1968 hectares consisting of core, built- up areas and extended areas (see Figure 1.1). The extended areas were then under the Drungkhag and covered or referred only broadly in land use in the PUDP. Hence, the PUDP mandated the preparation of detailed Local Area Plans for Kabraytar, Dhamdara, Pipaldara, Rinchending etc. These areas were referred as the Extended Areas of Phuentsholing Urban Plan.

However, the actual Municipal Boundary as per the Thromde Boundaries approved by the Parliament dated 2nd July 2010 is only 15.6 Sq. Km (1560 hectares). The most recent structure plan, PSP 2013 -2028 covers only 1560 hectares. The new Thromde boundary map is shown in Figure 1.2. It outlined the need for preparation of local area plans for all the extended areas like Kabraytar, Dhamdara, Rinchending, Pekarshing (Toribari), Changmari, Pasakha,Gurungdangra, Malbase, Ammo Chhu land reclamation & Toorsatar.

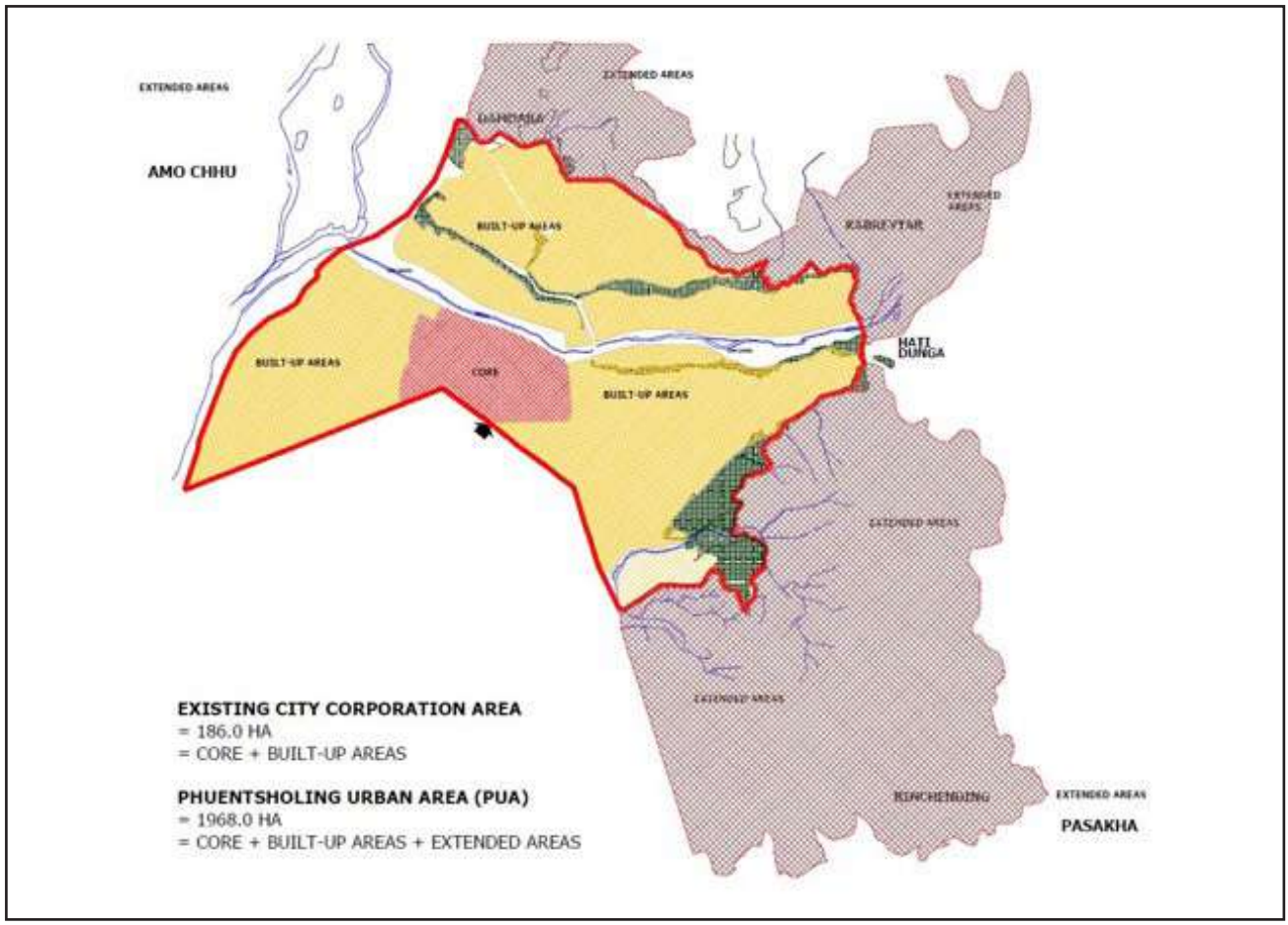

Figure 1.1 Map showing the Thromde Boundary in 1987 Development Plan and Extended Areas of 2002 Plan

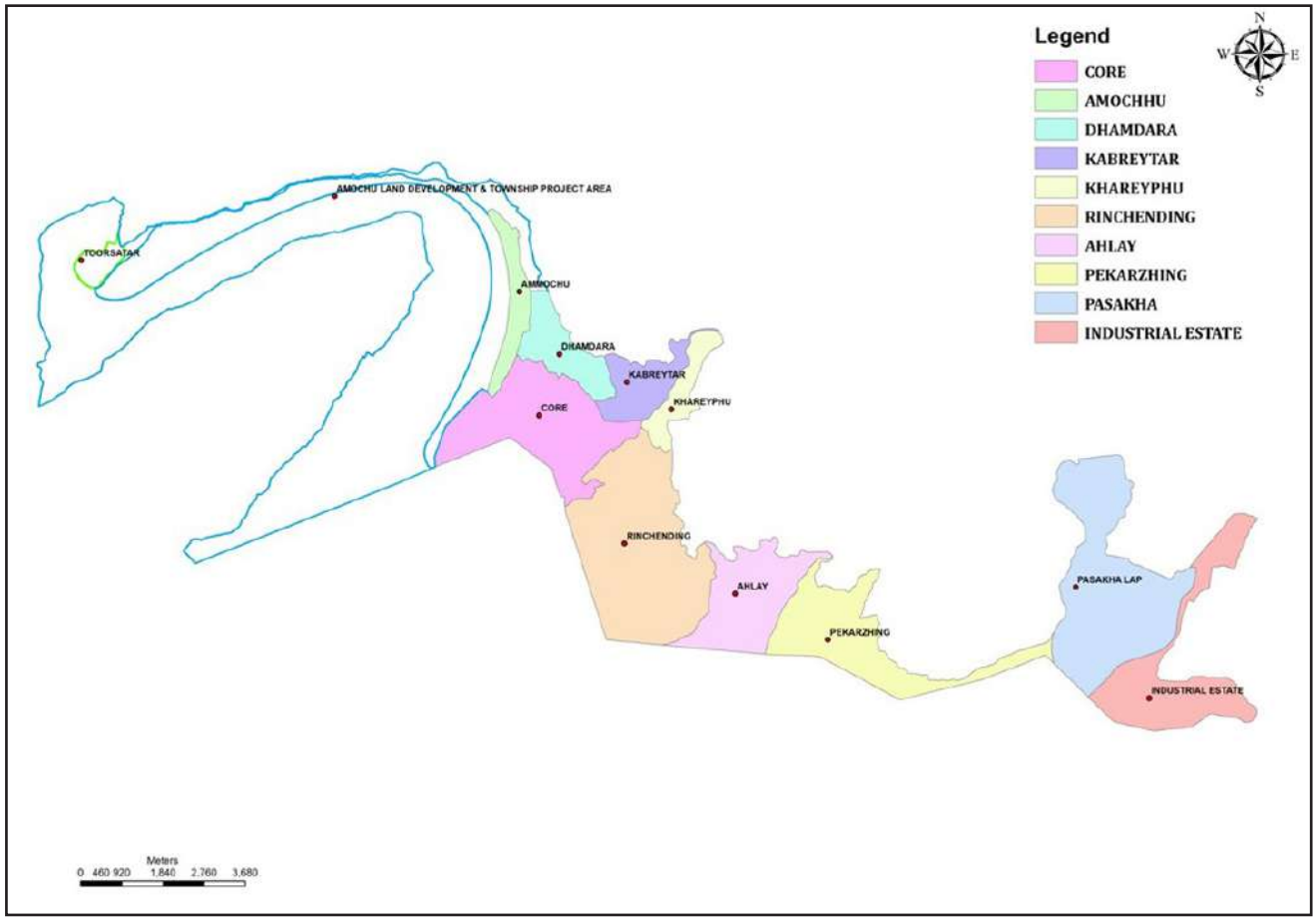

Figure 1.2 Map showing the Thromde Boundary in PSP 2013

1.2. EXTENDED MUNICIPAL AREAS

The reasons for inclusion of the Extended Areas in the Phuentsholing Urban Area (PUA) are due to the following reasons: -

a. Confront the acute shortage of land within the present City area - 82% of the area was already built-up and the city had no scope for expansion due to the International boundary towards south and Amo Chhu River towards the West and north-west.

b. Increase availability of urbanisable land in the catchments area (based on terrain analysis). - The adjoining rural areas like Kabraytar, Dhamdara, and Rinchending offered potential and opportunity for expansion of the city area.

c. Good scope for spill-over additional and complimentary urban developments in the surrounding hills of Kabraytar, Dhamdara, Rinchending and Pasakha as they are in close proximity to Phuentsholing and offered cheaper land cost and rent which was taken advantage to the maximum by desperate/opportunist Land Owners or Buyers or Developers.

d. Construction in the Extended areas. - Kabraytar, Dhamdara, Rinchending etc enjoy urban life but pay rural taxes. Thus, there is a need for regulation of construction in these Extended Areas.

Although the PUDP advocated the inclusion of the Dhamdara and Kabraytar areas within the City, the document was approved by the Council of Cabinet Ministers only in March, 2004 and the actual handing and taking occurred only in June, 2006. By that time, these areas had already developed to a large extent as a residential area while under the Drungkhag administration. The first LAP for Kabraytar was prepared in 2002 by Department of Urban Development and Engineering Services in accordance with PUDP. However, with new PSP 2013-2028, the Kabraytar LAP was revised and a new Dhamdara LAP was prepared in 2014.

1.3. OBJECTIVES

As mentioned in the ToR, the objectives of the Dhamdara and Kabraytar LAP Revision and Infrastructure Design are as follows:

A. To review whether the LAP implementation is in line with the DCR and Phuentsholing Structure Plan 2013-2028

B. To revisit the existing infrastructure and services in both the LAPs and assess the future requirements.

C. To adapt to the finding of Geotechnical Investigation and Slope Stability Assessment study and make necessary changes in both the LAPs.

D. To prepare and improve Storm Water Drainage Master Plan for both the LAPs.

1.3.1. UNDERSTANDING OF THE OBJECTIVES

a) To review whether the LAP implementation is in line with the DCR and Phuentsholing Structure Plan (2013-2028)

Local Area Plans (main component of the Phuentsholing Structure Plan) would be to come up with a detailed layout of the area to have a definite and planned development. The local area plans basically translate the broad framework of the Structure Plan in a detailed manner. It will go to an extent of dictating a development on an individual plot.

Whereas, the Phuentsholing Structure Plan (2013-2028) with the vision "To create Phuentsholing as a business and tourism hub within the south-western region by applying smart growth principles" lays down the strategic framework & policy guidelines for the future development of the town, the review of LAP will look into whether the implementation is in line with the overall vision, goal and objectives of PSP and the DCR.
As any planning will have direct implications for the land and property owners, the LAP will be a product of collaborative and consultative process with the stakeholders, local government, and central authorities.

The existing circulation, mobility and access plan will also be reviewed and come up with recommendation for realignment wherever required.

b) To revisit the existing infrastructure and services in both the LAPs and assess the future requirements.

The LAP will aim to facilitate a pattern of development that will facilitate provision of efficient infrastructure in a planned and sustainable manner protecting the existing habitat, scenic beauty and topography; provide the required amenities within comfortable walking distance; effectively link the Core Area in an efficient manner; rationalize the land subdivision in a manner which allows the efficient introduction of

urban infrastructure and services; assure that all plots are facilitated through a road network which provides access; and to protect the environment and existing greenery. The major focus here will be the provision of drainage facility.

c) To adapt to the finding of Geotechnical Investigation and Slope Stability Assessment study and make necessary changes in both the LAPs.

One of the major focus of the assignment will be to review the LAP considering the findings of the recent Geo-tech studies and the Climate Resilience Planning Principles. It will identify and delineate areas (zones) needing special protection including surface and ground water supply sources and catchments; soil erosion and land slide prone areas; flood-prone areas; forests; agricultural areas, cultural significant areas. It will also identify the measures required to mitigate hazards and to protect assets in all protection zones, including permitted/prohibited development and uses.

d) To prepare and improve Storm Water Drainage Master Plan for both the LAPs

Storm Water Drainage

As mentioned in the Terms of Reference (ToR), one of the objectives for the assignment is the need for a proper and holistic storm water drainage system and one of the main problems with Urban Storm Water designs and other water infrastructures is flooding during the monsoon. Proper flood analysis of Kabraytar and Dhamdara area under intensity-duration frequency analysis of rainfall shall also be carried out under the scope to ensure that the designs are not impacted by floods. We know that the most urban areas in Bhutan are susceptible to summer floods during the monsoon which are all chiefly due to the fact of under-designed storm water designs. The Rationale method shall be used for analysis of Storm Water.

The Rational Method is most effective in urban areas with drainage areas of less than 200 acres. The method is typically used to determine the size of storm sewers, channels, and other drainage structures. It is used to determine the size of the detention basin required for your construction site.

General Procedure of Rationale methods are as below;

- Step 1: Determine the drainage area (in acres.)
- Step 2: Determine the runoff coefficient (C).
- Step 3: Determine the hydraulic length or flow path that will be used to determine the time of concentration.
- Step 4: Determine the types of flow (or flow regimes) that occur along the flow path.
- Step 5: Determine the time of concentration (Tc) for the drainage area.
- Step 6: Use the time of concentration to determine the intensity.
- Step 7: Input the drainage area, C value, and intensity into the formula to determine the peak rate of runoff.

Water Supply

Further, for other infrastructure like the design of Urban Water Supply, Sewerage and related infrastructure, relevant software programs are also planned to be made use of. Experts in the group have exposure and skills in learning and using multiple software programs for environmental solutions. Some of the programs that are usable are EPANET from the US Environment Protection Agency. EPANET is software that models water distribution piping systems which is freely copied and distributed. EPANET performs extended period simulation of the water movement and quality behavior within pressurized pipe networks. Pipe networks consist of pipes, nodes (junctions), pumps, valves, and storage tanks or reservoirs.

The other program that is suitable is WaterCAD which is an easy-to-use hydraulic and water quality modeling solution for water distribution systems. WaterCAD helps engineers and utilities analyze, design, and optimize water distribution systems. Water utilities, municipalities and design engineering firms trust WaterCAD as a reliable, resource-saving, decision-support tool for their water infrastructure. They depend upon its robust hydraulic analysis, practical model management, and eloquent result interpretation.

Solid Waste

The Solid Waste Management (SWM) System will be highly based on the concept of 4Rs- Reduce, Reuse, Recycle and Recover. Land fill should be the least favoured option as shown in Figure 1.3. The ideas of waste segregation and reduction shall be highly encouraged by the way of incorporating it in the Waste management system. The waste collected shall be disposed off and taken proper care through sanitary landfill either within the urban area or outside depending on the site conditions. The issues of sizing

appropriate community basins or truck schedules shall also be determined and planned accordingly. A widely accepted solid waste management activity hierarchy that promotes sustainability is shown in figure below. It shows that the best way to minimize the negative impact of waste is to avoid creating waste in the first place. Reducing waste avoids consuming primary resources in the extraction, production, and distribution of products and packaging. Once a material is in the waste stream, reusing, recycling and composting are preferred waste management activities. After that, recovering energy takes its place in the waste management hierarchy as an activity preferred over landfill disposal.

A Master plan for Solid Waste Management shall be developed with a comprehensive document keeping in view of the long-term requirement. It shall contain the following:

a. Existing infrastructure available

b. Gaps and issues

c. Project service demands and targets to be achieved

d. Plan system

e. Various interventions and subprojects

Sewerage Master Plan

Management and Treatment of urban waste water is a big challenge for every municipal authority. As we bring in people closer, the intensity and severity of the issues become critical. We propose on concentrated treatment plants. Wastewater treatment is a process to convert wastewater - which is water no longer needed or suitable for its most recent use - into an effluent that can be either returned to the water cycle with minimal environmental issues or reused. The plant operation begins as the wastewater enters the plant at a self-cleaning bar screen with compactor combined with a grit chamber with grit washer to remove trash. The wastewater will enter vertical loop reactor tanks disc aerators, and supplemental blowers to begin the cleaning process. The clarifiers act as the settling area for separation of the water from solids. The water on the top of the clarifiers travels to the chlorination tanks for disinfections, then to the de-chlorination tanks before it is discharged into the River. The solids are transferred into a sludge thickener before the final process in the aerobic digester. The sludge from the digester is transferred to the belt press, a post line stabilization facility, where additional liquids are removed. Finally, the remaining solids are transported to the landfill for disposal. This process is as shown in Figure 1.4. We shall ensure that proper studies and analysis are done before we decide and design the

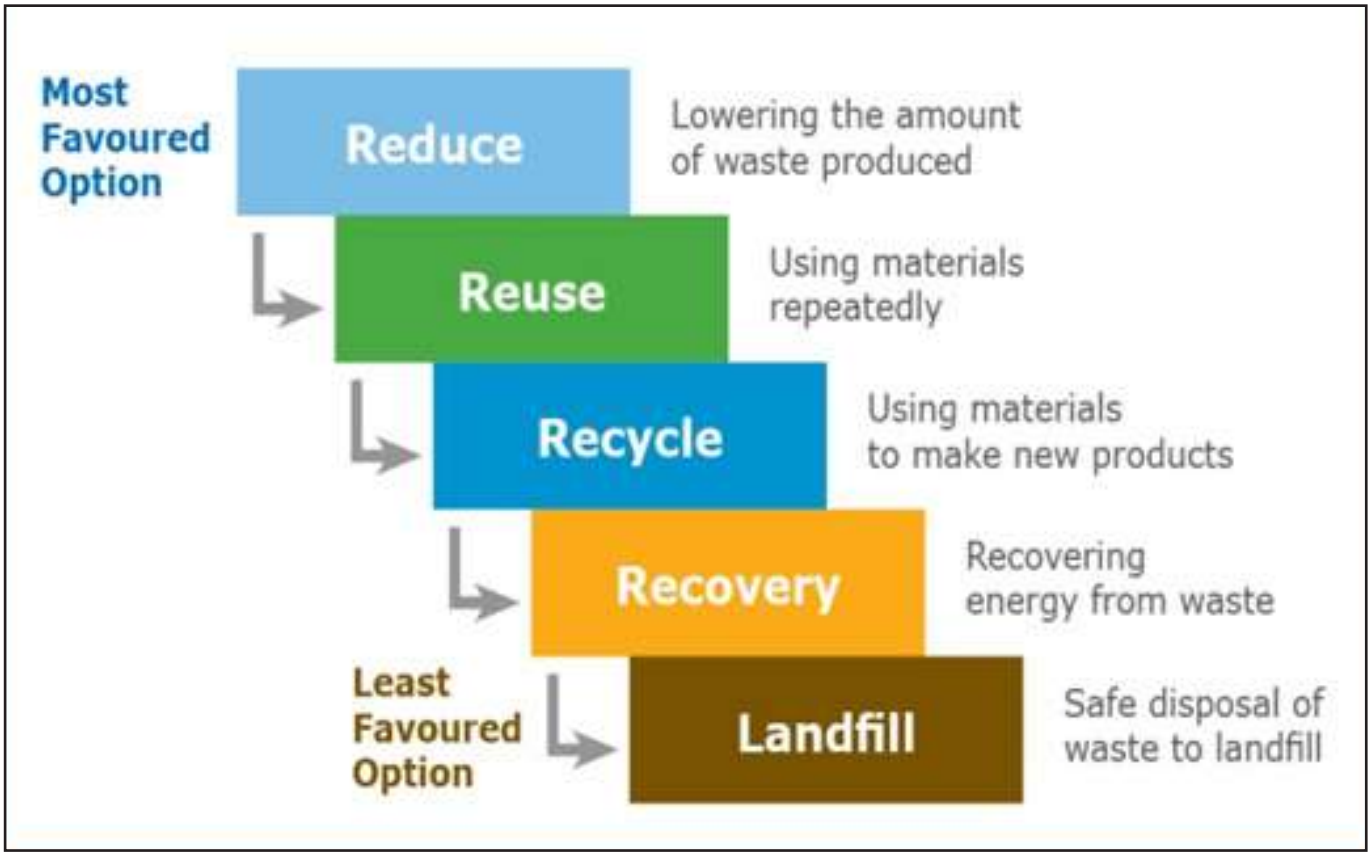

Figure 1.3 Solid waste management plan Source: Google, 2020

system completely. The steps that will be involved are both technical, socio-economic and site conditions as shown in Figure 1.5.

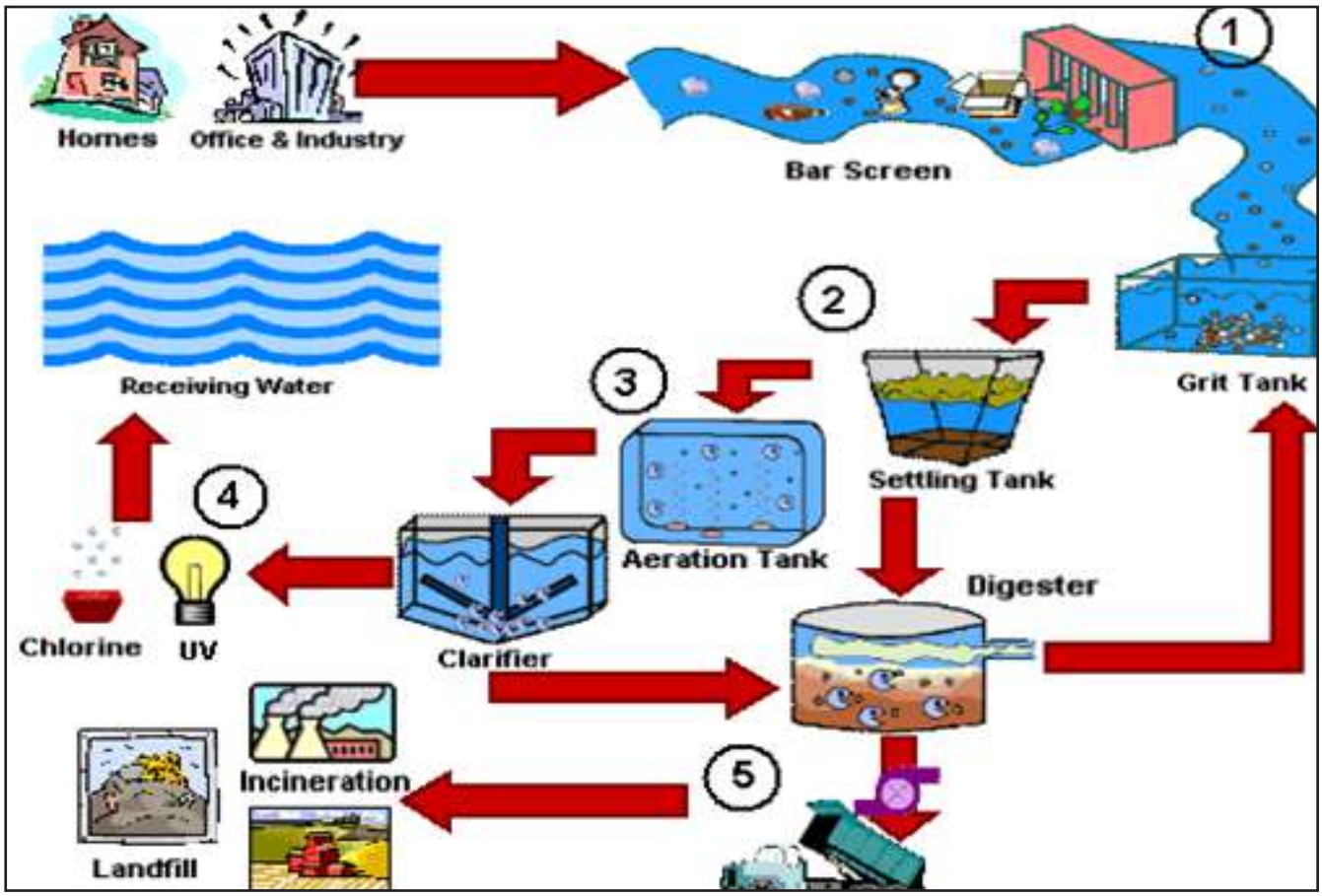

Figure 1.4 Typical layout of a municipal Waste Water Treatment system. Source, Google, 2020

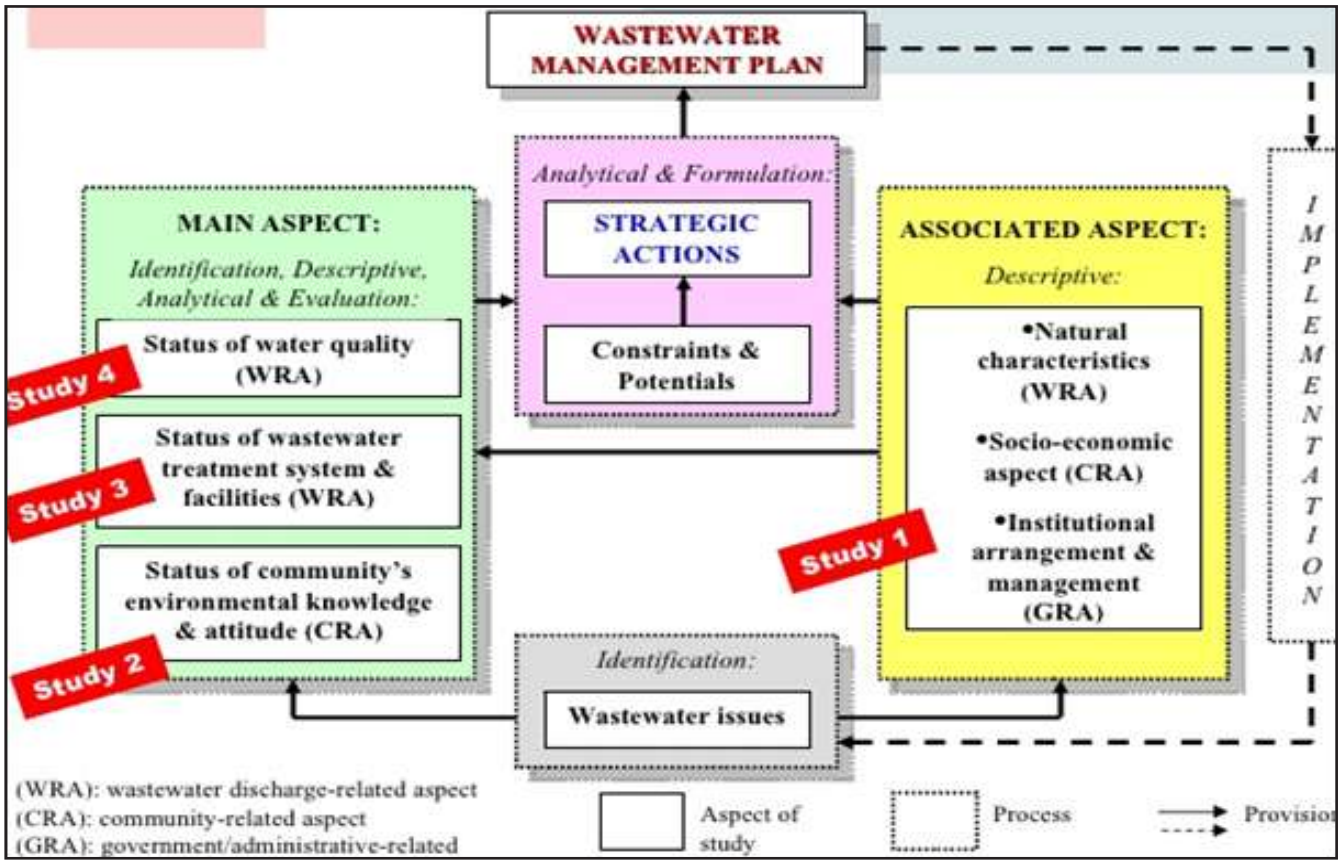

Figure 1.5 Analytical framework for waste water management plan. Source Google, 2020

1.4. METHODOLOGY

The process flow for the assignment is detailed in the figure 1.6. It has been prepared in line with the deliverables outlined in the Terms of Reference.

The review of Kabraytar and Dhamdara LAP and infrastructure design occur in various stages.

In stage one, inception report will be prepared. This will present the existing scenario of the place using secondary data available and primary data collected from site visit. Existing scenario will cover the following:

- Climate and vegetation: Rainfall, weather, temperature and existing vegetation. Secondary data sources, such as reports from National Centre for Hydrology and Meteorology, Bhutan Biodiversity portal and Royal society for Protection of Nature will be referred to gather data on the climate and vegetation of the study area.
- Topography and Land features: Slope and aspect, natural drainage (rivers, gullies, streams), soil conditions, fault lines. Topographical data and geo-technical study 2019 provided by the Phuentsholing Thromde will be used to understand the topography and land features. These data will be mapped to analyse and identify hazard and non-hazard areas.
- Land uses, Land holding pattern, demography: Data available from Thromde.
- Environmental and Social infrastructure: water supply, sewerage, solid waste, storm water drainage, underground utilities, police station, fire-fighting facilities, community halls, recreational areas, open areas, etc. This data will be mostly gathered from the site visit data collection and partly from secondary data provided by Thromde.
- Traffic and pedestrian circulation: Road network and hierarchy, intersections, footpath, public transport routes and nodes, parking facilities, signage, traffic count, etc. This data will be mostly gathered from the site visit data collection and partly from secondary data provided by Thromde.
- Initial literature review will also be carried out at this stage.
- Stage two is concept plan stage. Here, through analysis of the existing scenario will be conducted and compared with the existing LAPs. Issues will be identified and proposals will be made. Integrated base maps are produced at this stage incorporating new proposals. Presentation and discussion with the stakeholders will be conducted, noting the feedback and changes.
- In Stage three, draft plan will be prepared. At this stage, all the proposed drawings and report will be prepared incorporating the feedback from the stakeholders. This will be presented to the stakeholders and discussed. Feedback from them will be taken into consideration.
- Upon the approval of the draft plan and report, a final draft will be prepared incorporation suggestions and correction from the client and stakeholders.

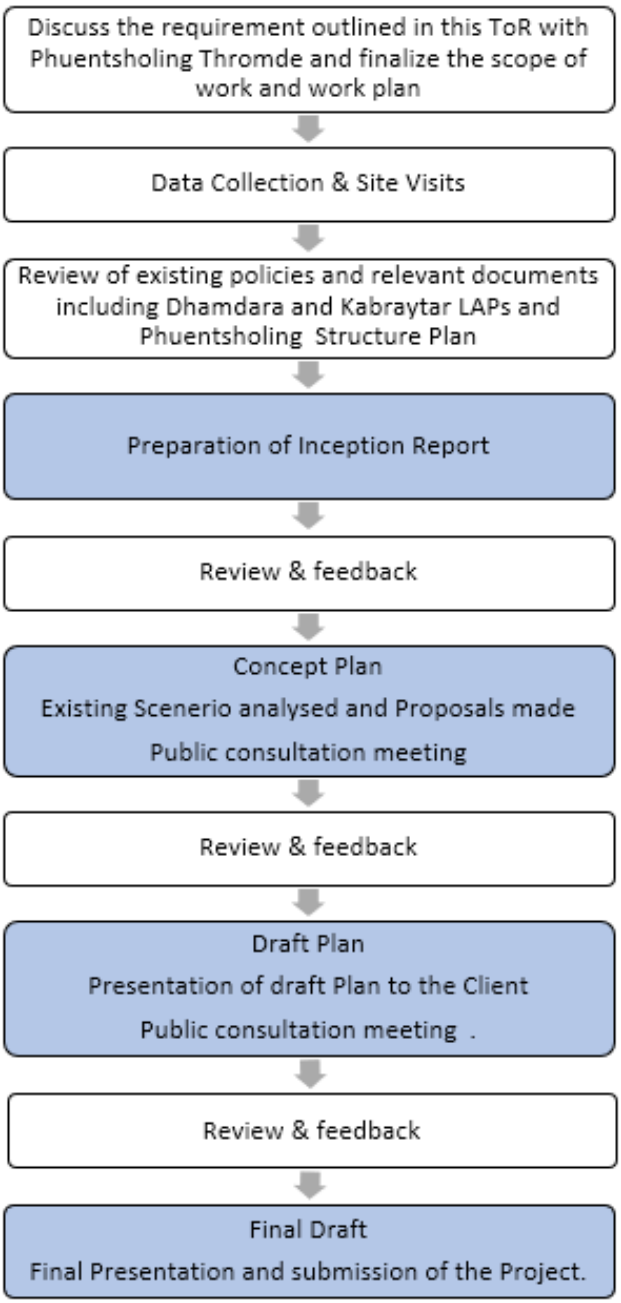

Figure 1.6 Process flow chart for the review of Dhamdara and Kabraytar LAP and infrastructure design

GOALS, OBJECTIVES & STRATEGIES

2. GOALS, OBJECTIVES & STRATEGIES

Vision	Goal	Objectives	Strategies
"To Create Phuentsholing as a socially and culturally vibrant city with the emphasis on Sustainable Business and Tourism by applying smart growth principles" – Phuentsholing Structure Plan 2013-2028	To achieve a unique sense of community and place, expand the range of transportation, employment, and housing choices, equitably distribute the costs and benefits of development, preserve and enhance natural and cultural resources and promote public health.	To review whether the LAP implementation is in line with the DCR and Phuentsholing Structure Plan (2013-2028)	Review PSP & DCR Review and analyze the existing scenario (Site visits) Find the inconsistencies
		To revisit the existing infrastructure and assess the future requirements.	Data collection Review existing infrastructure (Hospitals, Schools, Day care centre, Roads, Footpaths, Sport Infrastructure, Street lights, etc….) Future requirements assessment
		To adapt to the finding of Geotechnical Investigation and Slope Stability Assessment study and make necessary changes.	Review Geotech Study Compare the findings with PSP, DCR.
		To prepare and improve Storm Water Drainage Master Plan.	Collect data and Analyze existing Storm water drainage system Assess the future requirements in accordance with population growth and carrying capacity. Study standard designs suitable for the project area
		Providing proper Water Supply Networks	Collect data and Analyze existing water supply Assess future requirements Refer applicable international sources.
		Providing proper Sewerage Network	Collection of data Analyze existing Sewerage network Assess future requirements Desk study (Standard sewerage designs suitable

			for locations similar to the project area)
		Conservation of Natural, Religious and cultural features	Analyze existing scenario Future plans as per PSP. -
		Improvement of Traffic and Pedestrian Circulation	Data Collection and Assessing the existing scenario Future requirement assessment Compare circulation Plans (Traffic & pedestrian) as per PSP and existing scenario in the project area.
		Promoting Tourism	Assess the current tourism related infrastructures & Plans Map out tourist attractions Current tourist index and future projections.

LITERATURE REVIEW

3. LITERATURE REVIEW

3.1. PHUENTSHOLING STRUCTURE PLAN (PSP) 2013-2028

The Phuentsholing Structure Plan 2013-2028 (PSP) builds upon and revises the Phuentsholing urban development plan 2002 (PUDP). It provides overall strategic planning framework and guidelines for Phuentsholing Thromde. It was prepared in consultation with public and stakeholders with the vision to "Create Phuentsholing as a socially and culturally vibrant city with the emphasis on Sustainable Business and Tourism by applying smart growth principles". Some of the major issues and concerns identified before the preparation of the plan were regarding inappropriate mixture of land uses, acute shortage of housing, risk from natural disasters such as floods, landslides, and earthquakes, inadequate, inefficient and ineffective traffic circulation and management plan leading to traffic congestion and security issues due to location in the international boundary.

The over-arching objectives set in PSP that are relevant to the Dhamdara and Kabraytar LAPs are as follows:

- Promotion of tourism
- Solve housing inadequacy
- Improve existing infrastructure
- Better traffic and pedestrian circulation
- Enhance public amenities
- Conservation of natural, religious and cultural features.

In order to achieve the objectives of the plan a number of proposals were made as follows:

3.1.1. PRECINCT PLANS

For the proper management and segregation of different land uses, eight precincts were proposed namely,

a. urban village,

b. neighbourhood node,

c. institutional,

d. heritage,

e. environmental,

f. green open space,

g. special economic zone and

h. royal precincts.

Land uses in each of these precincts are governed by development control regulation (DCR).

Natural environment protection and enhancement zone

In order to protect the environment and to maintain ecological balance natural environment and enhancement zones, i.e.

- Riparian Protection Zones (E1 Environment conservation precinct)
- Slope and soil stablisation zones (E4 Agri-based environment) is identified and mapped.

While new construction other than those related to environmental conservation is strictly prohibited in E1, a number of land uses, especially related to farming, small industry and warehouses are permissible in E4.

Road network and Transportation plan

The proposed Transportation Plan attempts to be responsive to the existing traffic circulation issues while integrating the concepts of the Structure Plan like urban villages, neighborhood node, regional linkages and establishment of an urban corridor. The proposed transportation plan aims to connect all places with road and maintain clear road hierarchy of primary, secondary and access roads. Road side footpath and off-street walkways are also proposed to enhance and encourage pedestrian movement. Need for public transit system in future with routes and stops in urban villages and core areas is also mentioned. A number of projects are proposed for improving traffic circulation:

- Construction of new roads
- Construction of bus stops with adequate street furniture
- Constructing and developing both on-street and off-street pedestrian pathways
- Constructing new pedestrian bridges across Ammo chhu, Om chhu, Bhalu Jhora Chhu, Padsekha Chhu, and other major streams.
- Construction a new truck parking
- Upgrading existing bridges and culverts.

Open space network and pathways

Phuentsholing lacks in the presence of green open spaces that could serve to all age groups. The proposed open space system is aimed at managing and enhancing the natural landscape to fulfill the recreational requirements and to rejuvenate the existing open spaces. Four different categories of open spaces are proposed,

- Recreational open spaces (G2): This would include community parks, sports complex, archery fields and wildlife sanctuary.
- River and natural drains protection green belt (E1): Pedestrians walkways in the river and stream buffer would form pedestrian movement system connecting different urban villages and precincts.
- Riverfront (E1): Areas near Ammo chu which have the risk of flooding needs to be left vacant and developed into riverfront recreational areas such as play grounds, theme parks and jogging and bicycle tracks.
- Heritage open spaces (H): Heritage open spaces are the open spaces associated with cultural and heritage structures, national monuments and important religious buildings. The proposal will develop these spaces to enhance the heritage structures and their precinct, which will also act as public open space.

3.1.2. HIGH TENSION LINES RESERVATION

High tension lines corridors will be kept as buffer zones of certain metres depending upon the type of transmission lines. Except for some small temporary structure and permissible activities as per the Bhutan Power Corporation Ltd the land adjoining the high-tension lines will be kept idle.

3.1.3. INFRASTRUCTURE AND AMENITIES

One of the main objectives of Phuentsholing Structure Plan is the sequential allocation and development of amenities and services to prioritize potential growth areas within the town. Other objectives include the provision of basic amenities and services in all the identified urban villages to allow the town to function effectively as a network of self-contained urban units and to enable phased prioritization of services in these urban villages. Provision of facilities is eventually done by the competent departments in the required hierarchies, to encourage people's participation and ownership of the common amenities. A number of amenities related to education, health, sports and recreation, economy, security, law and order are proposed. Most importantly, each urban village needs to have basic amenities such as neighbourhood clinic, nursery school, toddlers park, convenience shopping, post office, library, news paper stand, ATM centre, community hall, lhakhang, internet café, space for community welfare organizations, public toilets, water storage reservoirs, pumping facilities, solid waste collection bin, parking lot, taxi stand, transit stop, police post, fire service, etc.

3.1.4. SANITATION AND UTILITIES

Planning for utilities and services is a basic need to ensure good living conditions in the town. The proposals are related to the population accommodation capacity and the proposed urban villages. One of the important aspects of these services is to encourage community participation at all relevant areas and at all relevant levels, which will ease the maintenance and management of the amenities.

a) Water

It is proposed that each urban village is equipped with a storage reservoir, to enable a pressure driven water supply system in these areas. A network of trunk infrastructure is proposed to be laid out covering the key areas of the periphery, from where branch lines would be let out as and when required. Hence the trunk infrastructure from the main reservoir to the respective urban villages would have to be established properly to facilitate easy operation and maintenance. The actual network for each urban village, as per the different systems of supply proposed would have to be worked out in detail at local area plan level.

b) Storm water drainage

Phuentsholing's drainage system was constructed in 1990's, which is a combined system with mostly open drains that conveys both storm water runoff and household wastewater. The system lacks a comprehensive planning and engineering standards, creating a hindrance in the repair and maintenance.

It is proposed that the present system should be upgraded to a comprehensive storm water management system. The natural surface storm water drainage pattern existing in the town's landscape (created as a result of its topographical conditions) will form the primary storm drainage network. It should be protected to allow for a smooth out-flow of the storm water from the town. The secondary storm-water

drainage network will run underneath the onstreet footpaths. A typical drain laid under the footpath, will have vertical grills, at appropriate intervals, as part of the level-difference between the footpath and the carriageway. This arrangement is suitable to prevent blocking of the drains due to garbage and other waste being accumulated on the horizontal grills. The secondary drains will open out into the natural storm water drains. The confluent part of the natural storm water drain and the river will be provided with storm water drain purification ponds. These storm water drain purification ponds will filter and purify the organic and suspended particles, carried by the surface run-off, before joining the natural water bodies.

c) Sewerage management

The sewerage system in Phuentsholing is more than 15 years old and not able to cope up with the present load. Areas like Dhamdara, Kabraytar, Karma Steel, Dry Port area, Rinchending and Pasakha Industrial Estate are still using septic tanks. In addition, the existing sewage network and treatment facility have to be extended to accommodate the collected from additional areas like banks of Ammo Chhu, area above Kabraytar, Kharaley, Khareyphu and Dokhiya. It is also proposed that the treated wastewater should be used for horticultural and other such purpose. The detail design and engineering of the sewerage network will have to be done by competent authority.

d) Solid waste collection and disposal system

It is proposed that the high and medium-density urban villages be served by a door-to-door solid waste collection system. The low density residential development areas can be provided with separate community bins at regular intervals and at strategic points, where each household will dispose its waste into recyclable and non-recyclable bins. The Thromde workers will then dump the non-recyclable wastes in the main garbage bins located along the primary roads at regular intervals. Disposal of this waste from bins will be carried out by Thromde on a regular basis, by taking it to Pekarshing (Toribari) disposal site. The present solid waste disposal site at Pekarshing (Toribari) will have to be expanded at the same location in order to accommodate the future waste disposals of the increased population. Special treatment arrangement should be also made for the industrial waste from Pasakha Industrial Estate and the medical waste collected from hospitals.

e) Street Lighting facilities

Phuentsholing Thromde provides the street lighting facilities and looks after the maintenance. Mainly due to the lack of finances and inadequate human resources, not all the roads of Phuentsholing have street lighting facility currently.

The primary objective of proposals devised for the street lighting system in the town is to facilitate the provision of lighting on all the roads of the transportation network, as well as access roads serving to the residential quarters in the future.

Towards achieving the objective, Phuentsholing Thromde could explore alternative options, which facilitate service provision through community participation. As an example for this method, citizens of one locality can contribute towards installation of streetlights in their area and the Thromde can provide incentives by waiving the water charges for a stipulated time period. Other similar schemes can be designed, which essentially encourage the citizens to contribute towards the installation of facilities of immediate help to them, by extending certain incentives to create win-win scenarios. This approach will effectively bypass the resource constraints issue and facilitate rapid provision of infrastructure. This method will well suit for providing facilities to the roads leading to residential quarters and to the ones running through housing colonies.

3.1.5. HOUSING

The housing and land shortage in Phuentsholing is on account of underutilization of land and delayed construction activity, in the absence of a proper Structure Plan for the town. The housing shortage will grow even more in the coming decades. Hence it is the prime responsibility of the planners to formulate a shelter strategy for the people of Phuentsholing. The proposed Shelter Strategy can be understood in two main parts:

a) Designing and Physical planning aspects

The Structure Plan advocates ‘medium-rise, high-density’ development as a development strategy. ‘Medium-rise, high-density’ means the maximum height allowed in Phuentsholing Town and its peripheral zone would be ground plus three floors at the maximum. But to accommodate higher density of population the allowable ground coverage of buildings would be relatively high, within the building setbacks rules proposed by the Development Control

Regulations.

b) Finance, management and administration

The solution to this "housing shortage" lies as much in the financial mechanisms we evolve and in the institutional modalities, as it does in the physical plans we prepare. It is important that we facilitate the private sector to become active in the provision of housing, in addition to the public sector agencies involved now. The idea is to get small and medium sized builders into the shelter provision business, which would also provide employment in the construction industry. Also, long-term loan schemes can be evolved for the buyers of housing units. For achieving the above said goal two strategies seem to be required. First, the problem needs to be re-conceptualized from that of a "housing shortage" to one of "facilitating a shelter process." Next, the problem has to be seen as promoting private sector initiatives. Thus, we are moving from the government provided minimum standard housing units to facilitating and promoting the private developers to create a range of shelters for all income groups.

The Structure Plan of Phuentsholing will fulfill the future housing demand of the town through designating Medium and High-density Housing in each self-contained urban village identified in the town, further amplified by the preparation of Local Area Plans. The Urban villages forming the basic planning unit of the Phuentsholing Structure Plan will be dominated by residential areas with varied density patterns to optimize the provision of essential urban services.

Conceptually, these units will have amenities, basic services and a convenience shopping core in their center called Neighborhood Node, surrounded by medium- to high density walk-up apartments, then with a ring of medium density housing units towards the periphery.
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3.2. DHAMDARA LAP 2014 OVERVIEW

Dhamdara and Pipaldara (referred to as Dhamdara LAP) are two pockets of land that have developed towards the northern part of the main City Core of Phuentsholing (see Figure 3.1). Since these places are next to each other and are small in size, the whole area is referred to as Dhamdara in this Local Area Map (LAP). The total area covered is 60.7046 hectares or 150 acres.

Figure 3.1 Location of Dhamdara LAP and its coverage

The area lies about 15 minutes walking distance from the Town Core area and is bordered by THPA Colony and the General hospital to the South, Kimbu Gairi to the east, Amo chhu to the west and Bumchaing Gairi to the north. The lap boundary in general follows natural features like stream, gulley, Amo chhu bank etc.

Land uses

Table 3.1 shows the existing land use in 2014. Apart from the forest/landslide area and vacant area, the prominent land use is residential. It can be observed that there is no dedicated land for recreational use.

The LAP has 82.12 acres of private land and 56.03 acres of government land which is about 60% and 40% respectively (see Table 3.2 Government and Private land in Dhamdara (DLAP, 2014). There are 116 structures in total of which maximum, i.e. 44 are single storied structure and there is just one five storied structure. See Table 3.3.

Table 3.1 Existing Land uses in Dhamdara (DLAP 2014)

Sl. no.	Type of land use	Area (Acres)	Area coverage %
1	Residential land	17.08	12.36
2	Agricultural/ Orchard land	7.39	21.57
3	Industrial/workshop land	6.75	5.35
4	Infrastructure (road, drainage, footpath)	3.36	4.88
5	Commercial Land	1.23	0.89
6	Private/Govt. vacant Land	29.82	21.57
7	Forest/Landslide area	72.61	52.52
	Total	138.24	100.00

Table 3.2 Government and Private land in Dhamdara (DLAP, 2014)

Sl. No.	Category of land ownership	Area (Acres)	Area Coverage %
1	Private Land	82.12	59.44
2	Government Land	56.03	40.56
	Total	138.15	100

Table 3.3 Existing building heights in Dhamdara (DLAP, 2014)

Sl. no	Category of Structure	Total no. of Structure
1	Permanent/ Semi-permanent	
	(a). Single-storied Structure	44
	(b). Double-storied Structure	18
	(c.) Triple-storied Structure	15
	(d). Four-storied Structure	7
	(e). Five-storied Structure	1
2	Temporary Structure	
	(a). Single-storied Structure	31
	Total no. of structures	116

3.2.1. EXISTING INFRASTRUCTURE AND PROPOSALS

Table 3.4 summarizes the infrastructure scenario in Dhamdara in 2014 and proposals made.

Table 3.4 Infrastructure Scenario in Dhamdara, 2014 & Proposals made

Sl. no	Infrastructure	Scenario in 2014	Proposals in LAP 2014
1	Water supply	Unreliable, most residences experience water shortage Covers an area of only 0.25 acres Privately collected from streams and gullies, only few are connected to water supply provided by the Thromde.	Water Treatment Plant
2	Sewerage system	Not connected to sewerage network Have septic tank and soak pits	Continue septic tank system due to a very low-density development Biological Sewerage Treatment plant will be built in the future when required with network lines running alongside the natural gullies.
3	Solid waste	Not all the areas are covered by garbage collection service provided by Thromde because of the inadequate vehicular access	Solid waste bin location sites would be identified
4	Road	Lacks extensive planned roads No road hierarchy Metalled roads: 1.37 km Unmetalled road: 2.50 km No parking areas	Broaden existing roads Build new roads to connect all the plots
5	Footpath	No formal concrete foothpath 3.21 km of Off-road footpath	Footpaths along roads
6	Drainage System	Very limited 118 metres in Pipaldara 134 metres in Dhamdara	The drainage system shall consist of cut-off drains, collector drains, catch drains. 0.25w x 0.3d roadside drains 0.3w x 0.4d outlet drains and storm water drains 0.4x o.6 sq m catch pit drains under roads
7	Other utilities/ infrastructure		Municipal extension office Meeting hall Bill collection office Security guard house New NHDCL Housing colony

3.2.2. PROPOSED LAND USE PRECINCTS

There are mainly five proposed Precincts for the Dhamdara LAP (see Figure 3.2). Table 3.5 shows the various land-uses, the proposed development in the land uses, as well as the total area under each land-use and the percentages of the same. It may be noted that the utilities and the infrastructures have also been listed in the table. The reason is because these two are part of all the various precincts and proposed in the LAP as required. The two provisions merit mention on basis of importance and also occupy a noticeable quantity of land in all the precincts. However, the proposed Neighbourhood Node is not yet plotted as it is proposed to be located on the backside of Dhamdara. A minimum provision of 1.20 acres has been kept as reserved for the purpose.

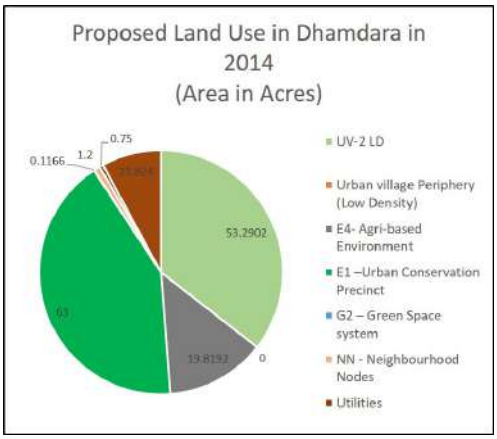


Figure 3.2 Land uses proposed in Dhamdara in 2014

3.2.3. LAND POOLING AND BETTERMENT CHARGES

After the Consultation with NLCS, land pooling percentage of 15% was adopted for the whole Dhamdara LAP. Where there was no actual physical land contribution, a betterment charge at the rate of 12% of the registered areas for vacant undeveloped areas and 7% of the registered areas for presently developed areas with basic access roads, drains, footpaths etc was proposed and unanimously endorsed by all participating Plot Owners. However, Cash Payment in lieu of Land Contribution (CPLC) was adopted later in 2014 which supersedes betterment charge practice.

Plot sizes

a) Standard plot size

The standard plot size shall be a plot with minimum plot size that is constructible with a permanent building of the permissible building height within the Dhamdara LAP area. The standard plot size in the Dhamdara LAP is fixed at 0.10 acres (10 decimals) since this figure is also closer to the minimum residential plot size of 4000 sq ft (0.0918 acres) for the Phuentsholing Core Area as specified in the PUDP.

Table 3.5 Proposed land use precincts (DLAP, 2014)

Sl. no	Type of land use	Proposal	Area acres	Coverage %
1	UV-2 LD Urban village Periphery (Low Density)	Allow residential building construction and lift construction moratorium imposed Some commercial activities are allowed as NN area is not identified	53.2902	35.53%
2	E4- Agri-based environment (30-50% stable slope)	Agricultural activities permitted Farm houses of G+1 and 20% maximum ground coverage permitted No subdivision allowed except for the construction of farm houses	19.8192	13.21%
3	E1 –Urban Conservation Precinct	To be kept free of constructions	63.0000	42.00%
4	G2 – Green Space system	Recreational open spaces shall be identified while making LAP for backside Dhamdara area.	0.1166	0.08%
5	NN - Neighbourhood Nodes	Identify plot for NN Set up commercial area at the extreme backside of Dhamdara	1.2000	0.80%
6	Utilities	Area in the existing Water treatment plant is identified for utilities Proposed infrastructure in the area: Municipal extension office Meeting hall, Bill collection office, security guard house, sewerage treatment plant	0.7500	0.50%
7	Infrastructure	Consists of proposed roads, drainage, footpath	11.8240	7.88%
	Total		150.00	100.00%

3.3. KABRAYTAR LAP 2014 OVERVIEW

Kabraytar is located at about 2.5 km from the Phuentsholing City/Town Core. It is situated on the right bank of the Om-Chhu River and towards the north of the Phuentsholing Thromde Extended Areas and hence under the jurisdiction of the Thromde. It is accessible by a paved motor able road and this is the only road serving Kabraytar at present. The total area covered is 47.39 hectares or 117.106 acres.

Figure 3.3 Location of Kabraytar LAP and its Coverage

Kabraytar has three distinct terraces namely the Lower Terrace, Middle Terrace and Upper Terrace. The Lower Terrace includes the areas along the bank of the Omchhu River (or Dhuti River). The Middle Terrace is fairly a built-up area and it encompasses areas along the Kabraytar road. It includes Core Area which is densely developed in terms of residential buildings. The Middle and the Lower Terraces are separated by an elongated and steep slope area, partly forested. The Upper Terrace consists of area just above the Middle Terrace. Although, a flat area is very little (above the Town Core), a majority of slopes and forested areas fall under this terrace.

Land uses

In 2014, residential land uses dominated the land uses in Kabraytar consisting 37% of the total land, whereas commercial area comprises only 2% of the total land. There is also a large chunk of private vacant land (see Table 3.6).

There are 92 structures in total from which maximum are the single storeyed structure with 44 numbers and there are only 5 five storeyed structures (Table 3.7).

Table 3.6 Land use composition in Kabraytar (KLAP, 2014)

Sl. no.	Type of land use	Area coverage %
1	Residential land	37%
2	Agricultural/ Orchard land	11%
3	Royal Use	3%
4	Government Land	19%
5	Commercial Land	2%
6	Private vacant Land	28%
	Total	100.00

Table 3.7 Existing building heights in Kabraytar (KLAP, 2014)

Sl. No	Category of Structure	Total no. of Structure
1	Single-storied Structure	44
2	Double-storied Structure	18
3	Triple-storied Structure	15
4	Four-storied Structure	11
5	Five-storied Structure	4
	Total no. of structures	92

3.3.1. EXISTING INFRASTRUCTURE AND PROPOSAL

Table 3.8 summarises the infrastructure scenario in Kabraytar in 2014.

Table 3.8 Summary of the infrastructure scenario in Kabraytar in 2014.

Sl.no	Infrastructure	Scenario in 2014	Proposals
1	Road	Almost all the buildings in the core have road access Roads are narrow and not to the standards No road hierarchy inadequate parking areas	Roads to all plots Establish road hierarchy
2	Footpath	Inadequate and needs up-gradation Needs footpath wherever access road is not possible	Make footpath along roads and in areas where access road is not possible.
3	Drainage System	Poor and inadequate	The drainage system shall consist of cut-off drains, collector drains, catch drains. 0.25w x 0.3d roadside drains 0.3w x 0.4d outlet drains and storm water drains 0.4x o.6 sq m catch pit drains under roads
4	Sewerage system	Not connected to sewerage network Have septic tank and soak pits	Continue septic tank system due to a very low-density development Biological Sewerage Treatment plant will be built in the future when required with network lines running alongside the natural gullies
5	Recreational facilities	No games or sports facilities	Sports and swimming pool complex Taekwondo complex
6	Water treatment plant	Located in middle terrace Covers an area of 0.97 acres.	Water reservoir tank in upper terrace to supply water to plots in higher areas
7	Other Utilities/ infrastructure		Toilet in middle terrace: 0.1091 acres Sewerage treatment plant: 0.2145 acres Primary school RBP outpost and firefighting unit Public parking Children park

3.3.2. PROPOSED LAND USE PRECINCTS

There are mainly nine proposed precincts for the Kabraytar LAP (see Figure 3.4). Table 3.9 shows the various land-uses, proposed development, as well as the total area under each land-use and the percentages of the same.

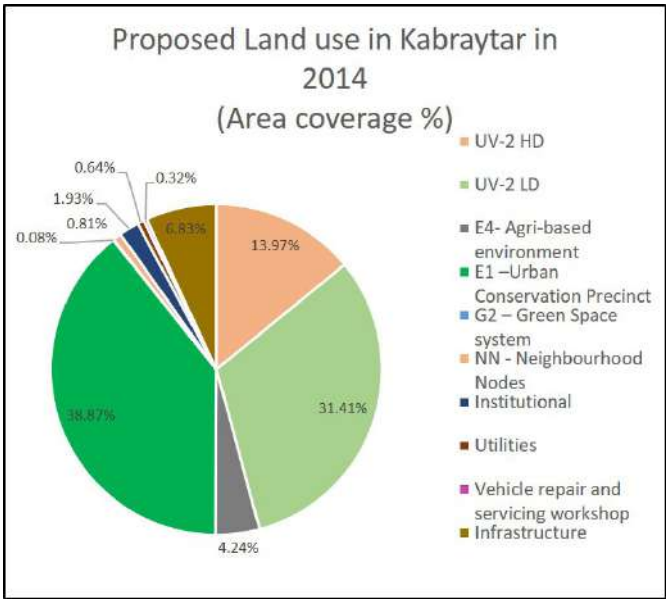


Figure 3.4 Land uses proposed in Kabraytar in 2014

3.3.3. LAND POOLING AND BETTERMENT CHARGES

After the Consultation with NLCS, land pooling percentage of 12% was adopted for the whole Dhamdara LAP area. Where there was no actual physical land contribution, a betterment charge at the rate of 12% of the registered areas for vacant undeveloped areas and 7% of the registered areas for presently developed areas with basic access roads, drains, footpaths etc was proposed and unanimously endorsed by all participating Plot Owners. However, CPLC was adopted later in 2014 which supersedes betterment charge practice.

Plot Sizes

a) Standard Plot size

The standard plot size shall be a plot with minimum plot size that is constructible with a permanent building of the permissible building height within the Dhamdara LAP area. The standard plot size in the Dhamdara LAP is fixed at 0.10 acres (10 decimals) since this figure is also closer to the minimum residential plot size of 4000 sq. ft. (0.0918 acres) for the Phuentsholing Core Area as specified in the PUDP

Table 3.9 Proposed land use precincts (KLAP, 2014)

Sl. No	Type of land use	Proposal	Area acres	Coverage%
1	UV-2 Urban village Periphery (High Density)	Allow high density residential building construction and lift construction moratorium imposed Some commercial activities are allowed as NN area is not identified	16.3590	13.97%
2	UV-2 LD Urban village Periphery (Low Density)	Allow high density residential building construction and lift construction moratorium imposed	36.7877	31.41%
3	E4- Agri-based environment (30-50% stable slope)	Agricultural activities permitted Farm houses of G+1 and 20% maximum ground coverage permitted No subdivision allowed except for the construction of farm houses	4.9654	4.24%
4	E1 –Urban Conservation Precinct	To be kept free of constructions	45.5282	38.87%
5	G2 – Green Space system	Children park	0.9500	0.08%
6	Sports and Recreation	About an acre of land has been reserved for sports and swimming complex and another half an acre for taekwondo complex. This area is located at the extreme east end of lower terrace.	-	-
7	NN - Neighbourhood Nodes	There is an existing NN No new proposals made	1.2124	0.81%
8	Institutional	Primary school RBP outpost and firefighting Public toilet and public parking	2.2635	1.93%
9	Utilities	Area in the existing Water treatment plant (middle terrace) is identified for utilities Proposed infrastructure in the area: Municipal extension office Meeting hall, Bill collection office, security guard house, sewerage treatment plant, public toilet Water reservoir tank proposed in upper terrace.	0.7500	0.64%
10	Vehicle repair and servicing workshop	Identified area for vehicle repair workshop and heavy workshops involving denting, smelting, engine overhauling etc	0.3745	0.32%
11	Infrastructure	Consists of proposed roads, drainage, footpath	7.9153	6.83%
	Total		117.1060	100.00%

3.4. DEVELOPMENT CONTROL REGULATIONS 2013 - PSP

The Development Control Regulations have been formulated as part of the Phuentsholing Structure Plan: 2013-2028.

The jurisdiction of these Regulations includes the area under the Phuentsholing Thromde and the 'Urban Peripheral Control Zone' (UPCZ) as defined in the Phuentsholing Structure Plan.

While the Phuentsholing Thromde shall be the 'Implementing Authority', implementing these Regulations within the Thromde area, the Department of Human Settlement (DHS) shall be the 'Implementing Authority' for the area outside the Thromde, which falls under the jurisdiction of these Regulations. The DHS may delegate the power of building approval in the UPCZ, only in the case of residential buildings up to two floors high and on plots up to 400sqm to the Dzongkhag.

The Bhutan Building Rules, 2002 (BBR, 2002) are applicable to urban areas across the country, in the absence of any structure plan for the urban areas in question. The operation of the Bhutan Building Rules 2002 is thus imperative, in urban areas where no structure plan exists.

Wherever a structure plan is sanctioned, the provisions of the accompanying Development Control Regulations, which are an intrinsic part of the concerned structure plan, will be applicable in that urban area. The provisions in the Bhutan Building Rules itself enable this. This is also enabled by Section 67 of the Bhutan Municipal Act, 1999, which specifically states that a "Municipal Corporation may adopt rules to carry out its functions specified in Sections 48 and 49 "(which includes Planning and Precincts).

Wherever a local area plan has been notified, its specific regulations, if any, shall be applicable within that local area alone. Generally, local area plans conform to the Development Control Regulations of the urban jurisdiction in which they fall.

Thus, in the absence of Local Area Plans, the provisions of the Structure Plan for that urban settlement shall prevail. In the absence of a Structure Plan for any given settlement, the Bhutan Building Rules, 2002 shall prevail.

3.4.1. LIST OF PRECINCTS DESIGNATED IN THE PHUENTSHOLING STRUCTURE PLAN

The Phuentsholing Structure Plan is ordered into several Precincts. The list of all the precincts in Phuentsholing structure plan are listed as follows:

- UV-1 - Urban Village Core
- UV-2 (HD) – High Density Urban Village Periphery
- UV-2 (LD) – Low Density Urban Village Periphery
- UC – Urban Core
- NN – Neighborhood Node
- I – Institutional
- H – Heritage Precincts
- E-1 - Environmental Conservation Precincts
- E-4 – Agri-based Environments
- G-1 – National Open Green Spaces
- G- 2 – Green Space System
- SE-2 – Multi-mode Transit Hub
- SE-3 – Dry Port and warehousing
- SE-4 – Service Centres and Industry (polluting)
- SE-4 – Service Centres and Industry (non-polluting)
- R – Royal Uses

3.4.2. DIFFERENCES BETWEEN PERMISSIBLE USES

Table 3.10 shows the differences between the permissible uses outlined in the DCRs of two LAPs and PSP.

Table 3.10 Key differences between the permissible uses outlined in the DCRs of two LAPs and PSP

S/N	Precincts	DCR (PSP 2013-2028)	Dhamdara LAP	Kabreytar LAP
1	E-4 Agri-based Environment	Ground coverage not more than 25% of plot area A detailed soil stability report needed for development proposals on slope ranging from 30% to 50%. No developments allowed on slopes greater than 50%	Ground coverage not more than 20% of plot area. No mention of soil stability report & development restrictions on slopes greater than 50%	Ground coverage not more than 20% of plot area No mention of soil stability report & development restrictions on slopes greater than 50%
2	UV-2 (LD) Low Density Urban Village Periphery	G+3 Storied Structures allowed. Resorts, Hotels with boarding and lodging facilities in a minimum of 2,000sq.m plot may be permitted. Commercial uses including retail outlets, shops, ware house and recreational centers shall not be permitted.	G+2 Storied Structures allowed. Resorts, hotels with boarding and lodging facilities in a minimum of 2,500sq.m plot may be permitted. Commercial uses like local level retail shops with floor area less than 40sq.m or internet browsing centre, fast food outlets, canteens, bars, snack bars not exceeding floor area of 30sq.m area will be permitted only on the ground floor per plot.	G+2 Storied Structures allowed. Resorts, hotels with boarding and lodging facilities in a minimum of 2,500sq.m plot may be permitted. Commercial uses like local level retail shops with floor area less than 40sq.m or internet browsing centre, fast food outlets, canteens, bars, snack bars not exceeding floor area of 30sq.m area will be permitted only on the ground floor per plot
3	G-2 Green Space System	Open Space Precincts of Public assets like Parks, gardens, Community Level/ Local Recreational and Sports Facilities etc… G+2 Storied structures allowed.	G+1 storied structure allowed Maximum ground coverage of 10% of Plot area. Basements/ attic not allowed.	G+1 storied structure allowed Maximum ground coverage of 10% of Plot area. Basements/attic not allowed.
4	Utilities	No provision of Utilities Precinct in DCR of PSP 2013-2028	G+1 storied structure allowed Maximum ground coverage of 20% of Plot area. Basements/ attic not allowed.	G+1 storied structure allowed Maximum ground coverage of 20% of Plot area. Basements/attic not allowed.
5	E -1 Urban Protection Precinct	Referred to as Environmental Conservation Precincts	No developments allowed	No developments allowed
6	NN – Neighborhood Node	Same in the LAP, and DCR (PSP 2013-2028)	No Neighborhood Node Precinct in Dhamdara LAP	Same in the LAP, and DCR (PSP 2013-2028)
7	UV-2 (HD) High Density Urban Village Periphery	Resorts, Hotels with boarding and lodging facilities in a minimum of 2,000sq.m plot may be permitted.	No UV -2 HD in Dhamdara LAP	Resorts, Hotels with boarding and lodging facilities in a minimum of 2,500sq.m plot may be permitted

3.5. COMPLIANCE AND DEVELOPMENTY REVIEW, MOWHS 2016

MoWHS reviewed the compliance and development of Phuentsholing Thromde and its urban development plans including the PUDP and PSP. The area covered for the review includes only the old municipal area under the Phuentsholing Thromde as stated in the PUDP 2002-2017, and does not include the extended areas. However, a separate review has been conducted for Dhamdara Area. Review has also been conducted on zone VI (as delineated PUDP) which includes some part of existing Kabraytar LAP.

3.5.1. OBSERVATIONS AND IMPLICATIONS IN DHAMDARA LAP

Table 3.11 shows the observations and implication of Dhamdara LAP mentioned in the review conducted by MoWHS in 2016.

Table 3.11 Observations and Implications in Dhamdara LAP (MoWHS, 2016)

Sl.no.	Issue	Observation	Implications
1	Topographical and Geo-technical condition	Dhamdara has steep slopes and the geo-technical report has that 40% of the area is under high hazard zone and 16% under medium hazard zone. This aspect needs to be considered while plotting and drafting DCR.	Apparently, majority of the area is plotted. (Once plotted and the plan is approved, landowners claim right to development shifting entire accountability of the risk on the plan).
2	Buffers	Adequate buffer has to be maintained from the environmentally sensitive areas such as natural gullies and from the high tension lines passing through Dhamdara. It is observed that there are plots falling within the buffer of high tension lines.	There will safety related problems for the plots falling within the buffer areas.
3	Land pooling and minimum plot size	With a LP of 15%, a minimum standard plot would be about 11.05 decimal or 0.1105 acres which is calculated after deducting 15% from 13 decimal. No subdivision should result in the plot size smaller than this. However, the minimum and the standard size of plot stated in the report are 0.0370 acre and 0.10 acre respectively.	Effecting appropriate plot subdivision and implementing plot subdivision related DCR would be difficult.
4	Plot widths and their develop-ability	There are plot widths as small as 4m to 12m.	Such plots may not be buildable or develop-able efficiently
5	Uniform land pooling and lack of road access for some plots	After contributing 15%, some plots do not have road access.	This is principally incorrect as per the land pooling rules and unfair for the landowners who have contributed equally.
6	Plot could be relocated to avoid double road	Access roads provided inefficiently.	Road that is not required should be avoided for efficient traffic movement and reduce on the land pooling contribution or to have more area for open spaces.
7	Roads	There is no road hierarchy (primary, secondary, and tertiary). The 6m roads terminate at dead ends after 200m to 400m	Traffic will not be efficient. Dead end roads create inefficient traffic movement and congestions.
8	The intersection of plot lines and precinct lines	There are many areas where precincts and plot boundaries are overlapping.	As there is no clarity in the extent of precinct boundary, there will be difficulty in the implementation of the precinct plan.

With these observation and implications, MoWHS has suggested some measures to correct, improve and align the LAP with PSP, to prevent deviating from the goals and objectives set in PSP and to undertake planning in accordance with the rules and regulations practiced in Bhutan. These suggestions are as follows:

- Verify the observations and implications stated in the review report and take necessary actions.
- Rectify and regularize deviations where possible so that the constructions/developments do not exist illegal in the context of the relevant rules and regulations.
- For improving the efficiency of traffic, there should be a clear hierarchy of roads and manage the vehicular movement accordingly.
- A clear delineation of footpaths and roads would

be necessary to avoid interference between the pedestrians and vehicles and to encourage walking. Parking areas could be designated around the periphery of the city core and not be allowed along the streets.

- Poor maintenance of infrastructures has been observed to be the common sight. Therefore, it is important that there is regular inspection and monitoring to ensure that footpaths, streetlights and drains are functional.
- Despite having a few good buildings, there is a general lack of architectural identity. Incorrect detailing of the Bhutanese architectural elements and contrasting colors of buildings have been observed to cause this unpleasantness. As most LAPs are yet to be developed, this aspect of town development needs to be seriously taken into consideration.
- There is need to regulate the use of balconies and ensure that the occupants do not store objects that could fall off the balconies. A guideline for using the balconies should be developed and implemented before any mishap occurs.
- There are some constructions observed on the steep slopes. Development on such areas would require thorough review as it would pose a risk to the adjacent settlements during landslides and other natural calamities. Developments on slopes need to be looked into from the perspective of fragile soil condition in Phuentsholing.
- Temporary sheds have been observed in the forested and green areas. Because of their substandard nature of design and construction, they could be the cause of fire and poor sanitation. Approval of temporary structure should go through the process of scrutiny against the minimum safety standards and guidelines.

3.6. TWELFTH FIVE YEAR PLAN

All planning in Bhutan is guided by GNH values through goals and policies framed by GNHC. Goals and objectives are set during the start of every five-year plan (FYP). With the 12th FYP's over-arching objective of creating "Just, Harmonious and Sustainable Society through enhanced Decentralisation" there are certain targets set for Phuentsholing Thromde, some of which that are of relevance to this task is discussed below.

The targets are set as Local Government Key Result Areas (LGKRA).

LGKRA 2: Enhancing livability, safety and sustainability of human settlements. Table 3.12 discussed this.

LGKRA 7: Carbon Neutral, Climate and Disaster Resilient Development Enhanced

Considering the international and national goals of achieving developments that results in minimal carbon emission, and are climate and disaster resilient following strategies have been suggested:

- Assess and explore mitigation measures pertaining to low emission in priority sectors like waste management, transport, residential building, industries, etc. Measures like energy efficient transport system, energy efficient buildings and appliances, use of renewable energy, and waste and waste water management will be explored and implemented accordingly.
- Energy efficiency will be promoted by installing energy efficient street lights (LED), replacing inefficient lights with efficient ones, encouraging households to use LEDs and exploring solar energy as a power alternative.
- Initiate and support green transportation by encouraging residents to buy electric and hybrid vehicles (EV/HV) for which supporting services like EV charging station will be installed in the Thromde.
- Enhance engineering capacity as well as collaboration with relevant central agencies to improve technology and quality of climate-proof and disaster-resilient drawings, design and construction of related infrastructures. Institute systems to monitor and enforce compliance to safety features in construction of structures for human occupancy.
- Thromde disaster-contingency plan with robust mechanism for information sourcing and sharing will be developed and capacity built for disaster preparedness, response and rehabilitation.
- Awareness, monitoring and enforcement systems will be strengthened to ensure that disaster resilient and adaptation standards and quality is incorporated and adhered to any development works and infrastructure constructions by both private and government entities.

Other LGKRAs focus on creating employment and enhancing local economy; providing transparent, efficient and effective public service delivery; improving quality of education and skills; enhancing health and nutrition; preserving and promoting culture and traditions; empowering women and promoting gender equality; and strengthening democracy and

decentralization.

Along with many proposals and targets, GNHC has provided funding for following specific projects:

- Construct one bus bay at Kabraytar
- Construct urban roads of 2000 m in Kabraytar and 500 m in Dhamdara
- Conduct geo-tech studies of Kabraytar and Dhamdara
- Construct storm water drain of length 8 Km within all Thromde area
- Carry out river training and flood mitigation structures of length 6 km within all Thromde area.

Table 3.12 Issues identified in Phuentsholing Throm and goals and proposals to address them

Infrastructure/utilities	Issues	Goals and proposals
Transportation	• Increasing number of vehicles • traffic congestion • vehicular accidents	• Improvement of existing 8 LAPs to create more parking to ease traffic congestion • Collaborate with central agencies and private sector to explore alternate transport means, particularly public transport options in the Thromde. • Plans to establish 2 new public transport buses
Solid waste	• Solid waste management challenge due to increased population and porous border. • 9 MT of wastes per day, the lifespan and capacity of the landfill is running out, thus calling foralternative solutions including recycling of solid wastes.	• Recycle waste at average rate of 0.5 MT per day • Provide waste collection services to all the places
Sewerage	• Sewerage network covers only 90% of the population in old Thromde area, leaving out whole of extended area unconnected to the sewer lines	• Shift from unhygienic septic tank system to mainstream sewerage management system by constructing additional sewer treatment plants
Water	• Daily demand for drinking water is 8,700 CBM, however current WTP can discharge only 4,500 CBM. • There is pressure to cater to the demand for drinking water as the problem will be exacerbated with the implementation of new LAPs	• Household storage tanks • Rehabilitation and augmentation of water distribution line and pumping stations • Better management of distribution and metering • Explore additional water sources • Build additional reservoir tanks and WTPs
Storm water Drainage	• Inadequate storm water drainage network • Occurrences of heavy rainfall, water logging, flooding and landslides	• Need for planned drainage systems • Implementation of disaster resilient and disaster management development
Housing	• There is chronic housing shortage	• Encourage private sector to construct affordable housing for public • Collaborate with government to use underutilised land and partner with NHDCL, NPFF to construct affordable housing • Monitor compliance to the Tenancy Act to prevent high rents
Safety issues	• Crime • Safety issues arising from porous border	• Make investment in smart city initiatives such as installation of CCTVs • Expand street light coverage with addition of 400 more street light • Provision of free wi-fi at strategic locations • Monitor of places of entertainment

3.7. GEO-TECHNICAL INVESTIGATION 2019

The main purposes of conducting a geotechnical investigation are:

- to evaluate the suitability of the site for development;
- to obtain physical and mechanical properties of the subsurface materials (i.e. soils and rocks), in order to determine their suitability as they may affect the construction and performance of the project;
- to enable safe and economical design of the project components; and
- to identify any potential problems or difficulties with the ground conditions that may affect construction or performance of the proposed project.

Site location

Thromde has identified Kabraytar and Dhamdara Local Area Plans (LAPs) for detailed geotechnical investigation and stability assessment (as shown in Figure 3.5). The size of the study area is about 410.20 acres (1.66 sq. km).

3.7.1. GENERAL INFERENCES FROM THE GEOTECHNICAL INVESTIGATION

Geology

It was found that the main hazards in the study area were slope instability, earthquake, liquefaction, and floods according to the geotechnical investigation.
Other hazards are attributable to lose soils (Colluvium) and weak geology of the area.
In general, the local geology of the area was divided into 4 units as: Rocks (Phyllite, Talcose Phyllite and Quartzite), Residual Soil, Colluvium, and Alluvial Deposit.

The soil deposits at the study area belong to three distinct classes of soils. They are residual soils, colluvium and alluvium. Figure 3.6 provides the detailed map of

Figure 3.5 Study area for geotechnical investigation

location of different types of soil and rocks, landslides and rivers/streams.

- Residual Soils - Landslides are common in residual soils, particularly during periods of intense rainfall. The rainfall- induced landslides are usually shallow in nature. The well-developed internal drainage of alteration and soils is conducive to water infiltration, subsequent reduction in pore-water tension, and consequent sliding.
- Colluvial Deposits - Colluvial/talus deposits are often loose and unconsolidated. An unstable condition can exist when colluvial/talus deposits rest on slopes and further slope movements are likely in such instances. Slope movements before total failures range from the barely perceptible movements of creep to the more discernible movements of several inches per week (Hunt. 1984a). The natural causes of these movements are weathering, rainfall, earthquake-induced vibrations. Cuts made in colluvial or talus slopes are expected to become less stable with time and usually lead to failure unless retained or removed.
- Alluvial Soil - Alluvial soil or alluvium includes all sediments that are transported and deposited by streams. The deposits are usually stratified into layers of clay, silt, sand and gravel.

The slopes are covered with thick deposit of residual soils overlying highly fractured and weathered Talcose phyllite, phyllite and quartzite. The quality of the rocks are classified as very poor. Landslides are prominent in areas covered with weathered Talcose phyllite. The landslides are mainly observed in thick deposits of residual soil and colluvium.

Since the area is in a very close proximity to faults in the Himalayas such as the Main Boundary Thrust (MBT) and Main Central Thrust (MCT), earthquake is another important hazard. The study area lies near regional fault zones as shown in Figure 3.7. In fact, there are 5 faults lines within 50 km of the study area.

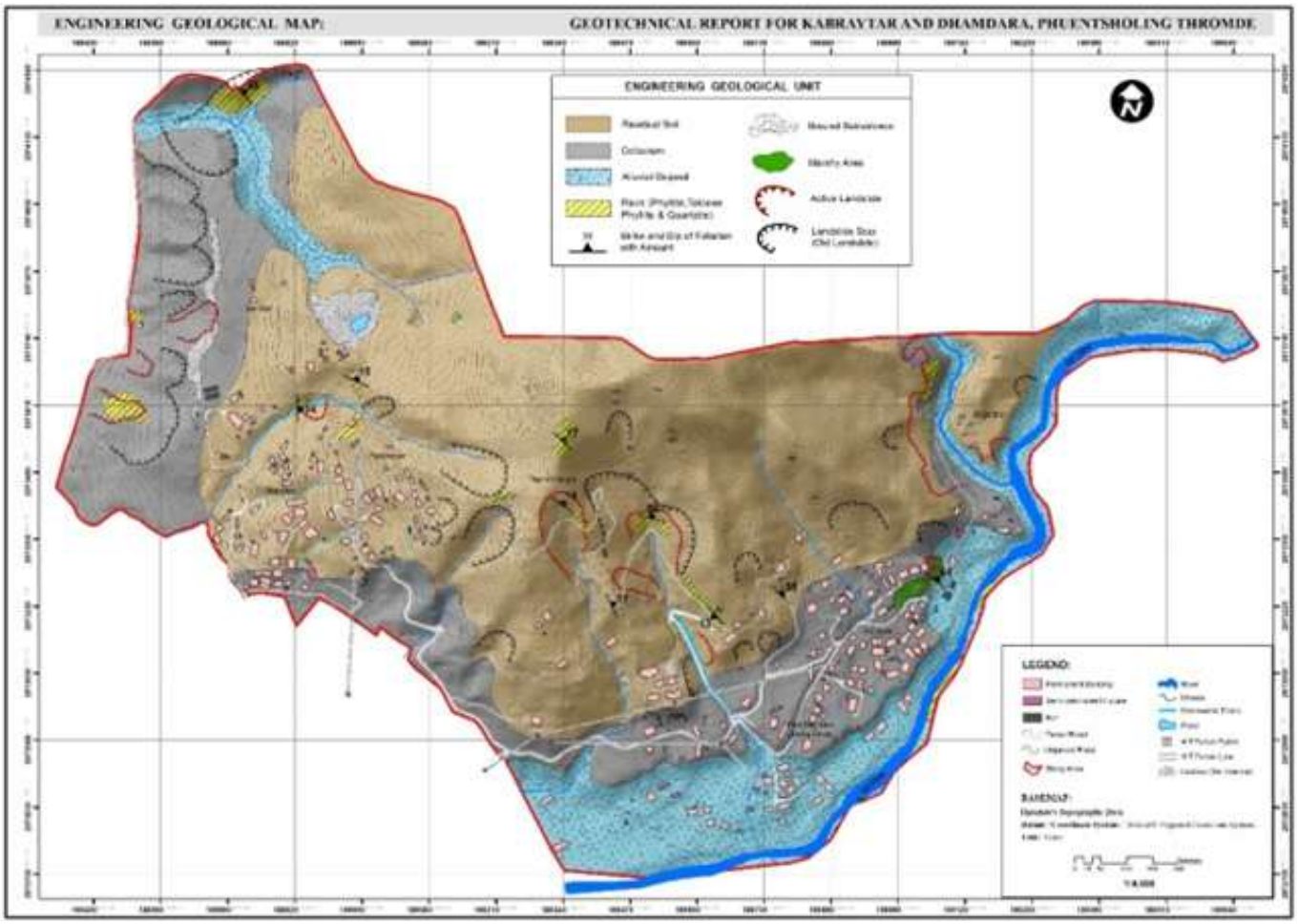


Figure 3.6 Geology of Kabraytar and Dhamdara

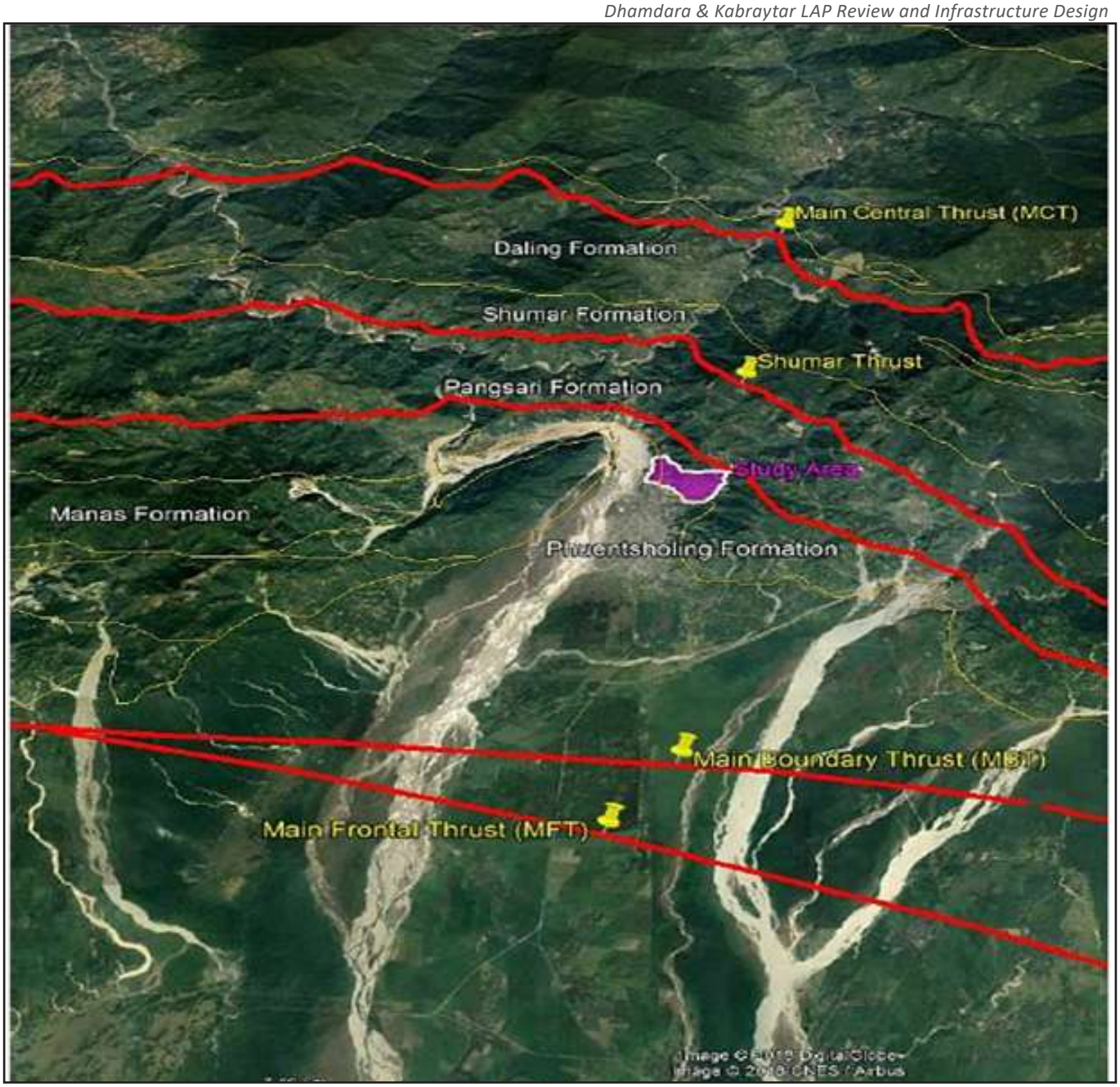


Figure 3.7 The Project area showing the fault lines

Slope

The low-lying areas near Om chhu are susceptible to both liquefaction and floods. It can be seen in map in figure 3.8 that only 15% of the area can be called gentle slope i.e. slope angle less than 10 Degrees. More than 41% of the area has slope more than 30 Degrees.

Hazard map

Based on the hazard map, 18% of the area (i.e. 73 acres) falls in low hazard zone, 17% (i.e. 70 acres) in medium hazard and 65% (i.e. 267 acres) in high hazard zone. See Hazard map in Figure 3.9.

While the whole country is subjected to earthquake hazard, the current project area is even more prone to seismic hazard due to its proximity to major faults. Soil liquefaction is another possible geo-hazard related to earthquake in the study area, especially at lowlands along Om Chu, where thick deposits of alluvium lies saturated from the river infiltration.

For the low and medium hazard area, the mitigation measures in the form of slope stabilization, drainage control, soil improvement, flood protection, etc. should be provided.

High hazard zones may be developed as a green belt. For any construction in “high hazard zones” i.e. red zones, it is recommended that a separate “Site Specific Geotechnical Report” and “Geotechnical Letter of Assurance” be prepared by a competent Geotechnical Engineer. The construction in “High Hazard Zone” may be allowed only upon the approval of such a report by the competent authority, which may be Phuentsholing Thromde or another agency designated by the Thromde/MoWHS.

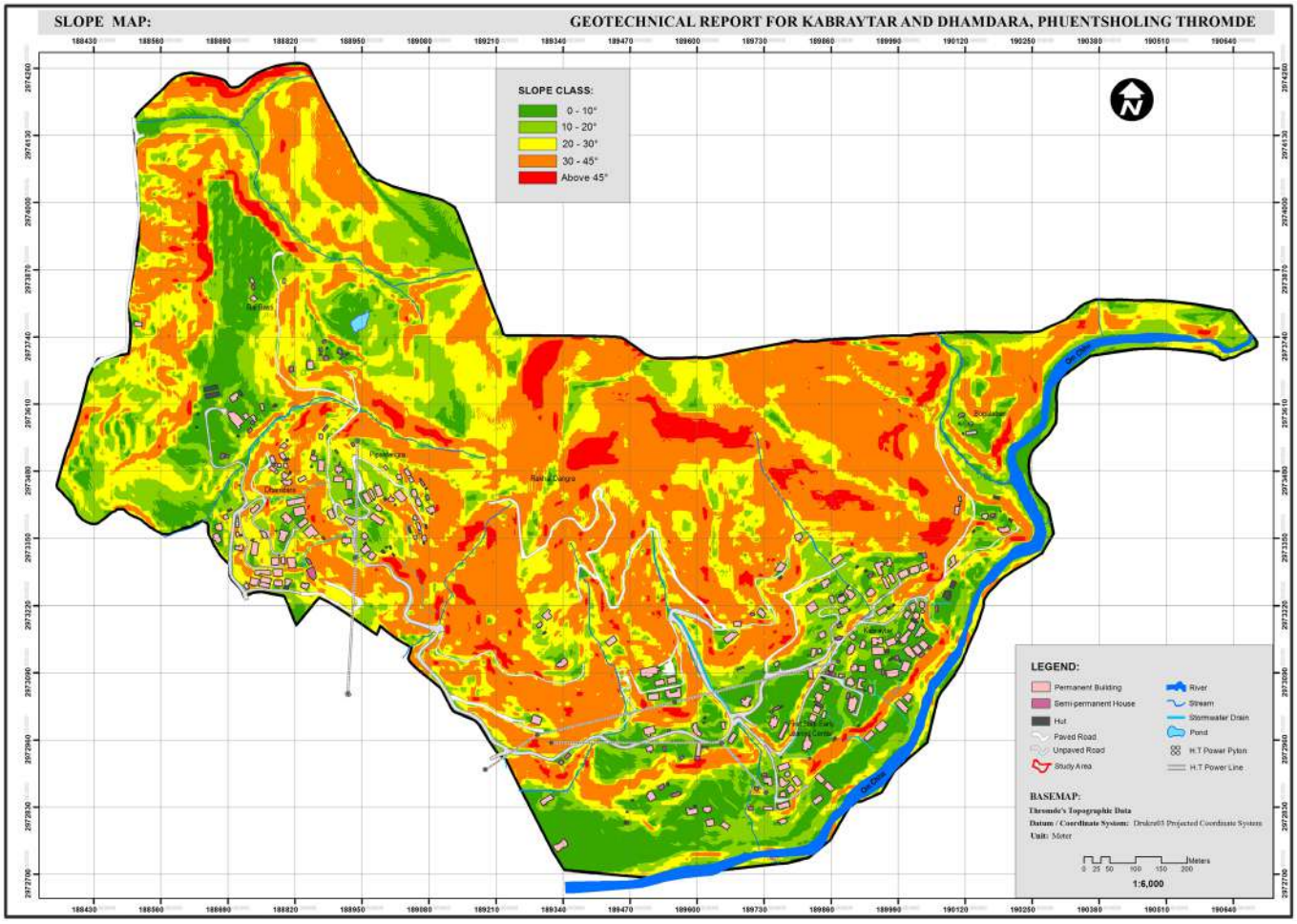


Figure 3.8 Map showing the slope of the area

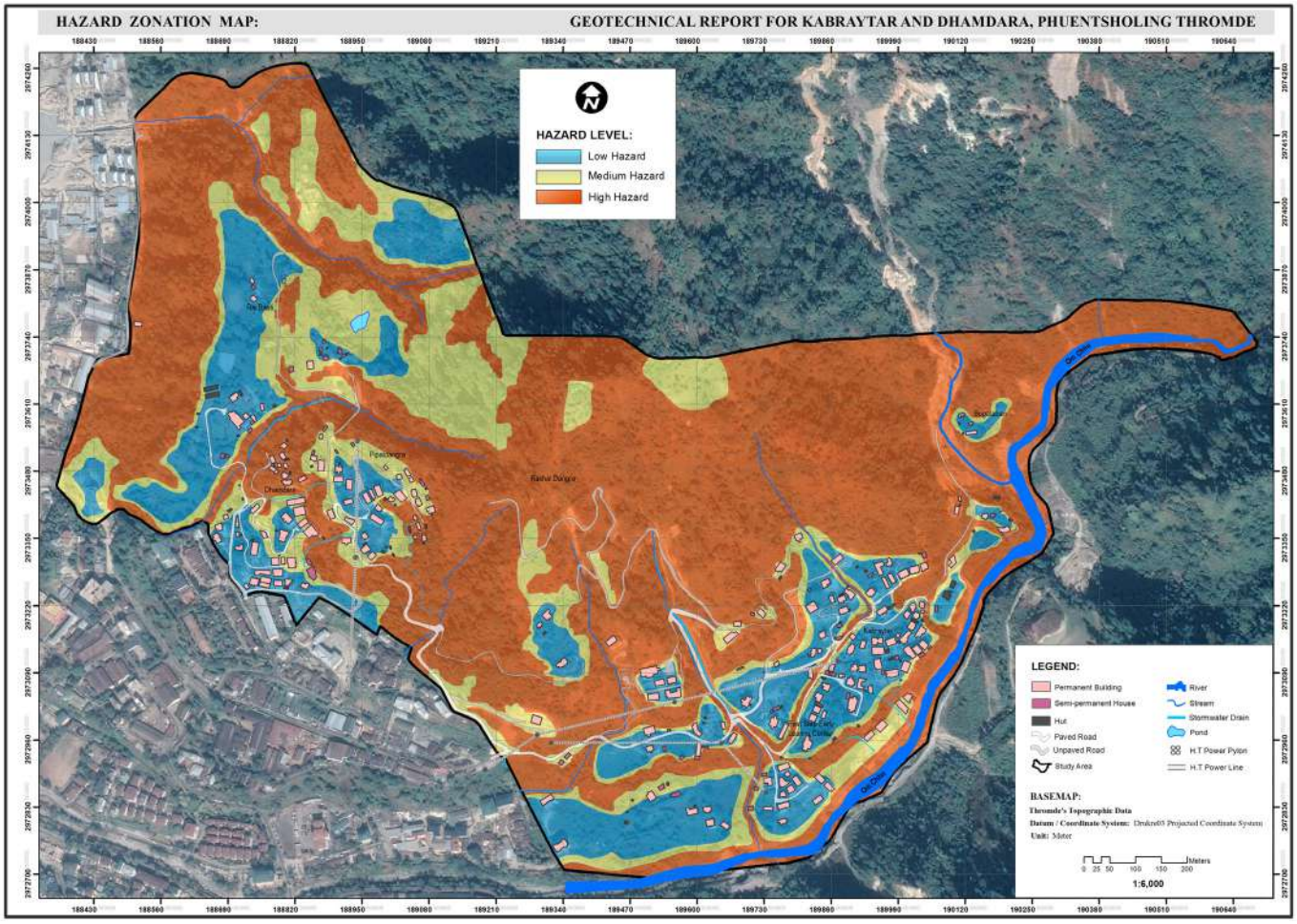


Figure 3.9 Hazard Map of the study area

Table 3.13 presents details of hazard classification criteria and implication for development in each of the different hazard areas.

Table 3.13 Hazard classification Table

Hazard level	Criteria	Implications for Development	Area	
			(Acre)	(%)
Low	Slope less than 20° and no major geologic hazard, No evidence of instability observed; instability not expected unless major site changes occur.	Suitable for development with some geotechnical measures.	73	18%
Medium	Slope 20° to 30° and some geologic hazard, Evidence of possible soil creep or a steep soil covered slope; significant instability can be expected if the development does not have due regard for the site conditions.	Engineering practices suitable to hillside construction necessary. Risk after development generally no higher than usually accepted.	70	17%
High	Slope > 30° and/or major geologic hazard, Evidence of active or past landslips or rock-face failure; significant instability may occur during and after extreme climatic conditions.	Site specific geotechnical investigation required for its development. Development restrictions are required.	267	65%
		Total	410	100%

DEMOGRAPHY

4. EXISTING POPULATION

PHCB 2017 noted a total population of 735,553 in Bhutan which is a 16% increase from 634,082 people in PHCB 2005. This translated to population growth rate of 1.3% per annum between 2005 and 2017. Phuentsholing Thromde had a population of 27, 658. The population in the Phuentsholing Thromde was 20,537 in 2005. The 2005 data cannot be used for analysis as the Thromde was much smaller compared to the present Thromde area. Hence, population change for Phuentsholing Thromde cannot be determined using 2005 data as base data. The population of Chhukha Dzongkhag decreased by 7.3 % between 2005 and 2017 with population of 74, 387 and 68,966 respectively. Other key demographic indicators are given in Table 4.1.

Table 4.1 Demographic Indicators (PHCB, 2017)

S/N	Indicator	P/ling Thromde	Chhukha Dzongkhag
1	Population 2017	27,658	68,966
2	Population 2005	20,537	74,387
3	Population growth rate	2.89%[1]	-0.607%
4	Total household	27,659	68,966
5	Average Household size	3.6	3.9
6	Area (Sq. km)	15.6	1880
7	Gross density (Persons per sq. km)	1773	37
8	Sex ratio (female per 1,000 male)	873.5	913.5
9	Literacy rate (% of total population)	85.9	75.1

Currently, there are 372 and 592 residential units in Dhamdara and Kabraytar respectively, as per the latest data provided by the Thromde. Taking average household size of 3.6 persons per household (PHCB, 2017), the population of Dhamdara and Kabraytar would be 1,339 and 2,131 persons in each LAP respectively.

4.1. POPULATION PROJECTION

4.1.1. PHUENTSHOLING STRUCTURE PLAN 2013

The 2005 population survey data was taken as the base for all the population studies during the preparation of PSP. The population of Phuentsholing in 2005 and 2012 were 20,537 and 23,915 respectively which was a growth of only 2.5% per annum. However, after the literature review and analysis of various existing scenario during the time, two population projections were conducted taking a population growth rate of 3% and 5% Compound Annual Growth Rate (CAGR) as shown in Table 4.2.

Table 4.2 Phuentsholing Population Projection conducted in 2012 (PSP, 2013)

Year	Population Projection with 3.0 % CAGR	Population Projection with 5.0% CAGR
2012	23912	23912
2017	27721	30518
2022	32136	38950
2027	37254	49711
2032	43188	63446
2037	50066	80975

Referring to the population projections in PSP the following population projection scenario taking a population growth rate of 3% and 5% Compound Annual Growth Rate (CAGR) could be estimated for Kabraytar and Dhamdara as shown in Table 4.3.

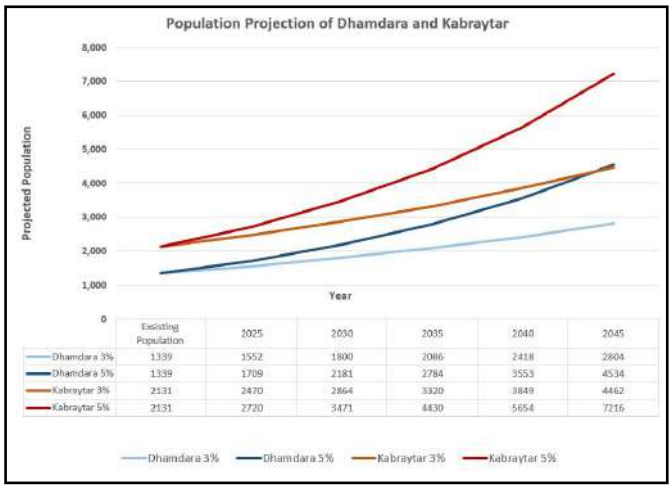


Figure 4.1 Graph showing the Projected population growths in Kabraytar and Dhamdara for 25 years

Table 4.3 Dhamdara and Kabraytar population projection with 3% and 5% CAGR

LAP	Existing Population	Population growth rate	2025	2030	2035	2040	2045
Dhamdara	1,339	3% **CAGR**	1552	1800	2086	2419	2804
		5% **CAGR**	1709	2181	2784	3553	4534
Kabraytar	2,131	3% **CAGR**	2470	2864	3320	3849	4462
		5% **CAGR**	2720	3471	4430	5654	7216

4.2. POPULATION DENSITY ANALYSIS AND CARRYING CAPACITY

Carrying capacity discussed here is in the form of total number of people that can be accommodated as per the existing and proposed precinct and land use permissibility.

4.2.1. POPULATION DENSITY

Carrying capacity of each of the LAPs was conducted during the preparation of Water Master Plan in 2016. The population densities for different precincts (see Table 4.4) were calculated first and carrying capacity of each LAP was determined. The population projection was also calculated from carrying capacity

Table 4.4 Population densities in different precinct calculated for Phuentsholing Water Master Plan Study, 2016

Land use	Density (pph)
UV1	90
UV2 HD	362
UV2 LD	102
SE4	90
E4	61
E1	0
I	361
NN	90
G2	61
S1 - Service Precinct	61

The total population carrying capacity for Phuentsholing Thromde was worked out to be 67, 577 people. It was assumed that 70% of total population based on the carrying capacity would reached by 2028. This translates to total population of 47,304 in the Thromde by 2028.

Further by 2047, another 20% of the maximum carrying capacity is expected to be accommodated and the remaining 10% spanning over the period of time till 2077. However, if needed, PSP may be revised after 2028 thereby creating room for further population carrying capacity which may be 10% over maximum carrying capacity of 67, 577.

Similarly, the population carrying capacity, and projection for 2047 and 2077 for Dhamdara and Kabraytar was calculated. These values are presented in Table 4.5.

Table 4.5 Population carrying capacity for Dhamdara and Kabraytar (Phuentsholing Water Master Plan, 2016)

LAP	Carrying capacity	Medium Term 2047 (90% over of carrying capacity)	Long Term 2077 (10% over of total population)
Dhamdara	2491	2242	2740
Kabraytar	3563	3207	3919

4.3. PSP VISION FOR BUILDING HEIGHTS

With due consideration to the present context, the Structure Plan advocates medium-rise development with built structures not more than six floors high in Core areas and two floors in the peripheral areas. This, apart from maintaining the vertical scale of the town, will also help in preserving the views and vistas of the town and its immediate surroundings. The low-density development also takes into account the hot and humid weather conditions and the natural setting of Phuentsholing town.

The residential densities envisioned in PSP for different precincts are given below:

- Urban Village Core (UV1): <125 pph
- Urban Village Periphery - High Density (UV2-HD): >350 pph
- Urban Village Periphery – Low Density (UV2-LD): <125 pph

This vision, however, has not been properly reflected

in DCR and has failed in Dhamdara and Kabraytar. PSP DCR allows G+4 in UV2 HD and G+3 in UV2 LD with 40% coverage, and G+1 in E4 with 25% coverage. This has resulted in much higher population densities, ruined natural vistas and increased damage to natural setting of the environment disturbing slopes and natural gullies.

4.4. EXISTING DENSITIES FOR BUILT UP AREAS

Figure 4.2 shows the process by which average population density of precincts in terms of persons per hectare (pph) was determined.

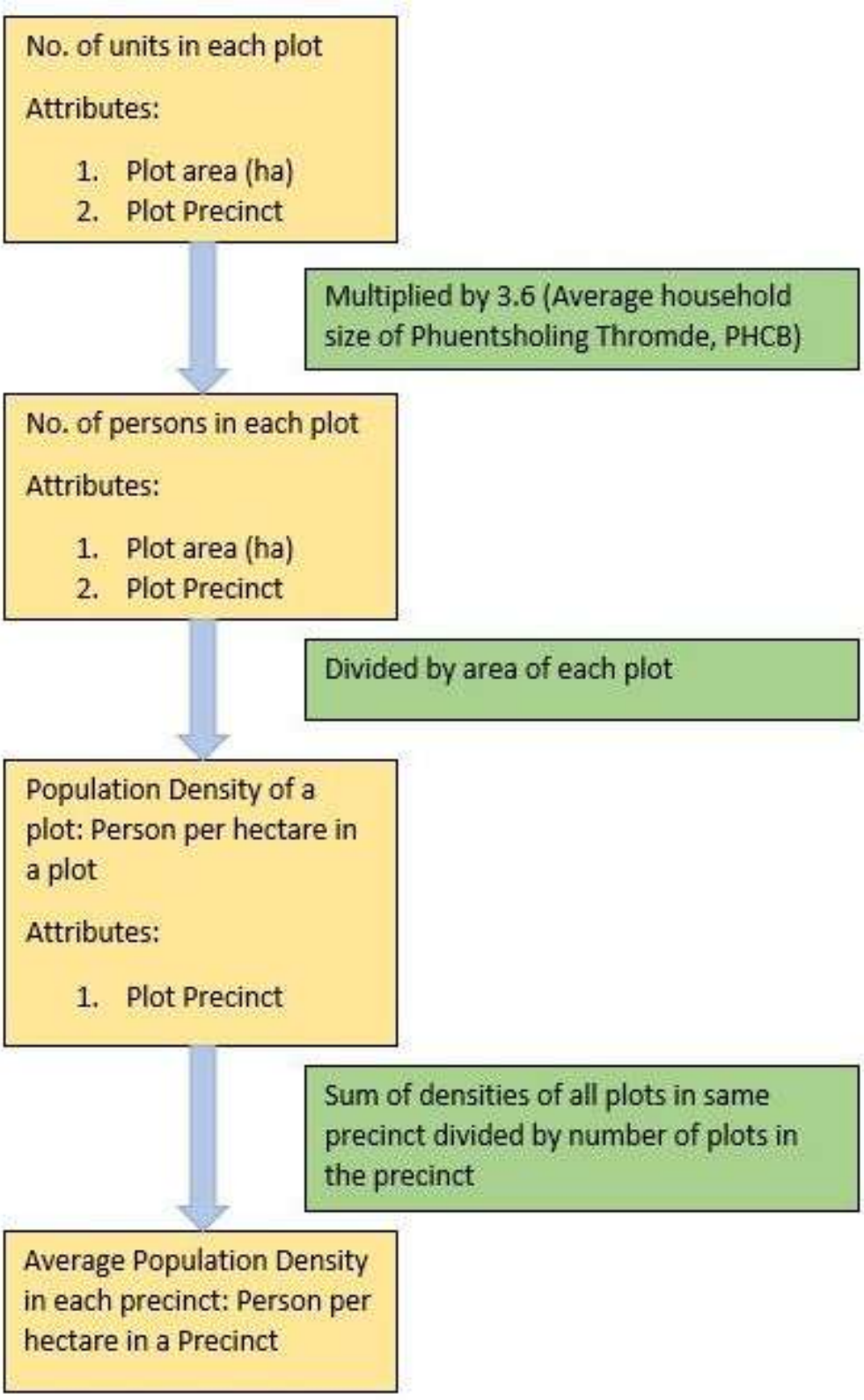


Figure 4.2 Method adopted for calculating average population density (pph) for precincts

4.4.1. DHAMDARA

The average population densities for different precincts in Dhamdara are given in Table 4.6. As per the data available, densities for only four precincts could be determined.

- E4-Argi-based Environments

The density for E4 were calculated taking 12 households in 5 plots. All the buildings in the precinct are below 2 floors which are permissible in E4 precinct. The average population density for E4 is 75 pph.

- UV2 –LD Urban Village Periphery (Low Density)

Density for UV2-LD were calculated based on the data available for 63 plots which had 89 buildings and 341 units (households) and a total population of 1228 (3.6 times 341 households). The average density is 325 persons per hectare. However, taking the density of only plots with buildings of 4 floors (G+3 maximum height permissible in the precinct) and average coverage of 40% (maximum permissible coverage), the density was calculated to be 495 persons per hectare.

- UV2 –HD Urban Village Periphery (High Density)

Density for UV2-HD were calculated based on the data available for 1 plot which had 1 building and 10 units (households) and a total population of 36 (3.6 times 10 households). The density is 806 persons per hectare. The building is of 5 floors (G+4 maximum height permissible in the precinct) and 39% coverage (50% is the maximum permissible coverage in the precinct), hence, it gives the rough estimate of maximum population density for the precinct, which is 806 pph.

- S1 - Service Precinct

The precinct had only one plot with one unit. This calculated to be 35 pph.

Table 4.6 Average Population densities for different precincts in Dhamdara

Precinct (NCRP)	Population density (pph)	Maximum Population density (pph)[2]
E4	75	Not enough data
UV2-LD	325	495
UV2-HD	806	806
S1 - Service Precinct	36	Not enough data

4.4.2. KABRAYATAR

The average population densities for different precincts in Kabraytar are given in Table 4.7. As per the data available, densities for only four precincts could be determined.

- E4-Argi-based Environments Precinct

The density for E4 were calculated taking 18 households in 3 plots. Two of these plots had buildings of 3 and 4 floors which are not permissible in E4 precinct. Therefore, the average population density for E4 is 447 which is very high for the precinct.

- UV2 – LD Urban Village Periphery (Low Density)

Density for UV2-LD were calculated based on the data available for 80 plots which had 102 buildings and 466 units (households) and a total population of 1678 (3.6 times 466 households). The average density is 368 persons per hectare. However, taking the density of only plots with buildings of 4 floors (G+3 maximum height permissible in the precinct) and average coverage of 40% (maximum permissible coverage), the density was calculated to be 511 persons per hectare.

- UV2 – HD Urban Village Periphery (High Density)

Density for UV2-HD were calculated based on the data available for 9 plots which had 15 buildings and 105 units (households) and a total population of 378 (3.6 times 105 households). The average density is 537 persons per hectare. However, taking the density of only plots with buildings of 5 floors (G+4 maximum height permissible in the precinct), the density was calculated to be 684 persons per hectare.

- S1 - Service Precinct

The precinct had only one plot with one unit. This calculated to be 8 pph.

Table 4.7 Average population densities for different precincts in Kabraytar

Precinct (NCRP)	Population density (pph)	Maximum Population density (pph)[3]
E4	447	Not enough data
UV2-LD	368	511
UV2-HD	537	684
S1 - Service Precinct	8	Not enough data

4.5. RESIDENTIAL DENSITIES CATEGORIZATION AND ESTIMATION IN SPS

Table 4.8 below presents the typical residential density in terms of population per hectare (pph)

Table 4.8 Typical population densities for various types of settlements

Level of density	Density
Very Low	<80
Low	80-300
Medium	300-500
High	>500

Table 4.9 presents recommended combinations of building height and coverage with resulting population density.

Table 4.9 Typical Combinations of Building Height, coverage percentage, GFA, and Population density for Residential areas

Building height (floors)	Coverage ratio (%)	Gross floor area (sq. m/ha)	Residential density (pp/ha)[2]	Level of density
2	25	5,000	250	Low
2	35	7,000	350	Medium
2	45	9,000	450	Medium
3	30	8,000	400	Medium
3	35	10,000	500	Medium
3	40	12,000	600	High
4	30	12,000	600	High
4	40	16,000	800	High
4	50	20,000	1,000	High
5	32	16,000	800	High
5	40	20,000	1,000	High
5	48	24,000	1,200	High

4.6. COMPARISON OF EXISTING DENSITIES AND STANDARD DENSITY AS MENTIONED IN SPATIAL PLANNING STANDARDS

It can be noted that the existing maximum densities and the maximum density as mentioned in SPS differ (see Table 4.10). This could be due to the following reasons:

- Lower per capita existing density than per capita density assumed in SPS which is 20 sq. m.
- Household size of 3.6 which is the average household size of Phuentsholing Thromde may not reflect the household size in the study area
- Lack of enough household data available for the study area.

Table 4.10 Comparison of existing density and standard density as per Spatial Planning Standards

LAP	Precinct	Building height (floors)	Coverage ratio (%)	Gross floor area (sq. m/ha)	Residential density (pp/ha) as per SPS	Maximum Existing Density (pp/ha)
Dhamdara	E4	2	20	4,000	200	Not available
	UV2-LD	4	40	16,000	800	495
	UV2-HD	5	50	25,000	1,250	806
Kabraytar	E4	2	20	4,000	200	Not available
	UV2-LD	4	40	16,000	800	511
	UV2-HD	5	50	25,000	1,250	684

4.7. CARRYING CAPACITY CALCULATION

Carrying capacity is calculated in terms of the total number of people that can be accommodated in each LAP when the LAP fully develops achieving the maximum permissible height and coverage ratio in each precinct.

Method:

- Calculate the total area of each precinct in a LAP in Hectares
- Multiply the area of a precinct by density (pph) of the precinct which gives the population accommodated in each precinct.
- Add the population accommodated in all precincts

Since the density mentioned in SPS is much higher than the existing density in the area, two scenarios are adopted to calculate the carrying capacity.

Scenerio1:

The density per capita is taken as 20 sq. m as per the SPS which is 72 sq. m for a household of 3.6 persons.

Scenerio2:

As mentioned earlier that the existing per capita density could be lower than 20 sq. m. The standard unit size usually ranges from 80 – 120 sqm. Hence, 100 sq. m per household with average household size of 3.6 is taken as scenario 2.

4.7.1. CARRYING CAPACITY FOR EXISTING PRECINCT

Total population that can be accommodated under existing precinct (with propsed reconfiguration) and land uses is calculated in two scenarios are discussed below.

Scenario 1

In this scenario, Dhamdara and Kabraytar can accommodate population of 17,313 and 18,158 respectively as shown in Table 4.11.

Scenario 2

In this scenario, Dhamdara and Kabraytar can accommodate population of 12,465 and 13,074 respectively as shown in Table 4.12.

Table 4.11 Scenario 1: Carrying capacity of Kabraytar and Dhamdara under existing precinct

Existing Precincts	Permissibility			Dhamdara		Kabraytar	
	Floors	Coverage %	Density (pph)	Area (Ha)	Carrying Capacity	Area (Ha)	Carrying Capacity
E4- Agri-based Environments	2	25%	200	5.376	1344	2.775	694
NN- Neighbourhood Node	3	40%	600	0.076	45	0.175	105
UV2 (HD) - Urban Village Periphery (High Density)	5	50%	1250	0.000	0	6.039	7,549
UV2 (LD) - Urban Village Periphery (Low Density)	4	40%	800	19.905	15,924	12.262	9,810
Total					17,313		18,158

Table 4.12 Scenario 2: Carrying capacity of Kabraytar and Dhamdara under existing precinct

Existing Precincts	Permissibility			Dhamdara		Kabraytar	
	Floors	Coverage %	Density (pph)	Area (Ha)	Carrying Capacity	Area (Ha)	Carrying Capacity
E4- Agri-based Environments	2	25%	144	5.376	968	2.775	500
NN-Neighbourhood Node	3	40%	432	0.076	33	0.175	76
UV2 (HD) - Urban Village Periphery (High Density)	5	50%	900	0.000	0	6.039	5,435
UV2 (LD) - Urban Village Periphery (Low Density)	4	40%	576	19.905	11,465	12.262	7,063
Total					12,465		13,074

4.7.2. CARRYING CAPACITY FOR PROPOSED PRECINCT

Scenario 1

In this scenario, Dhamdara and Kabraytar can accommodate population of 12,988 and 15,513 respectively as shown in Table 4.13.

Scenario 2

In this scenario, Dhamdara and Kabraytar can accommodate population of 9,352 and 11,170 respectively as shown in Table 4.14.

Table 4.13 Scenario 1: Carrying capacity of Kabraytar and Dhamdara under proposed precinct

Proposed Precincts	Permissibility			Dhamdara		Kabraytar	
	Floors	FAR	Density (pph)	Area (Ha)	Carrying Capacity	Area (Ha)	Carrying Capacity
E4- Agri-based Environments	2	0.6	200	8.890	2,222	2.806	720
NN-Neighbourhood Node	3	1.5	600	2.494	1,496	1.330	798
UV2 (HD) - Urban Village Periphery (High Density)	5	2.5	1250	0.000	-	6.039	7,549
UV2 (LD) - Urban Village Periphery (Low Density)	3	1.5	525	15.449	9,270	10.775	6,452
Total					12,988		15,513

Table 4.14 Scenario 2: Carrying capacity of Kabraytar and Dhamdara under proposed precinct

Proposed Precincts	Permissibility			Dhamdara		Kabraytar	
	Floors	FAR	Density (pph)	Area (Ha)	Carrying Capacity	Area (Ha)	Carrying Capacity
E4- Agri-based Environments	2	0.6	144	8.890	1,600	2.806	505
NN-Neighbourhood Node	3	1.5	432	2.494	1,077	1.330	575
UV2 (HD) - Urban Village Periphery (High Density)	5	2.5	900	0.000	-	6.039	5,435
UV2 (LD) - Urban Village Periphery (Low Density)	3	1.5	378	15.449	6,674	10.775	4,655
Total					9,352		11,170

The carrying capacities of Dhamdara and Kabraytar under different scenarios are summarized in Table 4.15 and graphically represented in Figure 4.3.

Table 4.15 Summary of the carrying capacities of Dhamdara and Kabraytar under different scenarios

LAP	Scenario 1		Scenario 2	
	Existing Precinct	Proposed Precinct	Existing Precinct	Proposed Precinct
Dhamdara	17,313	12,988	12,465	9,352
Kabraytar	18,158	15,513	13,074	11,170

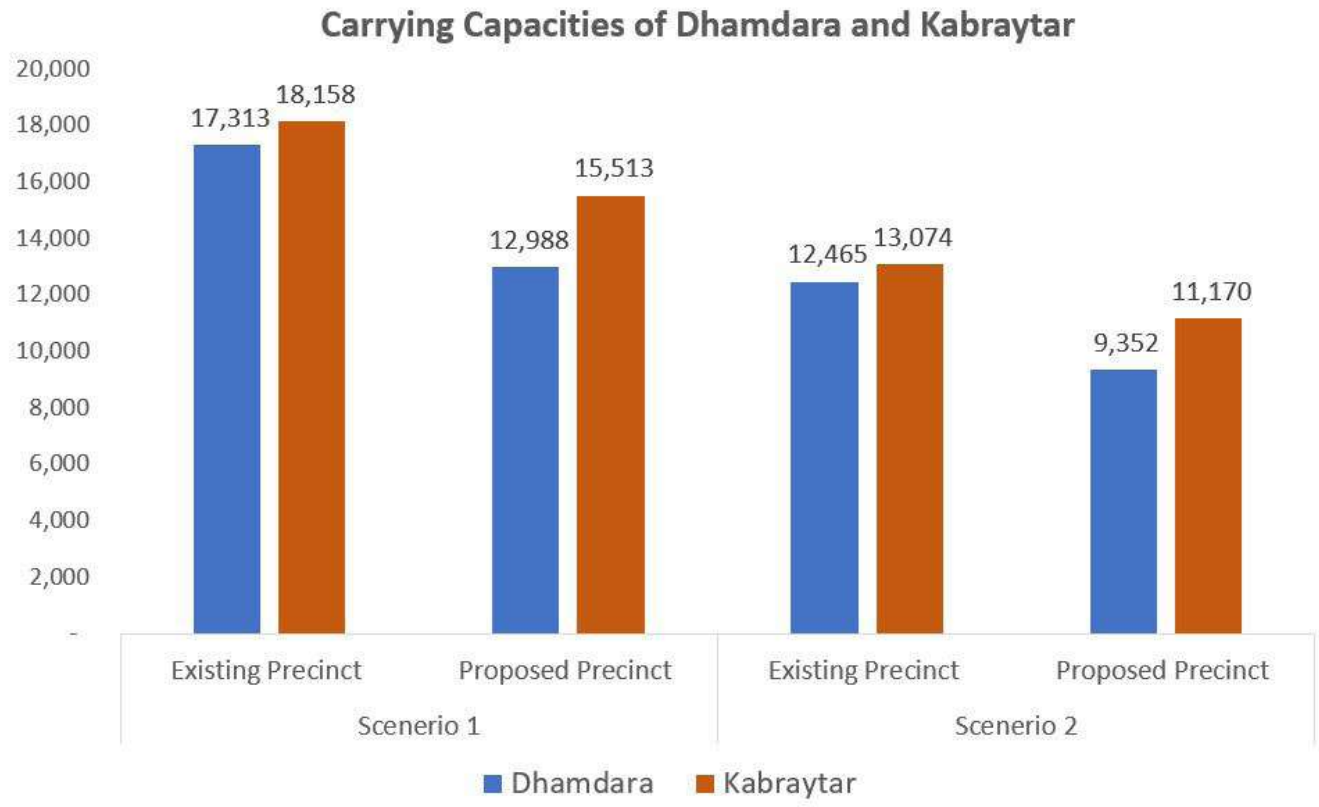


Figure 4.3 Graph representing the carrying capacity of Kabraytar and Dhamdara under different scenarios

4.7.3. TIME WHEN POPULATION CARRYING CAPACITY WOULD BE REACHED

Taking the Compound Annual Growth Rates (CAGR) of 3% and 5%, the estimated years in which the carrying capacity under the two different scenarios has been calculated. These figures are represented inTable 4.16 and Table 4.17.

Table 4.16 Years in which Carrying capacity would be reached for Dhamdara

	Carrying Capacity (Population)			
	Scenario 1		Scenario 2	
	Existing Precinct	Proposed Precinct	Existing Precinct	Proposed Precinct
	17,313	12,988	12,465	9,352
Growth Rate (CAGR)	Year in which these population would be reached			
3%	2107	2097	2095	2086
5%	2072	2067	2066	2060

Table 4.17 Years in which Carrying capacity would be reached for Kabraytar

	Carrying Capacity (Population)			
	Scenario 1		Scenario 2	
	Existing Precinct	Proposed Precinct	Existing Precinct	Proposed Precinct
	18,158	15,513	13,074	11,170
Growth Rate (CAGR)	Year in which these population would be reached			
3%	2092	2087	2081	2076
5%	2064	2061	2057	2054

EXISTING SCENARIO AND PROPOSALS

5. PLANNING AND LAND USE

5.1. EXISTING PRECINCT

Kabraytar and Dhamdara have 7 precincts. Figure 5.1 shows the distribution of the various precincts for Kabraytar and Dhamdara.

Table 5.1 shows the breakdown of plots and precinct information for both the LAPs. As per the analysis, there are a total of 464 plots in two LAPs The majority of the plots lie in the UV-2 LD (Urban village Periphery-Low density) precinct, for both the LAPs. For Dhamdara, the percentage coverage of UV-2 LD is 34% while that of Kabraytar is 24%.

There are 33 plots in the E-1 Environment Conservation Precinct, where construction is restricted as per PSP. 21 plots in Kabraytar and 12 plots in Dhamdara covering areas of 33,192 sqm and 14,785 sqm respectively are under E-1 precinct.

There are two plots under OS - 2 Green Open Space in Kabraytar, and none in Dhamdara. 26 plots fall under E-4 Agri based Environments in Kabraytar, and 60 plots in Dhamdara. There is a total of 3 plots under S1 - Service Precinct, out of which 2 plots are in Kabraytar and 1 plot in Dhamdara.

A vacant government land in Backside Dhamdara is marked as NN-Neighbourhood node. However, nothing has been developed as of now.

There is a total of 20 plots whose precinct data is unavailable.

5.2. PRECINCTS AS PLANNED IN PSP

The precinct classification as per PSP is shown in Figure 5.2. PSP has a few extra precincts compared to existing precinct. Precincts such as I-Institutional and SE-4 Service Centers and Industries are not in existing precinct.

Since the precinct classification in PSP was not done at plot level, plot level precinct breakdown was not possible. However, Table 5.2 shows the breakdown of areas of different precincts in both the LAPs.

A large part of Kabraytar, 34%, falls under UV-2 HD precinct whereas there is no UV-2 LD precinct. Dhamdara, in the other hand, has 34% of the total area under UV-2 LD and only about 4% in UV-2 HD.

Table 5.1 Table showing the area, coverage and number of plots in each existing precinct in Dhamdara and Kabraytar

	Dhamdara			Kabraytar			
Precinct	**Plots Area (Sqm)**	**%Coverage of total LAP area**	**No. of Plots**	**Plots Area (Sqm)**	**%Coverage of total LAP area**	**No. of Plots**	**Total Plots in Both LAPS**
E-1 (Plots only)	14,785	2.6%	12	33,192	6.3%	21	33
E-4	54,326	9.6%	60	24,918	4.7%	26	86
OS - 2	-		-	5,865	1.1%	2	2
UV-2 (HD)	-		-	61,074	11.6%	24	24
UV-2 (LD)	193,650	34.2%	155	125,496	23.8%	134	289
S1 - Service	1,196	0.2%	1	5,544	1.0%	2	3
NN	726	0.1%	1	1,705	0.3%	6	7
Unallocated	20,718	3.7%	13	4,442	0.8%	7	20
Others (Govt E1 area, roads)	280,758	49.6%		261,842	50.3%		
Total	566,159	100%	242	528,008	100%	222	464

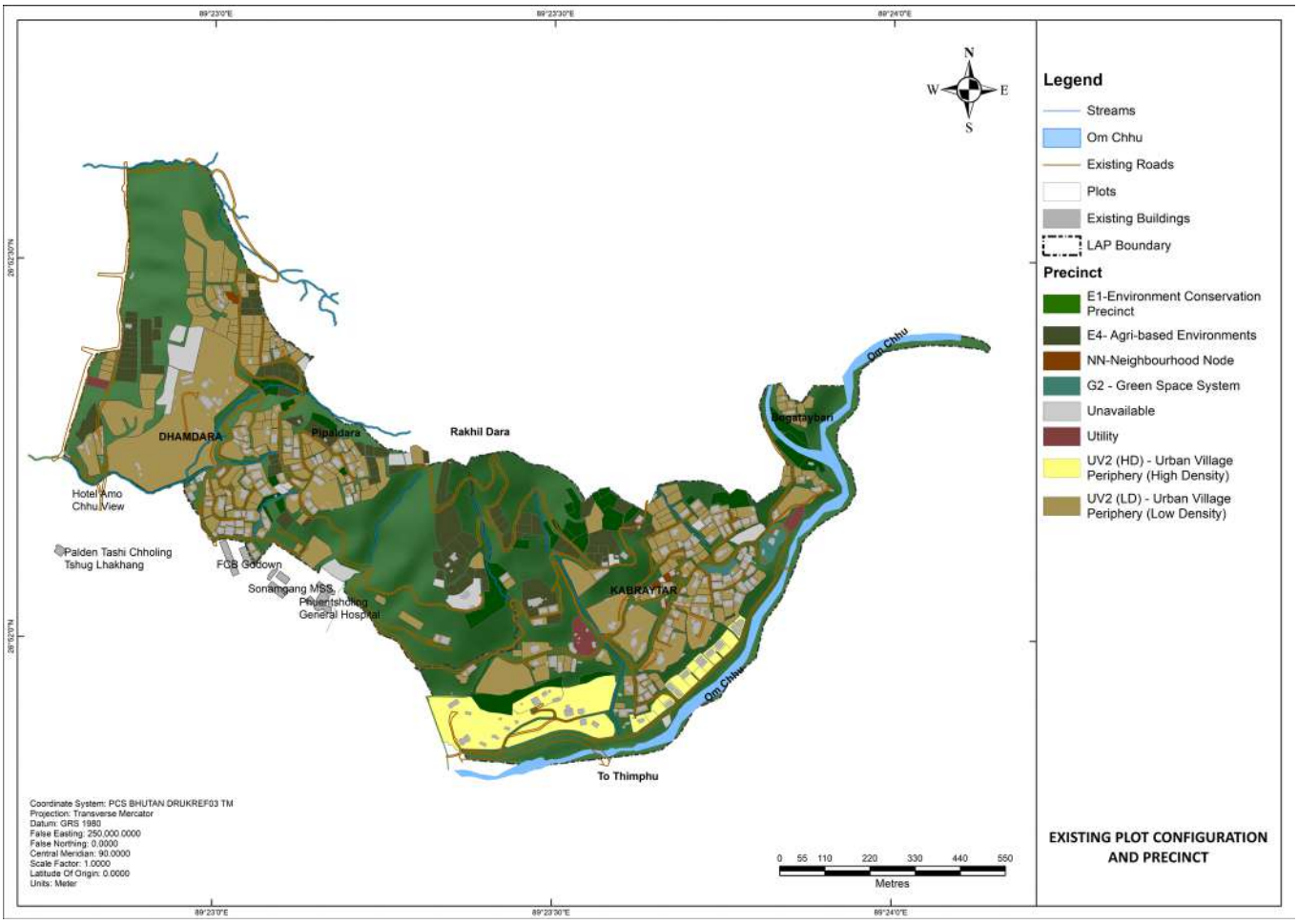


Figure 5.1 Existing Precinct Map

Table 5.2 Table showing the area coverage percentage of precincts in Dhamdara and Kabraytar as classified in PSP.

	Dhamdara		Kabraytar	
Precinct	Area (Sqm)	% coverage	Area (Sqm)	% coverage
E-1	266,052	47.0%	249,680	47.3%
E-4	52,050	9.2%	20,606	3.9%
OS - 2		0.0%	5,968	1.1%
UV-2 (HD)	20,986	3.7%	178,784	33.9%
UV-2 (LD)	194,162	34.3%	0	0.0%
S1 - Service Precinct	0	0.0%	4,810	0.9%
SE-4	0	0.0%	2,279	0.4%
NN	0	0.0%	5,090	1.0%
Institutional	0	0.0%	7,121	1.3%
Other (roads, streams, footpaths)	29,222	5.2%	51,027	9.7%
Overall LAP Area	566,159	100.0%	528,008	100.0%

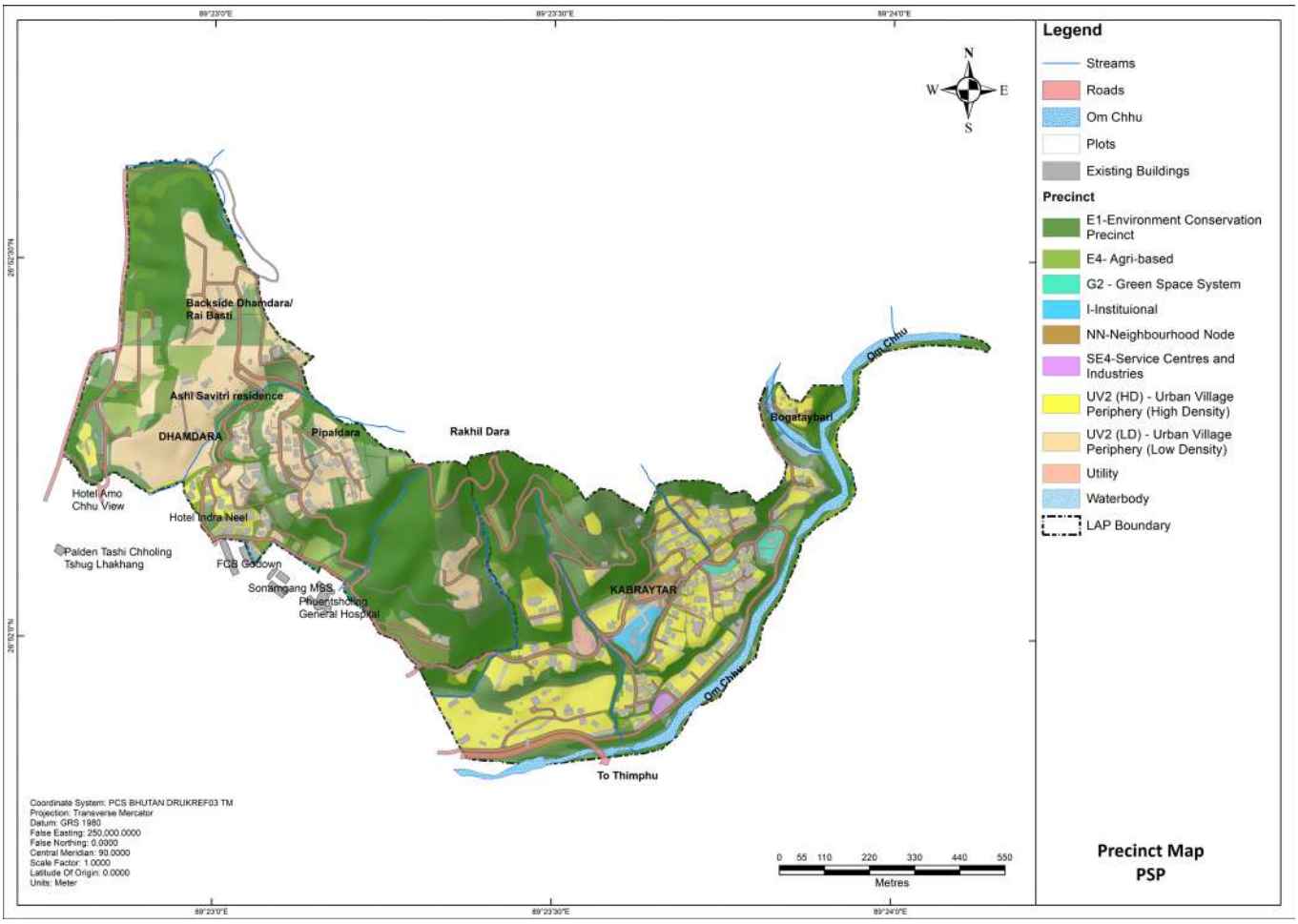


Figure 5.2 Precinct as planned in PSP Map

5.3. EXISTING LAND USE CHARACTERISTICS FOR KABRAYTAR AND DHAMDARA

The land uses for various precincts of Kabraytar and Dhamdara is based upon the land uses as per PSP. There are slight variations in the landuse between the PSP, and the LAPs for Kabraytar and Dhamdara, but the implementation at the site was followed as per PSP. The land uses and special conditions as per PSP for various precincts are as follows.

E1- Environmental Conservation Zone

The land supported by the river, streams, rivulets, and their immediate surroundings form the Environment Conservation Zone. Considering the eco-fragile nature of the areas surrounding the streams, and drains, and the swelling width of the water bodies during peak rainy seasons, a green buffer zone of fifteen meters wide right of way along the dominant and primary natural surface drain courses identified in the structure plan is proposed. The proposed green buffer zone shall not be less than as provided below (PSP):

- Ammo Chhu: 30 meters on both the sides
- Om Chhu: 15 meters on both the sides
- Bhalu Jhora Chhu: 15 meters on both the sides
- Padsekha Chhu: 15 meters on both the sides
- Singye Chhu: 15 meters on both the sides
- Major streams: 9 meters on both the sides (at Pekarshing (Toribari) and Ahlay)
- All other minor streams: 5 meters on both the sides

The important features of this precincts are as follows:

- This precinct shall be allocated to areas with slope greater than 50%
- Most of the areas falling under Slopes greater than 50% falls under the high hazard zone as per geo-technical investigation.
- However, the above conditions may not always apply since the areas around the rivers, streams, and rivulets will also be classified under this

precinct. Thus E-1 will be classified into two types, River and stream side protection zone, and Ground water protection and management zone.

A. River and Stream Protection Zone Permissible uses and Conditions

- No development/construction shall be permitted within 5 metres from the defined edge of the natural drain course, or such distance as prescribed under any other specific rules of the kingdom of Bhutan.
- Construction of roads, underground cables, and other service networks, high tension cable lines, electric towers, and other structures shall not be allowed in this zone.
- Natural landscape features of the surface drains, edges, soil, vegetation, boulders and other natural features shall not be disturbed from its natural state.
- Disposal of waste water, sewerage, solid wastes, washing of automobiles, or other actions which are deemed as polluting this zone shall not be permitted.
- Existing structures within this zone can be retained, but the future developments to these structures shall not be allowed.
- Active and Passive Recreational open spaces which does not block the storm water flow will be allowed with permission from the competent authorities. However, active recreational spaces should be allowed only in areas which are not fragile ecologically.
- Permanent landscape features like footpaths, cycle tracks, vehicular and pedestrian bridges, lamp posts, benches, gazebos, children play equipment, waste bins should be allowed only beyond 5 metres from the edge of the storm water drain course.
- Actions related to protection, conservation and enhancement of the zone will be permitted under the guidance of the National Environment Commission or any other competent authorities.
- Actions related to changing, realigning and redefining the course of drainage pattern, edge protection works for the natural surface drains shall be permitted with the clearance from the National Environment Commission or any other competent authorities.

B. Ground Water Protection Zone Permissible uses and Conditions

- The purpose of this zone is to protect, manage, and conserve the potential ground water resources and to prevent development and hard paving on these areas.
- Agriculture, horticulture, and floriculture are best suited for this zone.
- Existing vegetation should be retained.
- Construction of buildings which have hard paving shall not be permitted.
- This zone can be developed as parks, nurseries, and gardens without disturbing the subsurface geology and characteristics of the soil.
- Outdoor sports facilities which do not require hard paved surfaces and built structures shall be permitted after approval from NEC, or any other competent authority.

E4-Agri-based Environments

The purpose of this zone is to protect and stabilize the slopes of the mountains adjoining Phuentsholing town from soil erosion and landslides. This will reduce the intensity of surface runoff and help in protecting from risk of flooding. Those areas with slope greater than 30% in and around the area falls under this zone.
The characteristics of this precinct are as follows:

- Slopes ranging from 30-50% shall be allocated with this precinct.
- This precinct falls under medium to high hazard zone.

Permissible uses and Conditions

- Agriculture based activities should be encouraged in this zone.
- Planting of trees should be given priority in these areas. Activities related to de-forestation should be prohibited.
- Grazing on the slopes should be prohibited.
- Mining and Quarrying should not be permitted.
- Building of bunds and check dams along the course of the rivers and streams should be encouraged to reduce the downstream surface runoffs in an environment friendly manner.
- Those areas should be developed as a low-density development zone. The maximum density permitted will be one house per one thousand (1000 sqm) square metres of land area. Suitable developments in this zone are large institutional

campuses, eco-resorts, and farm houses.

- Farm houses of G+1 storied structures and maximum of 20% ground coverage shall be permitted.
- Future developments, under special circumstances, shall be permitted only after a thorough EIA (Environment Impact Assessment), and with the clearance from the competent authority.
- The developments should not alter the existing natural surface drainage pattern and should take care of the surface runoff.

G2-Local Green Open Spaces

Permissible uses and Conditions

- This precinct shall be used for public assets like parks, gardens, community level/local recreational and sports facilities.
- Maximum of G+1 storied structure shall be allowed, with plot coverage of 10%. Structures permitted shall be limited to storerooms, players restrooms, toilets, changing rooms, care takers house, and offices related to such recreational facilities.
- Attics and basements shall not be permitted.

UV-2 (HD) Urban Village Periphery (High Density)

- Those areas with slope ranging from 0-20% are designated with this precinct.
- This precinct falls in the low Hazard zone.
- The areas surrounding the Urban Village Core (UV1) are designated with UV-2(HD).

Permissible uses and Conditions

- This zone will have a high-density residential development as the name suggests. This precinct will have a high-density mixed use with density higher than 350 pph.
- Apartments and group housing are permitted in this precinct.
- Maximum plot coverage shall be 50%, with structures up to G+4 storeys.
- Local level retail shops and services, economic activity and cottage industries which does not involve the use of, or installation of machines driven by more than 1 KW power and which does not create noise and vibrations, dust, fumes, shall be allowed in dependent dwelling units.
- Local level retail shops with floor area less than 40 sqm, or fast food outlets, internet browsing centre, snack bars, and canteens not exceeding floor area of 30sq.m shall be permitted on the ground floor of each plot.
- Educational institutional buildings, day-care centers, dispensaries, clinics, public facilities and utilities, local community halls are allowed.
- Institutional uses shall be permitted in a plot with minimum area of 1000 sq.m. Likewise, resorts, and hotels with boarding and lodging facilities shall be allowed in a plot with minimum area of 2000 sq.m.
- Activities contradicting with residential uses such as bars, pool rooms, discotheque, karaoke, and any other night time entertainment facilities shall not be permitted.

UV-2 (LD) Urban Village Periphery (Low Density)

- This zone lies outside the UV-2(HD), where the slope is steeper, and where the developments are only possible in isolation or pockets.
- This zone falls in the area where the slope range is between 20-30%.
- Low and Medium Hazard zone dominate this precinct.

Permissible uses and Conditions

- This zone will have a low-density residential development with residential density less than 125 pph.
- This zone will have terraced structures.
- Maximum plot coverage should be 40% of the total plot area, with building stories up to G+3.
- Residential uses, resorts, professional services, office spaces, and educational institutes shall be permitted. However, minimum plot size for educational institutions and office buildings shall be 1000 sq.m. For resorts and hotels with boarding and lodging facilities, a minimum plot area of 2000 sq.m is required.
- Commercial uses like retail outlets, shops, warehouses, and recreational centers shall not be permitted.

NN-Neighbourhood Node

Permissible uses and Conditions

- G+2 storied structures will be allowed in this

precinct, with maximum plot coverage of 40%.

- Neighbourhood Node will have activities like retail shops, restaurants, hostels, hotels, clinics, convenience shopping, offices and establishments of less than 15 employees, ATMs, Creches/day care centre, pre-primary educational facilities, transit stops, public facilities and utilities, dispensaries, gardens, bakeries/confectioneries, libraries, community halls, club houses, service stations, kiosks, vegetable vendors, display areas, pubs, bars, pool rooms, discotheques, karaoke, outdoor cafes, indoor games and so on.
- LGO centers and fuel stations shall be permitted under the fulfillment of the safety norms.

H- Heritage

Permissible uses and Conditions

- This precinct shall be allocated for cultural and religious sites.
- Religious sites and artifacts, Lhakhang, Monasteries, Chortens, Mani Walls, Prayer wheels, statues, and any other activities related to enhancement, protection or conservation of the heritage structures shall be categorized under this precinct.

I-Institutional

Permissible uses and Conditions

- This precinct, as the name suggests, is for institutional activities.
- Institutions such as educational, training, cultural, public libraries, Art Galleries, Museums, Diplomatic Enclave, RBP, RBG, RBA, GREF, and DANTAK will be allowed.
- Residential and other activities incidental to the main institutional use shall be permitted, however the coverage for such activities shall not be more than 10% of the plot area

SE-4 Service Centres & Industries (Polluting and Non-polluting)

Permissible uses and Conditions

1. Non-Polluting

- The allowable uses in this precinct include wholesale markets, ice factory, cold storage, ware houses, go-downs, transport terminal for good and passengers, restaurants, lodges, dormitory, hospitality centers, steel and timber stock yard, oil depot, Junk yard, saw mill, LGP depot, vehicle workshops, and storage of permissible goods.
- Printing press, pasteurizing and milk processing, binding, packaging and sealing, paper box manufacturing, battery charging, bakeries & Confectioneries, laundry services, Light industry, waste recycling plants, banks, canteens, amenities for workers, shall be allowed.
- All uses allowed in UV-2 (LD) are also allowed in this precinct

2. Polluting

All uses permitted in SE-4 Non-polluting expect UV-2 (LD) uses.

S1 - Service Precinct

Permissible uses and Conditions

- This precinct shall be reserved for the S1 - Service Precinct structures such as Water Reservoir Tank, Garbage collection centers, Sewerage systems, BPC transformers and towers, etc.
- Maximum of G+1 storied shall be allowed in this precinct, with maximum plot coverage of 20%.
- Basements and attics shall not be permitted.
- Other permissible uses in this category include, Public facility, services buildings, bus stations, water supply, drainage, sanitation and garbage disposal stations, pumping station, purification plant, police buildings, post and telegraph, telephone booth, fire brigade station, parking lots, play grounds, open spaces, nursery, first aid medical centers, and dispensary.

Royal

This precinct shall be reserved for royal uses.

5.4. PRINCIPLES

5.4.1. GUIDED LAND DEVELOPMENT (GLD)

Guided Land Development involves the process of land development wherein the land owners on either side of the road contribute equal amount of land, as measured from the centerline, so that the roads have the best alignments while also providing enough space for other infrastructures such as roadside drains, footpaths, etc. It is considered the easiest method in comparison with other methods of Land development techniques such as land pooling and land acquisition.

Rationale behind using GLD:

- Both the LAPs have been pooled and the plots are rationalized.
- It is easy to implement since this method assists what anyway will happen as a natural process. The land for infrastructure (roads, drains, etc….) has to come from somewhere, thus the land owners will have to contribute a portion of their land for such developments.
- Managements costs are low compared to other techniques of land development. After the initial preparation of a plan, and agreement of the community, involvement of project management is minimal compared to land pooling. To some extent the community can be left to get on with implementation without further assistance.
- As implementation proceeds, if some plot owners refuse to give up land, they are soon made to feel outcasts. They are obliged to do so eventually. In some cases, other owners even club together to compensate for those who suffer severe losses.
- Also Guided Land development technique is preferred over other techniques when the number of existing buildings are too many, or the terrain is too steep in some areas.

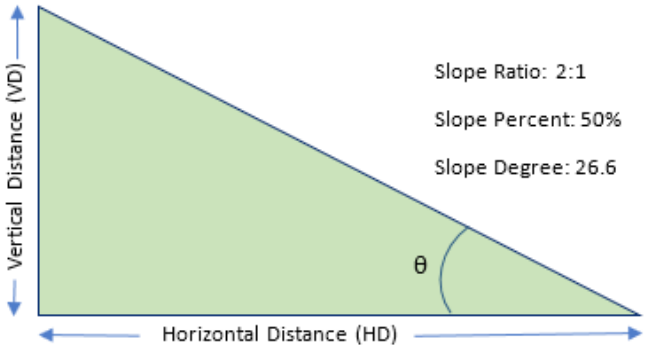
Guided land development will be used since the plots are already land pooled. However, GLD will be applied only when absolutely necessary. It is obvious that some of the land owners will have to contribute some portion of their land for this purpose, however, the benefit lies only for the land owners residing in that particular area. Proper and improved infrastructure such as roads, and spaces for public amenities will only lead to vibrancy of the space which will lead to social and economic developments.

5.4.2. SLOPE

Slope is a measure of change in elevation. Thus, slope analysis helps in understanding the topography of a place/region. It gives the slope ranges available in the region using contour data. Slope Analysis helps in determining the areas suitable for development thus allowing us to determine the precinct classification at some level. Slope can either be expressed as a percentage, degree, or even as a ratio.

Percent: Slope is expressed as a percent Value.

Degree: Slope is expressed as the angle of inclination from a horizontal plane.



Horizontal Distance (HD) = Run

Vertical Distance (VD) = Rise

Figure 5.3 Image showing the slope determination formulas

Table 5.3 Slope Determination Formulas

	Formula	Example	Result
Slope Ratio (HD: VD)	HD: VD	100:50	2:1
Slope Percentage (%)	(VD/HD) * 100	(50/100) * 100	50%
Slope Degree (°)	tan θ = VD/HD	tan θ = (50/100)	26.60°

For instance, when the horizontal distance (Run) is twice that of Vertical distance (Rise), then the slope

percentage is equal to 50% and the slope degree is 26.6°. Likewise, if the Horizontal distance is equal to the vertical distance, then the slope percent is equal to 100%, and the slope degree is 45°.

Slope Analysis is an important factor for determining the precinct classification of an area.

As per PSP 2013-2028, most of the developments should take place between the slope range of 0-30%. Slopes between 30-50% should be designated E-4 Agri-based environments, and E-1 Environment conservation Zone for slopes greater than 50%.

To further assist in setting the criteria for precinct classification, the development compatibility matrix from the PSP is followed.

5.4.3. DEVELOPMENT COMPATIBILITY MATRIX

The Development Compatibility Matrix is a comprehensive chart which determines the level of inter compatibility between the precincts, the natural determinants and other external determinants which will impact the future development of the area. This matrix will seek to allocate multiple precincts for a particular area rather than a single optimum precinct for one specific area. Since the matrix determines the compatibility of various precincts with other natural and external determinants, it will have profound effect on the precinct distribution in the area. A summarized matrix from PSP 2013-2028 is as shown in theFigure 5.4.

To take an example, from the development compatibility matrix, it is clear that the slope range of

DEGREE OF COMPATIBILITY		NATURAL DETERMINANTS													IN-TOWN DETERMINANTS				
		Slopes				Water Bodies		Vegetation		Flood Risks					Land Holdings				
		>30% (Very Steep)	20-30% (Steep)	10-20% (Moderate)	0-10% (Low/gradual)	Rivers	Natural Storm Water Drains	Forest Cover	Agriculatural Lands	Very High	High	Intermediate	Low	Scenic Locations	Government	Private	Army/Police occupied Lands	Existing Industrial Area	International Boundary (Buffer Zone)
URBAN PRECINCTS	UV-1 Urban Village Core	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	UV-2 Urban Village Periphery (HD)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	UV-2 Urban Village Periphery (LD)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	UC-Urban Core	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	NN-Neighbourhood Node	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	I-Institutional	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	E-1 Environmental Conservation	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	E-4 Agri-based Environment																		
	G-1 National Importance Green Open spaces	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	G-2 Local Green Open Spaces	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	E-7 International Boundary Buffer Zone	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	H- Heritage	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	SE-2 Multi-Modal Transit Hub	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	SE-3 Dry Port	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	SE-4 Service Centres & Industries	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	R- Royal	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

●	High Compatibility
●	Moderate Compatibility
●	In-Compatibility

Figure 5.4 Development Compatibility Matrix

20-30% is incompatible with UV-2 HD (Urban Village Periphery-high density). Thus, this will help us in allocation of precincts which are compatible with the slope range coupled with other determinants and principles.

5.4.4. HAZARDS

A hazard map assesses and highlights the areas that are vulnerable or affected by a particular hazard or disaster which occurs due to natural calamities such as floods, earthquakes, landslides, etc. The hazard analysis is carried out through a Geo-technical Investigation which involves a variety of assessment like slope stability, floods, landslides, etc. Through these analyses, areas suitable for development can be identified. It not only helps in identifying the areas suitable for development, but also helps in classifying the level and types of development that can take place in a particular area. Moreover, the analysis will provide a basis for strategizing mitigation plans for any future disasters in the area.

Hazard mapping is one of the most important features in determining the areas suitable for developments. Slope alone cannot determine such areas. Some areas with relatively flat terrain (river side area) might be in high hazard zones. Likewise, some areas with steeper slopes might fall in low hazard zone due to other geological factors. Therefore, it is imperative that the slope analysis is coupled in hazard mapping so that the land suitability for developments can be determined at a higher precision.

5.4.5. DENSITY

Density can be measured in a variety of ways, each of which is appropriate in different situations. There are no specific rules on how to measure density, and how to use density thresholds in plans and policies. In general, density is expressed as a ratio whereby the numerator is a quantity of human activity such as jobs, dwelling units, number of people, etc. and the given land base representing the denominator. For instance, density can be defined as population per hectare, or dwelling units per hectare.

The choice of the numerator influences the purpose of the study. Population density can be used to measure density where the people are the object of study. Population density can be helpful to measure the needs of infrastructures such as schools, hospitals, and transits where the individual person and not the household makes travel decisions. On the other hand, dwelling density is a more appropriate measure in terms of residential land consumption which would provide better insights on the provision of infrastructure services like roads, sewer lines, water supply, electricity, etc.

The dwelling density of an area will provide us with the infrastructure requirement of an area. To look at it from another perspective, having the idea of the built infrastructure and spaces available for future infrastructure will give us the base for allocating suitable density of the area.

5.4.6. EXISTING AND PLANNED INFRASTRUCTURE

Infrastructure services like water supply, storm water drainage, sewerage, electricity, and street lights are some of the basic essential services for any area. The number of people a place can sustain will depend upon the existing infrastructure, planned ones, and the space available for future developments. A high-density development in an area with limited infrastructure facilities, and available space for future infrastructure will not be a sustainable community.

5.5. ANALYSIS

5.5.1. SLOPE ANALYSIS FOR KABRAYTAR AND DHAMDARA

For the slope analysis of Kabraytar and Dhamdara area, the contour data has been provided by the UPD (Urban Planning Division) of Phuentsholing Thromde. The DEM (Digital Elevation Model) was prepared from the provided contour data, and then finally slope analysis done using ArcGIS. The slope values are calculated as percentage. The slope for the project area is classified into six categories as shown in the Table 5.4.

The slope analysis map (see Figure 5.5) provides the range of slope percentage for Kabraytar and Dhamdara. The colour ranges from green to red as the slope percentage increases. The areas with green, light green, and yellow depicts a slightly lower slope having slope percentage between 0-30 degrees while the darker shades of orange and red shows the steep slopes of the area with slope percentage of 30 and above.

According to the analysis, about 35% of the area falls under the slope of 30%, while the remaining 70% falls under 30 % and above. To narrow down further, about 38% of the area falls in more than 50% slope and about 27% of the area falls under the slope range of 30-50%. To have a flexibility in determining precinct based on slope due to factors which will be explained later, areas with slopes ranging from 50-60% are also analysed.

According to PSP, Areas with slope greater than 50% should be designated as E-1 Environment conservation Zone, where the developments are restricted. The areas with slope between 30- 50% should be designated as E-4 Agri-based Environments. The areas with slope range between 0-30% are specified for developmental activities.

Earlier plans such as Thimphu Structure plan (TSP) and Paro Valley Development Plan also suggests 30% as the maximum slope beyond which developments should not be allowed. The Spatial Planning Standard also prescribes 30% as the upper threshold for developmental activities. However, a very low- density developments can be allowed in areas with slope between 30-50% with some conditions. Those areas with slope greater than 50% should be prohibited from developmental activities since;

- Such areas are prone to landslides and soil erosion.
- Developments in such areas will involve cutting of

Table 5.4 Areas falling in different slope categories

Slope Class	Area (M2)	Area (Acres)	Area (KM2)	Area (%)
0-10%	80158.73	19.81	0.08	7.37%
10-20%	169210.76	41.81	0.17	15.56%
20-30%	145697.78	36.00	0.15	13.40%
30-50%	139626.24	34.50	0.14	12.84%
50-60%	264509.72	65.36	0.26	24.33%
60%+	288123.95	71.20	0.29	26.50%
Total	1087327.19	268.68	1.09	100.00%

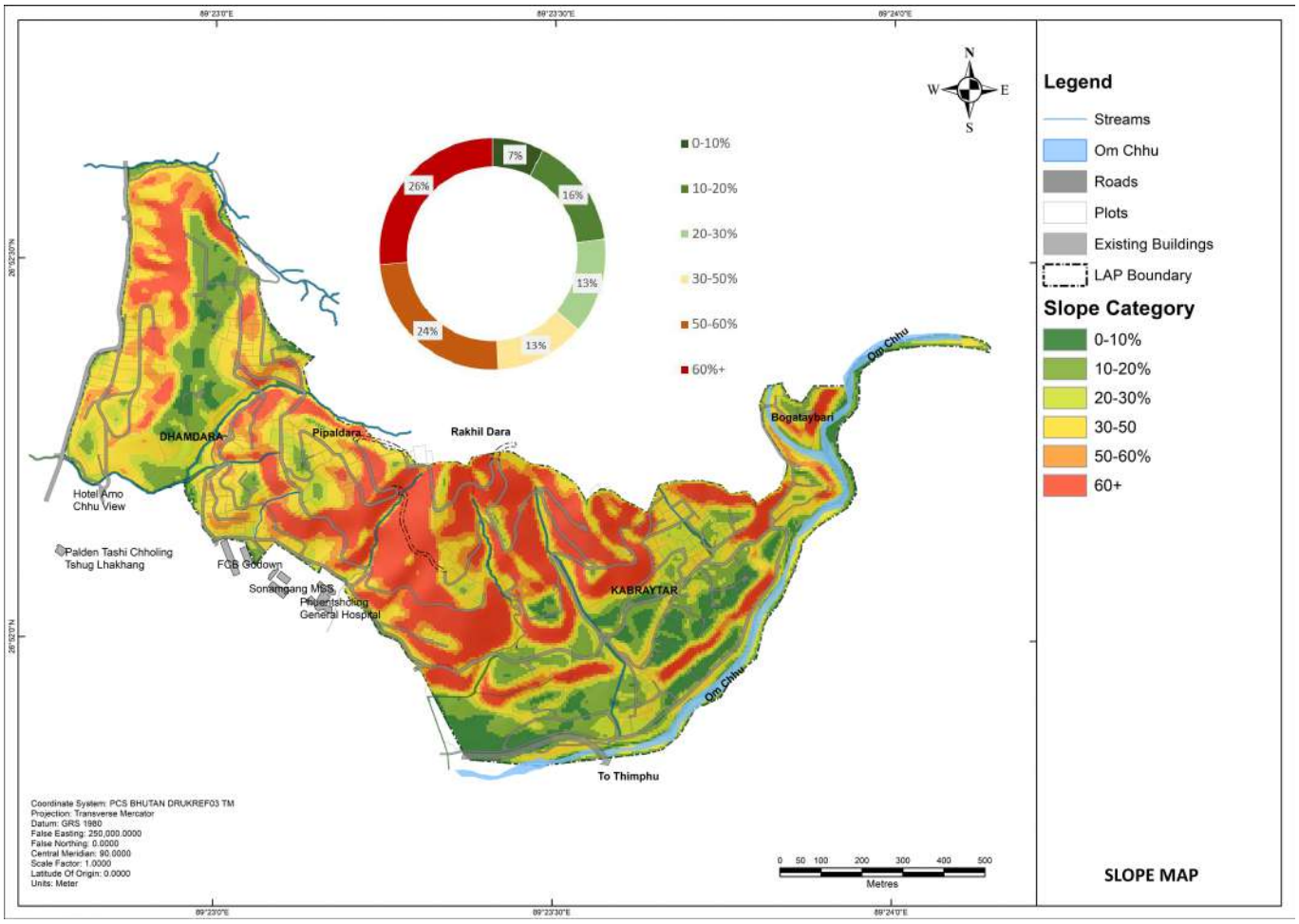


Figure 5.5 Slope map for Dhamdara and Kabraytar

slopes, thus affecting the slope stability.

- Areas falling in this slope category are mostly forested areas. Thus, allowing of development would mean deforestation.

5.5.2. HAZARD ANALYSIS FOR KABRAYTAR AND DHAMDARA

The Geotechnical Investigation and Slope Stability Analysis done by APLHA GEOTECH & COMPANY in 2019 carried out the following hazard assessment.

a. Seismic Hazard Analysis – Bhutan is located in a high earthquake hazard zone. The current project area is even more prone to seismic hazard because of its proximity to major fault lines within the area. The area has five major fault lines within 50 Km of Kabraytar and Dhamdara. The project area was found to be located on one of the regional faults, which makes it even more prone to seismic hazards.

b. Soil Liquefaction – Soil liquefaction is a possible geohazard related to earthquake. Soil liquefaction is a process in which a saturated or partially saturated soil loses strength and stiffness in which the ordinary solid soils behave like a liquid with no bearing strength. The lower part of the study area along Om Chhu is susceptible to such hazards since there are a lot of alluvium deposits saturated from the river infiltration. Liquefaction is expected to occur near the fault lines where the earthquakes are prone, and near the rivers where the soils are mostly sandy in nature.

c. Flood Hazard – Om Chhu passes through many settlements in Phuentsholing Thromde. The river brings a lot of sediments and sometimes blocks its path in the summer leading to changing its path. This poses great threat to the settlements down below, including the lower part of Phuentsholing and RICB Colony. Om Chhu is fed by rains during summer, and there is risk of flooding during such seasons. Moreover, the watershed of Om Chhu was found to be about 20sq. km. Such small watersheds are highly sensitive to high-intensity and short duration rainfalls.

d. Landslides and Ground Subsidence – Because of the hilly region, slope stability is a huge geotechnical challenge for Kabraytar and Dhamdara. Various studies have found that soil slips, which cause avalanche failures, commonly initiate on slopes greater than 33% or 18°. However, serious erosion can occur on much shallower slopes and the potential for erosion is greatest in the period between removal or disturbance of vegetation and re-establishment of new vegetation.

e. Hazard Mapping – The project area (Kabraytar and Dhamdara) is divided into three hazard zones. The basis for the hazard mapping is slope angle, material type, geomorphology, land cover, extent of degradation, susceptibility to erosion, and climatic factors.

Hazard analysis map is shown in Figure 5.6. As indicated in the map, the areas highlighted with blue represent the low hazard zone where the slope ranges between 0-20° (0-36%), and there are no major geological hazards and slope instability associated with these areas. Such areas are suitable for developments with some geotechnical measures.

The areas marked with yellow patches are the medium hazard areas. These areas have slope ranging between 20-30° (36-57%), and are susceptible to geological hazards. There are also evidence of soil creeps and steep slopes leading to instability of the area. In order for developments in such areas, engineering practices suitable to hillside constructions should be adopted.

The areas marked with red zones are the high hazard areas where the slope values exceed 30° (57%). Such areas are highly prone to major geological hazards. There are also past evidences of land slip or rock-face failure in those areas. Developments should be restricted in such areas. However, if developments are to take place, site specific geotechnical investigation must be conducted.

Based on the hazard mapping from the Geotechnical Investigation and slope stability assessment for Kabraytar & Dhamdara LAP 2019, 25% of the area (i.e. 67 acres) falls in low hazard zone, 15% (i.e. 42 acres) in medium hazard and 59% (i.e. 159 acres) in high hazard zone. The schedule of hazard classification, their classification criteria and the areas falling in each zone are as provided in Table 5.5.

Table 5.5 Table showing the areas falling under different hazard categories (adapted from Geotechnical Study, 2019)

HAZARD LEVEL	Area (M2)	Area (Acre)	Area (Km2)	Area (%)	DETAILS
Low Hazard	272593.54	67.36	0.27	25.06	Slope with an angle ranging from 0-20°. No major Natural or Geological Hazard.
Medium Hazard	171234.30	42.31	0.17	15.74	Slope Angle between 20-30° with some Natural or Geological Hazard. However, this type of Hazard can be minimized by Mitigation Measures.
High Hazard	644007.85	159.14	0.64	59.20	Slope Angle above 30°.These are High Risk Areas of Slope Instability due to weak Geology.
Total	1087835.70	268.81	1.09	100.00	

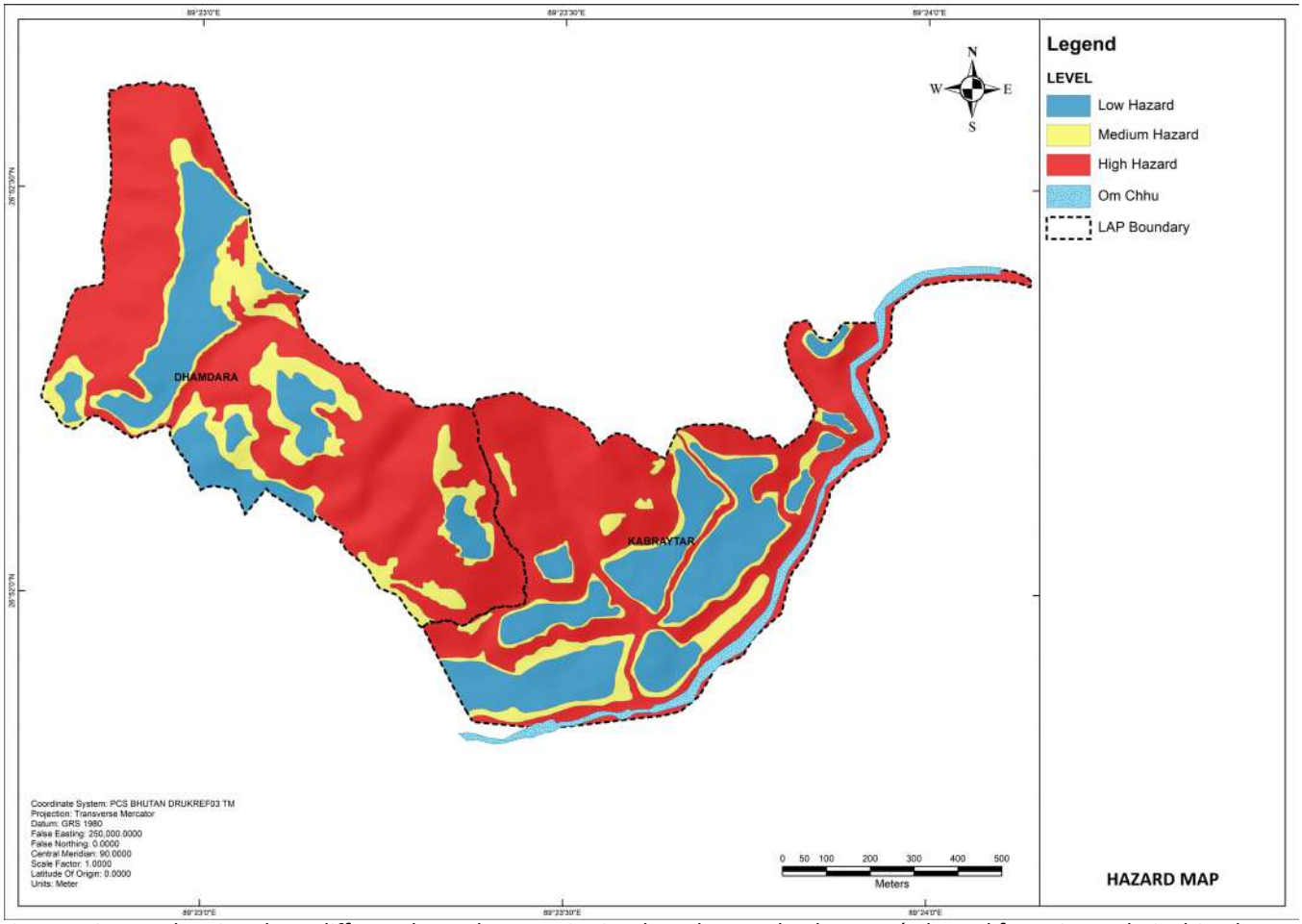


Figure 5.6 Map showing three different hazard categories in Dhamdara and Kabraytar (adapted from Geotechnical Study, 2019)

5.6. PRECINCT PROPOSAL

5.6.1. PRECINCT RECOMMENDATION AT CONCEPT STAGE

During the initial analysis, slope, hazard, density, and infrastructure were the sole determinants for the proposed precincts. Those plots falling in the high hazard zones, including river and stream buffers were allocated as E1-Environment conservation Precincts, while those falling in the low and medium hazard zones were allocated with other precincts in accordance with factors like density, availability of infrastructure, and space for future infrastructure.

In areas where a plot are in more than one hazard zone and slope slope category, careful measures were taken to allocate a suitable precinct for them. For instance, for a plot in medium and high hazard zone, the hazard zone occupying the maximum area of the plot was considered. If the major portion of the plot is under the high hazard zone, they were assigned with E1 Precincts. However, if the major portion of the plot falls in the medium hazard zone, then they were assigned with E4 precinct.

Those areas falling in the low hazard zones were assigned with Urban Village Periphery Precincts or precincts with higher development permissibility.

The physical criteria used for determining the precincts at this stage is shown in Table 5.6 below.

5.6.2. RE-CONSIDERATION OF PRECINCT ALLOCATION

Initially, Precinct for each plot was allocated solely based on the principles mentioned earlier. However, after the concept report presentation and discussion on 10th April, 2020, the following decisions were taken by Thromde regarding precinct allocation:

1. *Existing precinct to be respected to the extent possible unless there are strong technical justification at the site, for which every plot level detail must be captured.*
2. *Wherever feasible, infrastructure provision like roads must be kept for E1 plots.*
3. *Details of existing structures in different hazard categories as per Geo-tech investigation to be prepared and balanced proposal to be proposed after taking consideration of all the technical and social issues in both the LAPs*
4. *Since there are scopes of upgradation of some plots from E1 to E4 or E4 to UV2 as per ground conditions, proper verification at the plot level must be done*

Considering these decisions, the following three additional factors were included in the eventual evaluation and allocation of precincts.

Table 5.6 Physical Determinants/ criteria for precinct determination

	Physical Determinants/ Criteria for Precinct Determination		
Precincts	**Slope (%)**	**Hazard**	**Other Criteria**
E1	Above 60%	High	3m, 5m and 15m buffers from minor streams, Bogataybari chhu and Om Chhu respectively.
E4	30-60%	Low-Meduim	-
OS-2	0-50%	Low-Medium	Available vacant government plots/ excess/ pooled land
S1	0-50	Low-Medium	Vacant government plot
UV2-LD	0-30%	Low-medium	Existing buildings constructed under UV2 LD precinct
UV2-HD	0-20%	Low-medium	Existing buildings constructed under UV2 LD precinct
NN	0-30%	Low-medium	Centrally located in the LAP

1. 10% slope tolerance for E4 plots

Although the PSP and the national standards don't allow constructions above 50% slope, the development pressure and existing scenario in the study area demanded some flexibility. Hence, E4 is proposed in slopes ranging from 30-60%. This, however, is accompanied by strict construction regulations mentioned in the DCR.

2. Existing development in the site

The precinct of plots which are already built to maximum developable potential permitted by existing DCR (for example 4 storeys in UV2 LD and 2 storeys in E4) are not converted to E1 even if the slope is greater than 50% and in High Hazard area. However, in areas where there are active landslides and slopes 30-60%, UV2 LD plots are changed to E4.

3. Developments in the adjoining plots

The committee on the concept discussion accepted that it is socially unjust not to permit development of a plot where similar adjoining plots are already developed. In such cases, to maintain the existing neighbourhood characteristic and to permit development impartially, precinct of adjoining plots with similar slopes and hazard is allocated. However, it should be noted that the new proposed DCR has changes made to the existing DCR and any further developments are to be based on the new DCR.

4. Social Factors/Issues

A number of social issues that would arise due to the change of a large number of plots into E1 were discussed in the concept report discussion. Some of these issues are:

- Existing Housing shortage in Phuentsholing Thromde – Designating plots into E1 where construction is prohibited would exacerbate the housing shortage issue in the Thromde in the future.
- Access to Shelter – Some plot owners owning single plot would be deprived of shelter when her/ his plot is changed to E1.
- Lack of clear policy for the compensation of E1 plots – There are no defined policies on the matters relating to the compensation for the plots which are changed from more developable precinct to E1. Landowners have been paying land tax for many years and re-categorizing their plot into E1 without any benefits is not acceptable.

Hence, precinct for individual plots were decided based on the technical factors reported by geo-tech investigation, existing scenario and social issues.

The lack of community shopping in the area also needed to be addressed hence, some areas in backside Dhamdara, and central Kabraytar are proposed to be Neighbourhood Node precinct. Those areas fall under the low hazard zone, and are mostly flat areas. Due to the flat nature of the areas, such areas can be provided with mixed land use with various activities which would make the area and its surrounding more vibrant.

Utilities and Green space systems are proposed wherever there are vacant government lands suitable for such precincts. There are no particular criteria for determining the allocation of such precincts, however areas under high hazard zones, and those belonging to private owners cannot be used for such precincts.

5.6.3. FINAL PRECINCT ALLOCATION

Considering the factors mentioned above and from the observations made during site visit, precincts of plots were assessed, and the proposal submitted to Thromde for their review and feedbacks.

The final precinct were based on Thromde's recommendations and feedbacks in addition to the principles mentioned earler. Thromde advised us that there were inaccuracies in topography data (contours) based on which slope was calculated, and the conditions at the site. Keeping in mind these inaccuracies, some plots have been alloted certain precincts which they would not have qualified as per the set slope criteria.

Furthermore, it was also advised not to determine the precinct based on hazard criteria presented in the geo-technical study conducted in 2019 as a large number of plots fall under high-hazard as per the study and alloting those plots in environmenal precincts (especially in E1) would result in many residents losing development rights in their plots. Construction approval was also issued for a number of plots based on the existing precinct. Reverting them back would not just result in public outcry and be legally challenging, but it would also excerbate the extreme housing shortage in the city.

Hence, the final precinct proposal is the combined result of physical criteria mentioned earlier, consultancy's assessment, and Thromde's recommendation considering environmental, social, and economic impacts of the changes.

The following map (see Figure 5.7) shows the overall precinct map of Kabraytar and Dhamdara and Table 5.7 shows the summary of number of plots falling under each of the proposed precinct and their coverage in terms of area.

53 new plots were also created in previously vacant government lands and excess areas, 24 in Dhamdara and 29 in Kabraytar. Furthermore, new subdivisions have created some more plots. Hence, the total number of plots in the proposed plan is 527.

Table 5.8 shows the summary of number of plots and their change of precincts. Map of all the plots with changed precincts are shown in Figure 5.8. The details of the plots and their proposed precincts are shown in Appendix A. Appendix B shows the list of plots with precinct proposed at the draft stage that were changed in the final stage as per Thromde's decision.

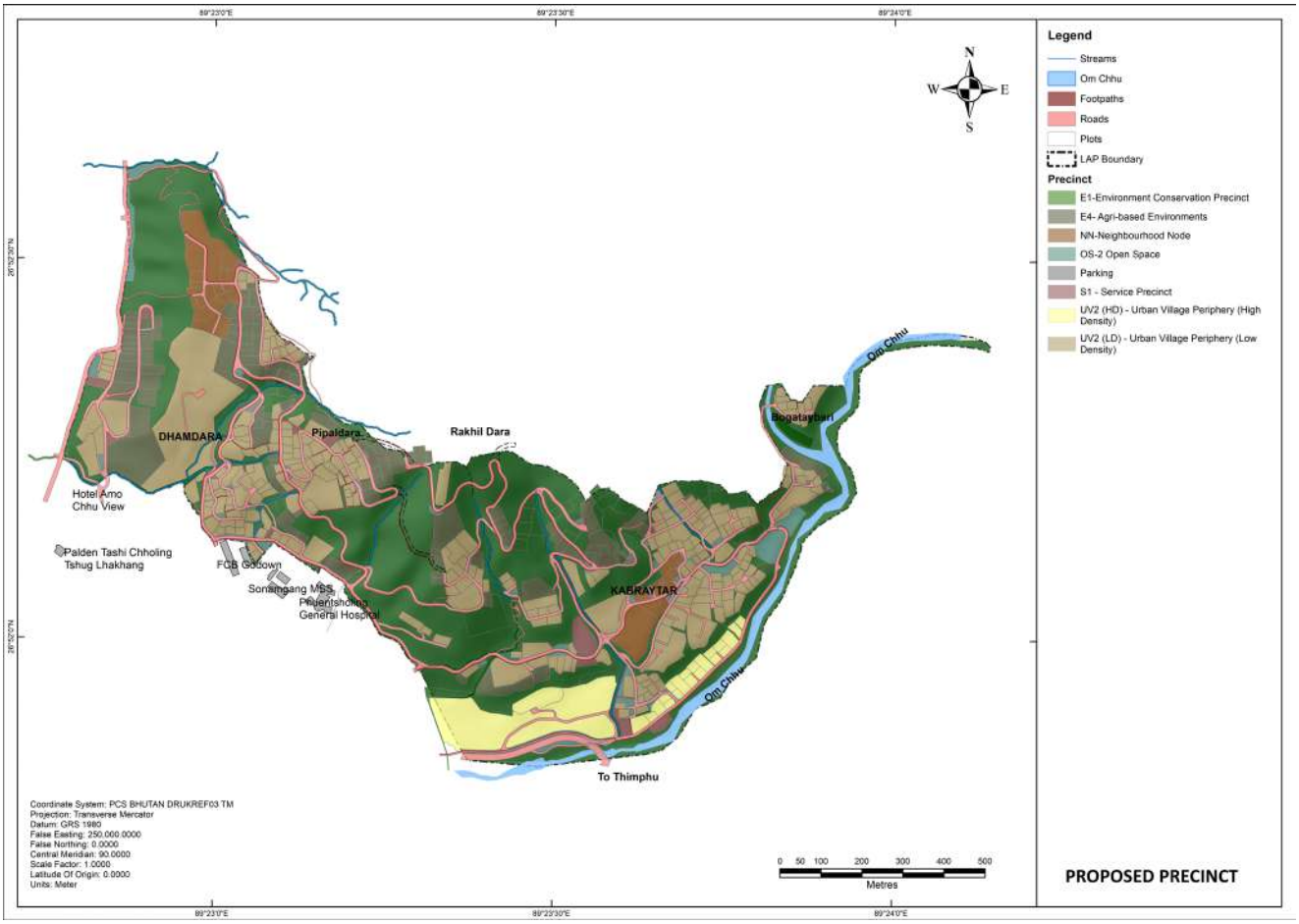


Figure 5.7 Proposed Precinct Map

Table 5.7 Table showing the precincts, total area coverage, and number of plots in proposed precinct plan

Precinct	Dhamdara			Kabraytar			
	Area Sq.m	Area %	No of Plots	Area Sq.m	Area %	No of Plots	Total Plots
E-1 (Plots Only)	11,922	2.11%	11	42,942	8.13%	29	40
E-1 (Vacant govt land)	268,737	47.47%		242,299	45.89%		0
E-4	87,884	15.52%	85	28,241	5.35%	28	113
NN	24,937	4.40%	18	14,924	2.83%	15	33
OS - 2	6,900	1.22%	12	16,093	3.05%	26	38
S-1	4,820	0.85%	12	7,704	1.46%	7	19
UV - 2 (HD)		0.00%		60,390	11.44%	24	24
UV - 2 (LD)	156,315	27.61%	132	109,487	20.74%	128	260
Total (For Plots only)	292,777	51.71%	270	279,781	52.99%	257	527
Parking	2,256	0.40%		2,180	0.41%		
Roads and Footpaths	2,389	0.42%		3,748	0.71%		-
Grand Total	566,159	100.00%		528,008	100.00%		527

Table 5.8 Summary of plots with change of precincts in proposed plan[1]

Changed from	Changed to	Number of plots (Dhamdara)	Number of plots (Kabraytar)	Total
E1-Environment Conservation Precinct	E4 - Agri-based Environments	5 (2 subdivided)	4 (1 Subdivided)	9
	UV2 (LD) - Urban Village Periphery (Low Density)	1	1	2
E4 - Agri-based Environments	E1-Environment Conservation Precinct	1	9 (2 Subdivided)	10
	S1 - Service Precinct	1		1
	UV2 (LD) - Urban Village Periphery (Low Density)	15 (1 Subdivided)	3 (1 Subdivided)	18
UV2 (LD) - Urban Village Periphery (Low Density)	E1-Environment Conservation Precinct	0	2 (2 Subdivided)	2
	E4 - Agri-based Environments	32 (3 Subdivided)	4 (1 Subdivided)	36
	NN - Neighbourhood Node	17	8	25

1 A single plot falling under more than one precinct after the precinct allocation analysis, is divided into two or more parts. Subdivided plot refers to those plots which have been subdivided (only the extra plots created) to accommodate more than one precinct. Refer section 5.6.3.

Changed from	Changed to	Number of plots (Dhamdara)	Number of plots (Kabraytar)	Total
S1 - Service Precinct	OS - 2 Open Space		1	1
Unavailable	UV2 (LD) - Urban Village Periph-ery (Low Density)	4	2	6
	E4 - Agri-based Environments	7 (1 subdivided)	1	8
	E1-Environment Conservation Precinct		2	2
	S1 - Service Precinct		1	1
Unchanged		187 (3 Subdivided)	219 (1 Subdivided)	406
Total		270 (10 subdivided)	257 (8 subdivided)	527 (18 subdivided plots)

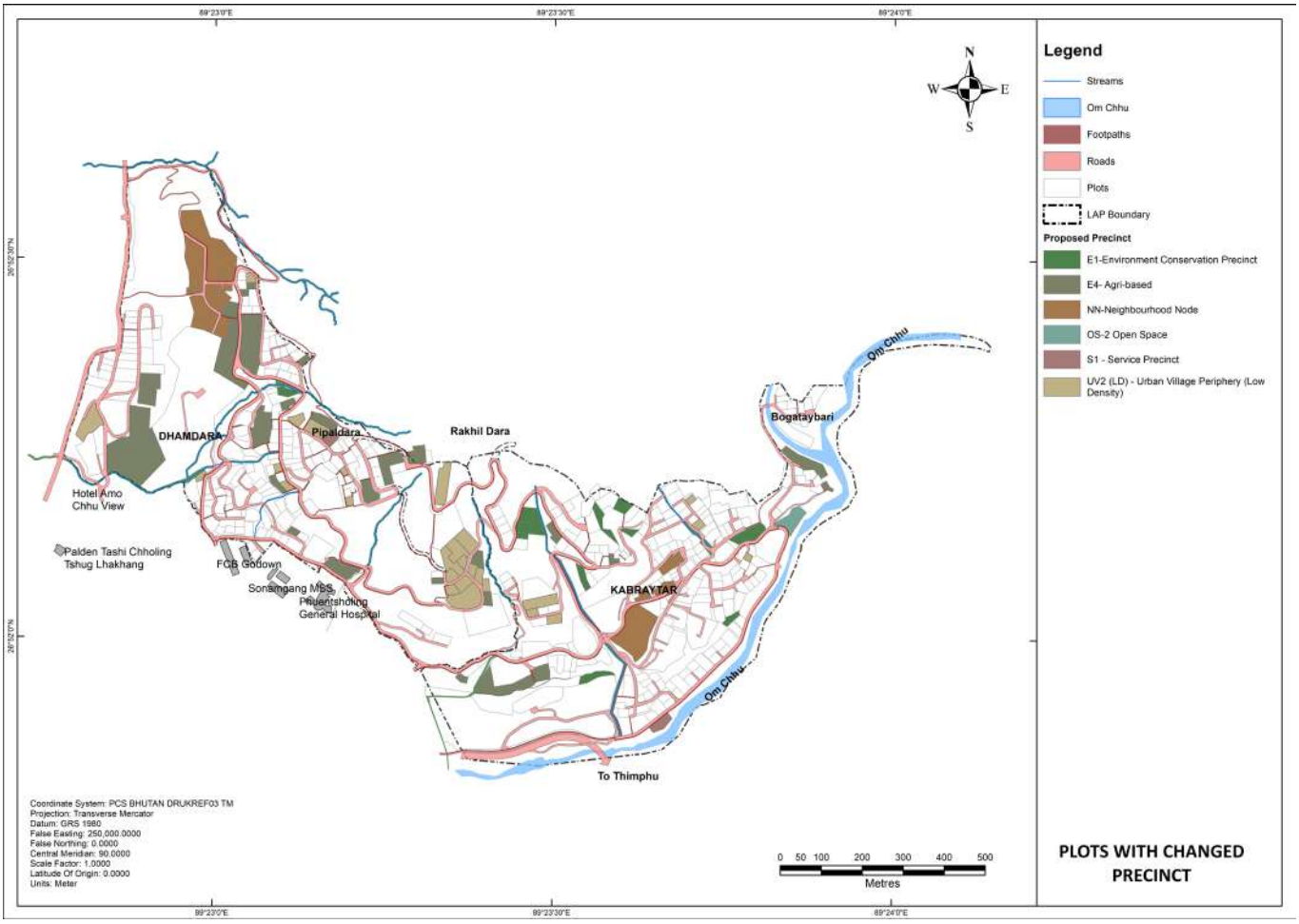


Figure 5.8 Map highlighting the plots with their Proposed Precincts which differs from the existing precinct.

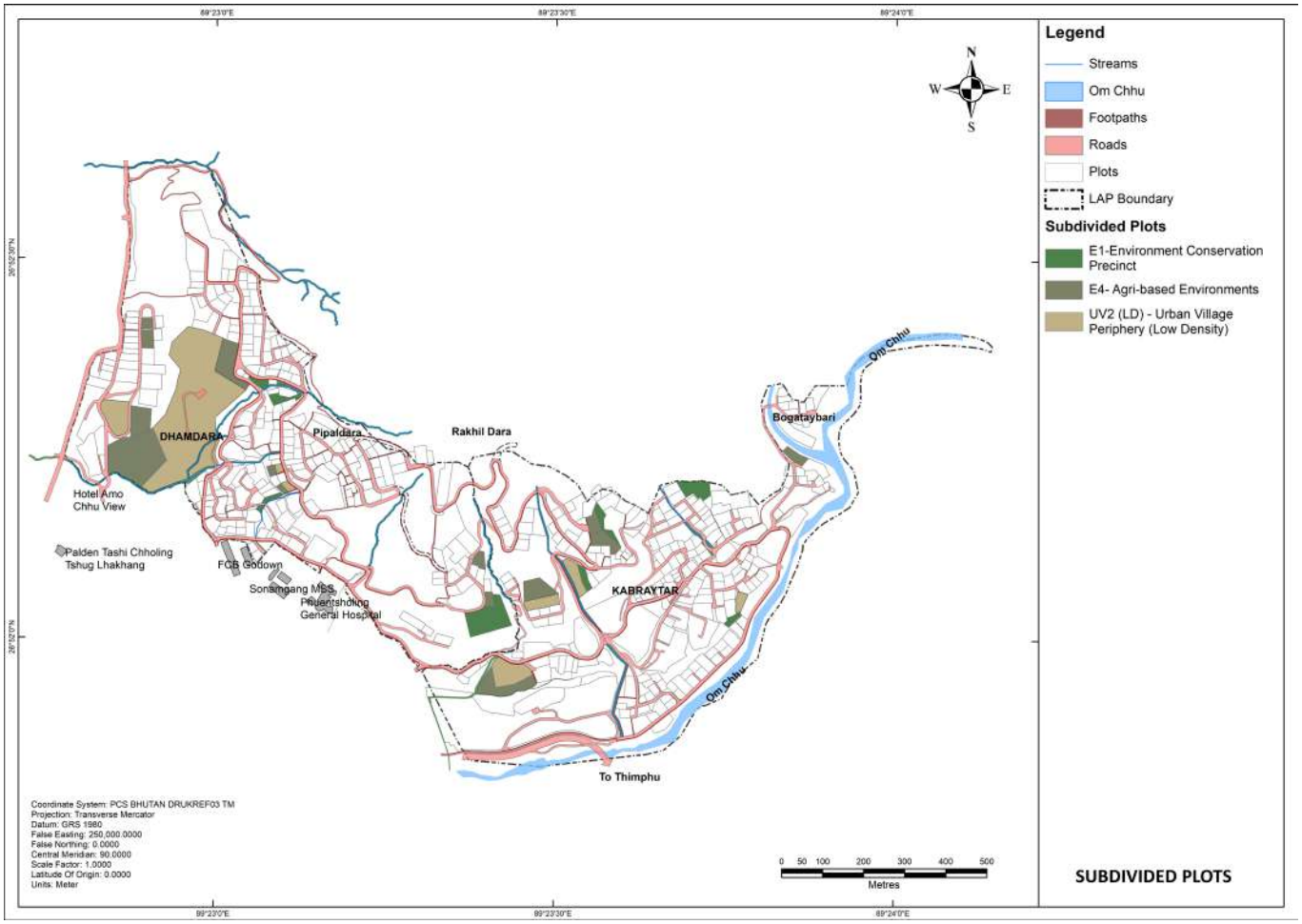


Figure 5.9 Map showing plots where subdivision is proposed

5.6.4. SUBDIVISION OF PLOTS

15 Plots with areas lying in different precinct categories have been subdivided to create new 18 more plots. The subdivision helped in determining a suitable precinct for a plot lying in different precinct categories. In some cases, plots were subdivided to seperate from a road, stream or large drain dividing them. Figure 5.9 shows the map of plots which are subdivided. The list of plots subdivided and their details is provided in Appendix C.

5.6.5. RECONFIGURATION OF PLOTS

Many plots have been reconfigured to some extent for the following reasons:

- For a large number of plots, the existing area on the map and area on record differed, hence reconfiguration involving either increasing or decreasing the area of the map was required to match with the recorded area
- Odd shaped plots were also reconfigured
- To accommodate widened roads and newly proposed footpaths
- Plots falling in buffer zones (stream and landslide buffers)
- To align with proposed road alignment

Plots which were significantly realigned involving shifting to new location are shown in Figure 5.10, Figure 5.11, Figure 5.12 and Figure 5.13.

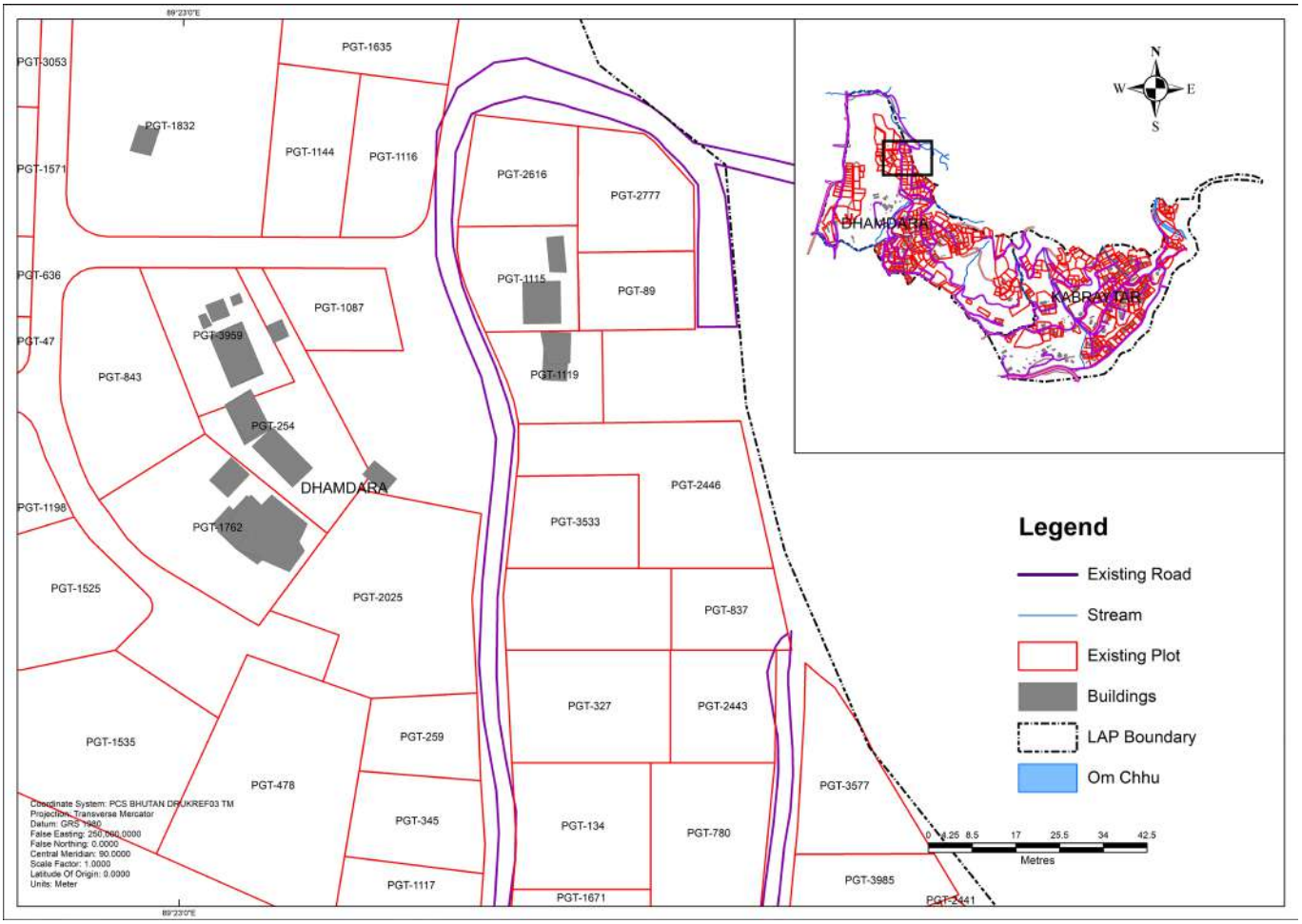


Figure 5.10 Existing Plot configuration in Backside Dhamdara

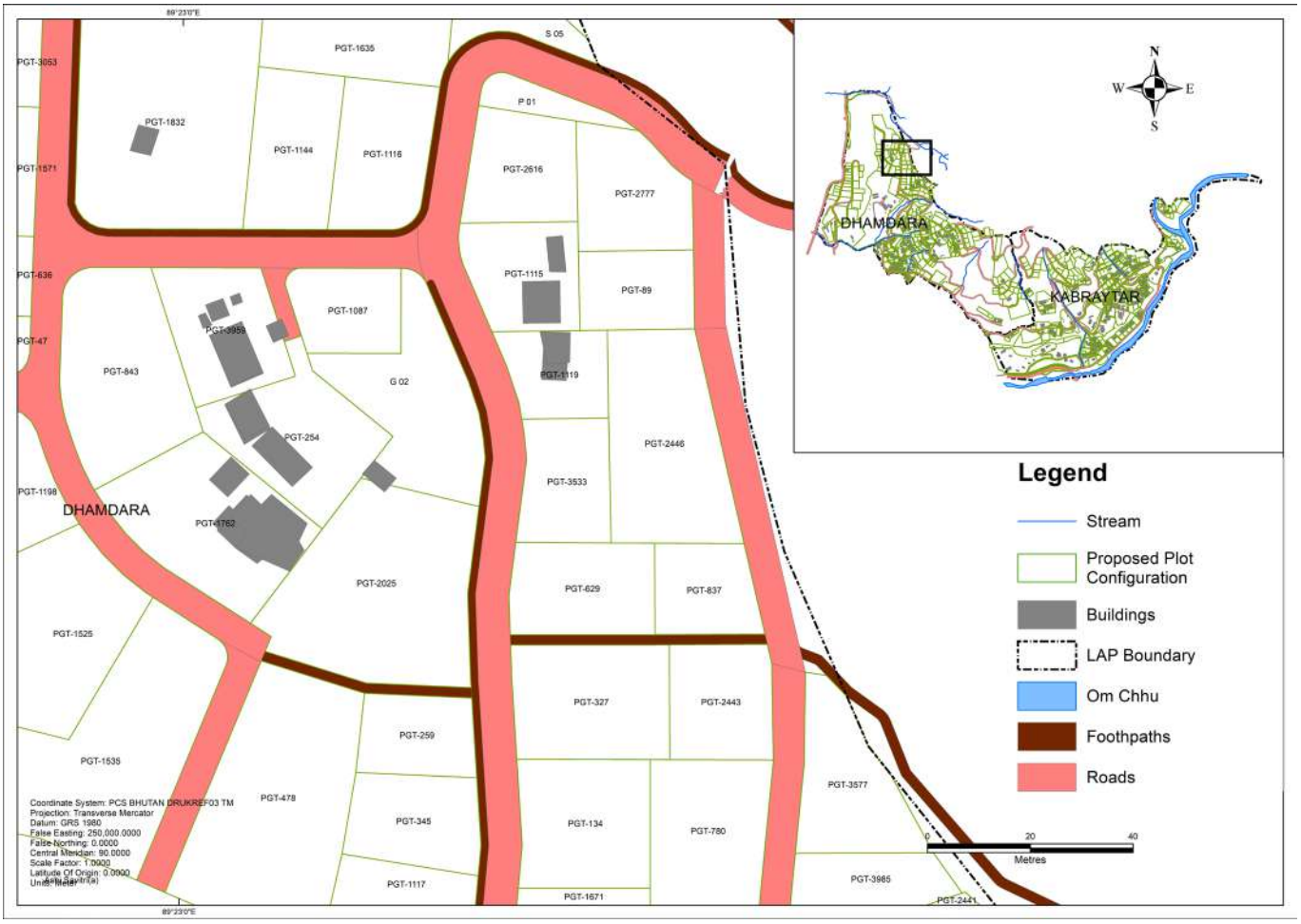


Figure 5.11 Proposed plot configuration in Backside Dhamdara

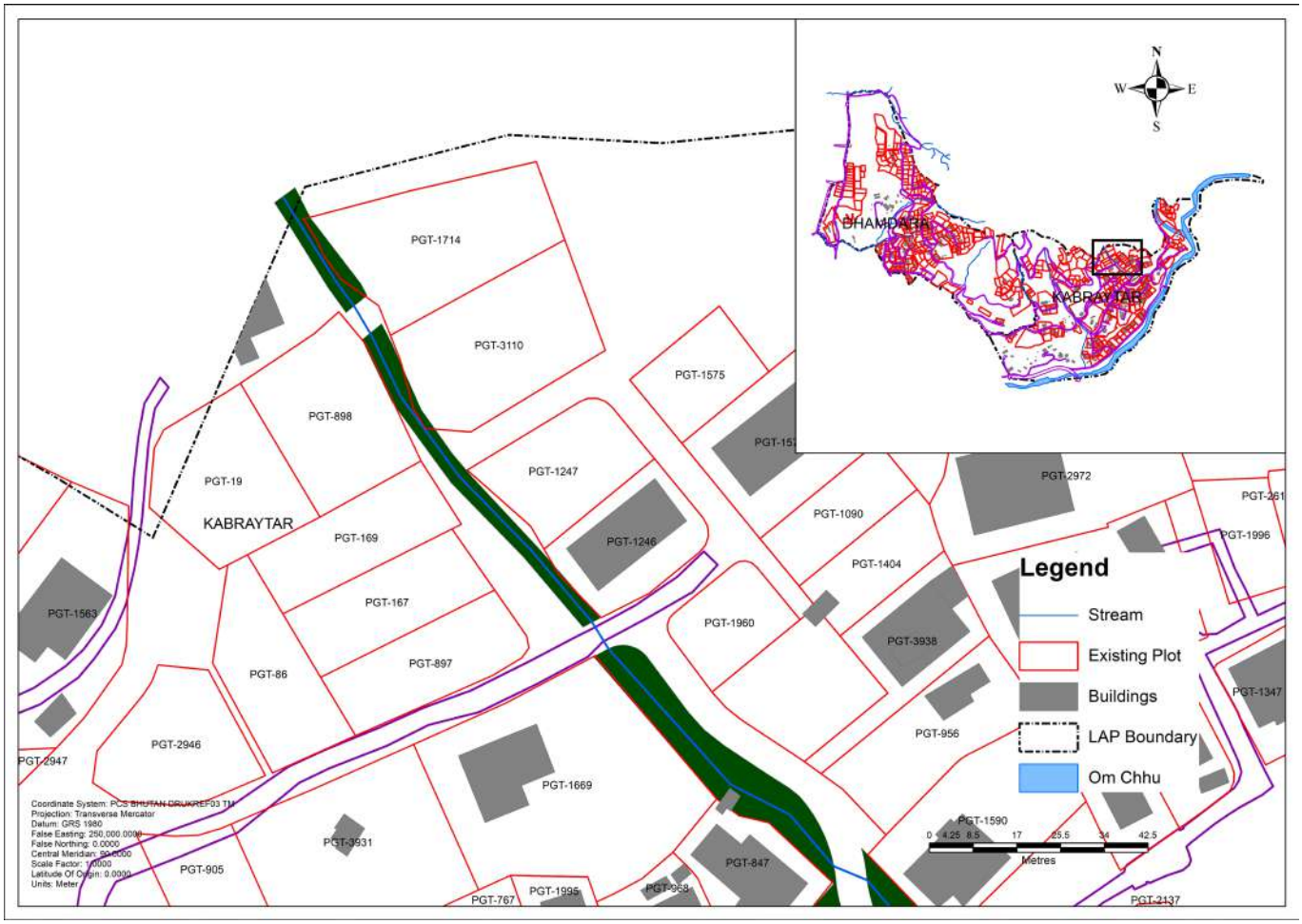


Figure 5.12 Existing plot configuration in Upper Terrace, Kabraytar

Figure 5.13 Proposed plot configuration in Upper Terrace, Kabraytar

5.6.6. RELOCATION OF PLOTS

The following four plots have been entirely relocated in new locations. The topography of the new substitute plots proposed are similar or better than the existing plots so that the affected landowners will agree to the proposal. The relocated plots and their new locations are shown in Figure 5.14, Figure 5.15, Figure 5.16, and Figure 5.17.

- PGT-2966: This plot has been re-located because the new proposed road goes right through it.
- PGT-1010: It is a lone plot without road access. The new proposed location is near other plots with road connection and better terrain.
- PGT-897: Plots in the area were affected as a result of reconfiguration for new road as the previously planned road was not feasible. One of the plots in these area had to be relocated and hence Thromde suggested to relocate this plot.
- PGT-922(b): Plot PGT-922 has been subdivided into two plots and this part is relocated.

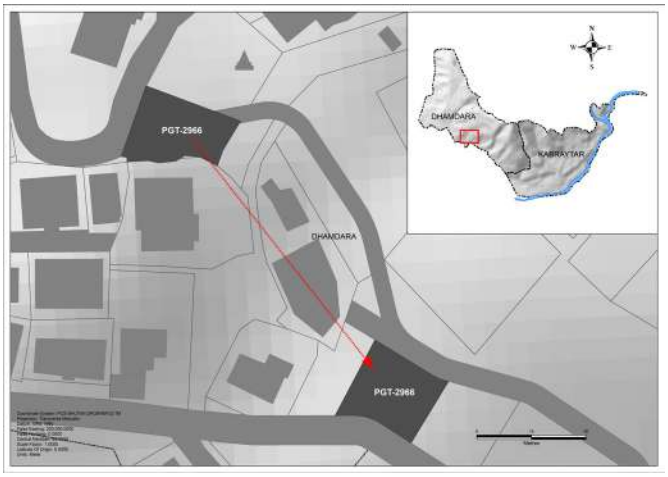


Figure 5.14 Relocation of plots PGT-2966

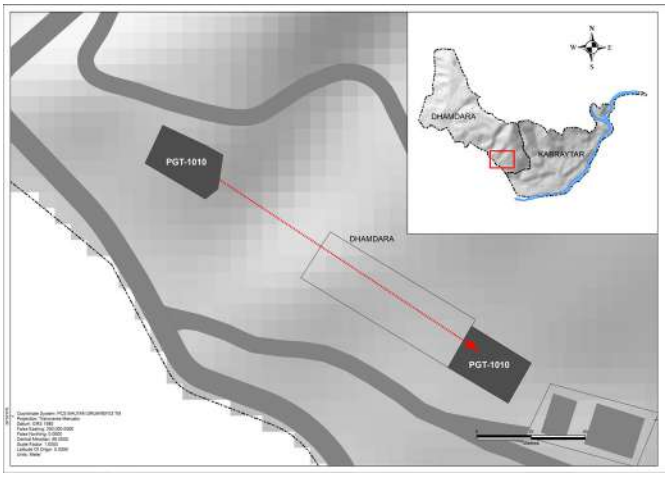


Figure 5.15 Relocation of Plot PGT-1010

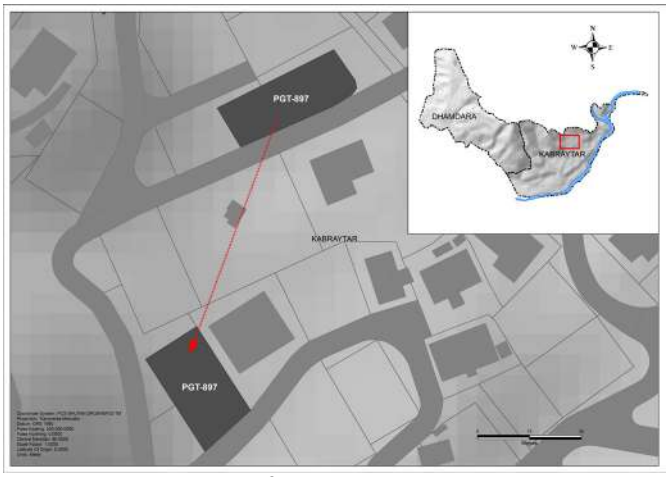


Figure 5.16 Relocation of Plot PGT-897

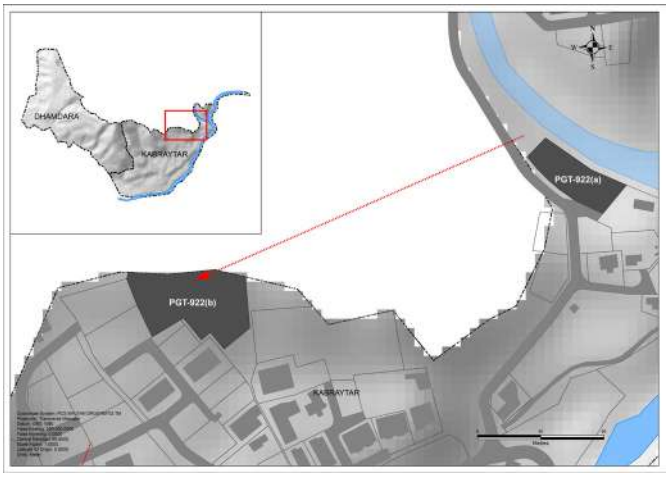


Figure 5.17 Relocation of Plot PGT-922(b)

5.6.7. NEED FOR NEIGHBOURHOOD NODE PRECINCTS IN THE LAPS

The purpose behind the establishment of neighborhood node (NN) and defining their composition as a conglomeration of these essential amenities is to create activity nodes in each urban village. Neighborhood Nodes would have amenities and facilities for the Urban Village it belongs to. Apart from such amenities, the nodes would be business centers with office space, banking facilities and other ancillary facilities.

PSP 2013-2028 states,

"Each Urban Village would have a node, which would be like a traditional village center. It would have a small park with toddlers play area. It would have a taxi kiosk, with a newsstand, a clinic, provisions shop, barber, neighborhood pub, bakery, cybercafé, laundry and other convenience shops. This would be a vibrant node where mothers can take some time off during the day and walk down to meet friends and do a little shopping"

Kabraytar and Dhamdara are urban villages with boundary defined by natural settings, concentration of population, environmental assets and geographical features. Urban Villages form the basic planning unit of the town, with each focusing on a Neighborhood Node/ Commercial.

The proposed NN in Kabraytar is as per the PSP 2013 – 2028. The location for a NN in Dhamdara is also mentioned in the Local Area Plan prepared in 2016. The strategic locations of NN in Urban Villages also serves the purposes of creating walkable neighbourhoods where people can just walk to convenient shopping without having to depend on automobiles, creates attractive communities with mixed of land uses which are the smart growth principles on which PSP 2013 – 2028 is based. Moreover, the identified sites for NN in Dhamdara and Kabraytar were relatively flat and accessible by proposed public bus route.

The proposed NN precinct is also related directly to the vision of PSP, "to create Phuentsholing as a socially and culturally vibrant city with the emphasis on sustainable business and tourism by applying smart growth principles". Making Dhamadra into a tourist hotspot by developing view spots is also specifically mentioned in PSP. Since there was no other relevant precinct for creating places attractive to tourists in PSP, NN was proposed especially in Backside Dhamdara where tourist standard viewpoints, restaurants, and cafes can be permitted.

In the light of recent COVID-19 situation which led the Government to establish self-containing zones having basic amenities, NN proved very effective and crucial.

TRANSPORTATION - CIRCULATION, MOBILITY AND INFRASTRUCTURE

6. TRANSPORTATION – CIRCULATION, MOBILITY AND INFRASTRUCTURE

6.1. EXISTING CIRCULATION

6.1.1. VEHICULAR CIRCULATION

Road Infrastructure

Figure 6.1 shows the existing roads in the area. Roads are too narrow with hardly any space for two vehicles. The road condition in Dhamdara is even worse. Some roads are under construction. Access roads are without retaining wall some of which are washed away posing grave risk to the residents around. Some of the roads can accommodate only one vehicle at a time and there is no space for extension. At many locations, vehicles have to reverse to give way to vehicle coming from the opposite direction. There is no proper road hierarchy and a single stretch of road often has differing widths and infrastructure.

Most black top roads have a roadside drain on one side. The drains are, however, not big enough to convey all the storm water during monsoon and this often leads to water flowing over the roads, flooding them. Most of the black topped roads have street lights except for road DD3 (Water Kingdom road in Dhamdara). Figure 6.2 shows the street light coverage in the area. Table 6.1 and Table 6.2 show the detailed existing scenario of Dhamdara and Kabraytar Roads respectively.

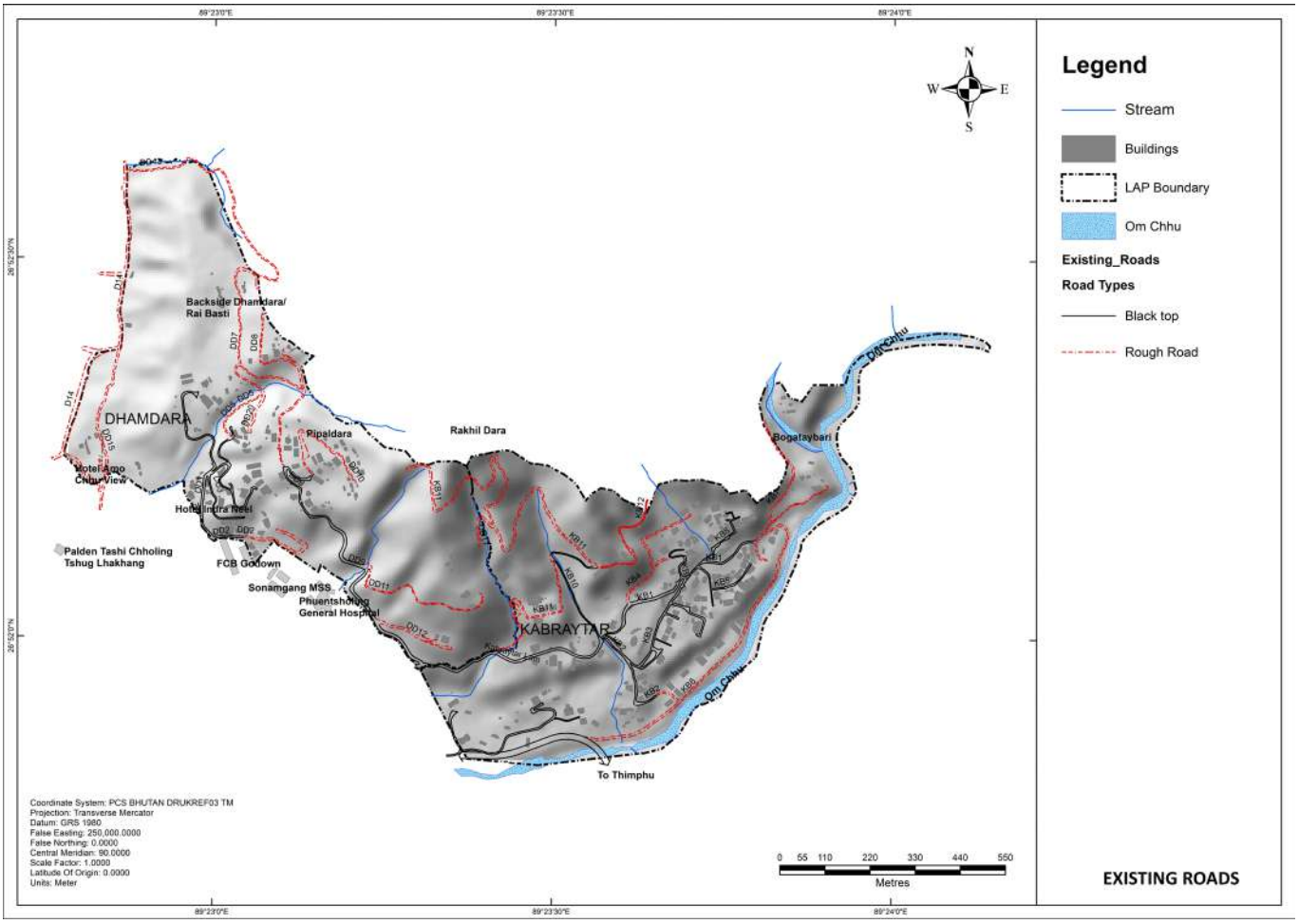


Figure 6.1 Existing Roads in Dhamdara and Kabraytar

Table 6.1 Existing Roads Scenario in Dhamdara

Road Name	Condition	Street Light	Roadside drain	Carriage-way Width (m)	Gradient	Remarks
DD1 (Main road going to Dham-dara)	Black top	Yes	One side	4	Gentle	Space for footpath on one side
DD2 (Upper Part)	Rough	-	-	-	Gentle	Under construction
DD2 (Lower Part)	Black top	No	One side	3.5	Gentle	
DD3 (Water King-dom Road)	Black top	No	One side	3.2	Gentle	Building construction below has dam-aged some portion of road where a temporary metallic brigde is placed. It is unsafe and risky.
DD4 (Nisha Nurs-ery Road)	Black top	Yes	One side	3.2	Steep	Long stretch of very narrow road. Buildings haven't maintained setbacks.
DD5 (Upper Part) Above Ashi's Prop-erty	Under construc-tion	-	-	-	Gentle	
DD5 (Lower Part)	Black top	No	No	3	Steep	This road would form a secondary route when it gets connected with DD5 (upper part). Needs widening.
DD20	Rough	-	-	-	Gentle	Excavation is deep posing landslide risk toadjoining plots.
DD7	Rough	-	-	-	Gentle	Under construction
DD8	Rough	-	-	-	Gentle	Under construction
DD9 (Upper Part)	Black top	Yes	One side	4	Steep	Too narrow for a secondary road. Hardly any space for expansion.
DD9 (Lower Part)	Black top	Yes	One side	7	Gentle	Wide enough.
DD10 (Upper Part)	Rough	-	-	-	Steep	A portion of it has been washed away posing risk to residents below.
DD10 (Lower part)	Black top	Yes	One side	3	Gentle	
DD11	Rough	No	One side	5	Gentle	
D12	Rough	-	-	-	-	
D13	Rough (Concrete in Some portion)	No	-	3	Varying gradients (gentle -very steep)	Lies outside Thromde boundary. Constructed privately but forms the direct connecting route from Back-side Dhamdara to Ammo Chhu Lap. This is strategically important.
DD15	Rough	-	-	-	Gentle	Some portion washed away No connected to DD14.

Table 6.2 Existing Roads Scenario in Kabraytar

Road Name	Condition	Street Light	Roadside drain	Carriageway Width (m)	Gradient	Remarks
Kabraytar Lam	Black top	Yes	Missing in some portions	7	Gentle	
KB1	Black top	No	One side	3.5	Gentle	
KB2 (Lower Part)	Rough	No	No drain	3.5	Steep	Drain water flowing on road
KB2 (Upper Part)	Black top	Yes	One side	3.5	Gentle	Footpath on one side
KB3	Black top	Yes	One side	3.5	Gentle	Very narrow with no space for expansion
KB4	Rough	No			Gentle	
KB5	Black top	Yes	No	<3	Gentle	Built above storm water drain. Very narrow with no space for expansion. No proper building setbacks.
KB6	Rough	No	No	5	Flat	Along the bank of Om chhu. There is steep edge towards OM chhu with no barricades.
KB7	Rough	No	No		Gentle	
KB8	Black top	No	No proper drains	<3	Gentle	
KB9	Black top	No	-	-	Steep	
KB10	Black top	Yes	Both sides	5	Gentle	
KB11	Under construction	-	-	-	-	
KB12	-	-	-	-		
KB13	Rough	No	No	3	Gentle	

Junctions/Intersections

Junctions lack proper signage and markings and they don't have roundabouts. Some intersections have more than four roads merging which are placed awkwardly and can be prone to accidents. Figure 6.3 shows all the junctions in the area. There are a total of 27 junctions.

Parking Facilities

Except for the private parking facilities in private plots, there is no public parking facilities for buses or taxis. Some of the vacant lands are being used for parking. The narrow roads make it impossible for roadside parking.

Road Connectivity

As shown in Figure 6.1 many roads lead to dead ends with only one entry/exit and lack an effective traffic connectivity and permeability.

6.1.2. PEDESTRIAN CIRCULATION

On-street footpath is non-existent in the entire Dhamdara and Kabraytar area and there is no space for the provision for on-street footpath. Some access pathways have been developed by private individuals. Existing pathways are underdeveloped, lack proper connectivity, are unsafe and are not disable friendly. Pedestrians walk on the roads which are already narrow posing grave safety risks. There aren't any pedestrian crossings.

6.1.3. BUS STOPS AND TAXI STANDS

There is no public transportation in the area except for taxi service. There are no designated taxi parking spaces.

Lack of public transport and proper footpath encourage car ownership choking roads which are narrow already. Taxi service is expensive and the socio-economically disadvantaged who don't own a car are affected the most because they have to avail taxi for commuting to

work and getting access to market or other amenities which are mostly located in the core area.

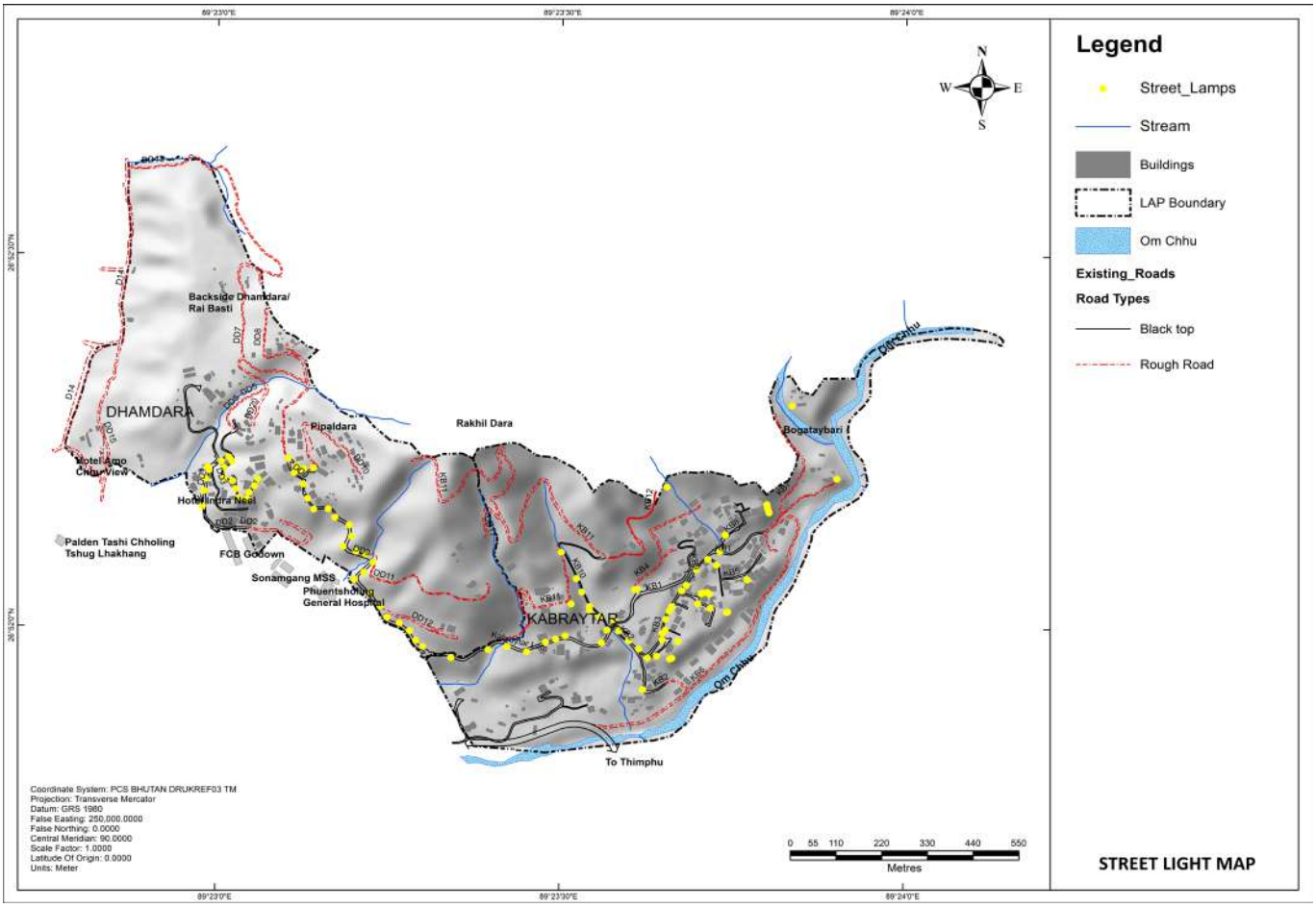


Figure 6.2 Street Lights

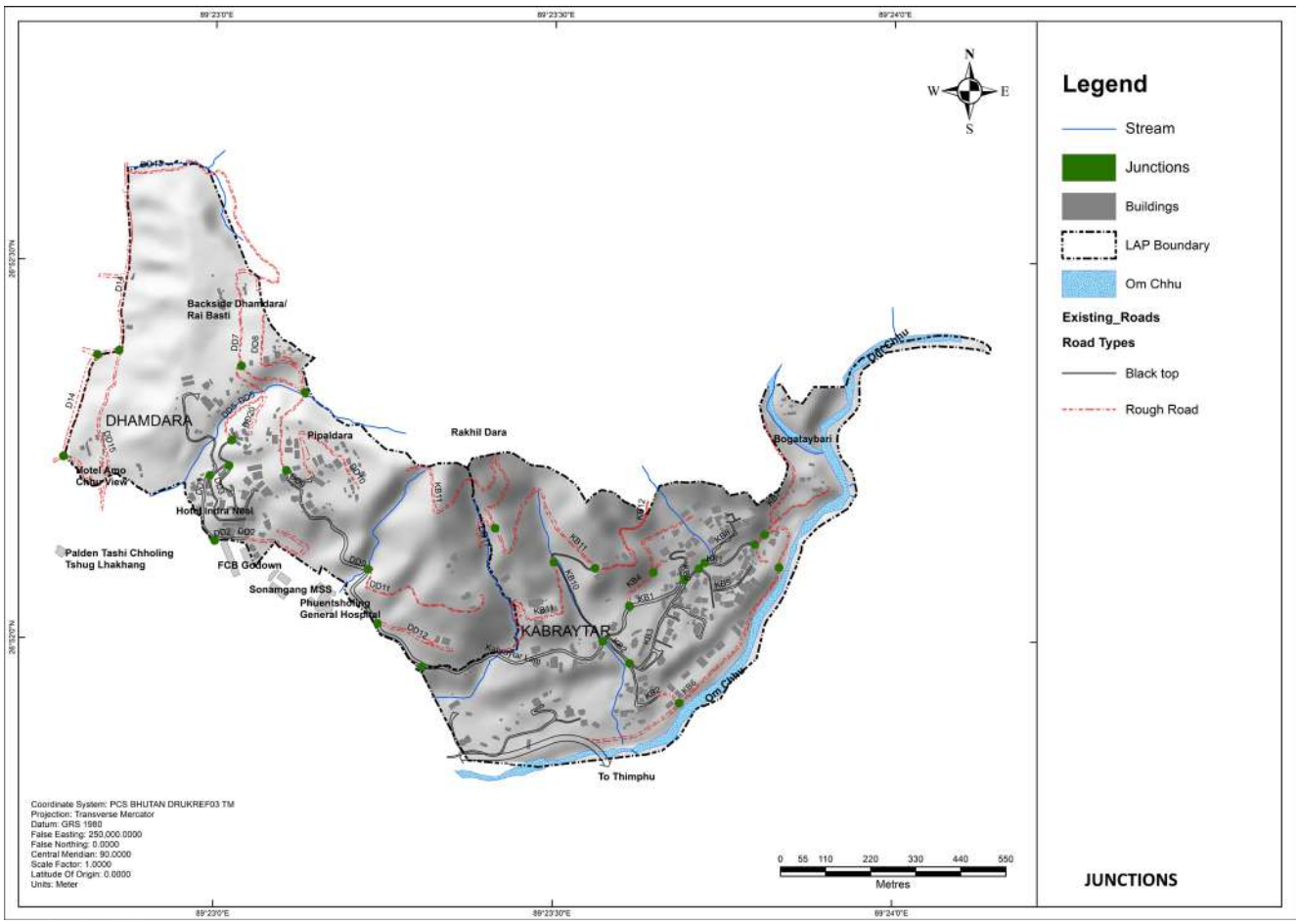


Figure 6.3 Junctions

6.2. PRINCIPLES

The following smart growth principles directly relate to the transportation and mobility.

i. Walkable Neighbourhood- Second smart growth principle of PSP

As mentioned earlier, walkable communities enhance mobility, reduce environmental impacts, strengthen economies, foster stronger communities through improved social interaction. Walkable communities have walkable access to services which is very beneficial especially to the young, poor and the old groups.

ii. Provide a variety of transportation options – Seventh smart growth principle of PSP.

Providing people with more choices in transportation is a key aim of smart growth. With rapid urbanization and increased distances, communities are increasingly seeking for a wider range of transportation options that are time and cost efficient. This would also mean coordination between land use and public transportation as transit services would require supportive Land-use in order to be most cost effective. The provision of parking lots at convenient locations is also important as that will influence an individual's choice to drive, walk or take public transport. There should be an integrated transport system comprising walkways, cycle paths, bus lanes and automobile channels. The modal split nodes between these become the public domains around which cluster high density, mixed- use urban villages. The city will grow in an ad-hoc manner unless the transport network is carefully conceptualized. Modes of transport such as air, bus, truck, taxi, automobile, cycle and pedestrian must all be integrated. Advocating a transit-oriented development is a goal of the plan.

iii. Safe and Efficient Transportation

Traffic safety and efficiency is the most important factor to be considered while planning and designing transportation infrastructure. Traffic safety and efficiency comprise of proper categorization of roads, design of roads and intersections, footpaths and pedestrian crossings, traffic signs and signals. Meeting the proper standards are crucial in creating a safe traffic environment which efficiently conveys traffic flow.

6.3. STRATEGIES

The following strategies would be adapted to achieve efficient transportation and mobility in the area.

i. Provide Road Accessibility

Road accessibility to all the plots would be ideal. However, if access road is non-feasible or risky due to topography, a proper footpath from the nearest road is recommended. Provision for parking bays for inaccessible plots in the nearest road is required.

ii. Classify Road Hierarchy

Roads need to be classified into clear road hierarchy. 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. These objectives and design criteria are aimed at achieving an efficient road system whereby conflicts between the roadway and the adjacent land use are minimized and the appropriate level of interaction between the roadway and land use is permitted.

The key objective of a road hierarchy is to ensure the orderly grouping of roadways in a framework around which state and local governments can plan and implement various construction, maintenance, and management schemes and projects. It should also assist local and national governments with the adoption of appropriate standards for roadway construction.

A well-formed road hierarchy will reduce 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;
- preserving areas where through traffic is discouraged;
- ensuring activities most closely related to frontage development, including social interaction and parking, can be given more space within precincts where environmental and access functions should predominate.

The road hierarchy principles will assist planning agencies with:

- orderly planning of heavy vehicle and dangerous goods routes;
- planning and provision of public transport routes;
- planning and provision of pedestrian and bicycle routes;
- identifying the effects of development decisions in and on surrounding areas and roadways within the hierarchy;
- development design that facilitates urban design principles such as accessibility, connectivity, efficiency, amenity and safety;
- assigning control over access onto traffic carrying roads to ensure safe and efficient operation for traffic;
- identifying treatments such as barriers, buffers and landscaping to preserve amenity for adjacent land uses.

Urban Roads Standards 2002 (URS) and Spatial Planning Standards 2017(SPS) classify urban roads into following categories:

A. Primary Roads: These roads form the primary road network for the town as a whole. All long-distance traffic movements through to, from and within the town should be channeled onto these roads. They form a fully connected network and they only connect with other primary and secondary roads.

B. Secondary Roads: These roads form link between tertiary and primary roads. They collect traffic within the different zones in a town.

C. Tertiary Roads (missing from URS): These roads link with secondary roads to give direct access to buildings and land at neighborhood lev- el. They connect only to tertiary, secondary and access roads.

D. Access Roads: These roads lead to specific locations or amenities.

Road category should also be based on the geological and topographical conditions, environmental and aesthetic features, existing built environment and pattern of settlement, and traffic safety.

According to the definition of different categories of roads mentioned above, Dhamdara and Kabraytar have secondary tertiary and access roads. One Primary road section of Thimphu-Phuentsholing by-pass which is along the Om Chhu and another in Ammo chhu LAP seperating Dhamdara LAP.

Table 6.3 gives the details of width requirements for different road elements.

iii. Improve Road Network Connectivity

Connectivity (or permeability) refers to the directness of links and the density of connections in a transport network. A highly permeable network has many short links, numerous intersections, and minimal dead- ends. As connectivity increases, travel distances decrease and route options increase, allowing more direct travel between destinations, creating a more accessible and resilient transportation system.

Connectivity affects the degree to which transportation networks such as streets, walking and cycling paths, connect people to their destinations (including intermediate destinations such as public transport services). Good connectivity provides easy access to key destinations for pedestrians and seeks to discourage car use by making local trips easier and more pleasant by foot than by car.

Table 6.3 Width requirements for different road elements

Road Classification	RoW	Carriageway	Footpath, Drain, shoulder & median	Max. no. of lanes	Minimum widths
Primary	Min: 15 m	12 m	3 m	4	Footpath: 1.2m Drain: 0.3m Shoulder: 0.5m Median: 0.25m
	Ideal: 18 m	13.2 m	4.8 m	4	
Secondary	Min: 10 m	6 m	4 m	2	
	Ideal: 12 m	6.6 m	5.4 m	2	
Tertiary	Min: 6.2 m	3.5 m	2.8 m	1	
	Ideal: 10 m	6 m	4 m	2	
Access	Min: 6 m	3.5 m	2.5 m	1	
	Ideal: 8 m	3.5 m	4.5 m	1	

Road network connectivity helps reduce the volume of traffic and traffic delays on major streets (arterials and major collectors), and ultimately improves livability in communities. Bicycle and pedestrian travel are also enhanced when the number of street connections or local intersections in communities is increased. An ideal well-connected street network is the traditional grid pattern which, is not possible in Kabraytar and Dhamdara due to the topography.

Street network connectivity can be achieved by providing connections within individual developments, between developments, and by having a well-planned collector road network to compliment the arterial network. Characteristics of street network connectivity is short block lengths, numerous three and four-way intersections, and minimal dead-ends (cul-de-sacs)

Efforts will be made to improve the road network connectivity in the area by identifying provision for new linkages.

iv. Improve Intersection/Junction

Junction improvement is another key strategy to achieve safe and efficient transportation in the area. The basic purpose of a junction is to facilitate the transfer of traffic streams from one road to another in a safe and efficient manner. Junctions are one of the critical elements in road network, as they are major sources of detrimental impact such as accidents, congestion and delay, extra fuel consumption, air pollution and noise. The design standards are therefore aimed to minimize these impacts.

v. Design Considerations

The layout and design should meet the following requirements:

- ease of movement, not equating to higher speed but rather smoother, slower and safer speed;
- have the shortest vehicular path;
- have good visibility on entering a junction. To achieve this, traffic islands, control devices, traffic signs and road markings must be all considered; and
- should be large enough to enable the users to identify conflicting traffic movement.

Types of Junctions

Figure 6.4 shows different types of junctions.

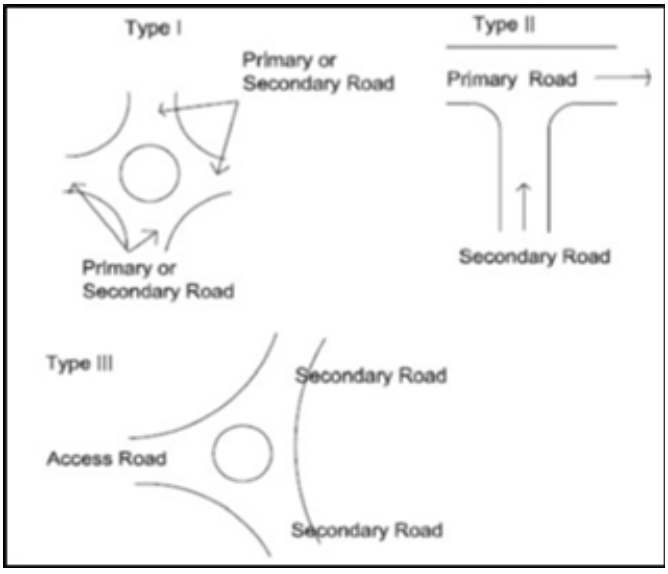


Figure 6.4 Types of Junctions (URS,2002)

Junction Spacing

The frequency and precise locations to be provided along a new road will depend upon its level in the road hierarchy and the nature and presence of intersecting roads. Table 6.4 indicates desirable and minimum spacing for the junctions.

Table 6.4 Minimum spacing for junctions

Road classification	Junction spacing in metres (Desirable minimum)	Junction spacing in metres (absolute minimum)
Primary Road	200	60
Secondary Road	150	40
Tertiary	100	25

To meet these requirements, the radius of the junction corner should have the minimum circular radius of 6 m

Roundabouts

A roundabout junction operates as a one-way circulatory system around a central island, where entry is controlled by “Give Way” markings and priority must be given to the traffic approaching from right.

Two types of round about and their details are provided in Table 6.5.

Table 6.5 Types of Roundabouts

Types	Description	Typical use/ Location
Conventional (see Figure 6.5)	Kerbed central island with diameter greater than or equal to 4m. Flared approached to allow multiple entry lanes.	New developments and constructions. Junctions within or at the end of dual carriageways. To change direction of a new road at a junction.
Mini (see Figure 6.6)	Flushed or slightly raised central island less than 4m in diameter. Road markings indicate patterns of movement. No street furniture on central island in order to allow long vehicles to overrun.	To improve the performance of existing junctions where space is severely constrained. Mainly as conversions from other roundabout and junction types. At sites subject to maximum speed limit of 50 km/h.

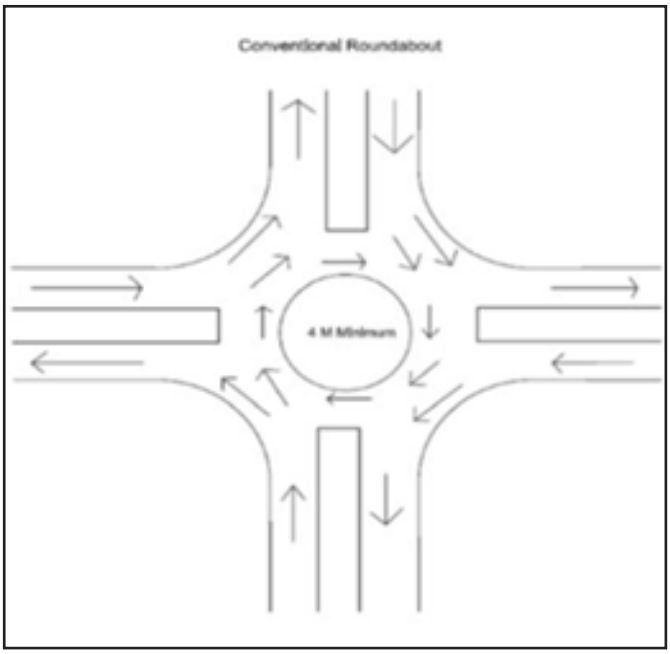


Figure 6.5 Conventional Roundabout (URS, 2002)

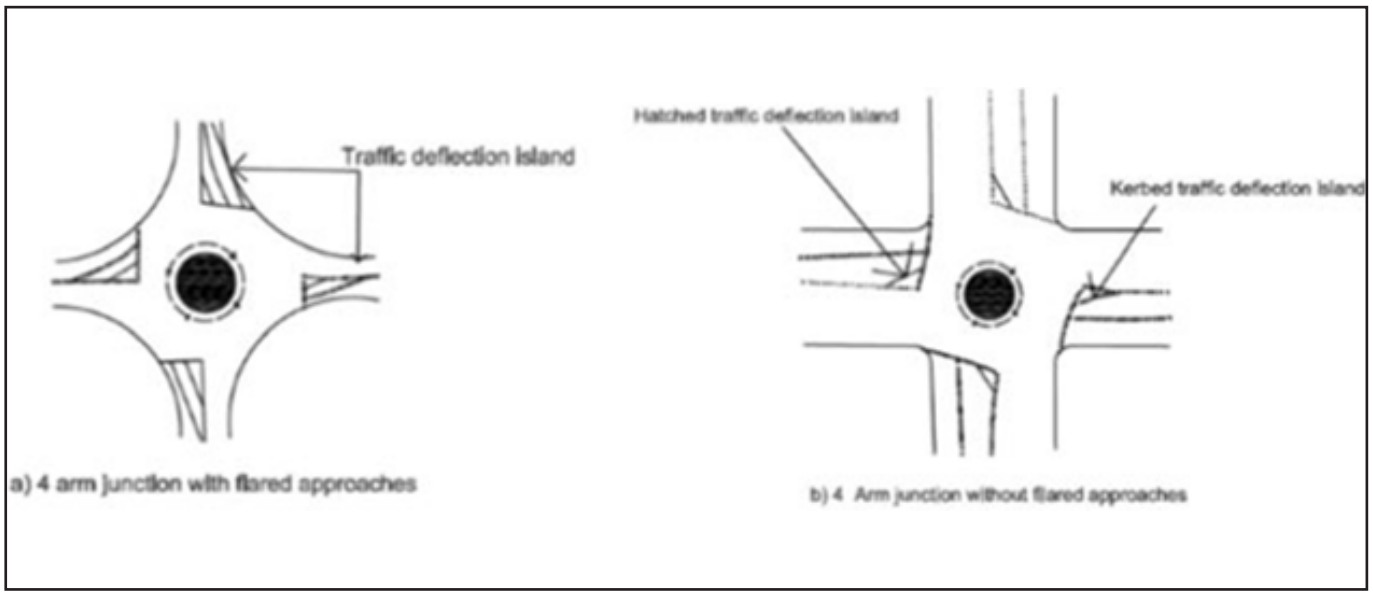


Figure 6.6 Mini Roundabout (URS, 2002)

vi. Develop a well -connected On-street and off-street footpath and Bike trail network

The provision of footpaths and bike trails is the main component of walkability. As mentioned earlier, good walkability enhances community vitality, benefits socio-economically disadvantaged groups, creates healthy walking habits and reduces the detrimental environmental impacts.

Pedestrian paths and cycling lanes should be planned as independent networks, integrated to the road system. They should create an alternative, safe and attractive way of moving into a settlement. On-street footpath of at least 1.2 m width on both sides of secondary road (URS, 2002) and one side of tertiary road (SPS, 2017) with gradient below 15% is required. Footpaths should also be designed in differently abled friendly manner to cater the needs of all groups.

Connectivity of on-street footpaths can be achieved if the roads are well connected. Even if the road connectivity is not feasible, footpath connectivity can be achieved through construction of off-street footpaths and stairs. Proper footpaths also serve as

recreational areas where people go for jogging and trekking.

vii. Create Pedestrian Crossings

Provision of pedestrian crossings in strategic locations is vital to encourage pedestrian mobility and to ensure pedestrian safety.

viii. Improve Street Light Coverage

Street lights on all the urban streets and off-road footpaths is required. Lighting of a road can be ensured by means of overhead fixtures of sufficient height. In pedestrian spaces, lower street lamps or outdoor luminaries may be considered. On footpaths and cycle tracks, the lamp post should be placed at least 0.45 m from the other edge of the adjoining pedestrian walkway. Table 6.6 presents the minimum luminance requirements for public lighting.

ix. Identify a public bus route and locations for bus stops

Use of public transportation as a mode of transport is socially, economically and environmentally sustainable. Options for a public bus loop-route and bus stop locations in Dhamdara and Kabraytar would be explored. Area for taxi stand also needs to be identified. Secondary road would be used public transport route.

SPS 2017 recommends the following public facilities for transport shown in Table 6.7.

Table 6.6 Luminance requirements for different types of roads

Type of road	Minimum Luminance (Lux)
Primary Road	15
Secondary Road	10
Tertiary Road	8
Footpath/ pedestrian space	20 – 50
Car parking	10 – 30

Table 6.7 Area requirements for public transport facilities

Facility	Area	Recommended Location
Bus terminal/ multi-mode terminal	From 500 sq. m up to 20,000 sq. m to be determined based on the size of the settlement	Away from main heritage sites and commercial area. Close to centre of town (preferably at the entrance of the town) Connected to the pedestrian network.
Taxi stand	250 sq. m to accommodate about 10 taxis (neighbourhood centre)	Close to bus terminal, heritage sites and commercial areas. Separate parking bays are recommended on busy roads for taxi and buses

6.4. ANALYSIS

6.4.1. ROADS

There is a total of about 14 kilometers of road of which 60 percent is under construction rough roads and rest are black top roads (see Table 6.8). Existing black top and rough roads are mapped in Figure 6.7. Most of the narrow roads are black topped roads which are in already built-up area.

Table 6.8 Road composition in Dhamdara and Kabraytar

Road type	Length (m)	Percentage
Rough Road	8,451.62	60.5
Black top Road	5,517.24	39.5
Total Length	13,968.86	100

6.4.2. ROAD CLASSIFICATION

Road classification for Dhamdara and Kabraytar has not been mentioned in PSP. Except for few major roads in the Thromde, PSP has not clearly classified much of the other roads in the Thromde. Dhamdara and Kabraytar being two of the nearest to core and densely populated Local Areas in the Thromde it is important to categorize roads for purposes mentioned earlier.

As per the definition of different categories of roads (URS, 2002; SPS, 2017) the Dhamdara and Kabraytar roads can be classified as shown in Table 6.9 and Table 6.10 respectively. The tables also show the minimum RoW and carriageway as per the urban roads standards and that of planned roads[4] (roads that are in the existing LAP) . Figure 6.8 shows the planned road and Figure 6.9 shows the existing road hierarchy.

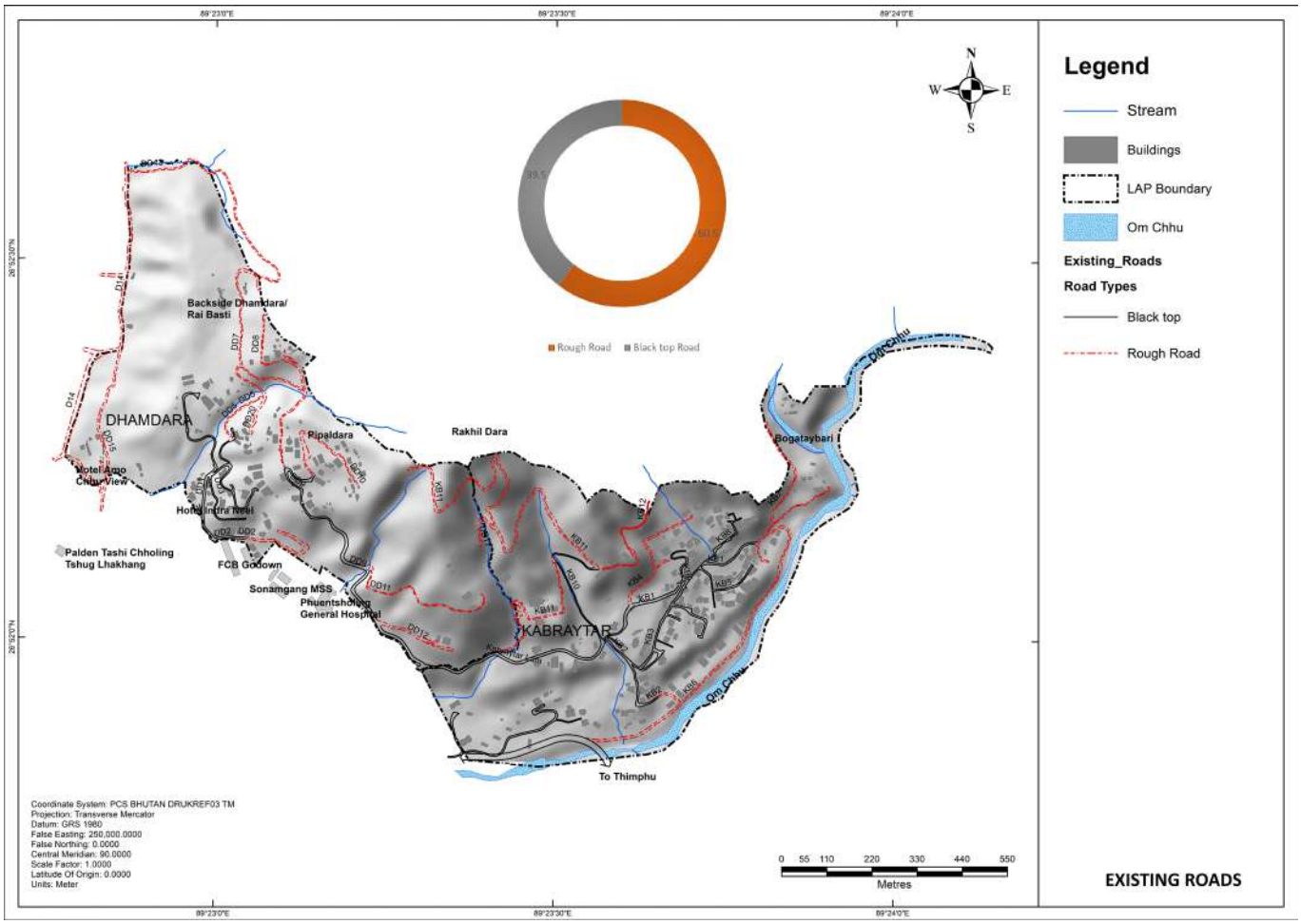


Figure 6.7 Map showing existing black top and rough roads in Dhamdara and Kabraytar

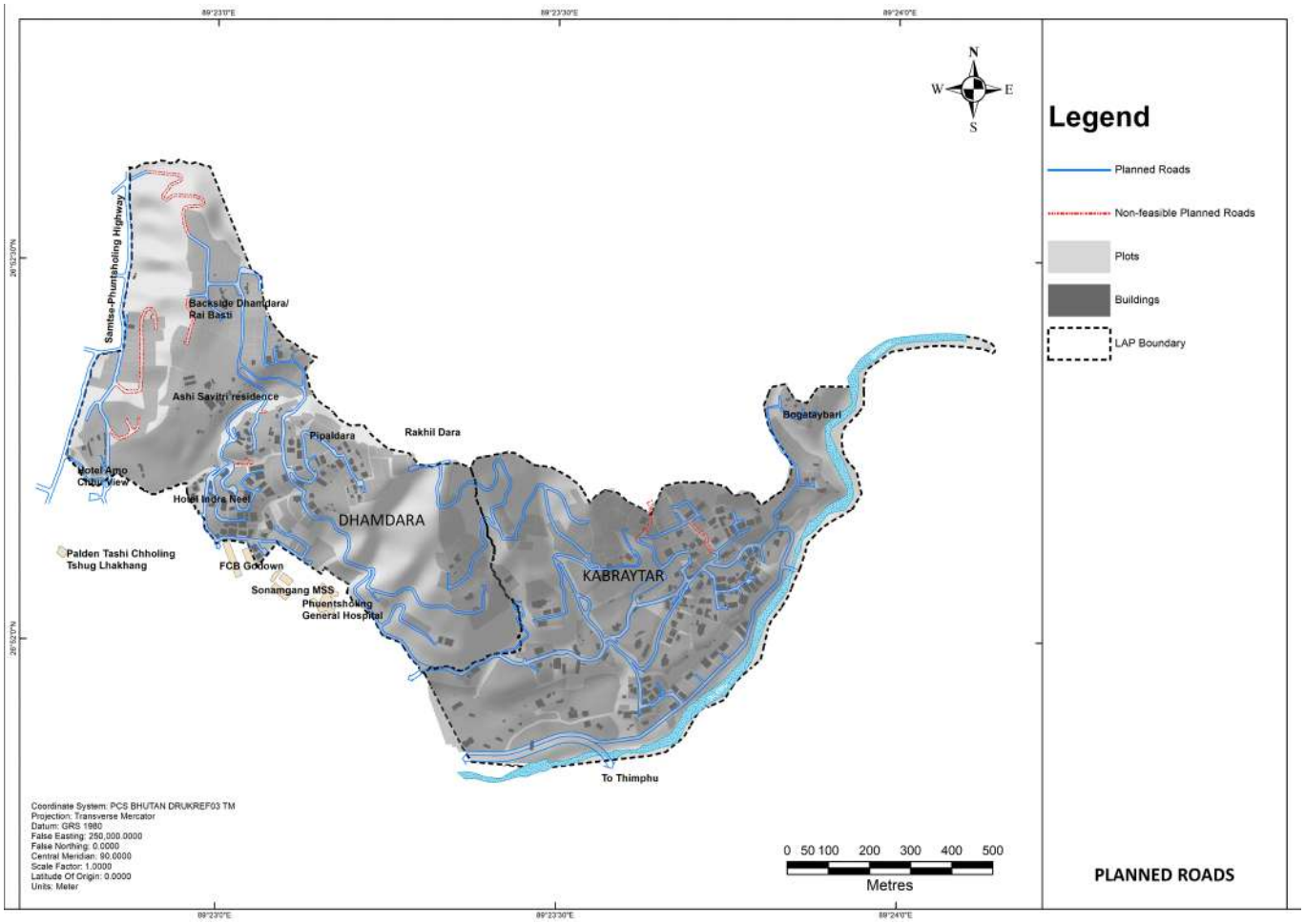


Figure 6.8 Planned Roads

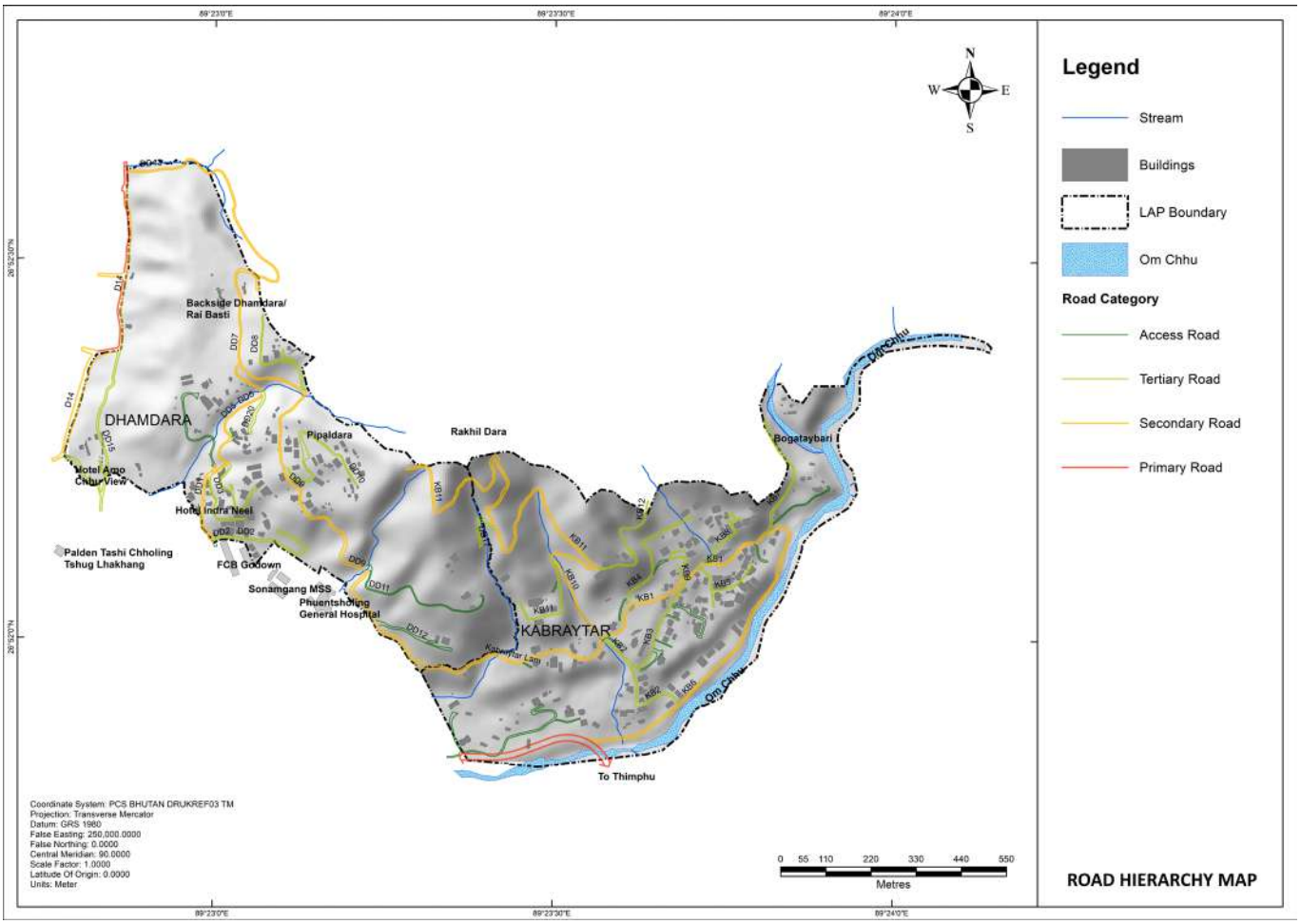


Figure 6.9 Existing Road Hierarchy

Table 6.9 Dhamdara Road Classification and Road width

Road Name	Category	Minimum RoW as per URS (m)	Minimum Carriageway as per URS (m)[5]	Existing Carriageway Width (m)	Planned RoW (m)	Planned Carriageway (m)
DD1	Secondary	10	6	4	8	5
DD2 (Upper Part)	Tertiary	6.2	3.5	-	6	3.5
DD2 (Lower Part)	Tertiary	6.2	3.5	3.5	6	3.5
DD3	Tertiary	6.2	3.5	3.2	4.5-6	3-3.5
DD4	Tertiary	6.2	3.5	3.2	5.5-6	3.5
DD5 (Upper Part)	Secondary	10	6	-	6	3.5
DD5 (Lower Part)	Secondary	10	6	3	5-5.5	3.5
DD6	Tertiary	6.2	3.5	-	6	3.5
DD7	Secondary	10	6	-	6-7	3.5-4
DD8	Tertiary	6.2	3.5	-	6	3.5
DD9 (Upper Part)	Secondary	10	6	4	6	3.5
DD9 (Lower Part)	Secondary	10	6	7	6	3.5
DD10 (Upper Part)	Tertiary	6.2	3.5	-	5	3
DD10 (Lower part)	Tertiary	6.2	3.5	3	6	3.5
DD11	Access	6	3.5	5	6	3.5
D12	Tertiary	6.2	3.5	-	6	3.6
D13	Secondary	10	6	3	Not planned	Not planned
DD15	Tertiary	6.2	3.5	-	7	-

Table 6.10 Kabraytar Road Classification and Road Width

Road Name	Category	Minimum RoW as per URS (m)	Minimum Carriageway Width as per URS	Carriageway width (m)	Planned RoW (m)	Planned carriageway (m)
Kabraytar Lam	Secondary	10	6	7	8	5
KB1 (Western part)	Secondary	10	6	3.5	8	5
KB1 (Eastern part)	Secondary	10	6	3.5	8	5
KB2 (Lower Part)	Tertiary	6.2	3.5	3.5	8	5
KB2 (Upper Part)	Tertiary	6.2	3.5	3.5	7	4
KB3	Tertiary	6.2	3.5	3.5	6	3.5
KB4	Tertiary	6.2	3.5		6	3.5
KB5	Tertiary	6.2	3.5	<3	6	3.5
KB6	Secondary	10	6	5	8	5
KB7	Tertiary	6.2	3.5		6	3.5
KB8	Tertiary	6.2	3.5	<3	6	3.5
KB9	Tertiary	6.2	3.5	-	6	3.5
KB10	Secondary	10	6	5	6	3.5
KB11	Secondary	10	6	-	6	3.5
KB12	Tertiary	6.2	3.5	-	4	3.5
KB13	Tertiary	6.2	3.5	3	6	3.5

Except for DD9 (Lower Part) none of the existing secondary road meets the ideal carriageway width of 6m. All the existing tertiary roads in the area is two ways, one lane road. For such road, minimum carriageway width should be 3.5 m which most roads do not meet except DD2 (lower part).

All existing secondary roads and tertiary roads have carriageway widths below the minimum standard width except for Kabraytar Lam, KB2 and KB3. Along with carriageway being too narrow, the roads lack footpaths and most of them do not have space for expansion.

6.4.3. EXISTING VS PLANNED ROADS

Existing roads do not reflect the dimensions outlined in the plan. Almost all of the planned roads are wider than the existing roads. In many of the built areas on site, there is no space for expansion of roads which are narrow. This could be the result of private developments (buildings and boundary walls) encroaching the land pooled for road infrastructure.

6.4.4. PLANNED ROADS VS URBAN ROAD STANDARDS

Roads have been planned without clear hierarchical categorization. This is reflected in the fact that most of the planned secondary roads do not meet the URS minimum width requirements. However, given the fact that land pooling has already been conducted and the mountainous topography of the area, it may not be possible to achieve the road widths as per the URS requirements nor it is desirable to carry out further land pooling.

The better alternative to improve the road infrastructure would be to try and achieve the RoW as planned. The encroaching lands must be identified to clear up the space for road expansion. In the worst case scenario, guided land development should be applied for the cause.

Since more than half of roads are under construction where built up area is minimal, there is potential to meet the road requirements as planned.

6.4.5. ROAD ACCESSIBILITY

There is a total of 38 plots which are not accessible by roads because it is not feasible to construct roads due to the topography of the land.

There are 15 plots in Dhamdara and 23 plots in Kabraytar are inaccessible by roads which are shown in Figure 6.10 and Figure 6.11 and listed in Table 6.11 and Table 6.12 respectively.

Table 6.11 List of plots inaccessible by road in Dhamdara

Plots	Remarks
PGT-48, PGT-1216, PGT-1982, PGT-3952, PGT-253, PGT-807, PGT-109, PGT-87, PGT-1208, PGT-99, PGT-1212, PGT-105	These plots in Pipaldara lie in E1, E4 and UV2 LD. Road provisions need to be explored and existing footpaths needs to be improved to provide better accessibility to these plots.
PGT-771, PGT-889, PGT-2975	Accessibility for these plots in Dhamdara needs to be considered, although PGT-889 and PGT-2975 are under E1.

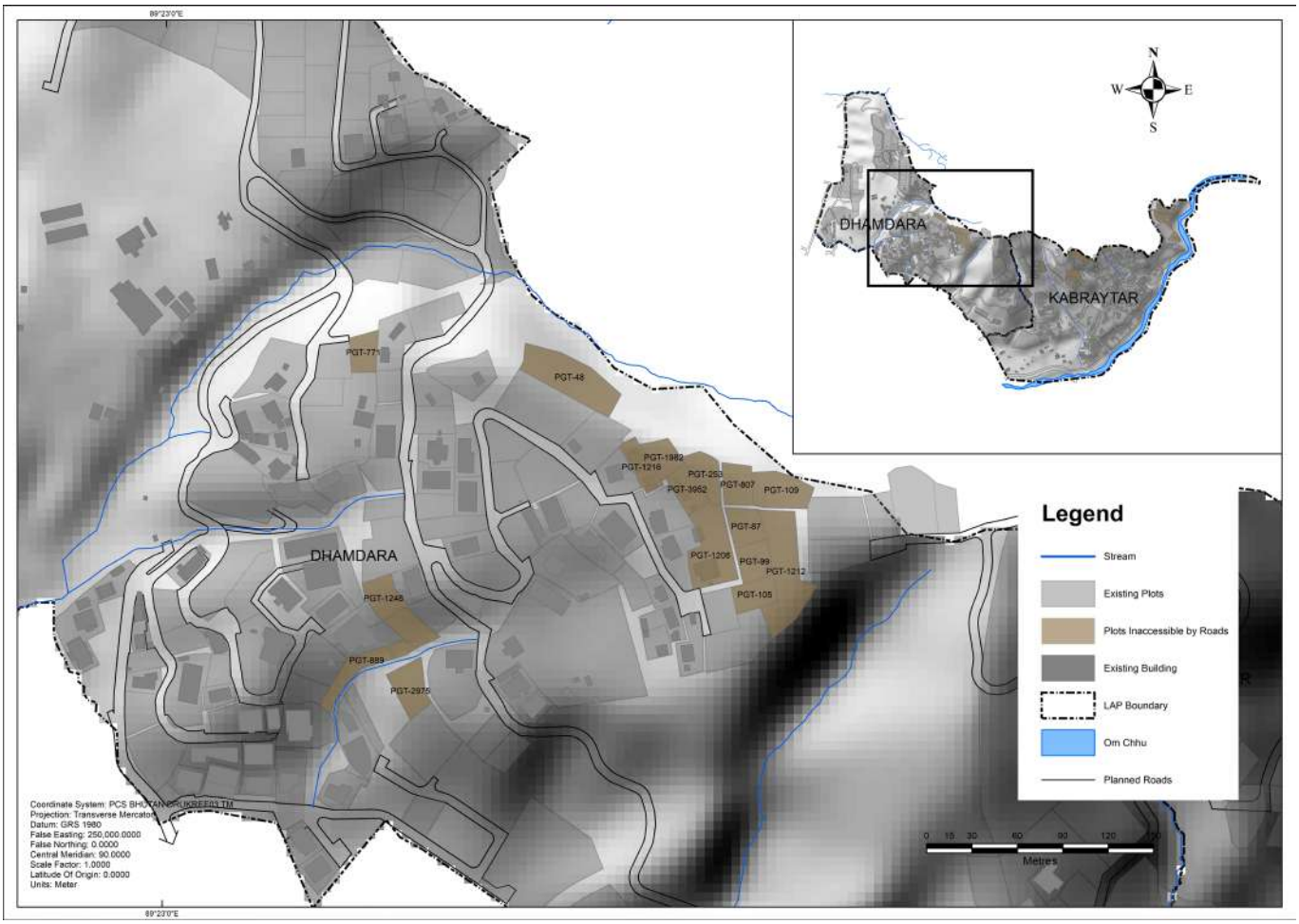


Figure 6.10 Plots inaccessible by Roads in Dhamdara

Table 6.12 List of plots inaccessible by roads in Kabraytar

Plots	Remarks
PGT-970, PGT-971, PGT-972, PGT-973, PGT-974, PGT-975, PGT-976, PGT-883, PGT-849	All these plots fall in UV2-LD and are located in Bogataybari which is separated from rest of Kabraytar by a seasonal stream. The stream and landslide has damaged the road connection and there is no motorable bridge. Establishing road connection is possible only with a new motorable bridge.
PGT-17, PGT-3971	These three UV2-LD plots have a private road constructed along a gully. The road is rough and not safe.
PGT-1284, PGT-825(b), PGT-501, PGT-184, PGT-3054, PGT-1714, PGT-2447, PGT-1147, PGT-669, PGT-668, PGT-921, PGT-2934	These plots lie mostly in steep terrain and in E1 and E4 precincts and not accessible by road.

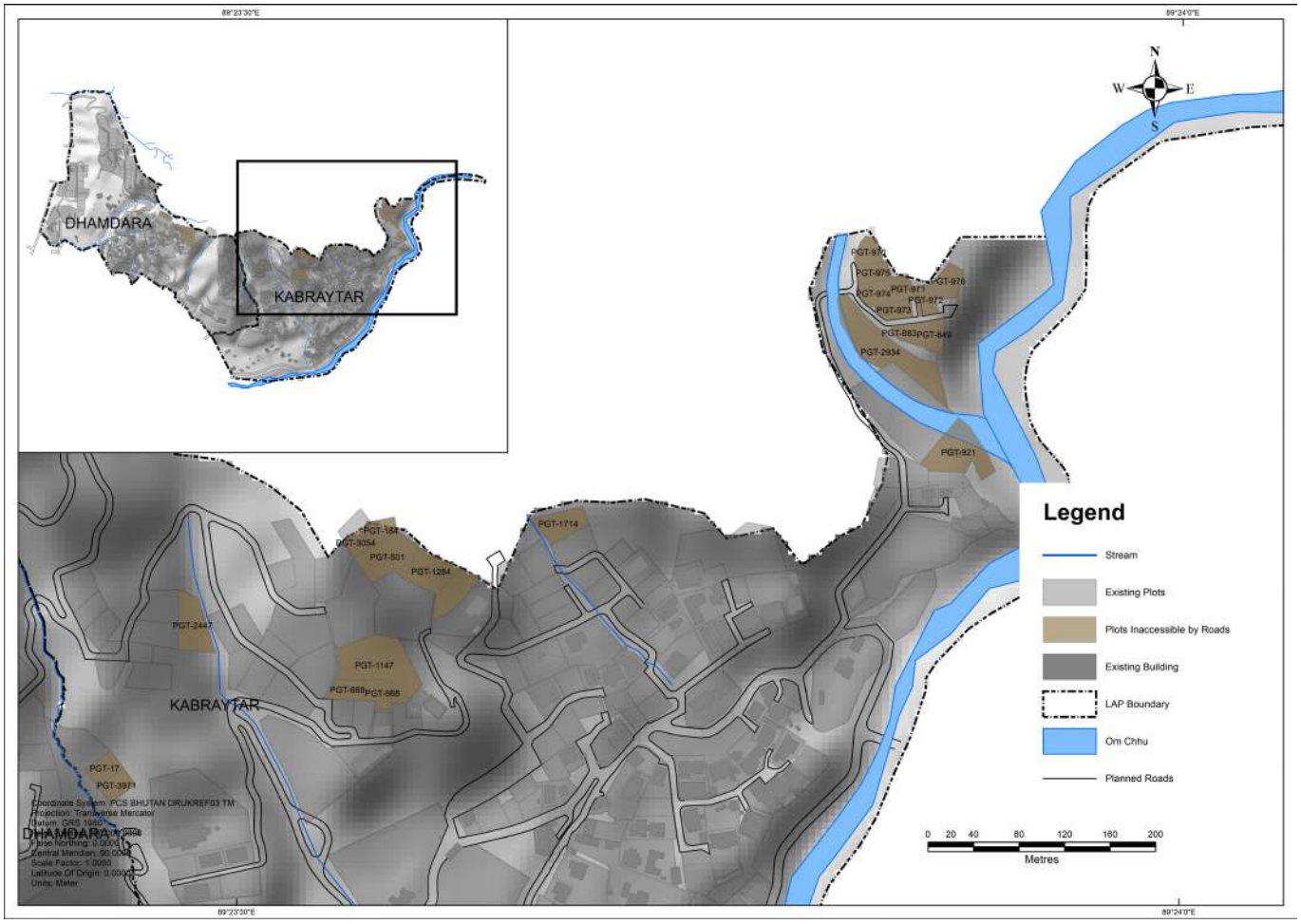


Figure 6.11 Plots inaccessible by Roads in Kabraytar

6.4.6. ROAD NETWORK CONNECTIVITY

Due to the mountainous terrain, it is difficult to create a perfectly connected road network. Most of the tertiary roads in the area have dead ends. This, in addition to narrow roads and two-way traffic, create traffic problems such as congestion and safety risks. Congestion is not a major issue in the area now because most of the plots in the area are still underdeveloped and there is low car ownership. However, there is significant traffic safety issues now and as the area develops to its potential in the future, there would be significant traffic congestion. This will be further exacerbated by increasing car ownership rate which, as trend shows, is increasing.

Some of the dead ends could be extended and connected with other roads improving the overall connectivity in the area. Kabraytar has better road network connectivity compared to Dhamdara which has pockets of settlements not properly connected with each other.

6.4.7. PEDESTRIAN MOBILITY

The absence of on-street footpaths and narrow roads with hardly any space for its provision make it difficult for pedestrians. It discourages walkability and people have to depend on vehicular mode of travel. It is good that 60% of the roads are still under construction. Footpaths, at least along one side is necessary. There are few disconnected off-street footpath networks. Green spaces and residential areas are not well connected. There is a high potential for creating off-street footpaths which are well connected with the amenities, residential, commercial and recreational areas. Map in Figure 6.12 shows the existing footpath in Kabraytar and Dhamdara

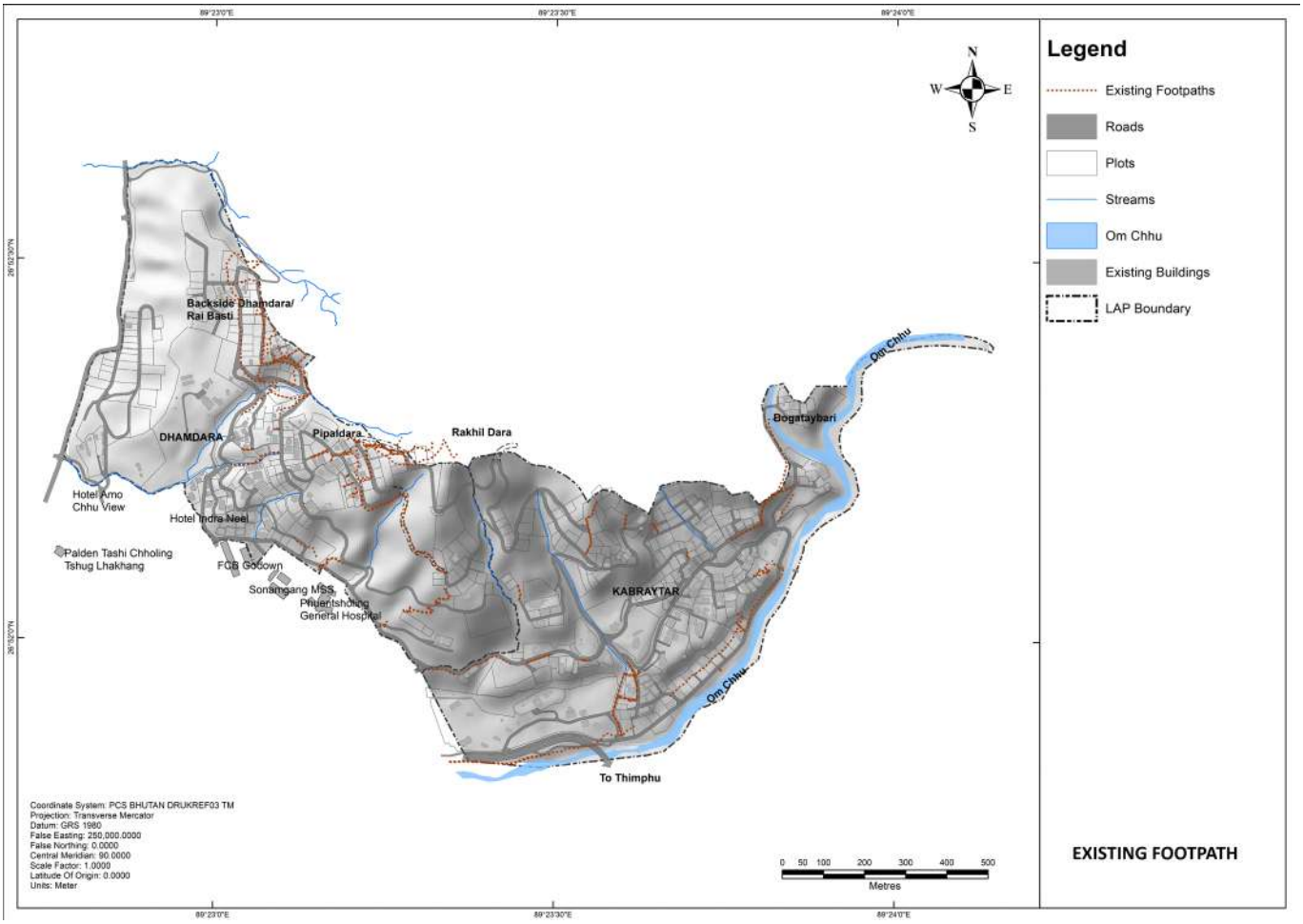


Figure 6.12 Existing footpath network

6.4.8. JUNCTION

There are total of 27 junctions, none of them have a roundabout. 8 of them are critical as they are at the intersection of secondary roads where traffic volume is expected to be high (see Figure 6.13). Junctions lack signage, markings and enough space for the smooth flow of intersecting vehicles. These are the accident-prone areas. Road expansion and proper signage is of vital importance especially in these critical junctions. The junctions meet the absolute minimum spacing requirements as per URS.

6.4.9. PUBLIC TRANSPORTATION

There isn't any public transportation in the area. There is a good possibility to have a mini public bus route through the secondary roads. However, the secondary roads need widening to achieve the width of already planned road for the smooth flow of bus and other vehicles.

Internationally, 400 m is the standard distance for people to walk to nearest public bus transport. Since Kabraytar and Dhamdara are topographically not flat, 250 m is considered the standard distance for it. A 250 m buffer from the possible public bus route (secondary road) covers most of the area. Figure 6.14 shows the bus route and 250 m coverage from the route.

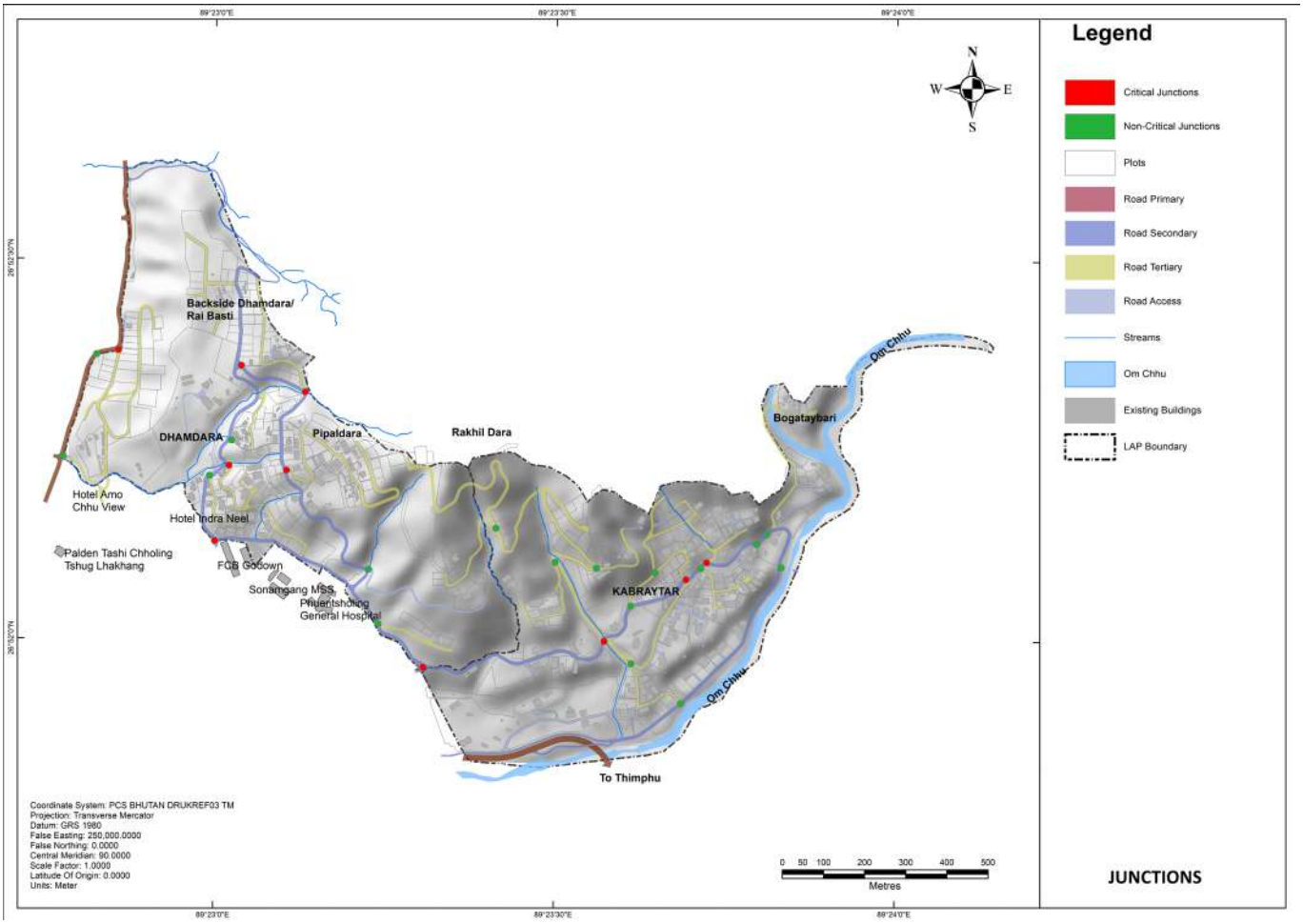


Figure 6.13 Map showing Critical and non-Critical Junctions

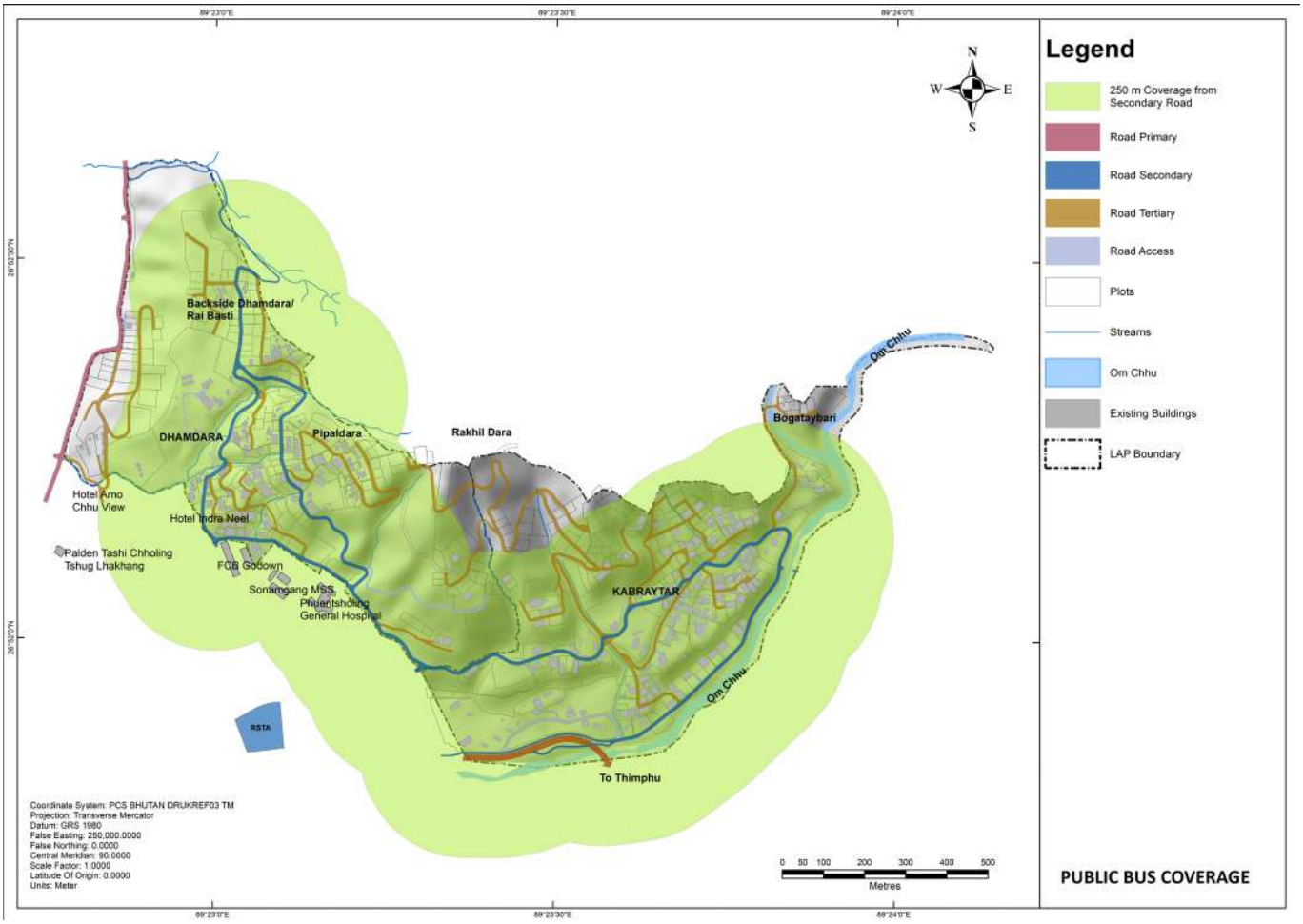


Figure 6.14 Map showing the possible public bus route and coverage

6.5. PROPOSALS

6.5.1. EXPANSION OF ROADS

Looking at the existing roads scenario and planned roads, it is clear that existing roads are much narrower than roads planned. As land pooling has already been conducted and plots boundary demarcated, further land pooling for road expansion is undesirable. However, it seems that many plots have encroached into road area resulting in narrower roads than what was planned. Encroached lands need to be identified and roads should be expanded as planned. Wherever the planned roads are too narrow, GLD has to be adopted to claim land for roads. Table 6.13 gives the proposed widths of road components. Widths for RoW and Carriageway are proposed examining the existing road conditions, planned road widths and topography of the areas and are smaller than the minimum standard widths. Figure 6.15 shows the proposed road road hierarchy in both the LAPs. Figure 6.16 and Figure 6.17 show proposed road hierarchy in Dhamdara and Kabraytar respectively.

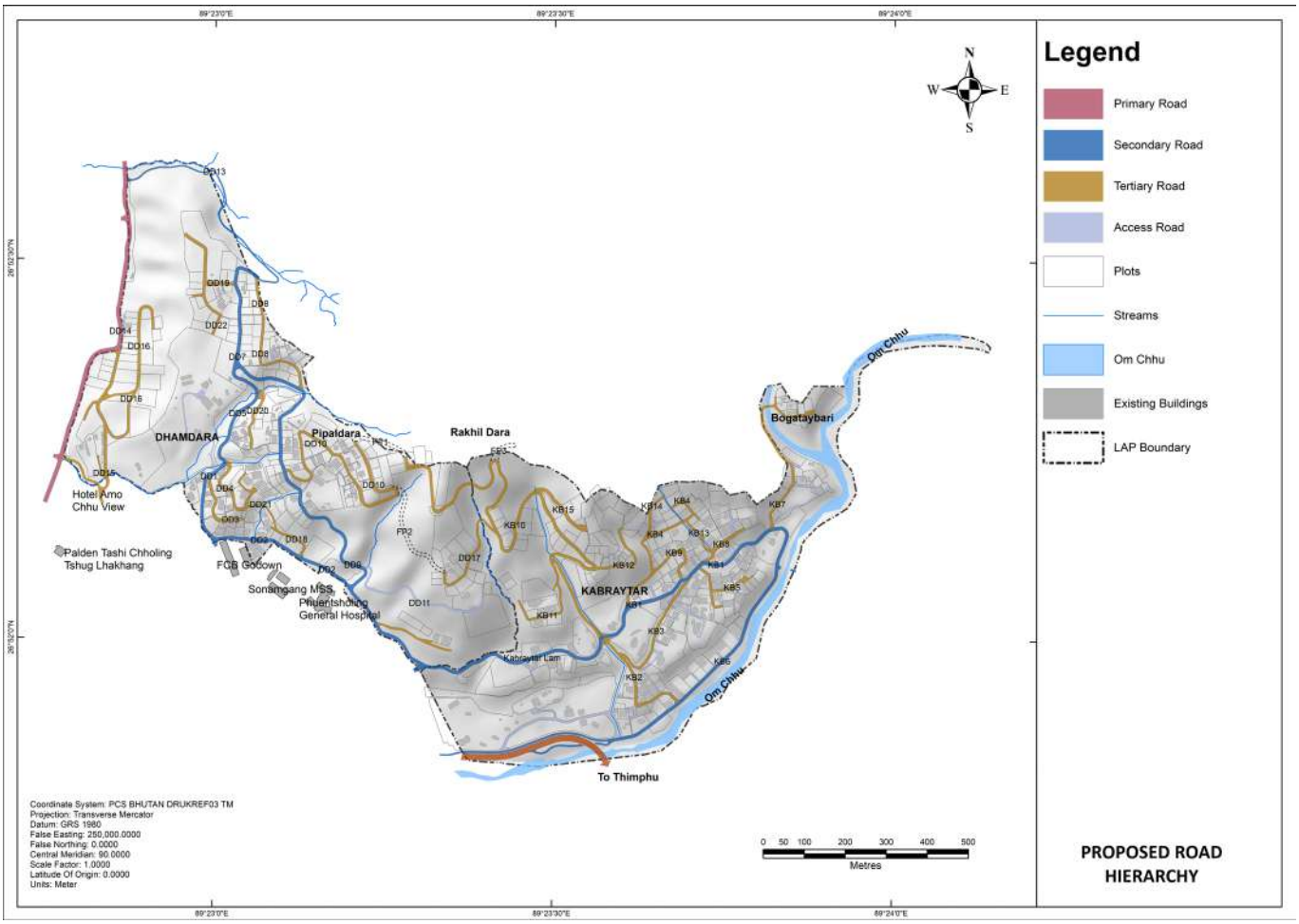


Figure 6.15 Proposed road hierarchy

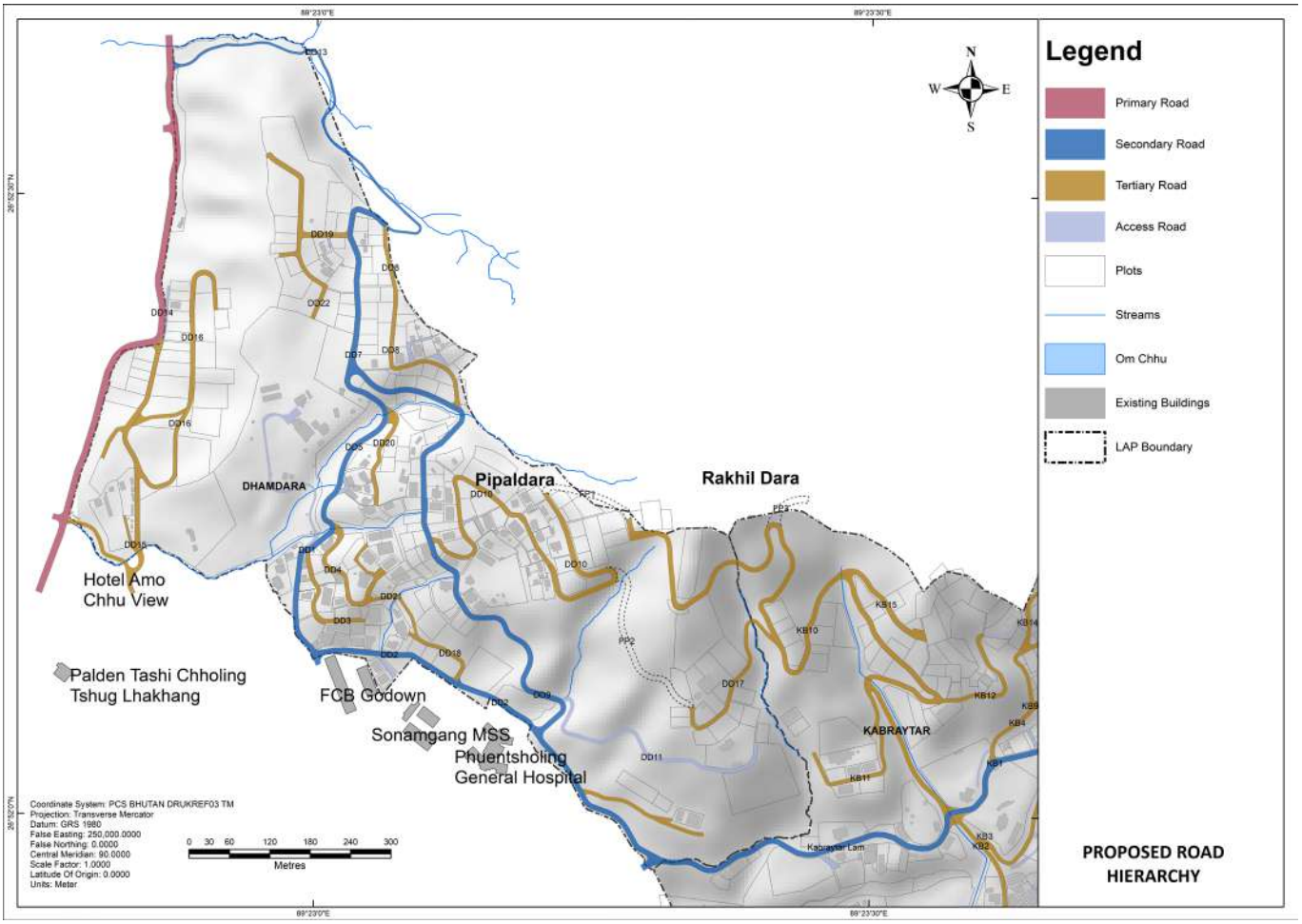


Figure 6.16 proposed road hierarchy in Dhamdara

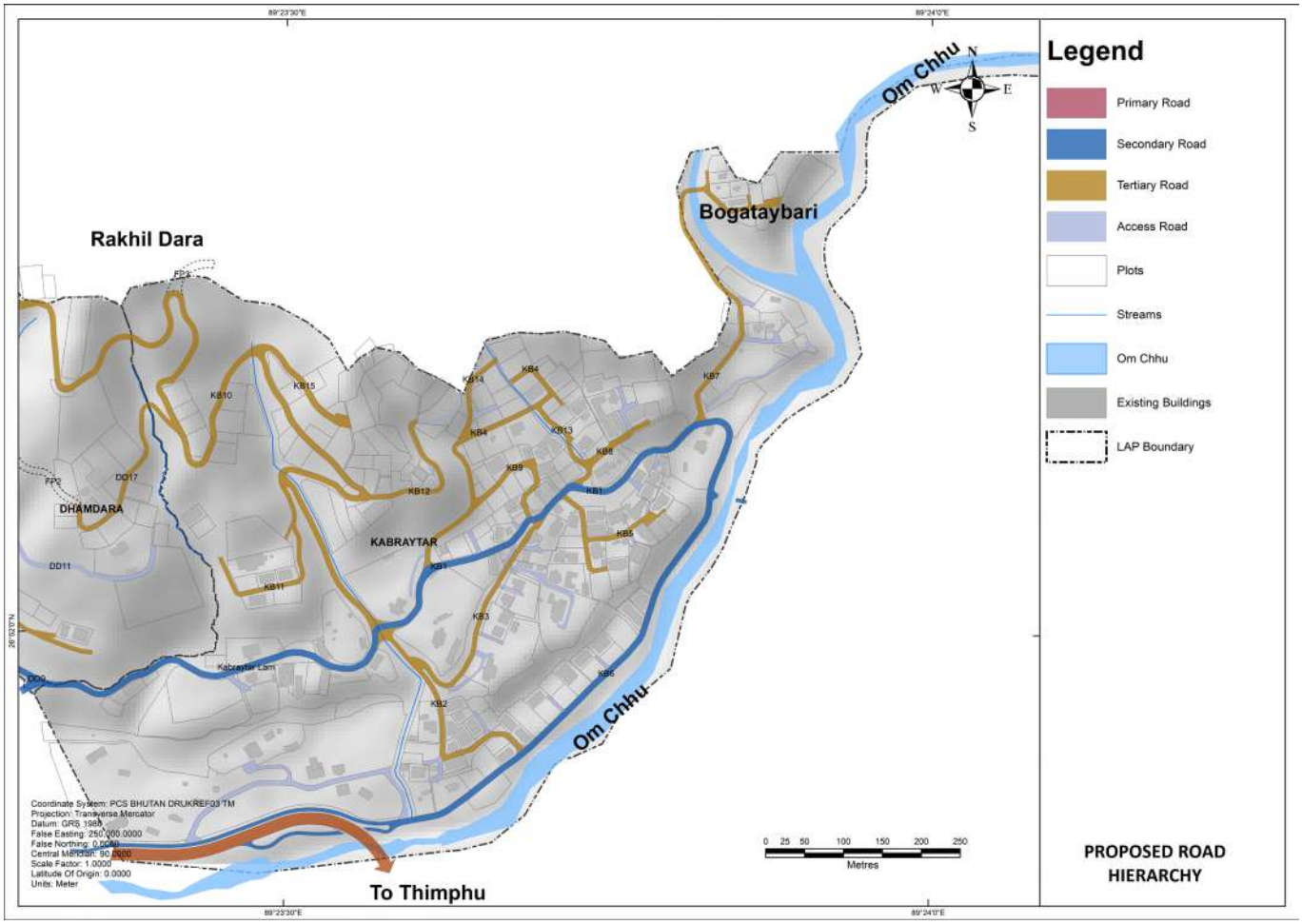


Figure 6.17 Proposed road hierarchy in Kabraytar

Details RoW for individual roads for Dhamdara and Kabraytar are given in Table 6.14 and Table 6.15 respectively.

Table 6.13 Proposed Widths of Road Components

Road Category	Proposed RoW (m)	Proposed Carriage-way (m)	Footpath	Roadside Drain
Secondary Road	8	6 (2 lanes)	1.5 m on one side	0.5 on one side
Tertiary	6	5.5 (2 lanes)	No	0.5 on one side
Access	3.5	3.5 (one lane)	No	No

Table 6.14 Dhamdara Road widths: Standard, existing, planned and Proposed

Road Name	Category	Minimum RoW as per URS (m)	Minimum Carriageway as per URS (m)	Existing Carriageway Width (m)	Previously Planned RoW (m)	Previously-Planned Carriageway (m)	Proposed RoW (m)
DD1	Secondary	10	6	4	8	5	8
DD2	Secondary	10	6	3.5	6	3.5	8
DD2(New Proposed)	Secondary	10	6	-	-	-	8
DD3	Tertiary	6.2	3.5	3.2	4.5-6	3-3.5	6
DD4	Tertiary	6.2	3.5	3.2	5.5-6	3.5	6
DD5	Secondary	10	6	-	6	3.5	8
DD7	Secondary	10	6	-	6-7	3.5-4	8
DD8	Tertiary	6.2	3.5	-	6	3.5	6
DD8(New Proposed)	Tertiary	6.2	3.5	-	6	3.5	6
DD9(Upper Part)	Secondary	10	6	4	8	5	8
DD9(Lower Part)	Secondary	10	6	7	8	5	8
DD10(New Proposed)	Tertiary	6.2	3.5	-	-	-	6
DD10(Upper Part)	Tertiary	6.2	3.5	-	5	3	6
DD10(Lower part)	Tertiary	6.2	3.5	3	6	3.5	6
DD11	Access	6	3.5	5	6	3.5	3.5
D12	Tertiary	6.2	3.5	-	6	3.6	6
D13	Secondary	10	6	3	Not Planned	Not planned	8
DD15	Tertiary	6.2	3.5	-	6	-	6
DD16	Tertiary	6.2	3.5	-	6	3.6	6
DD17	Tertiary	6.2	3.5	-	6	3.6	6
DD18	Tertiary	6.2	3.5	-	6	3.5	6
DD19	Tertiary	6.2	3.5	-	6	3.6	6
DD20	Tertiary	6.2	3.5	-	6	3.6	6
DD21 (new proposed)	Tertiary (one-way)	6.2	3.5	-	-	-	4.5
DD22 (new proposed)	Tertiary	6.2	3.5	-	-	-	6

Table 6.15 Kabraytar Road widths: Standard, existing, planned and Proposed

Road Name	Category	Minimum RoW as per URS (m)	Minimum Carriageway Width as per URS	Carriageway width (m)	Previously Planned RoW (m)	Previously Planned carriageway (m)	Proposed RoW (m)
Kabraytar Lam	Secondary	10	6	7	8	5	8
KB1	Secondary	10	6	3.5	8	5	8
KB2 (Lower Part)	Tertiary	6.2	3.5	3.5	8	5	6
KB2 (Upper Part)	Tertiary	6.2	3.5	3.5	7	4	6
KB3	Tertiary	6.2	3.5	3.5	6	3.5	6
KB4	Tertiary	6.2	3.5		6	3.5	6
KB5	Tertiary	6.2	3.5	<3	6	3.5	6
KB6	Secondary	10	6	5	8	5	8
KB7	Tertiary	6.2	3.5		6	3.5	6
KB8	Tertiary	6.2	3.5	<3	6	3.5	6
KB9	Tertiary	6.2	3.5	-	6	3.5	6
KB10	Tertiary	10	6	5	6	3.5	8(roadside footpath included)
KB11	Tertiary	6.2	3.5	-	6	3.5	6
KB12	Tertiary	6.2	3.5	?	4	3.5	6
KB13 (one-way)	Tertiary	6.2	3.5	3	6	3.5	6
KB14(new proposed, one-way)	Tertiary	6.2	3.5	-	-	-	4.5
KB15(new proposed)	Tertiary	6.2	3.5	-	-	-	8

The following figures Figure 6.18, Figure 6.19 and Figure 6.20 show the cross sections of proposed roads.

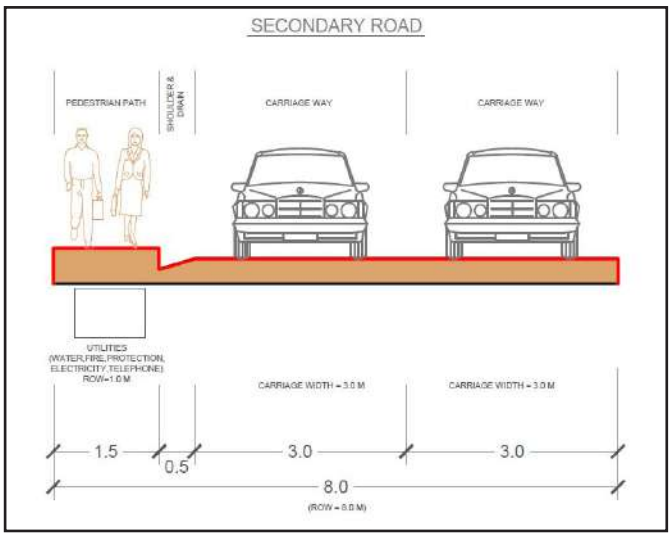


Figure 6.18 Secondary Road Cross section

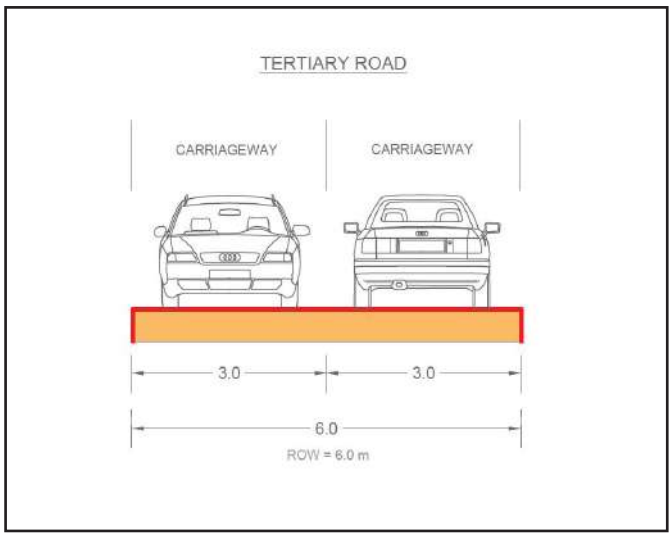


Figure 6.19 Tertiary Road Cross section

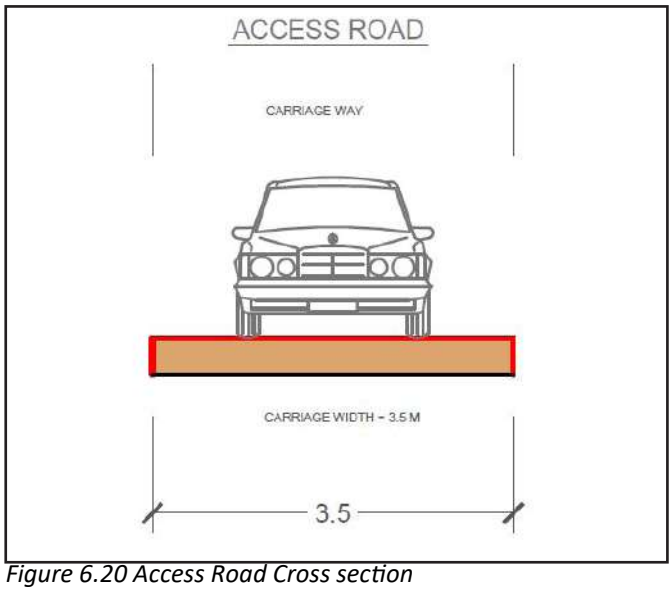


Figure 6.20 Access Road Cross section

6.5.2. NEW ROADS PROPOSED

Ten new roads are proposed, five in Dhamdara and five in Kabraytar are proposed to improve road connectivity, accessibility and overall flow of traffic in the area. Figure 6.21, Figure 6.22, Figure 6.24, Figure 6.25 and Figure 6.25 show new proposed roads in Dhamdara and Kabraytar.

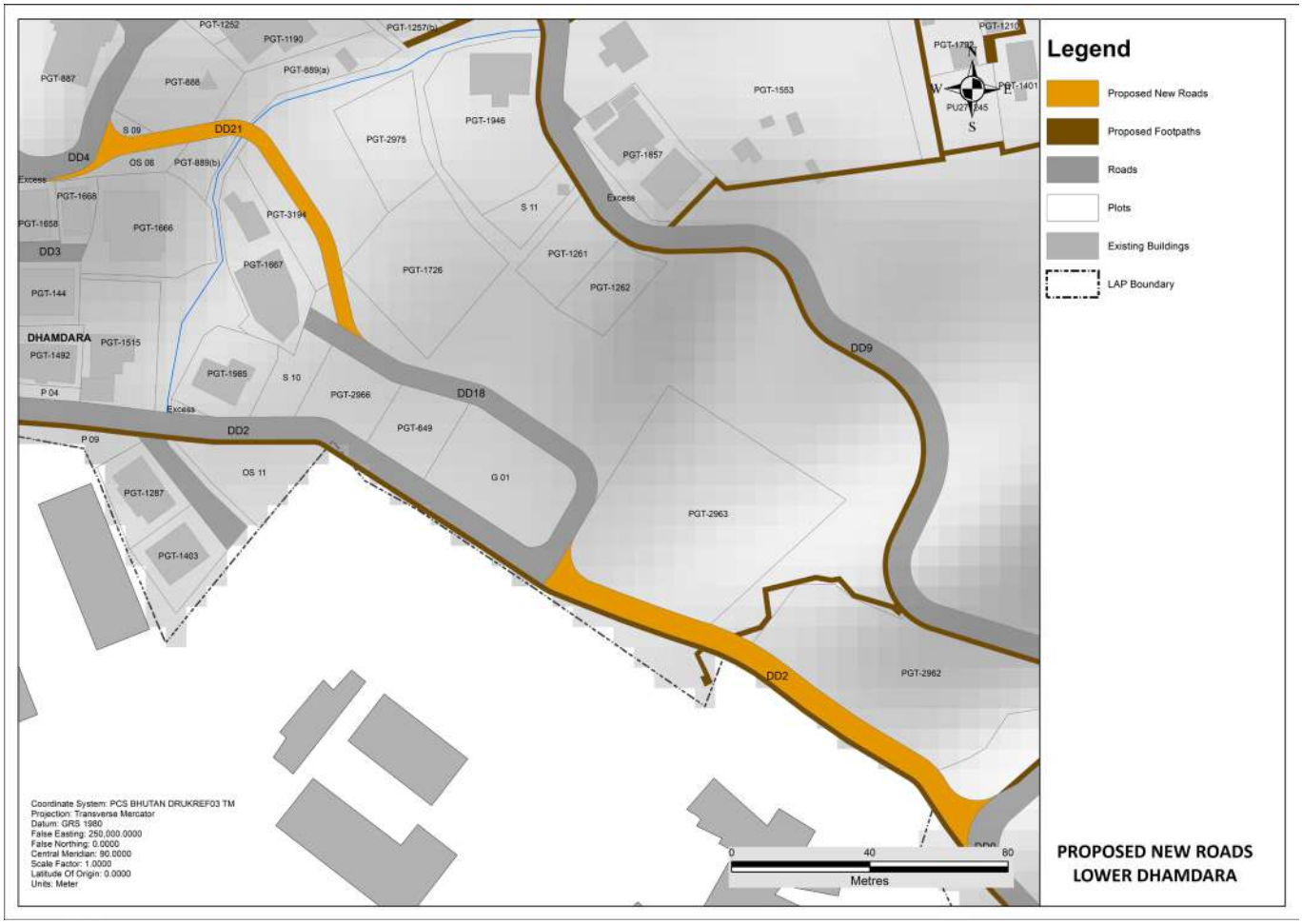


Figure 6.21 New proposed Roads DD2 and DD21 in Lower Dhamdara

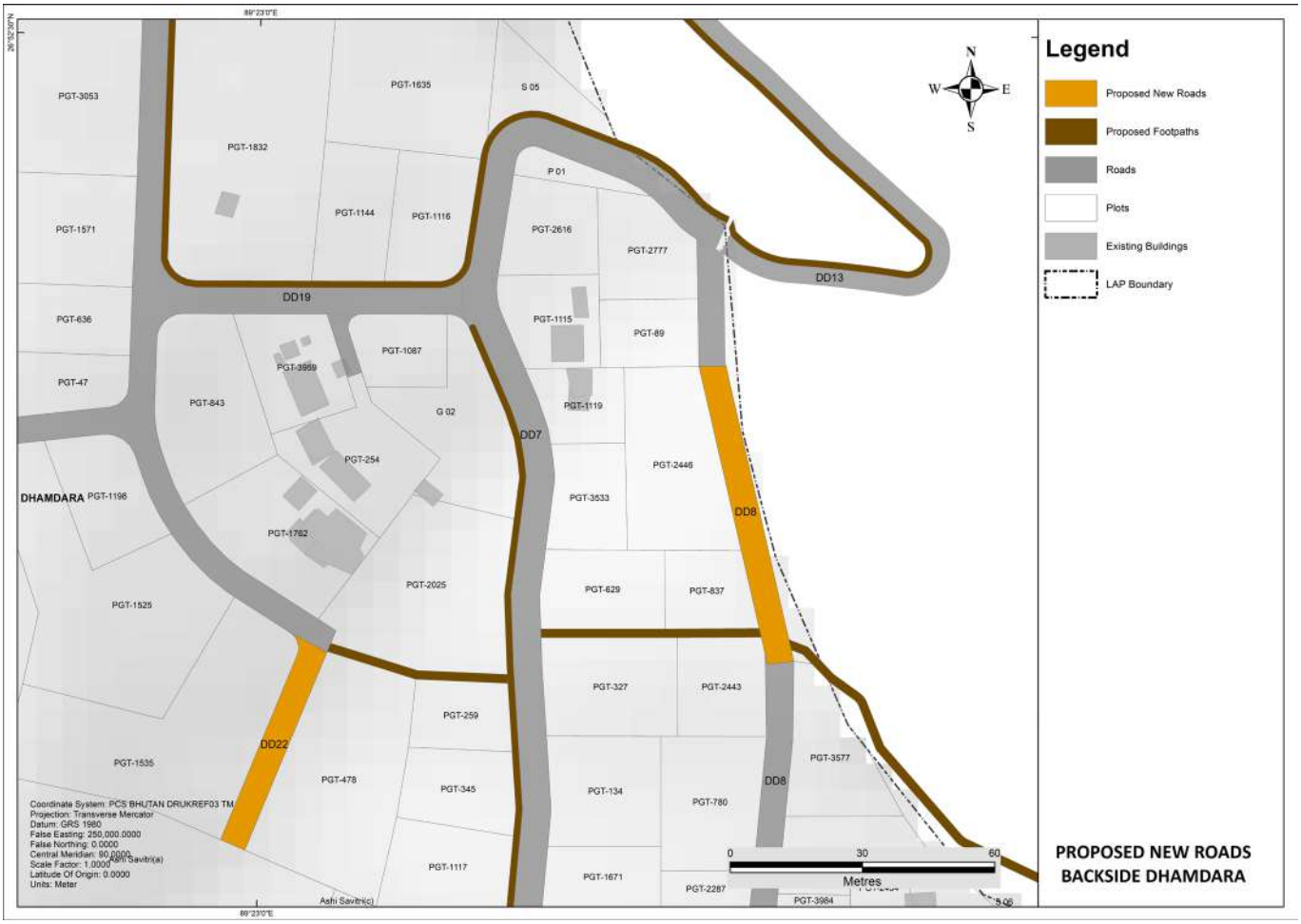


Figure 6.22 New Proposed Roads DD8 and DD22 in Backside Dhamdara

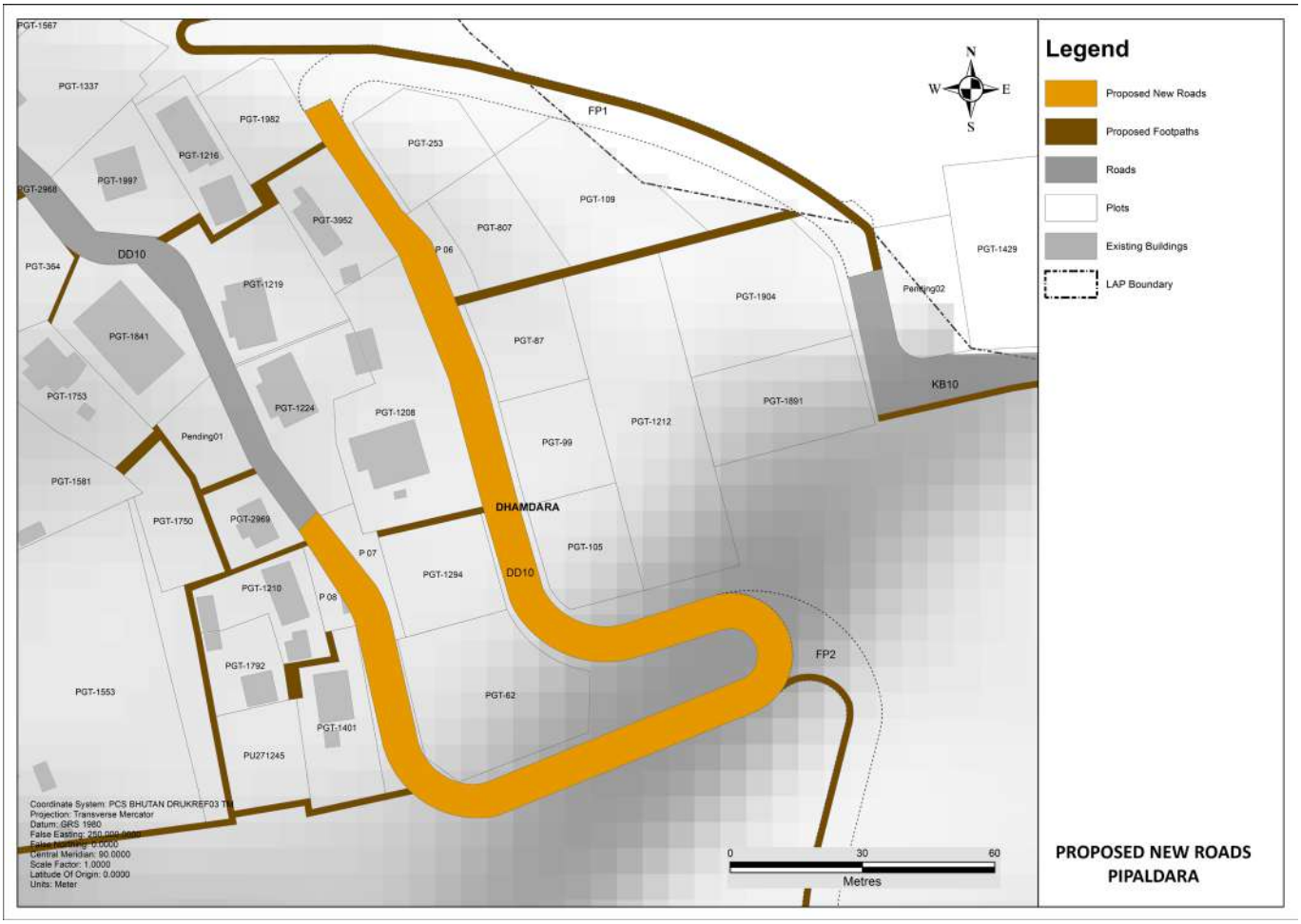


Figure 6.23 New Proposed Road DD10 in Pipaldara

Figure 6.24 New Proposed Roads KB14 and KB4 in Kabraytar

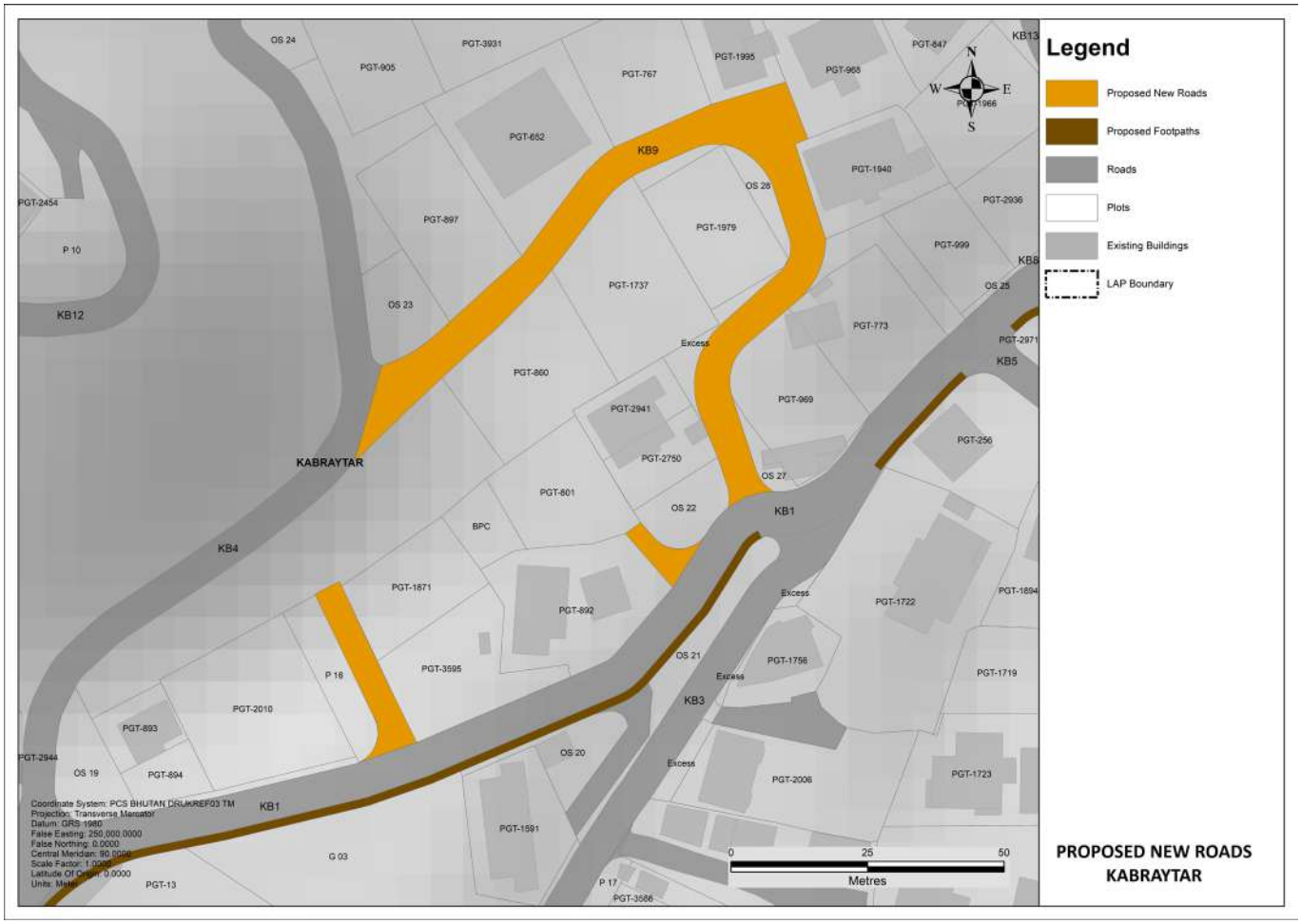


Figure 6.25 Realigned Roads in Kabraytar

6.5.3. ACCESSIBILITY

As discussed earlier, not all the plots have road accessibility. After close examination of these plots and topography, the following proposals are made.

Dhamdara

Most of the inaccessible plots are located in Pipaldara, existing footpaths connectivity is improved and and a new road extending from DD10 has been proposed. See Figure 6.23. Footpaths are proposed where road is not feasible.

Kabraytar

Road accessibility to Bogataybari plots can be achieved only by construction of a motorable bridge over Bogataybari Chhu. Footpaths have been proposed for other plots inaccessible by roads.

6.5.4. FOOTPATHS

As proposed in RoW earlier, on-street footpath of 1.5 metres on one side of secondary roads is proposed. A new walking and biking trail connecting Ammo Chhu Lap, Backside Dhamdara, Pipaldara, Rakhildara, Kabraytar and core is proposed. This track would serve the following purposes:

- Improve the overall footpath network connectivity encouraging people to walk
- Will substitute for the lack of enough recreational area in Kabraytar and Dhamdara
- Serve the recreational purpose for the residents of Dhamdara, Kabraytar, Core and Ammo Chhu.
- The track would provide view of entire Phuentsholing Core and Ammo Chhu attracting tourists.

Maps showing the proposed footpaths and recreational trail is shown in Figure 6.26.

6.5.5. PUBLIC TRANSPORTATION

Based on the analysis conducted, a public bus route is proposed along the secondary road as shown in Figure 6.27.

6.5.6. PUBLIC PARKING SPACES

Map in Figure 6.28 shows the proposed locations for public parking spaces. The parking spaces are in NN precinct and lie next to Secondary roads (public transportation route) and hence can be used for public bus and taxi parking.

6.5.7. ROPE-WAY

Focusing on the tourism promotion vision of PSP, a rope-way (Cable Car) is proposed at the backside Dhamdara. The rope way which connects the Amo Chhu LAP and the proposed Neighbourhood Node at backside Dhamdara will not only act as a tourist attraction, but also cater to the needs of the local people. The proposed rope way is shown in the map in Figure 6.29.

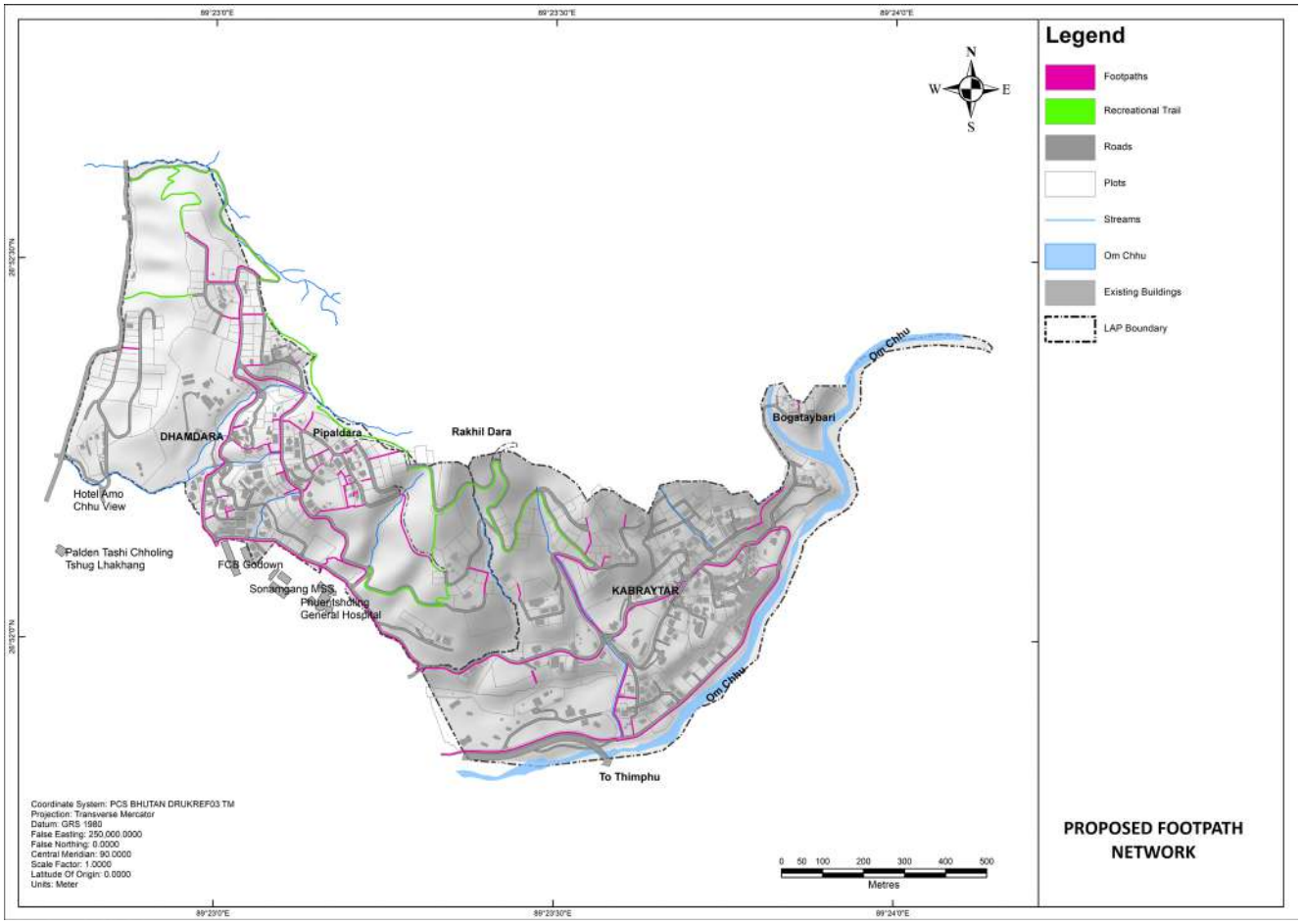


Figure 6.26 Proposed Footpath Network

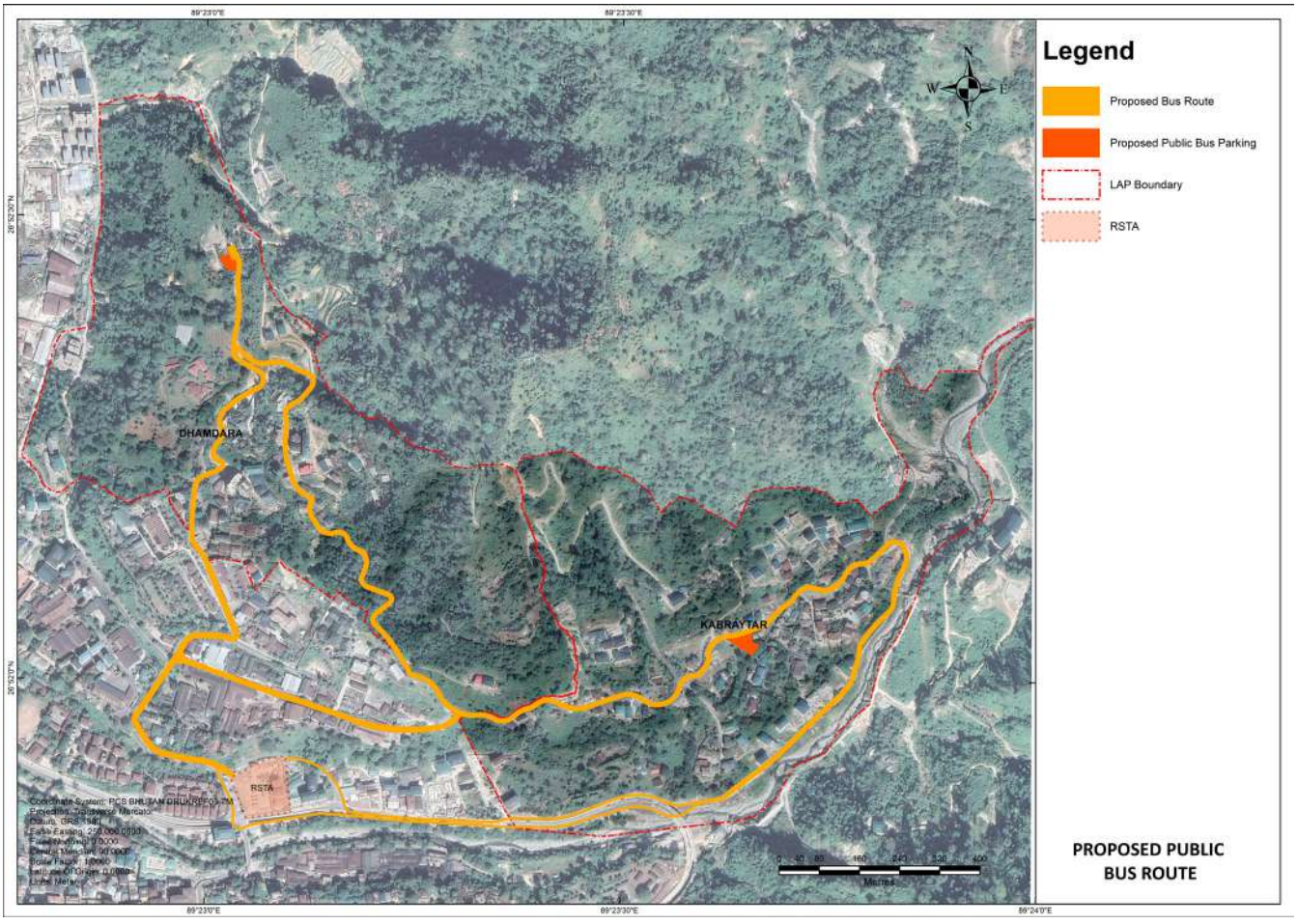


Figure 6.27 Proposed Public Bus Route

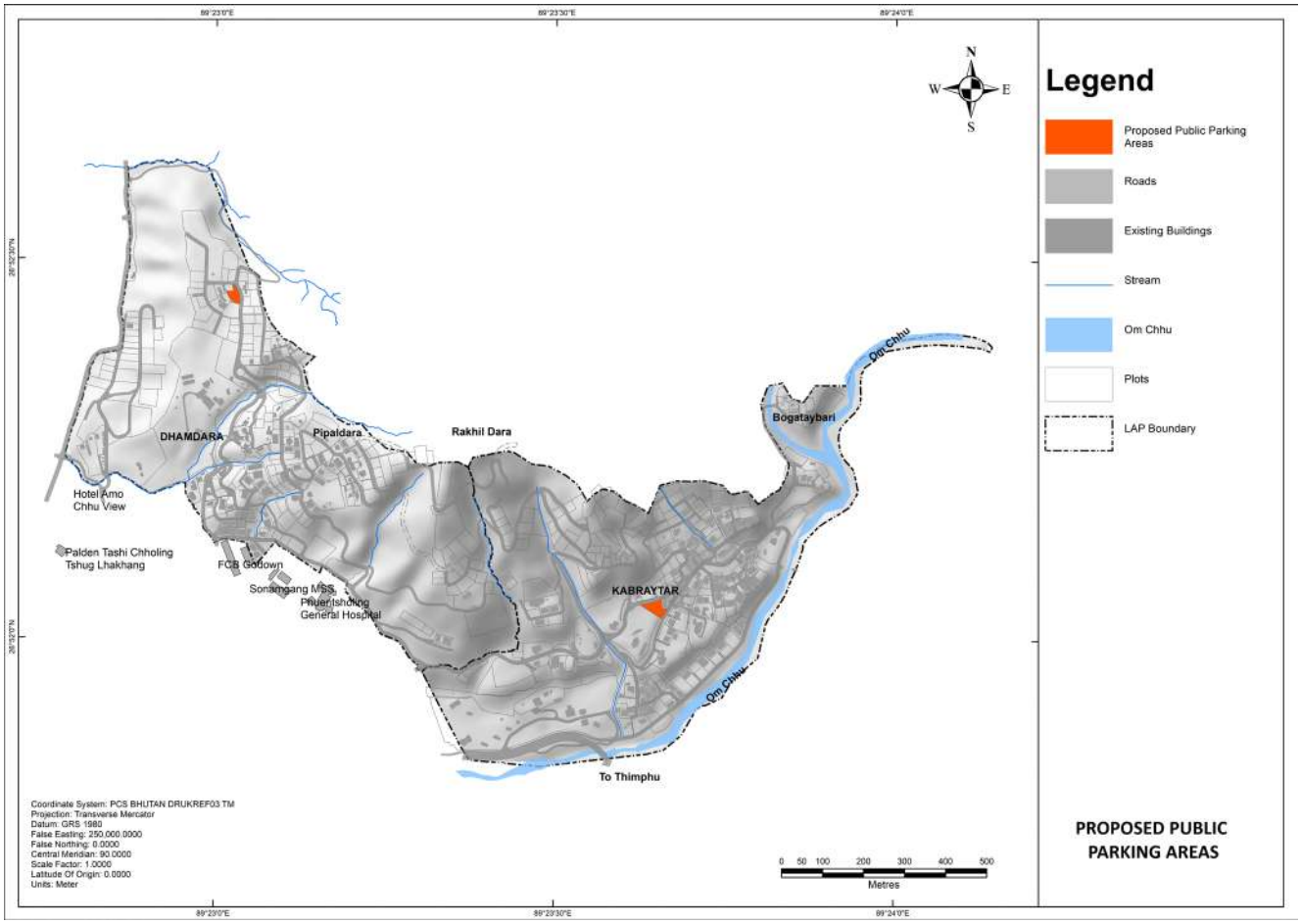


Figure 6.28 Map showing proposed Public Parking

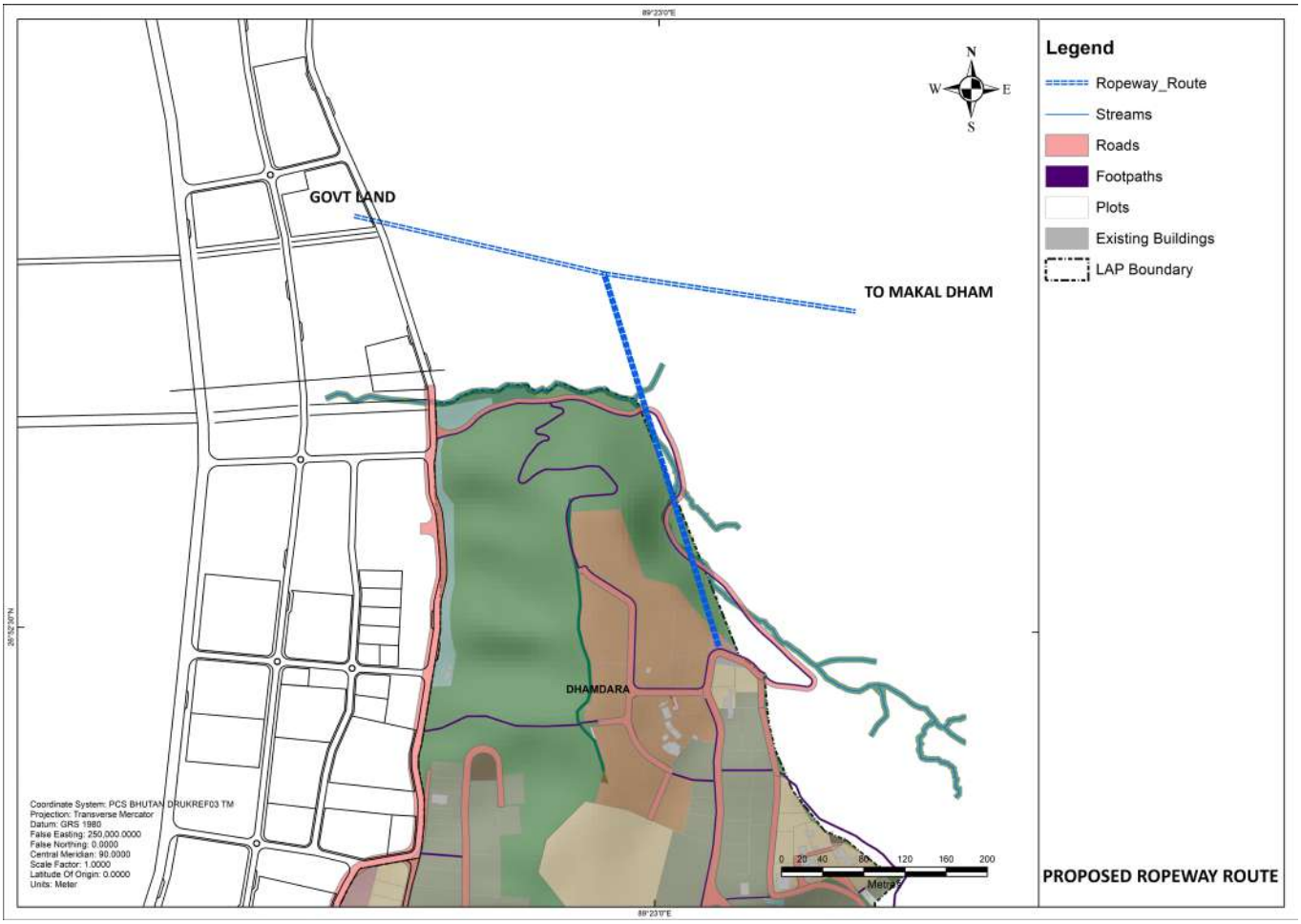


Figure 6.29 Proposed Rope-Way

6.6. ROAD/PAVEMENT DESIGN

6.6.1. PAVEMENT DESIGN

With the rapid growth of traffic plying over road network in Urban area, it has become necessary to design most economical combination of pavement layers in relation to both thickness and material type to suit the soil foundation and the cumulative traffic to be carried during the design life.

A flexible pavement is a multi-layered structure resting over the soil sub grade with quality of material decreasing with depth. It consists of compacted Sub-grade, Sub-base course, Base course and Surface course.

The pavement structure is expected deform in the same way as the sub grade through lateral distribution of the applied with depth. Moreover, the pavement thickness should be sufficient to distribute the wheel load to subgrade without causing over stressing in the sub grade. Thus, the strength of sub grade plays an important role in design of pavement.

Flexible Pavement Design should be in accordance with criteria laid down in the Pavement Manual, taking into consideration the traffic forecast Volumes and Sub-soil strength/ CBR ratio.

6.6.2. DESIGN CBR RATIO

The sub-grade strength of pavement is assessed in term of California Bearing Ratio (CBR) of the Sub- grade soil both in fill and cut section at the critical moisture conditions likely to occur in-situ.

Although site specific California Bearing Ratio Test was not performed but Geotechnical Investigation and Slope Stability Assessment of project was done on August, 2019. Using Geotechnical laboratory tests data and the correlation CBR & Ultimate Bearing capacity of soil. We are able to determine CBR Ratio for the project site in general.

The relation between CBR & Ultimate bearing capacity of cohesionless soil/granular soil is given by;

Where, = Ultimate bearing Capacity of soil CBR= California Bearing Ratio
Using Ultimate Bearing Capacity data and the above equation, the minimum CBR for project site was found out to be 20.25%. Similarly, the maximum and mean CBR was found out to be 28.24% and 23.71% respectively.

Taking Minimum, Maximum and Mean CBR values into CBRsection equation given in Pavement Design Manual. The CBRsection was found out be 21.20% but CBRsection is more than 20, the design CBR shall be 20%.

The CBRsection equation is given by; CBRsection=CBRmean-(CBRmax-CBRmin)/C Where, CBRsection= Section CBR
CBRmean= Mean CBR CBRmax= Maximum CBR CBRmin= Minimum CBR
C = Coefficient given in table 1.3 in Pavement Design Manual.

Design CBRsection= 23.71- (28.24-20.25)/3.18

= 21.20%

As per table 1.4 of Pavement Design Manual, Design CBR will be 20%.

6.6.3. DESIGN TRAFFIC

There are no data available on past or existing traffic in terms of commercial vehicles per day. So therefore, the computation of Design Traffic (Ns) in terms of cumulative number of standard axles was not possible. As per Urban Road Standard, secondary roads are designed for Traffic Volume 3 to 5 million standard axles and Access roads for Traffic Volume of 1 to 3 million standard axle. Kabratyar & Dhamdara LAPs being in India-Bhutan border area and has lots of development works going on in the LAPs areas, the secondary and Access roads shall be designed to accommodate traffic volume 5 msa and 3 msa respectively.

6.6.4. PAVEMENT THICKNESS

The proposed Pavement thickness was based on CBR ratio derived from Geotechnical laboratory tests data for overall project site and assumed traffic Volumes. Therefore, site specific CBR tests and traffic survey needs to conducted in the project area to come up with economical pavement thickness that can take up traffic volumes effectively and perform its function efficiently during its design life.

As per Pavement Design Manual, the minimum thickness of sub base should not be less than 150mm for design traffic up to 10 msa and 200mm for design traffic 10 msa and above. The recommended minimum thickness of granular base should be 200mm for traffic up to 2 msa and 250mm for traffic exceeding 2 msa.

For CBR value of 9% and above, the minimum thickness of base should be 200mm.

The proposed pavement thickness for Secondary roads for CBR Value of 20% and traffic Volume of 5 msa is given in Table 6.16.

Table 6.16 Pavement Composition of secondary roads

Pavement Composition	Thickness(mm)
Asphalt Concrete	40
Dense Bituminous Macadam	60
Aggregate Granular Base	200
Granular Sub-base	150
Pavement Thickness	450

The proposed pavement thickness for Access roads for CBR Value of 20% and traffic Volume of 3 msa;

Table 6.17 Pavement Composition of Tertiary Roads

Pavement Composition	Thickness(mm)
Pre-Mix Carpet	25
Dense Bituminous Macadam	50
Aggregate Granular Base	200
Granular Sub-base	150
Pavement Thickness	450

The given figures (see Figure 6.3030 to Figure 6.333 represents typical secondary roads section. The roadside drain could be either be L-shaped PCC drain or PCC Rectangular drain with U-shaped base depending on sites. Refer drainage proposed in Strom Water Management section for more details.

Similarly, in case of Tertiary roads the roadside drain shall be placed only on the one side of carriageway due to inadequate space. The roadside drain could either be PCC L-shaped drain or PCC Rectangular drain with U-shaped base depending on site.

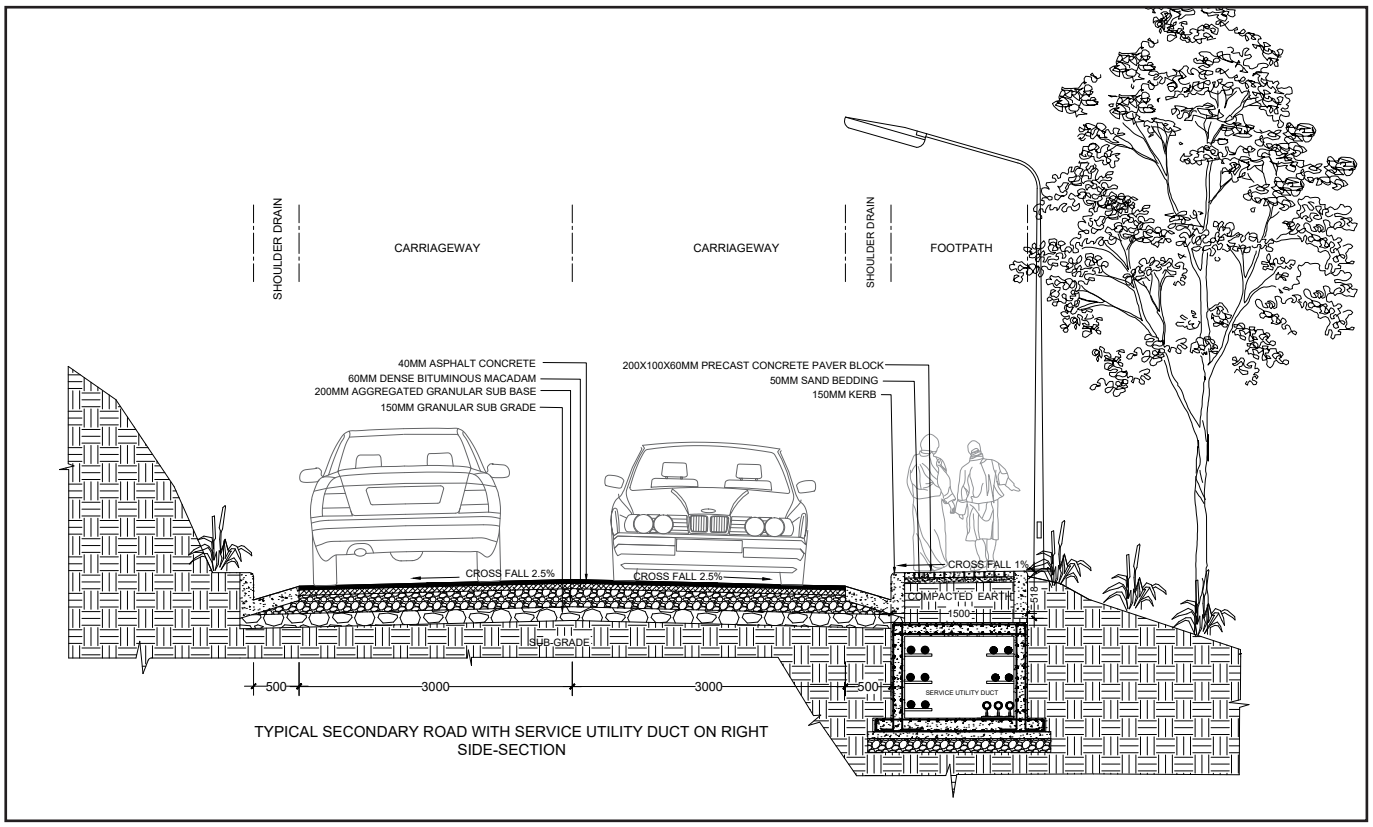


Figure 6.30 Secondary Road section with utility duct

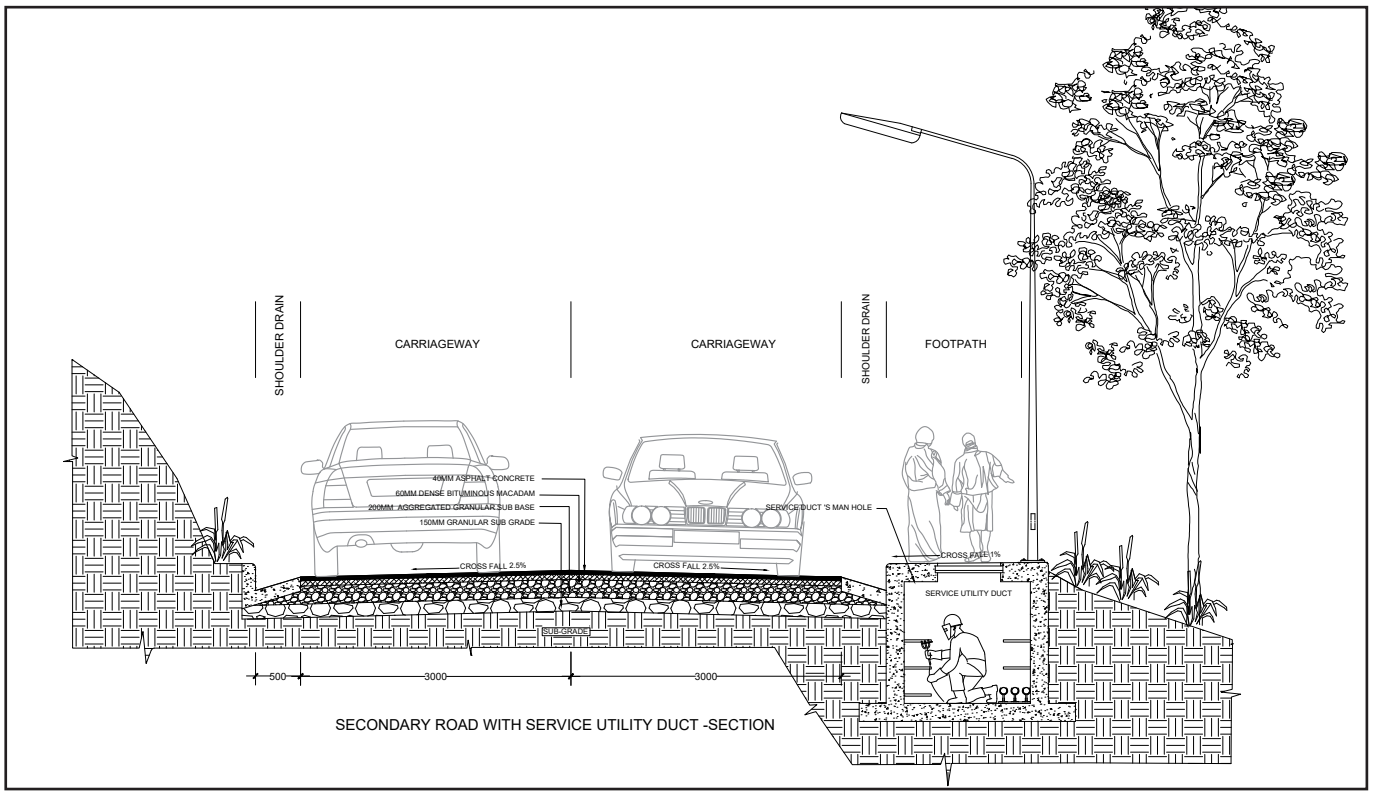


Figure 6.31 Secondary Road section with utility duct (at man-hole)

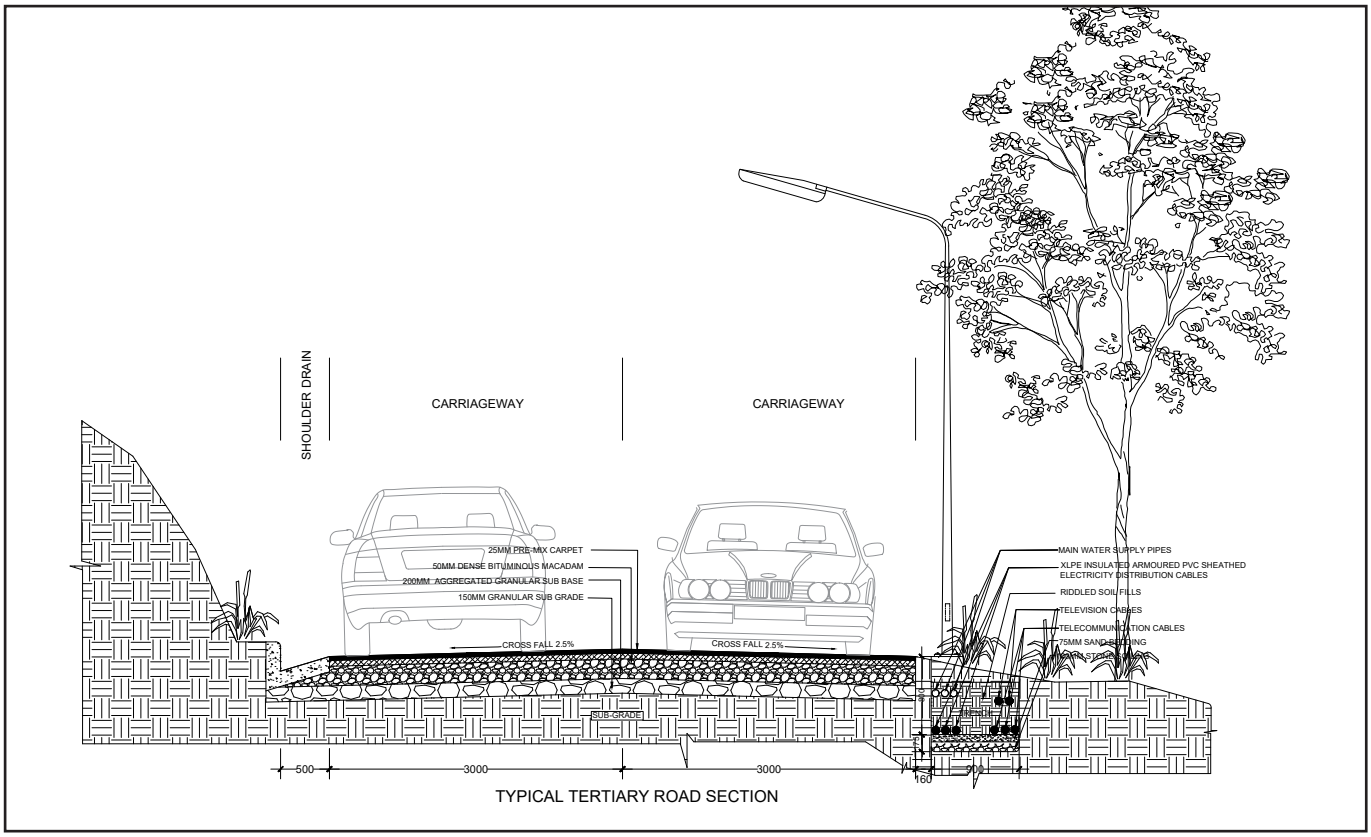


Figure 6.32 Proposed Typical Tertiary Roads Section

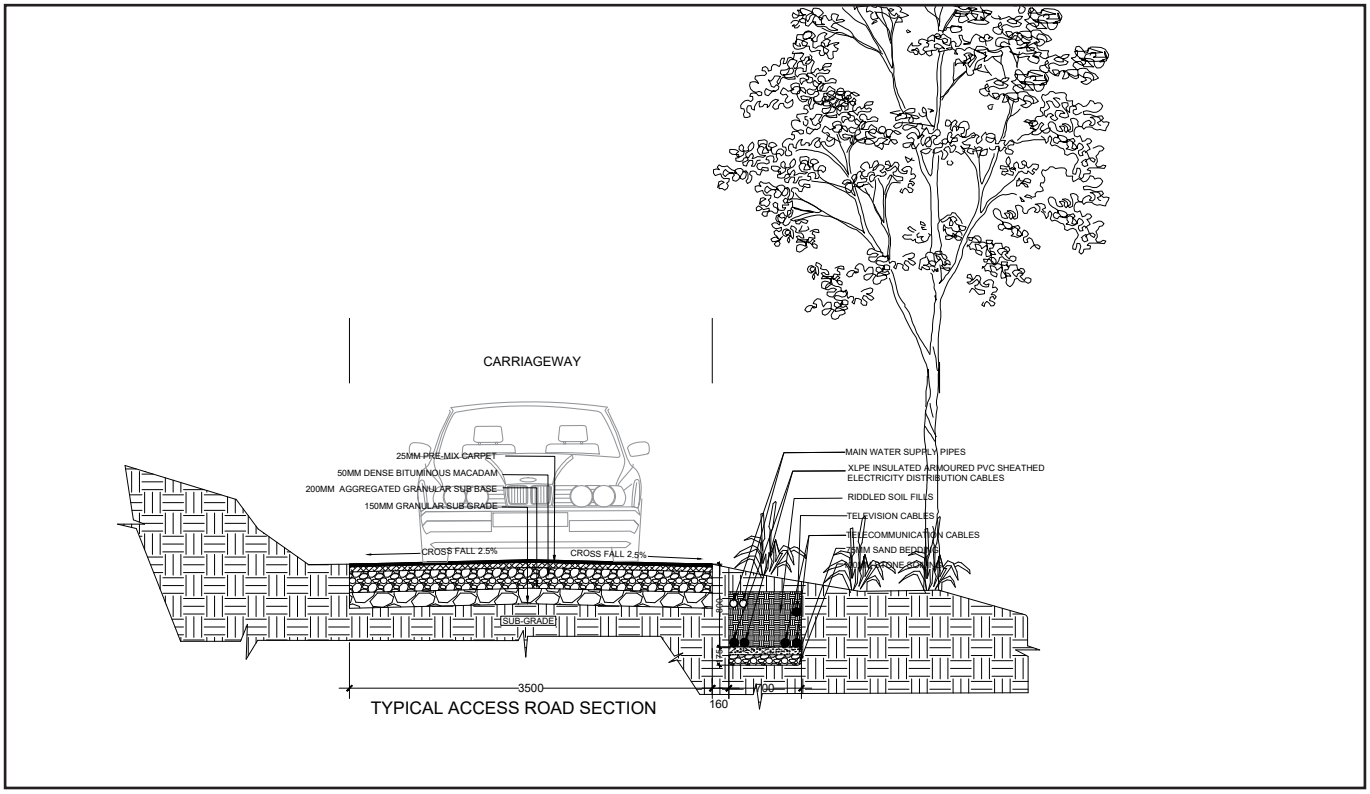


Figure 6.33 Proposed Typical Access Road Section

6.7. UTILITY DUCT

6.7.1. INTRODUCTION

Almost all utilities and services in urban settlements are aligned along the road. Unplanned, uncoordinated and lack of standards to design and layout of the utility and service infrastructure have resulted in repeated digging of the roads, not only damaging structure but also affecting public safety. Moreover, with demand of urban residents for prompt and efficient delivery of services, it has become necessary to design and built integrated system where all utility and service line can be laid.

The advantages of such integrated duct are as follows;

- Convenient laying of pipes and cables by various agencies without having to dig the roads every time new connection has to be made.
- Easy repairs and laying of new pipes and cables in the future.
- Reduction in the recurring cost
- Proper coordination amongst the different utility services providers.

6.7.2. DESIGN CONSIDERATION

For Integrated Duct design, due consideration on Electrical safety rules & regulations are must so that authorized/competent person can perform installation, operation, maintenance & inspection safely. Moreover, it is must for it to perform its function safely, effectively & efficiently and for public safety.

As proposed Integrated Duct accommodate low voltage underground power cables. ALthough underground cables eliminate the electric field altogether as it is screened out by the sheath around the cable, they still produce magnetic field. So underground cable should be typically installed at its minimum burial depth.

As per Indian Standard Code of Practice for Installation & Maintenance of Power cables up to and including 33kV rating (IS: 1255-1983), the desired minimum depth of laying from ground surface to the top of the cables are as follows:

- Low Voltage and control cables: 0.7m
- Cables at road crossings: 1.0m

The desired clearance from power cable to communication cable shall be 0.3m and power cable to gas/water main shall be 0.3m.

The space provided for cable racks has to be sufficient. They are generally fixed to the wall or supported by standing columns or structures enabling easy installation or replacement of cables.

The vertical distance between two racks should be minimum 0.3m and the clearance between first cable and the wall should be 25mm.

In the case of Manholes, the width sufficient to leave a free passage of that least 600mm to 800mm either from one side or in the middle.

When three single-core cables are laid in one plane, the spacing between the cables should not be less than cable diameter.

The desired horizontal and vertical clearance for telecommunication optics cables are similar as for electricity power cables. To reduce interference of both electricity and telephone/cable-television/data cables, the telecommunication cables should be rack from separate wall. Its relative location to other service should be at a distance of 500mm.

Where electricity power cables and communications cables must be racked from same wall, the electricity power cables should be racked below the communication cables.

6.7.3. PROPOSED INTEGRATED DUCT

The proposed Integrated Duct shall be constructed along secondary roads in Kabratyar & Dhamdara. It shall be placed at minimum depth 550mm below the proposed footpath along secondary roads and at least 850mm below pavement whenever it crosses the roads.

Manholes shall be constructed at 50m interval for timely inspection, operation and maintenance of the electricity lines, telephone lines, TV cables and Water supply lines by concerned authority.

Proper drainage and ventilation should be provided in utility Duct to dissipate heat generated from electricity distribution cables and to drain out water in time of hazard/accidental bursting of water pipes in duct.

The electricity distribution lines, telephone lines, TV Cables and water supply pipes once taken out of the duct, shall be buried at safe depth below ground surface along tertiary roads in LAPs to deliver utilities and services to plots in LAPs.

6.7.4. PROPOSED UTILITY DUCT DESIGN

The proposed Utility Duct/Integrated Service Duct shall be Reinforced Concrete Structure placed along the secondary roads in Kabraytar and Dhamdara.
It shall be designed structurally to withstands earth active/passive pressure from side. The dimenaions of proposed utility duct network are shown in Figure 6.34 and Figure 6.35. The network is planned to be along the secondary roads below footpaths as shown in Figure 6.36.

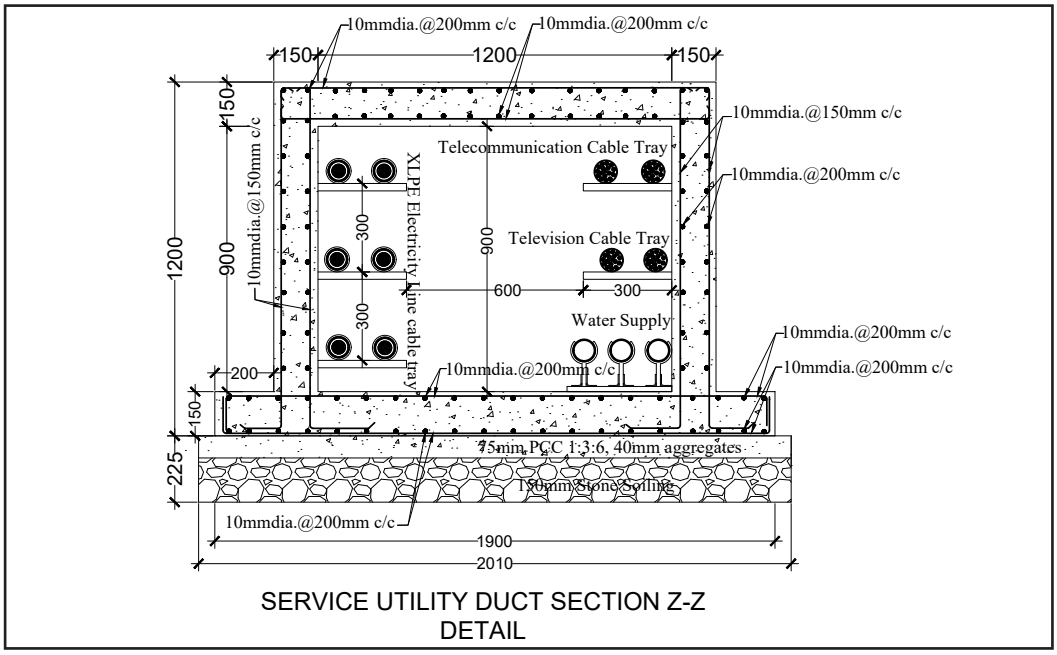


Figure 6.34 Utility duct section

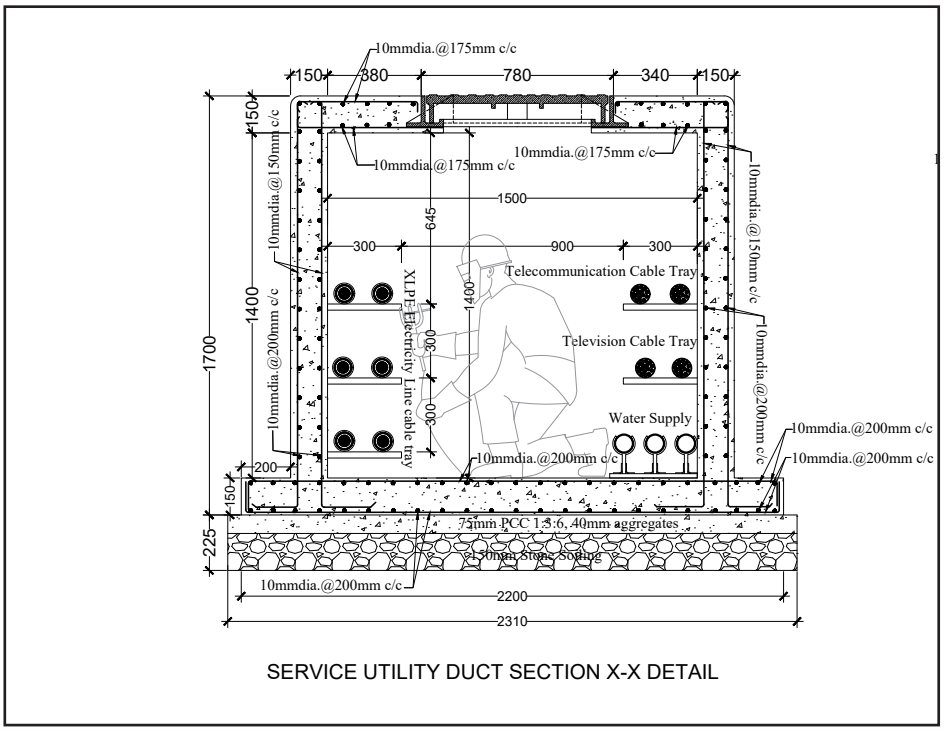


Figure 6.35 Utility duct section at man-hole

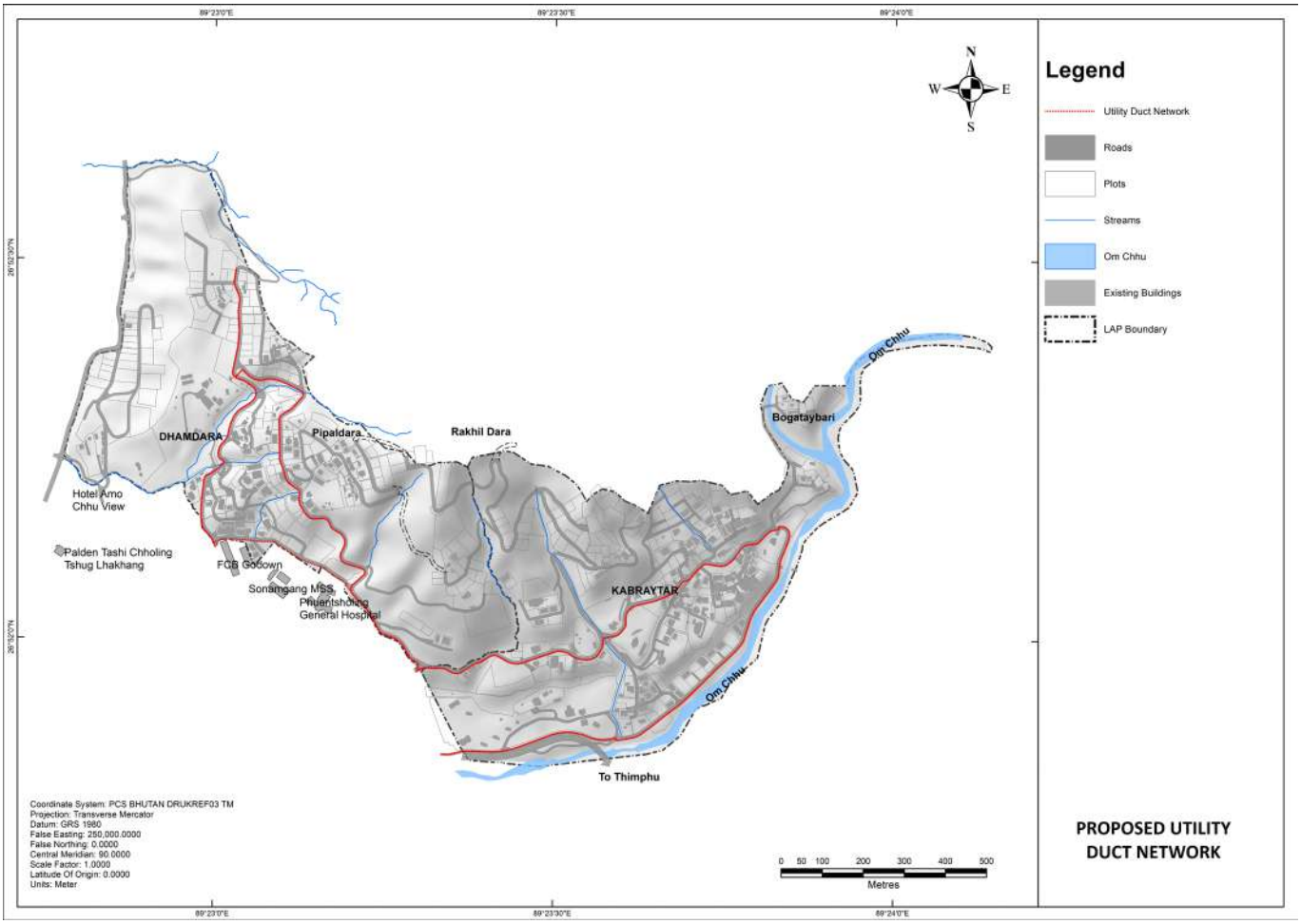


Figure 6.36 Proposed Utility Duct Network

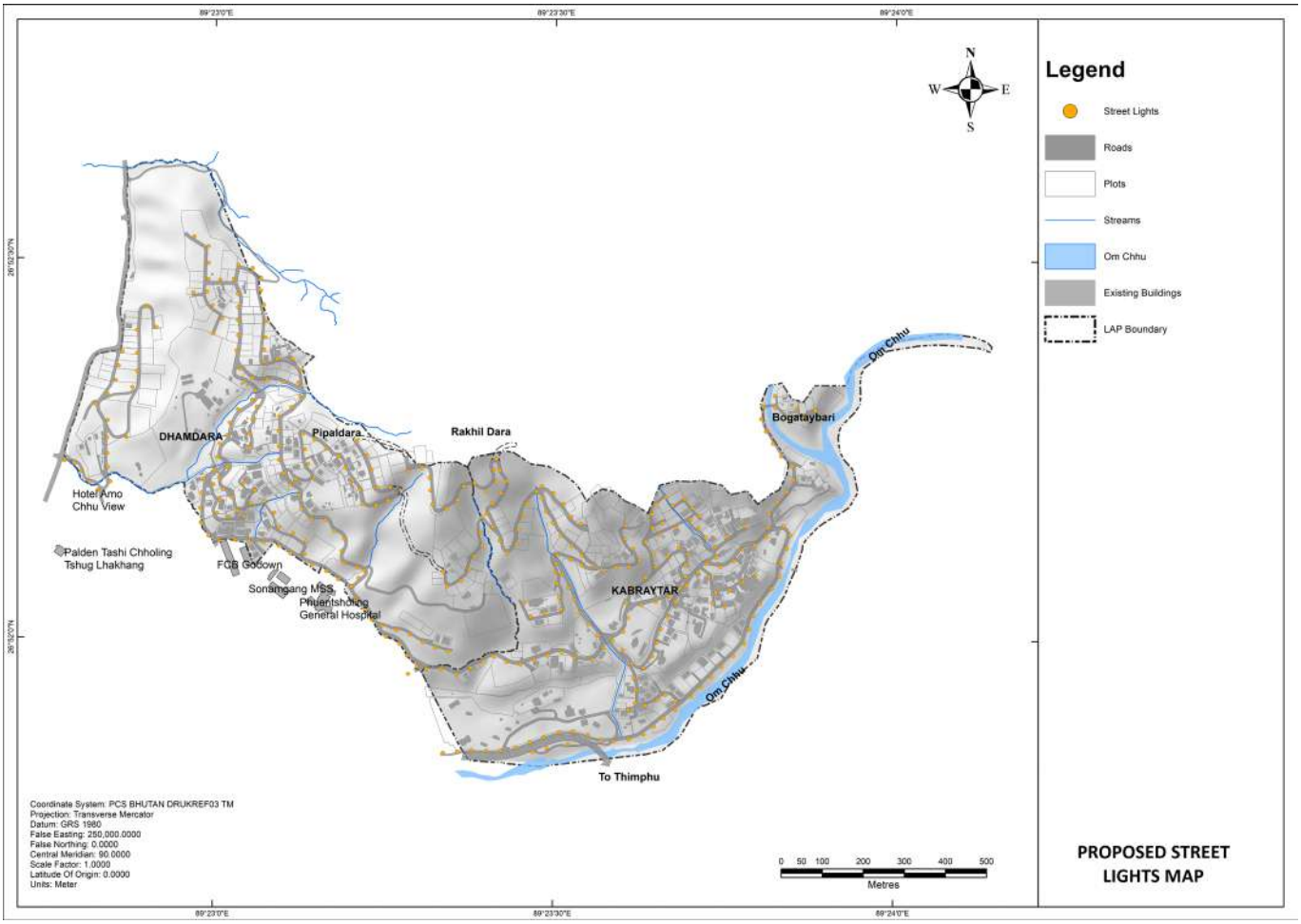


Figure 6.37 Proposed Street Light Network

6.8. STREET LIGHTS

Map in Figure 6.37 shows the location of street lights in the proposed plan. Details of street light design, distribution and specifications are provided in the documents attached.

6.9. LAND CONTRIBUTION FOR INFRASTRUCTURE

A number of plots have been affected by widening of roads and new proposed footpaths and walking trails. As mentioned earlier, since the land pooling has already been conducted, Guided Land Development (GLD) is applied for acquiring land needed for the proposed infrastructure. The list of plots and the area that is to be contributed is provided in Appendix D.

AMENITIES AND SOCIAL INFRASTRUCTURE

7. AMENITIES AND SOCIAL INFRASTRUCTURE

One of the factors satisfying the basic needs is the social infrastructure. Transportation facilities, health and education facilities, social protection & safety, housing services are some of the social infrastructure needed in a community to see its economic developments, social security, political stability, self-fulfillment and professional development of the individuals, and so on. However, social infrastructure is provided in response to the needs of the communities.

Governments in the developed countries now recognize the mistakes and costs associated with failing to provide adequate social infrastructure in communities. There are evidences through research around that world that the economic benefits of providing social infrastructure far outweighs the costs of provision of such facilities. In a cost-benefit analysis by the Washington State Institute for Public Policy (WSIPP), they calculated a benefit-cost ratio of over $2 per dollar of cost for some pre-kindergarten education facility, and benefit cost ratio of over $11 per dollar of cost for some youth development programs. This indicates that the need to incorporate social infrastructure requirements in planning and development proposals is an important requisite for the communities.

Social infrastructure is broadly classified in the following categories:

- Health
- Education
- Sports & Recreation
- Housing
- Emergency Services (Fire, Police, Postal, etc.)
- Public transport
- Legal and public safety
- Community development

Social sustainability needs to be considered when providing social infrastructure. Social sustainability refers to the capacity of a society to provide for the safety, care, leisure, and, education, to the people in a stable, reliable, and ongoing manner. Thus, provision of social infrastructure should focus on fulfilling the following goals:

- Equity of access to appropriate services
- Access to information and education
- Affordable and appropriate housing
- Safety
- Environmental quality
- Effective and viable networks to facilitate community participation
- Demographic diversity
- Sense of place
- Inclusion of socially disadvantaged groups
- Physically attractive neighborhoods and community Centers

The implications of a social sustainability framework to infrastructure planning would be to ensure, for example, that not only are there transport services but that they are accessible to older people or people with a disability; that not only are there adequate levels of housing but there is fair and equal access to affordable housing; that employment opportunities exist within local communities and that there is information about, as well as access to, a range of social and community services and opportunities. Most of all it means that there are local strategies in place that assist individuals and communities to develop relationships, communication systems and mutual trust between groups of people.

7.1. EXISTING SCENARIO

The map of the existing social infrastructure is shown in Figure 7.1.

7.1.1. HEALTH FACILITIES

The Phuentsholing General Hospital which was completed in 2005 is equipped with 40 beds along with specialists like General Surgery, Gynecology, Obstetrics, and general patient care services. Apart from the General hospital, there are two other health facilities, the dispensary at BFAL colony in Pasakha and Infirmary at the College of Science and Technology (CST).

7.1.2. EDUCATIONAL FACILITIES

Phuentsholing Thromde houses around 7 schools, 1 college, and 3 day care Centres. Out of the 7 schools, 2 of them are Lower Secondary Schools, 3 of them Middle Secondary Schools, and the remaining 2 are Higher Secondary Schools. Two of the day care centres are located in Kabraytar.

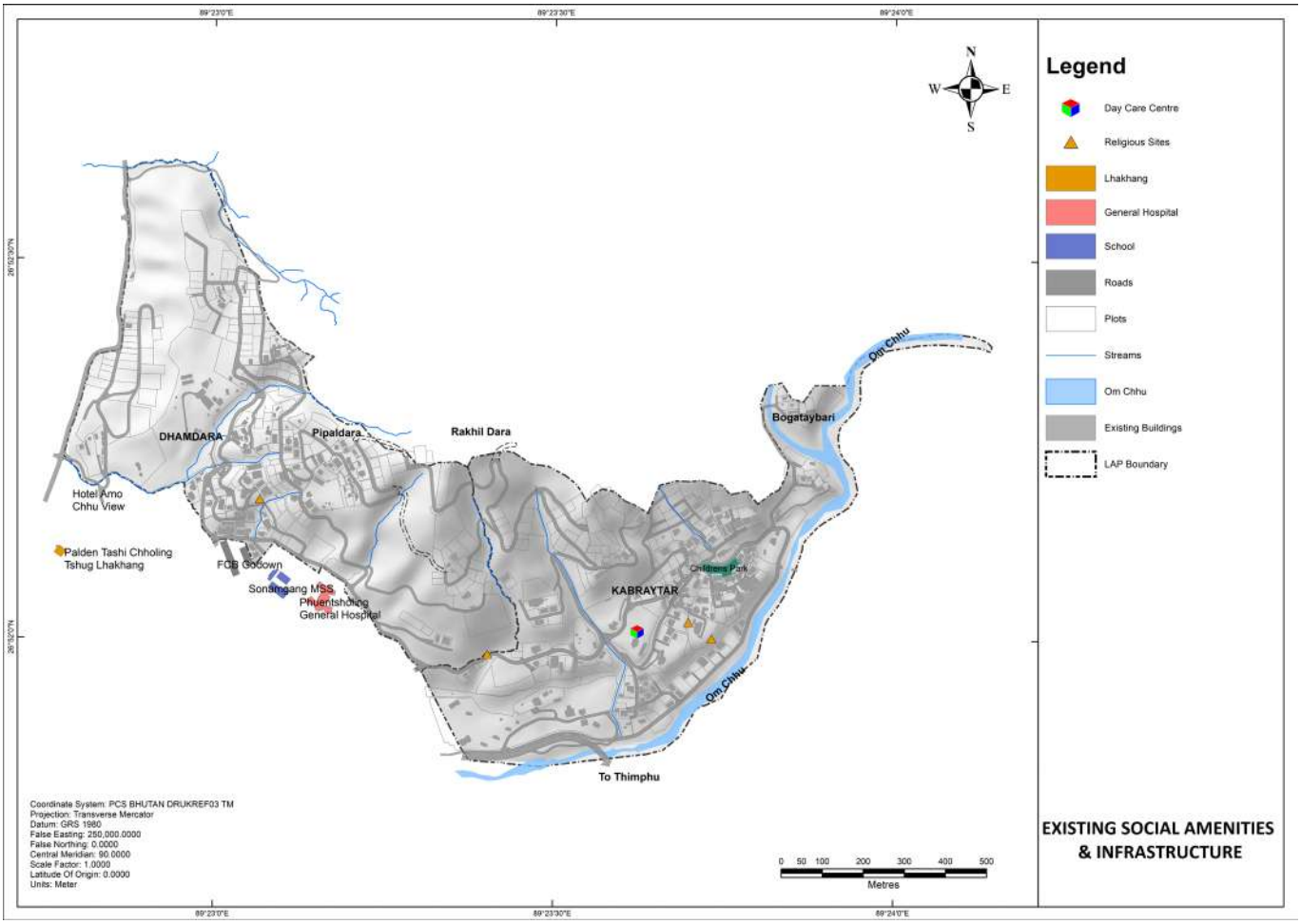


Figure 7.1 Map showing the existing social infrastructure

7.1.3. RELIGIOUS AND CULTURAL FACILITIES

Both the Laps doesn't have religious and cultural facilities as such, however there are a few religious sites in the area but are located in private properties. There is only one religious site accessible to public which is along the Kabraytar Lam. Those limited sites need to be preserved and maintained, and should be developed into community religious facilities if there are vacant spaces available around them.

Apart from those small sites, people in those LAPs will have to go outside their LAPs in order to visit religious facilities. The Zangtopelri Lhakhang, Rinchending Goemba, Rani Choni Wangmo Lhakhang, are some of the religious sites within the Thromde area. Also, the Dratshang complex at CHPC upper terrace provide religious facilities and hostels for monks. One of the nearest religious facility from the two LAPs is the Palden Tashi Chholing Tsug Lhakhang.

7.1.4. OPEN SPACES & RECREATIONAL FACILITIES

There are no proper recreational facilities in the LAPs. However, there is a small children's park in Kabraytar. Those recreational facilities such as the PSA mini stadium, the tennis court, children's park near PSA mini stadium, Zangtopelri park, the crocodile farm near Norgay area, and the archery ground are all located outside but close to the LAPs.

7.1.5. CONVENIENT SHOPPING

Both the LAPs have some general shops, usually on the ground floor of the buildings. However, there are no proper market areas in both the LAPs. People usually go to the city core or to Jaigaon for Sunday vegetable markets.

7.1.6. FIRE FIGHTING SERVICE

There are no firefighting facilities in the two LAPs. As a matter of fact, Phuentsholing has only one agency (Royal Bhutan Police) responsible for firefighting services in the area. Their office is located in the police colony in the core town area.

7.1.7. FINANCIAL FACILITIES

The LAPs do not have any financial facilities in the area. Lack of financial facilities like banks, and ATMs within walking distance makes it hard for the people to do financial transactions within the LAP. The bank offices, and ATM services available are located in the core area of Phuentsholing Thromde.

7.1.8. PETROL PUMP

The available fuel stations in Phuentsholing are located in the town area, thus leaving Kabraytar and Dhamdara with no provision for fuel stations.

7.2. PRINCIPLES

7.2.1. PLANNING REQUIREMENTS FOR PUBLIC AMENITIES

All the public amenities should be provided in accordance with the following requirements as per the spatial planning standards of Bhutan;

- Public amenities should be laid out as per the standard criteria including distance, and catchment area.
- Grouping of public amenities with public spaces on the same land wherever possible.
- Public amenities shall be located according to the hierarchy of roads, its accessibility, criteria related to noise, pollution, safety, and so on.
- All public amenities should be connected to pedestrian networks and cycle lanes.
- All public amenities should be accessible via public transport at a maximum of 30 minutes walking distance from transit stops.
- Public amenities should be provided with water, sanitation, electricity, and telephone.
- All public spaces should be lit at night.
- All public amenities should be accessible by persons with special needs.

The following tables gives the various types of social infrastructure, their suitable locations, maximum catchment radius and population, and land area required for their provision as per Spatial Planning Standards.

1. Health

Table 7.1 Basic planning requirements for Health infrastructure

Amenity	Location	Maximum Catchment Radius	Max Catchment Population	Land Allocated (sqm)
Regional Hospital	Central in the Region	60 Minutes Driving	30,000	5000-20000
Dzongkhag/District Hospital	Central in the District	30 minutes driving	15,000-20,000	3000-5000
Basic Health Unit	Centrally Located	30 minutes walking	1000-5000	500
Neighbourhood/outreach clinic	Neighbourhood centre	30 minutes walking	100-200	300-500
Small Pet Clinic	Residential areas	30 minutes driving	15000	500

2. Education

Table 7.2 Basic planning requirements for Educational infrastructure

Amenity	Location	Max Catchment Radius	Max Catchment Population	Land Allocated (Sqm)
Nursery School (100 Pupils)	Neighbourhood Nodal point, secondary road	10 minutes walking	5000	1000
Lower Secondary School (300 students)	Urban Nodal Point, primary road	15 minutes walking	5000	5000-10000
Middle Secondary School (600 students)	Periphery areas, primary road	45 minutes by school bus	20000	15000-20000
Higher Secondary School (600 students)	Periphery areas, primary road	45 minutes by school bus	20000	20000-30000

3. Recreation, Culture, and Sports

Table 7.3 Basic planning requirements for Recreational infrastructure

Amenity	Location	Max Catchment Radius	Max Catchment Population	Land Allocated (Sqm)
Indoor sports complex	Periphery areas with good access to public transport, primary road	5 km	5000-30000	15000-25000
Outdoor sports complex	Periphery areas with good access to public transport, primary road	5 km	5000-30000	20000-25000

4. Religious Sites

Table 7.4 Basic planning requirements for Religious sites

Amenity	Location	Max Catchment Radius	Max Catchment Population	Land Allocated
Community Temple	Neighbourhood Node	30 minutes walking	2500	200-1000
Crematorium	Whole urban area (one in every town)			

5. Emergency Services

Table 7.5 Basic planning requirements for Emergency services

Amenity	Location	Max Catchment Radius	Max Catchment Population	Land Allocated
Firefighting services	In the center of the catchment area, along or in proximity to main roads, primary road	30 minutes driving	2500-30000	200-500
Police service	In the center of the catchment area, along or in proximity to main roads, primary road	30 minutes walking	2500-5000	200-500

6. Public Spaces

Table 7.6 Basic planning requirements for Public Spaces

Amenity	Location	Max Catchment Radius	Max Catchment Population	Land Allocated
Parks	Location subject to existing natural spaces such as rivers, forest, etc.	No Limit	No Limit	>5000
Small gardens, children playground	Neighbourhood nodal point, Secondary road	10 minutes walking	2000	200-500
Children's' Playground	Neighbourhood nodal point, Secondary road	10 minutes walking	5000	200-500

7. Commercial Facilities

Table 7.7 Basic planning requirements for Commercial Facilities

Amenity	Location	Max Catchment Radius	Max Catchment Population	Land Allocated (Sqm)
Weekly market	Town or neighbourhood centre, high density areas, primary road	30 minutes walking	30,000	3000-5000
Neighbourhood Commercial Centre	Along the major neighborhood's street, primary road	30 minutes walking	5000	500-2000
Fuel Station	Along or in proximity to main roads, primary road	30 minutes driving	No Limit	500-1000

7.2.2. WALKABILITY AND PROXIMITY

Analysing how far apart to space things such as parks, trails, transit stops, and other amenities has a direct link on the cost of providing those services, and to the users as well. Placing facilities too far from one another, or too far from transit stops or traffic routes may discourage people from using them. On the other hand, placing them too close to one another may not be efficient. Thus, it is important that such services are provided at right distances from each other.

As per standards of many countries, a 10-minute walk is usually about 800 metres. Most countries with flat terrain consider this standard while making planning decisions. For a mountainous country like ours, due to circumstances like terrains, turns and twists in the roads, it would be advisable to take a radial distance of 500 metres or less for a walking time of 10 minutes.

7.3. ANALYSIS

7.3.1. HEALTH INFRASTRUCTURE

The analysis of the social infrastructure is done as per the planning requirements for the social infrastructure. As per the analysis and the standards provided in the spatial planning standards of Bhutan, the existing Phuentsholing General Hospital will be able to serve the two LAPs. Both the LAPs are within 1.5 Kilometers from the Hospital (see Figure 7.2) , which is within the set standards of the spatial planning standards. However, it is recommended to have private pharmacies within the LAPs, especially in those areas proposed for Neighbourhood Nodes.

7.3.2. EDUCATION INFRASTRUCTURE

The existing school, Sonamgang Middle Secondary School, will serve to the sudents upto class ten from Kabraytar and Dhamdara. The analysis (see Figure 7.3) shows that the school is located right outside Kabraytar LAP, and the maximum catchment radius from both the LAPs to the school is 1.5 Kilometres which is within the distance specified in the spatial planning standards of the country. High school is also located near the LAPs, within comfortable driving distance. The day care centre located in Kabraytar (See Figure 7.4) lies within the radial distance of 500 metres from most of the settlements within Kabraytar.

7.3.3. RELIGIOUS AND CULTURAL FACILITIES

As per the analysis, the religious sites located in the LAP (see Figure 7.5) area are within 5 – 10 minutes walking distance. However, those religious sites don't have facilities for people to gather and do religious ceremonies or festivals. The nearest religious facility is the Palden Tashi Chholing Tsug Lhakhang, which is located within 2 km radial distance (see Figure 7.6) from the furthest corner of the LAP area. As per the spatial planning standards, community temples shall be located within 30 minutes walking distance, which according to international standards is about 2.4 Kilometers.

7.3.4. OPEN SPACES & RECREATIONAL FACILITIES

The only open space in Kabraytar lies within a 10-minute walking distance from most settlements in the area. Figure 7.7 shows the location of the space and the radial distance of 500 metres from the centre of it.

7.3.5. CONVENIENCE SHOPPING

The existing scenario shows that there are no major market place in both the LAPs. However, there are a number of general stores in the ground floor of the buildings. Therefore, it is imperative that there is some market in the area so that people can enjoy shopping in their Neighbourhood. Provision of weekly markets in the proposed Neighbourhood Nodes would provide better opportunities and community vitality.

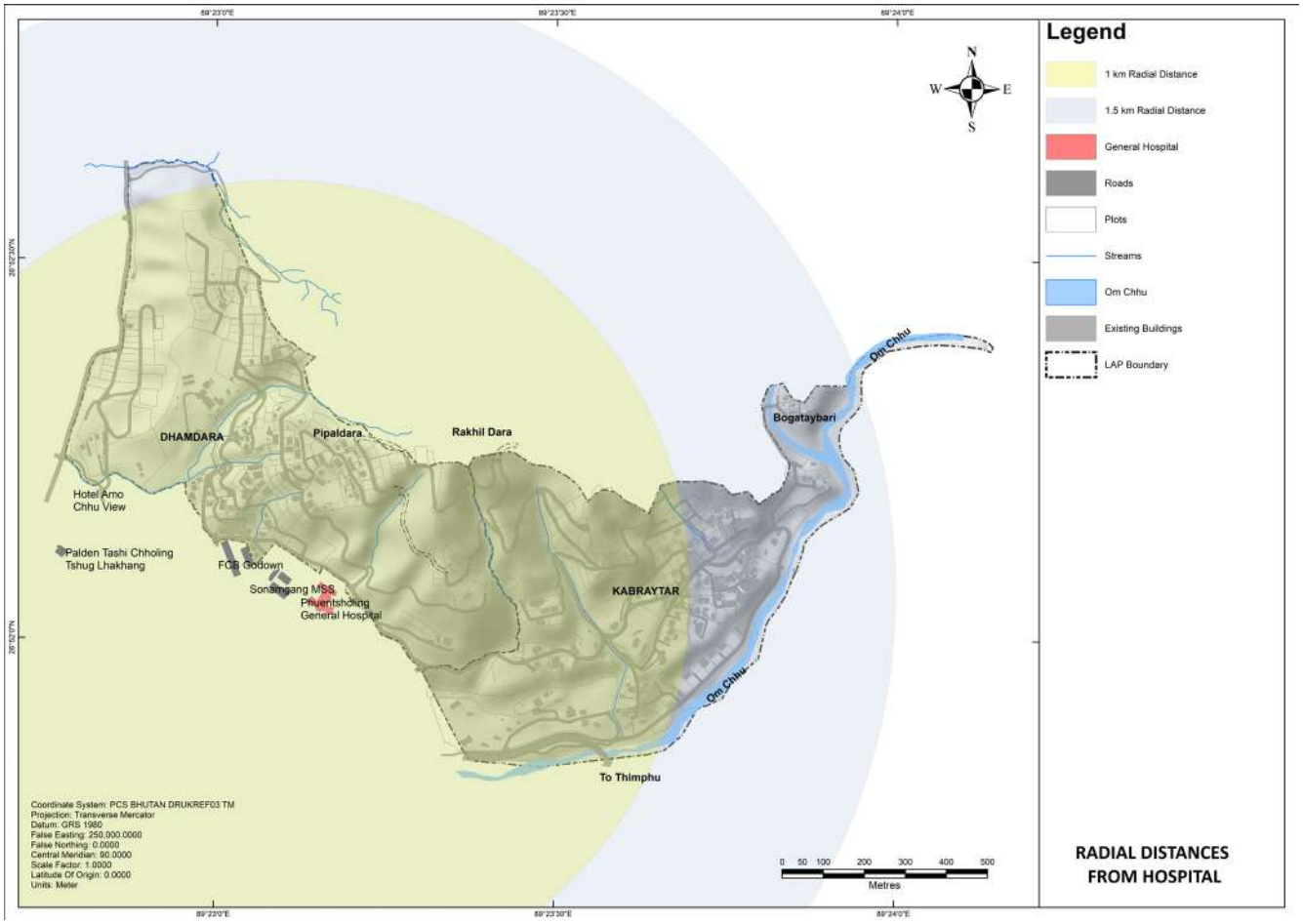


Figure 7.2 Radial distance from Phuentsholing General Hospital

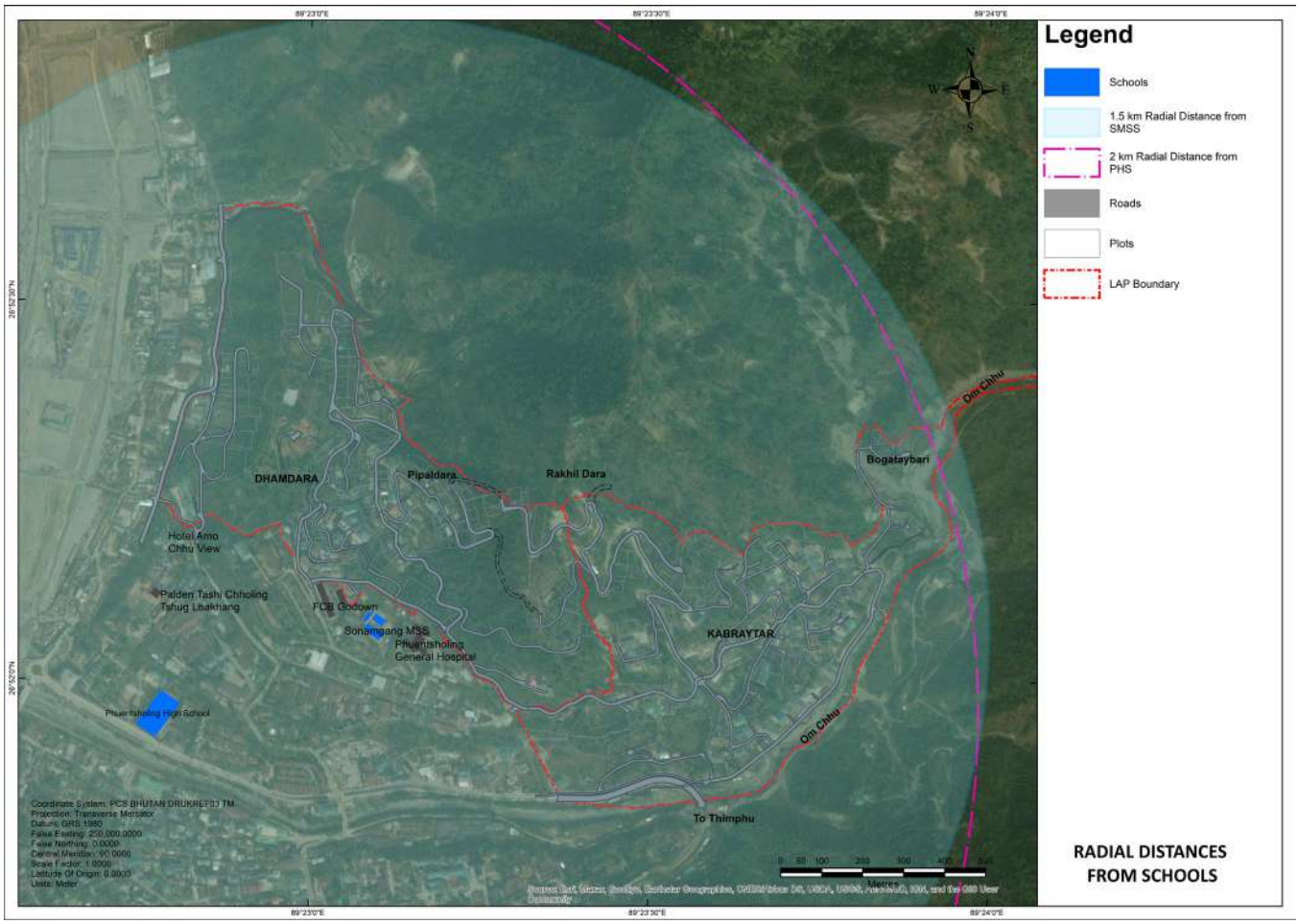


Figure 7.3 Radial Distance from Middle Secondary and High Schools

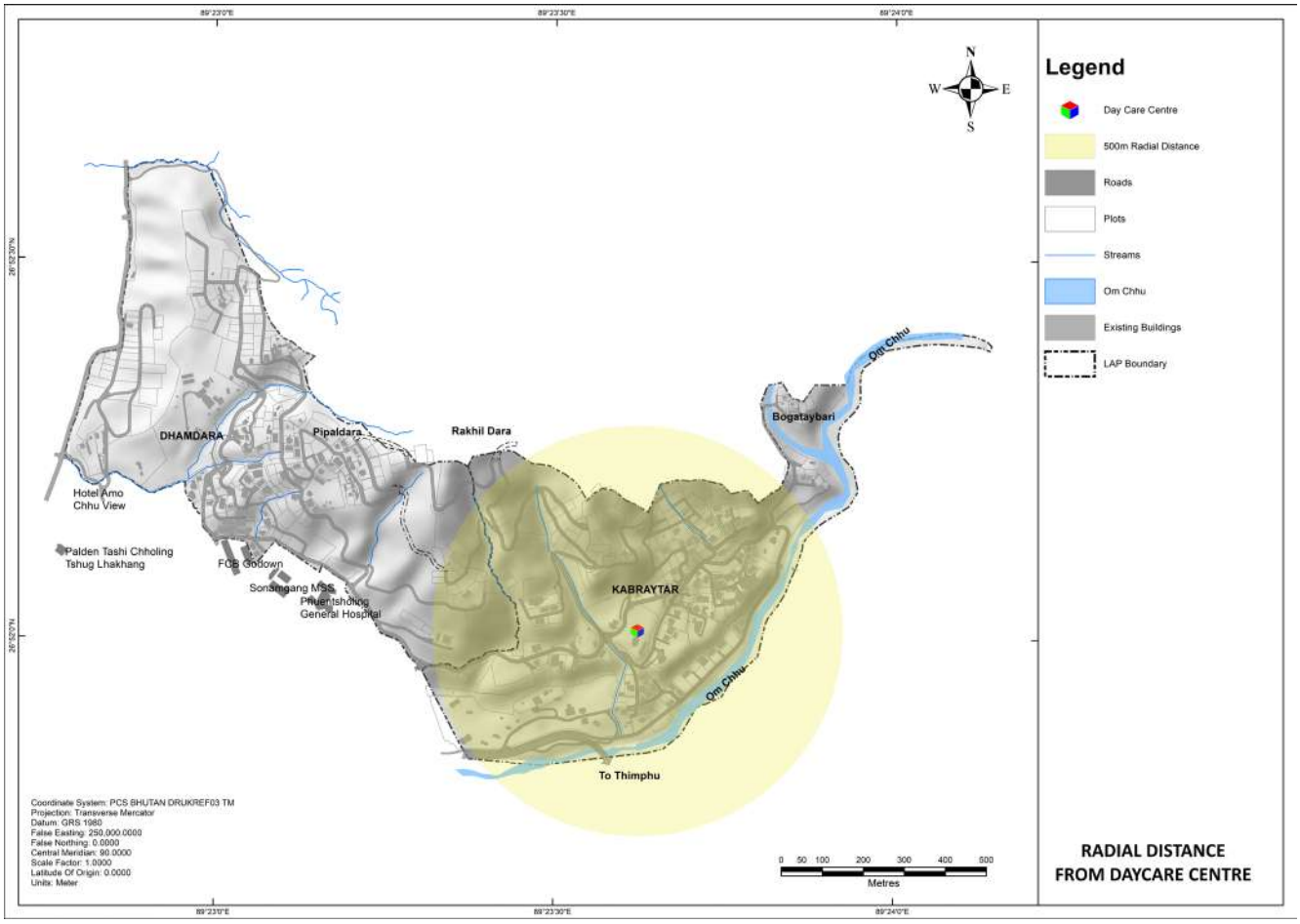


Figure 7.4 Radial distance from Daycare Centre

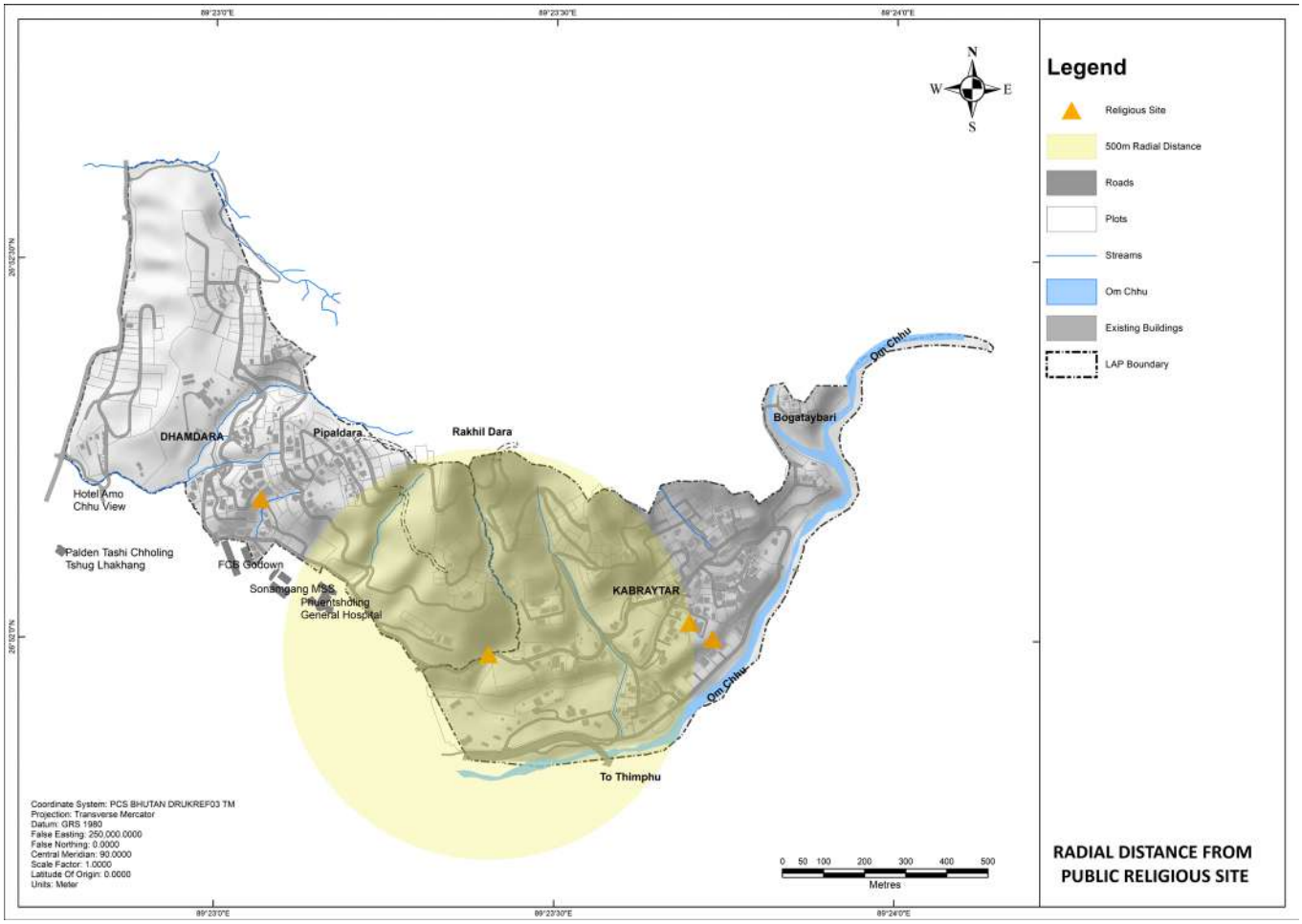


Figure 7.5 Radial distance from Religious Sites

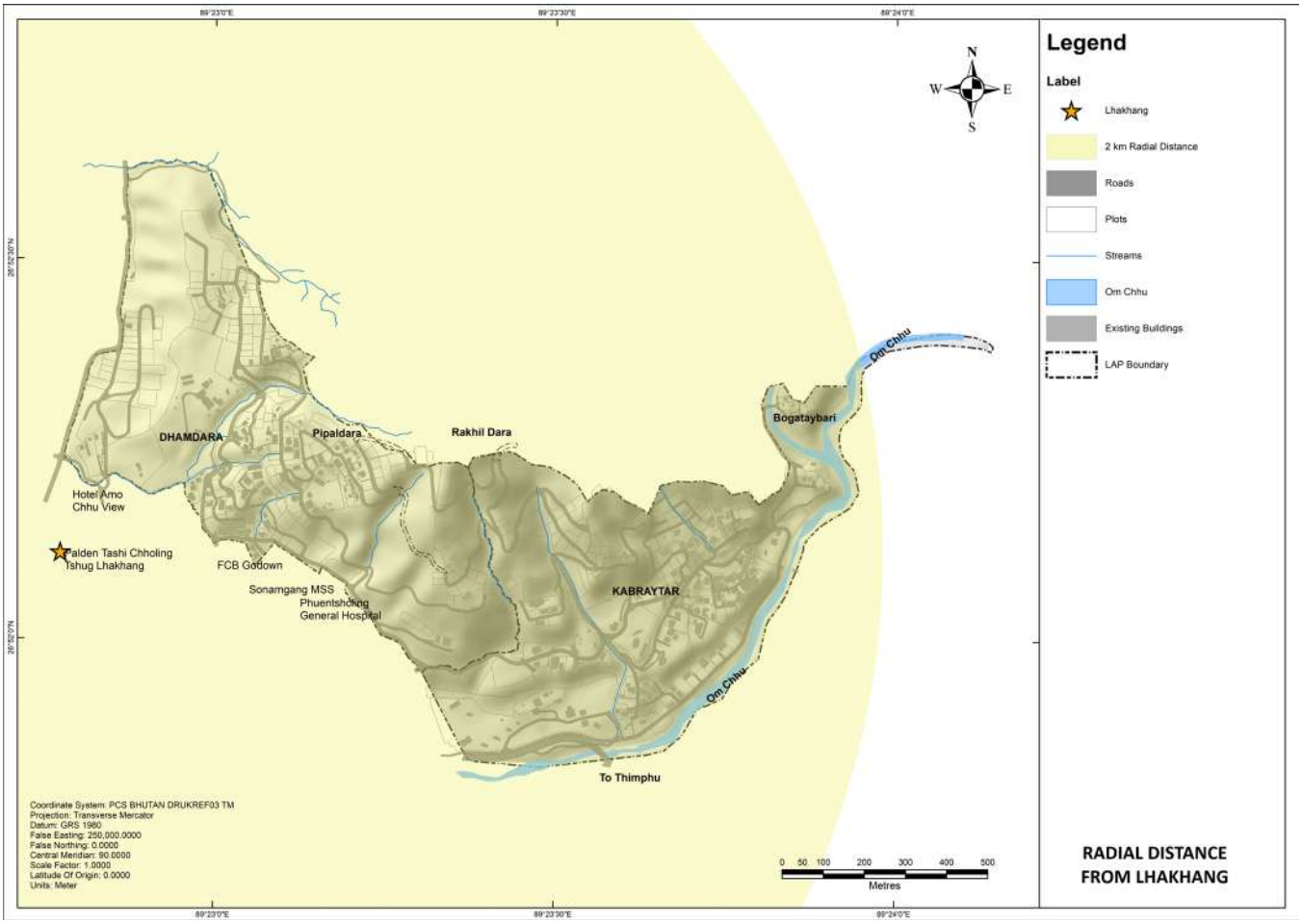


Figure 7.6 Radial Distance from Lhakhang

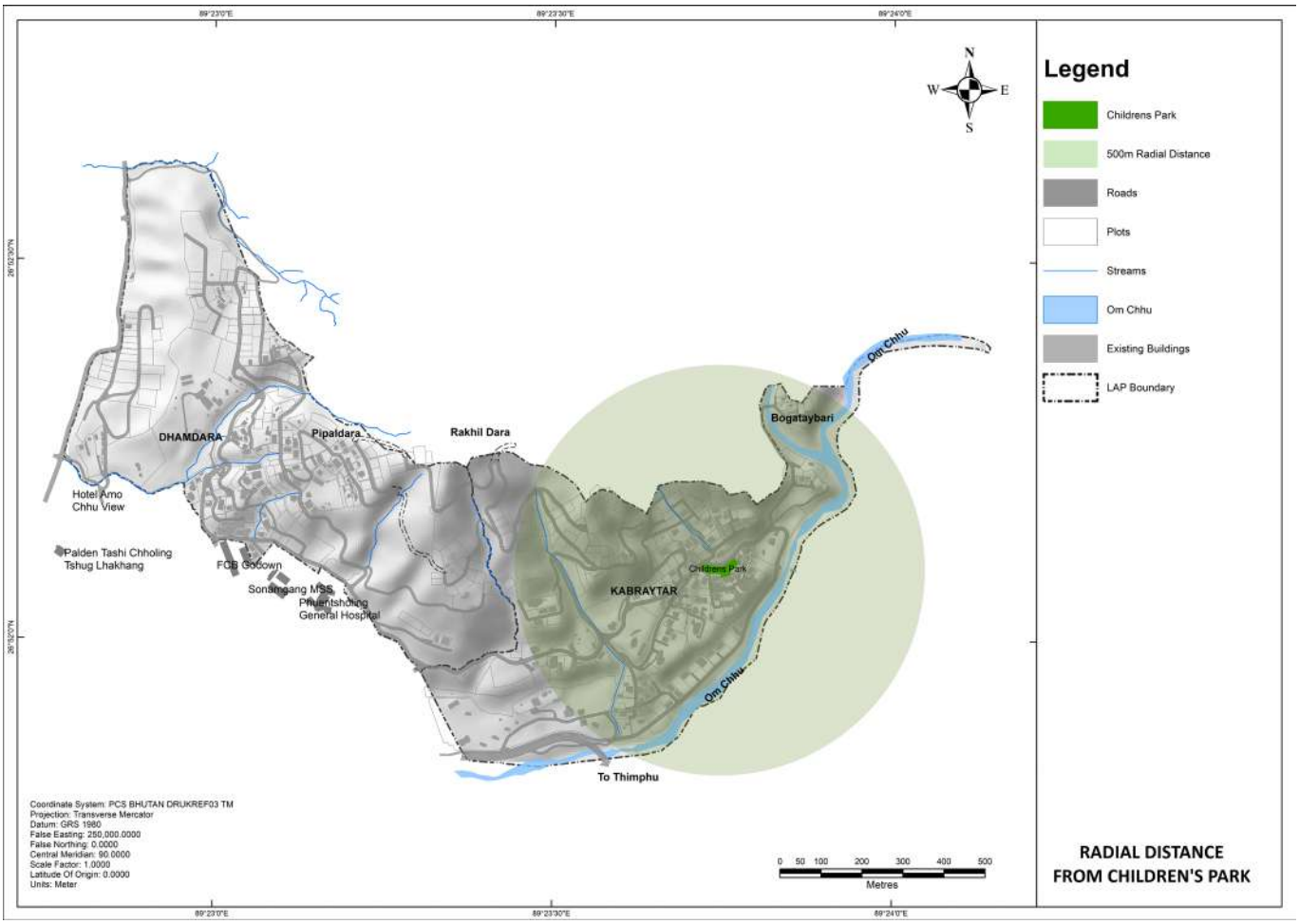


Figure 7.7 Radial distance from children park

7.4. PROPOSALS

Based on the existing scenario and analysis as explained, the following proposals have been recommended.

7.4.1. OPEN SPACE AND RECREATIONAL AREA

The overall location of the proposed social infrastructure is shown in the map in Figure 7.8. Due to the lack of vacant government land in the LAPs, it is difficult to propose open spaces.

The two vacant land located towards the eastern end of Kabraytar are proposed to have an indoor sports complex, and a swimming pool respectively. The plots are just adjacent to one another, thus the provision of a swimming pool near the sports complex will add to its functionality. Few open spaces are also proposed in Dhamdara.

The open space system can be provided with furniture such as seating benches, gazebos, children play area, and Manis, so that the space can be used by all age groups. The proposed open space and the recreational areas are within a walking distance of 10 minutes from majority part of the settlements.

7.4.2. ATM BOOTHS

There are 4 ATM booth locations proposed for the two LAPs (see Figure 7.8), out of which 2 of them are in Kabraytar and the remaining 2 in Dhamdara. The choice of their proposed locations are influenced by factors such as density in the particular area, accessibility & connectivity, and walking distance. They are proposed in areas where the density is quite high, and are located within walking distance of 5-10 Minutes. Moreover, they are proposed to be located near the main road sides so that people going towards the town area can access them without having to enter into pocketed settlements within the LAP.

7.4.3. PETROL PUMP

A location in lower Kabraytar is identified for a new petrol pump along the newly constructed Thimphu-Phuentsholing By-pass. The location is shown in Figure 7.9.

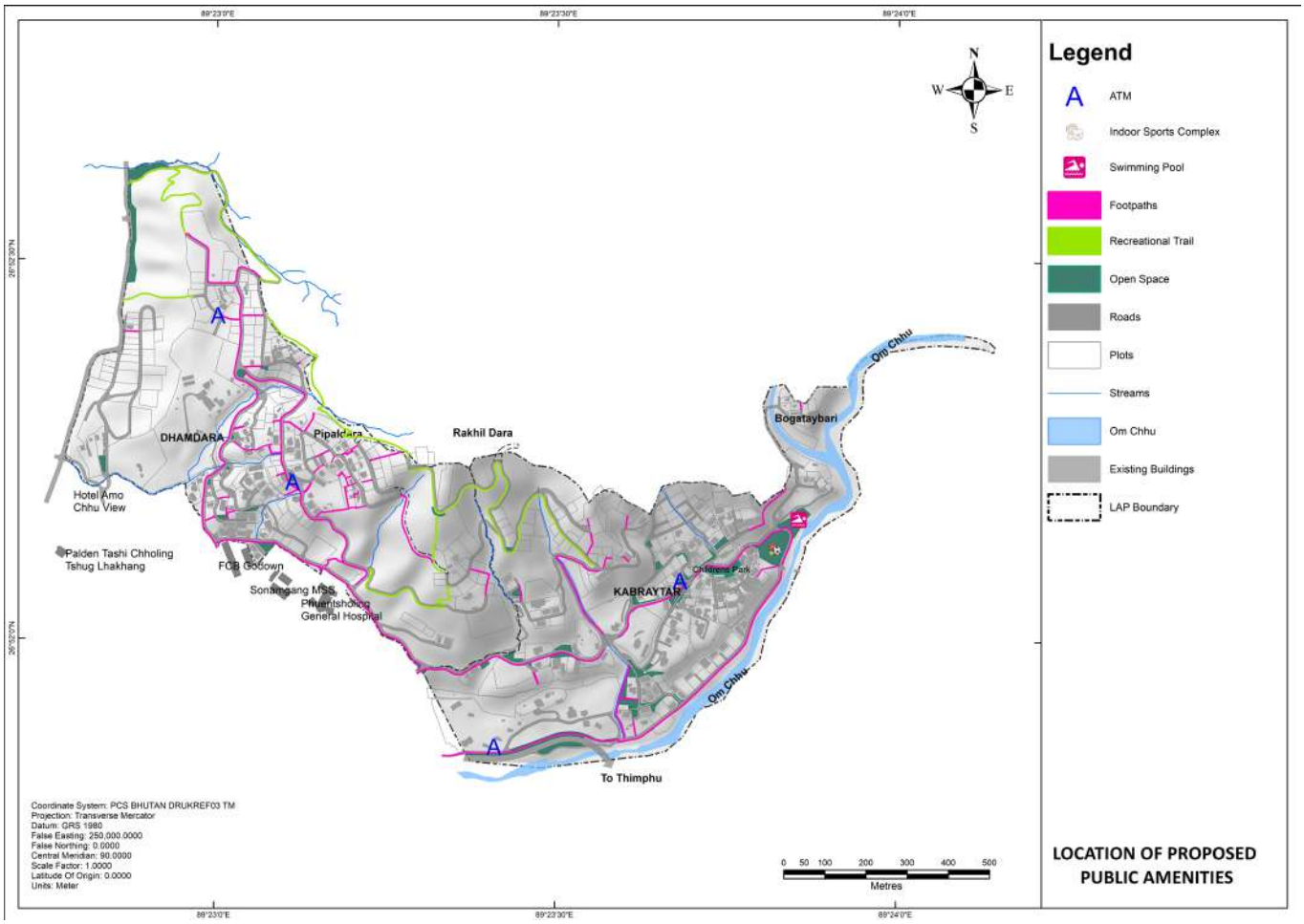


Figure 7.8 Map showing the location of proposed public amenities

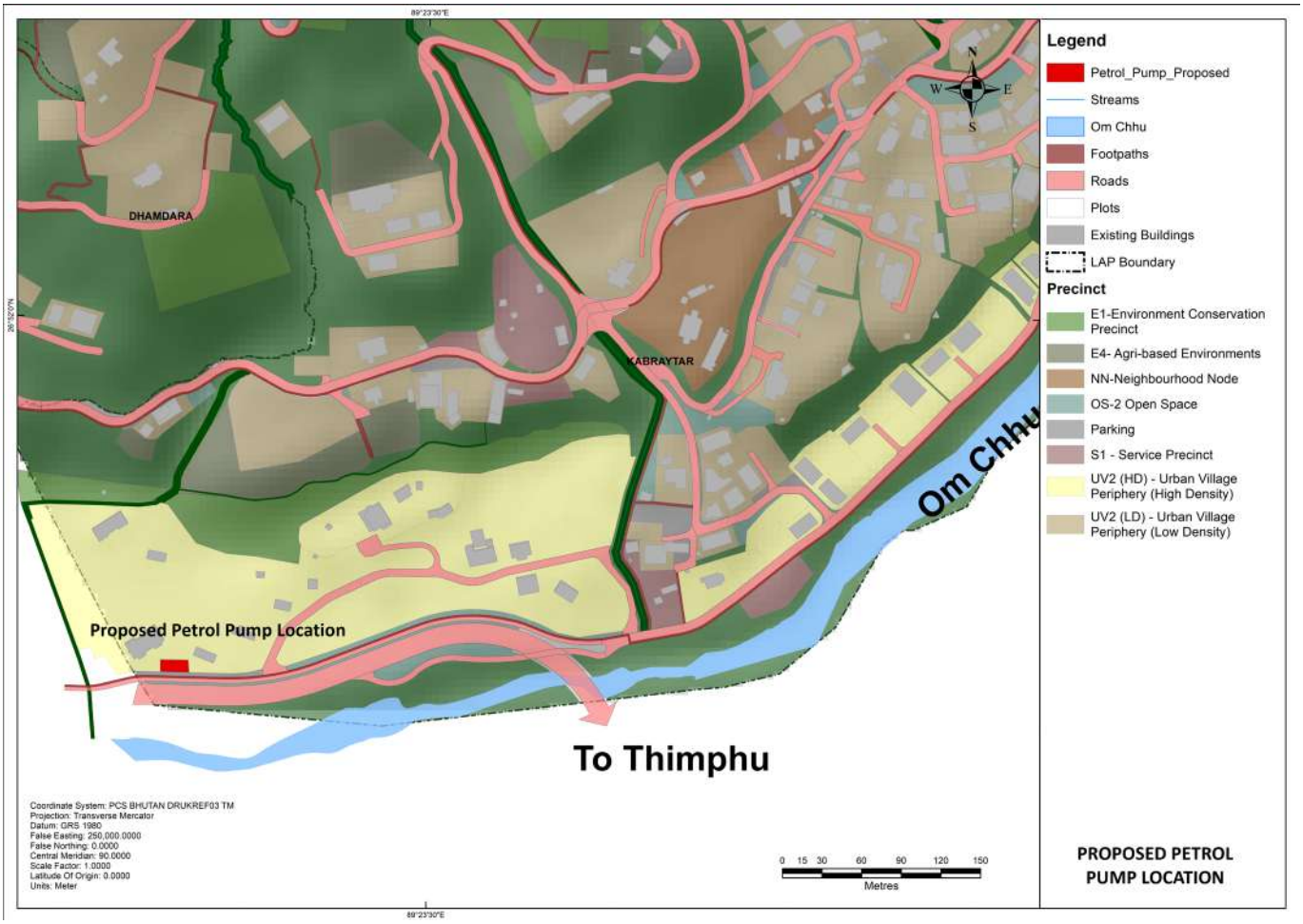


Figure 7.9 Proposed location for a Petrol Pump

8. REFERENCES

Alpha Geotech & Company. (2019). *Geotechnical Investigation and Slope Stability Assessment for Kabraytar and Dhamdara*. Phuentsholing: Phuentsholing Thromde.

Development and Review Division: Ministry of Works and Human Settlement. (2016). *Compliance and Development Review - Phuentsholing Throm.* Phuentsholing: MoWHS.

Egis International and Gyaltshen Consultancy. (2019). *Environmental Progress and Monitoring Report: Phuentsholing Township Development Project.* Phuentsholing: Phuentsholing Thromde.

Gross National Happiness Commission. (2019). T*welfth Five Year Plan (2018 -2023) Phuenstholing Thromde.* Thimphu: GNHC Royal Government of Bhutan.

Ministry of Works and Human Settlement. (2002). *Phuentsholing Urban Development Plan 2002-2017.* Phuentsholing: MoWHS.

Ministry of Works and Human Settlement. (2013). *Phuentsholing Structure Plan 2013-2028*. Phuentsholing: MoWHS.

Phuentsholing Thromde. (2014). *Dhamdara Local Area Plan 2014. Phuentsholing*: Phuentsholing Thromde.

Phuentsholing Thromde. (2014). *Kabraytar Local Area Plan 2014. Phuentsholing:* Phuentsholing Thromde.

9. APPENDICES

9.1. APPENDIX A LIST OF PLOTS WITH EXISTING AND PROPOSED PRECINCTS

Sl no	Plot_ID	Location	Net Area sqft	Map Area sqft	Existing Precinct	Proposed Precinct
1	Ashi Savitri(a)	Dhamdara	515,820	515,820	UV2 (LD)	UV2 (LD)
2	Ashi Savitri(b)	Dhamdara	140,098	140,098	UV2 (LD)	E4
3	Ashi Savitri(c)	Dhamdara	47,576	47,576	UV2 (LD)	E4
4	G 01	Dhamdara		11,083	New Plot	UV2 (LD)
5	G 02	Dhamdara	8,143	8,143	NN	NN
6	G 05	Dhamdara		30,533	New Plot	E4
7	OS 01	Dhamdara		16,492	New Plot	OS-2
8	OS 02	Dhamdara		27,094	New Plot	OS-2
9	OS 03	Dhamdara		4,033	New Plot	OS-2
10	OS 04	Dhamdara		3,367	New Plot	OS-2
11	OS 05	Dhamdara		1,354	New Plot	OS-2
12	OS 06	Dhamdara		1,612	New Plot	OS-2
13	OS 07	Dhamdara		2,395	New Plot	OS-2
14	OS 08	Dhamdara		438	New Plot	OS-2
15	OS 09	Dhamdara		559	New Plot	OS-2
16	OS 10	Dhamdara		5,915	New Plot	OS-2
17	OS 11	Dhamdara		11,009	New Plot	OS-2
18	OS 26	Dhamdara		2,595	New Plot	OS-2
19	Pending01	Dhamdara	3,050	3,050	Unavailable	UV2 (LD)
20	Pending02	Dhamdara	5,562	5,562	Unavailable	E4
21	PGT-1005(a)	Dhamdara	7,749	7,749	E1	E1
22	PGT-1005(b)	Dhamdara	12,328	12,328	E1	E1
23	PGT-1006	Dhamdara	5,554	5,554	UV2 (LD)	UV2 (LD)
24	PGT-1010	Dhamdara	4,813	4,813	UV2 (LD)	UV2 (LD)
25	PGT-1018	Dhamdara	10,738	10,738	E4	E4
26	PGT-1019	Dhamdara	11,397	11,397	E4	UV2 (LD)
27	PGT-1027	Dhamdara	4,813	4,761	UV2 (LD)	E4
28	PGT-1029	Dhamdara	4,813	4,736	UV2 (LD)	E4
29	PGT-103	Dhamdara	5,036	5,036	UV2 (LD)	UV2 (LD)
30	PGT-105	Dhamdara	5,554	5,554	E4	E4
31	PGT-1065	Dhamdara	14,070	14,070	E4	E4
32	PGT-1076	Dhamdara	4,813	4,813	UV2 (LD)	E4
33	PGT-108	Dhamdara	6,665	6,665	UV2 (LD)	UV2 (LD)
34	PGT-1087	Dhamdara	3,703	3,703	UV2 (LD)	NN
35	PGT-109	Dhamdara	8,886	8,886	E4	E4
36	PGT-1115	Dhamdara	4,813	4,813	UV2 (LD)	UV2 (LD)
37	PGT-1116	Dhamdara	5,554	5,554	UV2 (LD)	NN
38	PGT-1117	Dhamdara	7,035	7,035	UV2 (LD)	E4
39	PGT-1119	Dhamdara	3,703	3,555	UV2 (LD)	E4
40	PGT-1144	Dhamdara	5,554	5,554	UV2 (LD)	NN
41	PGT-115	Dhamdara	19,994	19,994	UV2 (LD)	E4
42	PGT-1190	Dhamdara	5,663	5,663	UV2 (LD)	UV2 (LD)
43	PGT-1198	Dhamdara	5,554	5,554	UV2 (LD)	NN
44	PGT-1208	Dhamdara	14,027	14,027	UV2 (LD)	UV2 (LD)
45	PGT-1210	Dhamdara	4,813	4,813	UV2 (LD)	UV2 (LD)
46	PGT-1211	Dhamdara	4,813	4,813	E4	E4
47	PGT-1212	Dhamdara	17,772	17,772	UV2 (LD)	E4
48	PGT-1216	Dhamdara	4,813	4,813	UV2 (LD)	UV2 (LD)
49	PGT-1219	Dhamdara	8,516	8,068	UV2 (LD)	UV2 (LD)

Sl no	Plot_ID	Location	Net Area sqft	Map Area sqft	Existing Precinct	Proposed Precinct
50	PGT-1224	Dhamdara	7,681	7,681	UV2 (LD)	UV2 (LD)
51	PGT-1248	Dhamdara	4,814	4,814	E1	E4
52	PGT-1249	Dhamdara	4,443	4,438	UV2 (LD)	UV2 (LD)
53	PGT-1250	Dhamdara	4,813	4,813	UV2 (LD)	UV2 (LD)
54	PGT-1252	Dhamdara	5,663	5,663	UV2 (LD)	UV2 (LD)
55	PGT-1257(a)	Dhamdara	5,103	5,103	Unavailable	UV2 (LD)
56	PGT-1257(b)	Dhamdara	3,783	3,783	Unavailable	E4
57	PGT-1261	Dhamdara	4,813	4,813	UV2 (LD)	E4
58	PGT-1262	Dhamdara	4,443	4,443	E4	E4
59	PGT-1269	Dhamdara	4,073	4,072	UV2 (LD)	UV2 (LD)
60	PGT-1278	Dhamdara	57,800	57,800	E4	E4
61	PGT-128	Dhamdara	5,702	5,702	UV2 (LD)	UV2 (LD)
62	PGT-1287	Dhamdara	4,813	4,813	UV2 (LD)	UV2 (LD)
63	PGT-1294	Dhamdara	5,924	5,924	UV2 (LD)	E4
64	PGT-1317	Dhamdara	6,534	6,534	UV2 (LD)	UV2 (LD)
65	PGT-1324(a)	Dhamdara	49,190	49,190	UV2 (LD)	UV2 (LD)
66	PGT-1324(b)	Dhamdara	34,445	34,445	UV2 (LD)	E4
67	PGT-1337	Dhamdara	10,894	10,894	E4	S1
68	PGT-134	Dhamdara	7,035	6,860	UV2 (LD)	E4
69	PGT-1392	Dhamdara	13,700	13,700	UV2 (LD)	UV2 (LD)
70	PGT-1394	Dhamdara	5,554	5,554	UV2 (LD)	E4
71	PGT-1401	Dhamdara	5,924	5,924	UV2 (LD)	UV2 (LD)
72	PGT-1403	Dhamdara	4,814	4,814	UV2 (LD)	UV2 (LD)
73	PGT-1407	Dhamdara	6,294	6,294	E4	E4
74	PGT-1410	Dhamdara	6,294	6,294	E4	E4
75	PGT-1411	Dhamdara	37,026	37,026	UV2 (LD)	UV2 (LD)
76	PGT-1414	Dhamdara	15,551	15,551	UV2 (LD)	UV2 (LD)
77	PGT-142	Dhamdara	3,703	3,703	UV2 (LD)	UV2 (LD)
78	PGT-1429	Dhamdara	12,959	12,959	UV2 (LD)	E4
79	PGT-144	Dhamdara	4,356	4,356	UV2 (LD)	UV2 (LD)
80	PGT-147	Dhamdara	3,483	3,483	UV2 (LD)	UV2 (LD)
81	PGT-1492	Dhamdara	4,356	4,356	UV2 (LD)	UV2 (LD)
82	PGT-1515	Dhamdara	8,727	8,727	UV2 (LD)	UV2 (LD)
83	PGT-1521	Dhamdara	9,147	9,147	E4	UV2 (LD)
84	PGT-1525	Dhamdara	18,513	18,513	UV2 (LD)	NN
85	PGT-1535	Dhamdara	18,513	18,513	UV2 (LD)	NN
86	PGT-1553	Dhamdara	64,425	64,425	UV2 (LD)	UV2 (LD)
87	PGT-1565	Dhamdara	20,735	20,735	UV2 (LD)	UV2 (LD)
88	PGT-1567	Dhamdara	18,141	18,141	E4	UV2 (LD)
89	PGT-1569	Dhamdara	4,356	4,356	UV2 (LD)	UV2 (LD)
90	PGT-1571	Dhamdara	9,257	9,257	UV2 (LD)	NN
91	PGT-1581	Dhamdara	14,440	14,440	UV2 (LD)	UV2 (LD)
92	PGT-1616	Dhamdara	11,478	11,132	UV2 (LD)	E4
93	PGT-1635	Dhamdara	16,662	16,662	UV2 (LD)	NN
94	PGT-1654(a)	Dhamdara	4,008	4,008	E4	UV2 (LD)
95	PGT-1654(b)	Dhamdara	5,249	5,249	E4	E4
96	PGT-1657	Dhamdara	8,886	8,886	UV2 (LD)	UV2 (LD)
97	PGT-1658	Dhamdara	7,035	7,035	UV2 (LD)	UV2 (LD)
98	PGT-1660	Dhamdara	16,117	16,117	UV2 (LD)	UV2 (LD)
99	PGT-1663	Dhamdara	8,381	8,308	UV2 (LD)	UV2 (LD)
100	PGT-1666	Dhamdara	10,453	10,453	UV2 (LD)	UV2 (LD)
101	PGT-1667	Dhamdara	9,171	9,171	UV2 (LD)	UV2 (LD)
102	PGT-1668	Dhamdara	2,178	2,178	UV2 (LD)	UV2 (LD)

Sl no	Plot_ID	Location	Net Area sqft	Map Area sqft	Existing Precinct	Proposed Precinct
103	PGT-1671	Dhamdara	7,035	6,776	UV2 (LD)	E4
104	PGT-1726	Dhamdara	14,070	14,070	E4	E4
105	PGT-1732	Dhamdara	2,840	3,049	UV2 (LD)	UV2 (LD)
106	PGT-1733	Dhamdara	5,554	5,554	UV2 (LD)	UV2 (LD)
107	PGT-174	Dhamdara	4,813	4,813	UV2 (LD)	UV2 (LD)
108	PGT-1748	Dhamdara	7,181	7,181	UV2 (LD)	UV2 (LD)
109	PGT-1750	Dhamdara	4,443	4,443	UV2 (LD)	UV2 (LD)
110	PGT-1753	Dhamdara	6,665	6,665	UV2 (LD)	UV2 (LD)
111	PGT-1762	Dhamdara	9,257	9,257	UV2 (LD)	NN
112	PGT-177	Dhamdara	2,178	2,178	UV2 (LD)	UV2 (LD)
113	PGT-1786	Dhamdara	7,035	7,035	UV2 (LD)	UV2 (LD)
114	PGT-1792	Dhamdara	3,485	3,485	UV2 (LD)	UV2 (LD)
115	PGT-1819	Dhamdara	7,405	7,405	UV2 (LD)	UV2 (LD)
116	PGT-1820	Dhamdara	5,184	5,184	UV2 (LD)	UV2 (LD)
117	PGT-1832	Dhamdara	85,436	85,436	UV2 (LD)	NN
118	PGT-1841	Dhamdara	8,516	8,516	UV2 (LD)	UV2 (LD)
119	PGT-1851	Dhamdara	4,356	4,356	UV2 (LD)	UV2 (LD)
120	PGT-1855	Dhamdara	6,397	6,397	UV2 (LD)	UV2 (LD)
121	PGT-1865	Dhamdara	7,775	7,775	UV2 (LD)	UV2 (LD)
122	PGT-1888	Dhamdara	4,813	4,813	UV2 (LD)	UV2 (LD)
123	PGT-1891	Dhamdara	8,516	8,516	E4	E4
124	PGT-190	Dhamdara	8,712	8,712	E4	E4
125	PGT-1904	Dhamdara	11,478	11,478	Unavailable	E4
126	PGT-1911	Dhamdara	3,703	3,703	UV2 (LD)	UV2 (LD)
127	PGT-1946	Dhamdara	14,810	14,810	UV2 (LD)	UV2 (LD)
128	PGT-1968	Dhamdara	9,257	9,257	UV2 (LD)	UV2 (LD)
129	PGT-1982	Dhamdara	4,813	4,813	UV2 (LD)	UV2 (LD)
130	PGT-1985	Dhamdara	5,924	5,924	UV2 (LD)	UV2 (LD)
131	PGT-1991	Dhamdara	3,049	3,049	UV2 (LD)	UV2 (LD)
132	PGT-1992	Dhamdara	7,405	7,405	E4	UV2 (LD)
133	PGT-1997	Dhamdara	6,294	6,294	UV2 (LD)	UV2 (LD)
134	PGT-1998	Dhamdara	7,035	7,035	UV2 (LD)	UV2 (LD)
135	PGT-2002	Dhamdara	6,665	6,531	UV2 (LD)	UV2 (LD)
136	PGT-2004	Dhamdara	4,813	4,813	UV2 (LD)	UV2 (LD)
137	PGT-2025	Dhamdara	13,688	13,688	UV2 (LD)	E4
138	PGT-2139	Dhamdara	12,671	12,671	UV2 (LD)	UV2 (LD)
139	PGT-2197	Dhamdara	18,513	18,513	E4	E4
140	PGT-2198	Dhamdara	18,513	18,513	UV2 (LD)	E4
141	PGT-2199	Dhamdara	11,108	11,108	E4	E4
142	PGT-2200	Dhamdara	5,554	5,554	UV2 (LD)	UV2 (LD)
143	PGT-2235	Dhamdara	6,480	6,480	UV2 (LD)	UV2 (LD)
144	PGT-2287	Dhamdara	9,627	9,615	UV2 (LD)	E4
145	PGT-237	Dhamdara	7,405	7,405	E4	UV2 (LD)
146	PGT-238	Dhamdara	5,554	5,554	E4	UV2 (LD)
147	PGT-2392	Dhamdara	3,703	3,703	E4	E4
148	PGT-2427	Dhamdara	3,408	3,408	E1	E1
149	PGT-2429	Dhamdara	4,813	4,813	UV2 (LD)	UV2 (LD)
150	PGT-2434	Dhamdara	4,813	4,813	UV2 (LD)	UV2 (LD)
151	PGT-2436	Dhamdara	19,624	19,624	E4	UV2 (LD)
152	PGT-2438	Dhamdara	4,813	4,813	E4	E4
153	PGT-2439	Dhamdara	4,813	4,813	E4	E4
154	PGT-2440	Dhamdara	19,624	19,624	E4	UV2 (LD)
155	PGT-2441	Dhamdara	4,813	4,813	UV2 (LD)	UV2 (LD)

Sl no	Plot_ID	Location	Net Area sqft	Map Area sqft	Existing Precinct	Proposed Precinct
156	PGT-2442	Dhamdara	6,039	5,737	E4	E4
157	PGT-2443	Dhamdara	4,813	4,813	UV2 (LD)	E4
158	PGT-2446	Dhamdara	9,627	9,627	E4	E4
159	PGT-2507	Dhamdara	18,404	18,404	E4	UV2 (LD)
160	PGT-253	Dhamdara	5,554	5,554	E4	E4
161	PGT-2538	Dhamdara	3,049	3,049	E4	E4
162	PGT-254	Dhamdara	7,013	7,013	UV2 (LD)	NN
163	PGT-2542	Dhamdara	12,959	12,959	E4	E4
164	PGT-2543 (a)	Dhamdara	14,413	14,413	E4	E4
165	PGT-2543 (b)	Dhamdara	8,178	8,178	E4	E4
166	PGT-2583	Dhamdara	4,813	4,813	E4	E4
167	PGT-259	Dhamdara	3,703	3,703	UV2 (LD)	E4
168	PGT-2616	Dhamdara	4,813	4,813	UV2 (LD)	UV2 (LD)
169	PGT-2628	Dhamdara	5,554	5,554	E4	E4
170	PGT-2690	Dhamdara	7,405	7,405	UV2 (LD)	UV2 (LD)
171	PGT-2777	Dhamdara	5,184	5,184	E4	UV2 (LD)
172	PGT-2780	Dhamdara	4,813	4,813	UV2 (LD)	UV2 (LD)
173	PGT-2781	Dhamdara	4,813	4,813	E4	E4
174	PGT-2786	Dhamdara	3,317	3,317	E4	E4
175	PGT-2817	Dhamdara	5,554	5,554	Unavailable	E4
176	PGT-2940	Dhamdara	29,211	29,211	E4	UV2 (LD)
177	PGT-2956	Dhamdara	8,093	8,093	E4	UV2 (LD)
178	PGT-2962	Dhamdara	25,639	25,639	Unavailable	E4
179	PGT-2963	Dhamdara	32,541	32,541	UV2 (LD)	UV2 (LD)
180	PGT-2964	Dhamdara	4,810	4,810	UV2 (LD)	UV2 (LD)
181	PGT-2965	Dhamdara	8,323	8,207	UV2 (LD)	UV2 (LD)
182	PGT-2966	Dhamdara	4,813	4,813	UV2 (LD)	UV2 (LD)
183	PGT-2968	Dhamdara	9,645	9,645	UV2 (LD)	UV2 (LD)
184	PGT-2969	Dhamdara	3,057	3,057	UV2 (LD)	UV2 (LD)
185	PGT-2975	Dhamdara	6,970	6,970	E1	E1
186	PGT-3053	Dhamdara	35,262	34,136	UV2 (LD)	NN
187	PGT-3059	Dhamdara	7,100	6,745	E4	E4
188	PGT-3060	Dhamdara	4,112	4,112	E1	E1
189	PGT-3062	Dhamdara	37,766	37,766	Unavailable	UV2 (LD)
190	PGT-3109	Dhamdara	15,810	15,810	UV2 (LD)	UV2 (LD)
191	PGT-3176	Dhamdara	5,554	5,554	E4	E4
192	PGT-3194	Dhamdara	3,486	3,486	E1	E1
193	PGT-327	Dhamdara	7,405	7,299	UV2 (LD)	E4
194	PGT-345	Dhamdara	4,813	4,813	UV2 (LD)	E4
195	PGT-3532	Dhamdara	4,905	4,905	E4	E4
196	PGT-3533	Dhamdara	4,813	4,431	E4	E4
197	PGT-3537	Dhamdara	7,684	7,684	UV2 (LD)	UV2 (LD)
198	PGT-3538	Dhamdara	6,644	6,644	UV2 (LD)	UV2 (LD)
199	PGT-3539	Dhamdara	8,555	8,555	E4	E1
200	PGT-3540	Dhamdara	6,534	6,207	E4	E4
201	PGT-3541	Dhamdara	4,900	4,639	E1	E1
202	PGT-3577	Dhamdara	5,845	5,845	UV2 (LD)	UV2 (LD)
203	PGT-3582	Dhamdara	6,479	6,479	UV2 (LD)	UV2 (LD)
204	PGT-3585	Dhamdara	31,363	31,363	E4	UV2 (LD)
205	PGT-3588	Dhamdara	6,665	6,332	UV2 (LD)	E4
206	PGT-364	Dhamdara	5,554	5,554	UV2 (LD)	UV2 (LD)
207	PGT-370	Dhamdara	5,227	5,227	UV2 (LD)	UV2 (LD)
208	PGT-3911	Dhamdara	5,554	5,554	E4	E4

Sl no	Plot_ID	Location	Net Area sqft	Map Area sqft	Existing Precinct	Proposed Precinct
209	PGT-3912	Dhamdara	4,356	4,356	Unavailable	UV2 (LD)
210	PGT-3939	Dhamdara	5,663	5,663	E4	UV2 (LD)
211	PGT-3952	Dhamdara	5,227	5,227	UV2 (LD)	UV2 (LD)
212	PGT-3953	Dhamdara	5,663	5,663	E4	UV2 (LD)
213	PGT-3955	Dhamdara	4,942	4,942	UV2 (LD)	UV2 (LD)
214	PGT-3959	Dhamdara	5,576	5,576	UV2 (LD)	NN
215	PGT-3984	Dhamdara	6,098	6,034	UV2 (LD)	UV2 (LD)
216	PGT-3985	Dhamdara	4,792	4,792	UV2 (LD)	UV2 (LD)
217	PGT-3990	Dhamdara	7,802	7,802	UV2 (LD)	UV2 (LD)
218	PGT-47	Dhamdara	5,924	5,924	UV2 (LD)	NN
219	PGT-478	Dhamdara	14,810	14,810	UV2 (LD)	NN
220	PGT-48	Dhamdara	15,682	15,682	E1	E4
221	PGT-49	Dhamdara	24,611	24,611	UV2 (LD)	E4
222	PGT-554	Dhamdara	4,813	4,813	UV2 (LD)	UV2 (LD)
223	PGT-59	Dhamdara	4,813	4,813	E4	E4
224	PGT-62	Dhamdara	12,219	12,219	UV2 (LD)	E4
225	PGT-629	Dhamdara	5,554	5,394	E4	E4
226	PGT-630	Dhamdara	9,627	9,627	UV2 (LD)	UV2 (LD)
227	PGT-633	Dhamdara	10,738	10,738	UV2 (LD)	UV2 (LD)
228	PGT-636	Dhamdara	5,554	5,554	UV2 (LD)	NN
229	PGT-649	Dhamdara	4,814	4,814	UV2 (LD)	UV2 (LD)
230	PGT-650	Dhamdara	5,554	5,554	UV2 (LD)	UV2 (LD)
231	PGT-651	Dhamdara	5,924	5,924	UV2 (LD)	UV2 (LD)
232	PGT-667	Dhamdara	1,307	1,307	UV2 (LD)	UV2 (LD)
233	PGT-675	Dhamdara	5,924	5,924	E4	E4
234	PGT-680	Dhamdara	12,589	12,589	UV2 (LD)	UV2 (LD)
235	PGT-697	Dhamdara	5,554	5,553	UV2 (LD)	UV2 (LD)
236	PGT-71	Dhamdara	7,405	7,405	E1	E4
237	PGT-710	Dhamdara	5,937	5,937	UV2 (LD)	UV2 (LD)
238	PGT-771	Dhamdara	4,813	4,813	UV2 (LD)	E4
239	PGT-780	Dhamdara	7,405	7,405	UV2 (LD)	E4
240	PGT-800	Dhamdara	5,554	5,554	E4	E4
241	PGT-803	Dhamdara	10,367	10,367	UV2 (LD)	UV2 (LD)
242	PGT-807	Dhamdara	5,554	5,554	E4	E4
243	PGT-837	Dhamdara	3,703	3,703	E4	E4
244	PGT-843	Dhamdara	9,257	9,257	UV2 (LD)	NN
245	PGT-862 (a)	Dhamdara	69,675	69,675	E1	E1
246	PGT-862 (b)	Dhamdara	11,071	11,071	E1	E4
247	PGT-862 (c)	Dhamdara	7,460	7,460	E1	E4
248	PGT-87	Dhamdara	5,554	5,554	E4	E4
249	PGT-887	Dhamdara	15,005	15,005	UV2 (LD)	UV2 (LD)
250	PGT-888	Dhamdara	8,149	8,149	UV2 (LD)	UV2 (LD)
251	PGT-889(a)	Dhamdara	5,430	5,430	E1	E1
252	PGT-889(b)	Dhamdara	1,975	1,975	E1	E1
253	PGT-89	Dhamdara	3,703	3,703	UV2 (LD)	E4
254	PGT-924	Dhamdara	3,485	3,485	UV2 (LD)	UV2 (LD)
255	PGT-95	Dhamdara	4,813	4,813	UV2 (LD)	UV2 (LD)
256	PGT-961	Dhamdara	4,813	4,813	Unavailable	E4
257	PGT-98	Dhamdara	5,184	5,184	UV2 (LD)	UV2 (LD)
258	PGT-99	Dhamdara	5,554	5,554	E4	E4
259	PU271245	Dhamdara	4,356	4,356	Unavailable	UV2 (LD)
260	S 01	Dhamdara	12,871	12,871	S1	S1

Sl no	Plot_ID	Location	Net Area sqft	Map Area sqft	Existing Precinct	Proposed Precinct
261	S 02	Dhamdara		1,017	New Plot	S1
262	S 03	Dhamdara		6,057	New Plot	S1
263	S 04	Dhamdara		5,859	New Plot	S1
264	S 05	Dhamdara		3,517	New Plot	S1
265	S 06	Dhamdara		1,248	New Plot	S1
266	S 07	Dhamdara		2,606	New Plot	S1
267	S 08	Dhamdara		1,248	New Plot	S1
268	S 09	Dhamdara		518	New Plot	S1
269	S 10	Kabraytar		3,222	New Plot	S1
270	S 11	Kabraytar		2,824	New Plot	S1
271	BPC	Kabraytar	1,403	1,403	Unavailable	S1
272	G 03	Kabraytar		14,308	New Plot	NN
273	G 04	Kabraytar		15,174	New Plot	UV2 (LD)
274	LPGT-128	Kabraytar	13,291	13,291	Unavailable	S1
275	LPGT-78	Kabraytar	25,373	25,373	S1	OS-2
276	No ID01	Kabraytar	13,585	13,585	Unavailable	E1
277	OS 12	Kabraytar		930	New Plot	OS-2
278	OS 13	Kabraytar		2,665	New Plot	OS-2
279	OS 14	Kabraytar		10,360	New Plot	OS-2
280	OS 15	Kabraytar		10,249	New Plot	OS-2
281	OS 16	Kabraytar		7,403	New Plot	OS-2
282	OS 17	Kabraytar		1,736	New Plot	OS-2
283	OS 18	Kabraytar		2,846	New Plot	OS-2
284	OS 19	Kabraytar		2,895	New Plot	OS-2
285	OS 20	Kabraytar		1,885	New Plot	OS-2
286	OS 21	Kabraytar		2,118	New Plot	OS-2
287	OS 22	Kabraytar		1,785	New Plot	OS-2
288	OS 23	Kabraytar		2,282	New Plot	OS-2
289	OS 24	Kabraytar		1,418	New Plot	OS-2
290	OS 25	Kabraytar		1,766	New Plot	OS-2
291	OS 27	Kabraytar		721	New Plot	OS-2
292	OS 28	Kabraytar		1,199	New Plot	OS-2
293	OS 29	Kabraytar		3,693	New Plot	OS-2
294	OS 30	Kabraytar		4,410	New Plot	OS-2
295	OS 31	Kabraytar		4,481	New Plot	OS-2
296	OS 32	Kabraytar		8,397	New Plot	OS-2
297	OS 33	Kabraytar		2,249	New Plot	OS-2
298	OS 34	Kabraytar		4,721	New Plot	OS-2
299	OS 35	Kabraytar		3,028	New Plot	OS-2
300	Pending03	Kabraytar	23,233	23,233	Unavailable	E1
301	PGT-1020	Kabraytar	9,257	9,257	E4	E4
302	PGT-1048	Kabraytar	4,983	4,983	UV2 (HD)	UV2 (HD)
303	PGT-1050	Kabraytar	13,416	13,416	UV2 (HD)	UV2 (HD)
304	PGT-107	Kabraytar	6,133	6,133	UV2 (LD)	UV2 (LD)
305	PGT-1083	Kabraytar	10,350	10,350	UV2 (LD)	UV2 (LD)
306	PGT-1085	Kabraytar	15,716	15,716	UV2 (LD)	E4
307	PGT-1090	Kabraytar	3,833	3,833	UV2 (LD)	UV2 (LD)
308	PGT-1147(a)	Kabraytar	24,417	23,829	E4	E4
309	PGT-1147(b)	Kabraytar	4,921	4,921	E4	E1
310	PGT-1149	Kabraytar	12,650	12,650	UV2 (LD)	UV2 (LD)
311	PGT-1150	Kabraytar	34,298	34,298	E1	E1
312	PGT-1237(a)	Kabraytar	10,400	10,400	UV2 (LD)	UV2 (LD)

Sl no	Plot_ID	Location	Net Area sqft	Map Area sqft	Existing Precinct	Proposed Precinct
313	PGT-1237(b)	Kabraytar	6,913	6,913	UV2 (LD)	E1
314	PGT-1246	Kabraytar	5,750	5,750	UV2 (LD)	UV2 (LD)
315	PGT-1247	Kabraytar	5,749	5,749	UV2 (LD)	UV2 (LD)
316	PGT-1264	Kabraytar	6,000	6,000	UV2 (LD)	UV2 (LD)
317	PGT-1272	Kabraytar	14,375	14,375	UV2 (LD)	UV2 (LD)
318	PGT-1284	Kabraytar	11,500	11,500	E4	E1
319	PGT-1286	Kabraytar	5,367	5,367	UV2 (LD)	UV2 (LD)
320	PGT-1295	Kabraytar	7,667	7,667	UV2 (LD)	UV2 (LD)
321	PGT-13	Kabraytar	90,102	90,102	UV2 (LD)	NN
322	PGT-1309	Kabraytar	4,983	4,983	UV2 (LD)	UV2 (LD)
323	PGT-1316	Kabraytar	5,663	5,663	E1	E1
324	PGT-1325	Kabraytar	4,600	4,600	E4	E4
325	PGT-1326	Kabraytar	5,750	5,750	UV2 (HD)	UV2 (HD)
326	PGT-1327	Kabraytar	5,750	5,750	UV2 (HD)	UV2 (HD)
327	PGT-1328	Kabraytar	4,983	4,983	UV2 (HD)	UV2 (HD)
328	PGT-1347	Kabraytar	5,367	5,352	UV2 (LD)	UV2 (LD)
329	PGT-1390	Kabraytar	6,532	6,532	E4	E4
330	PGT-1398	Kabraytar	4,356	4,356	UV2 (LD)	UV2 (LD)
331	PGT-1404	Kabraytar	3,833	3,833	UV2 (LD)	UV2 (LD)
332	PGT-1424	Kabraytar	102,251	102,251	UV2 (HD)	UV2 (HD)
333	PGT-1425	Kabraytar	229,105	229,105	UV2 (HD)	UV2 (HD)
334	PGT-1426	Kabraytar	120,046	120,046	UV2 (HD)	UV2 (HD)
335	PGT-1427	Kabraytar	49,177	49,177	UV2 (HD)	UV2 (HD)
336	PGT-1449	Kabraytar	4,356	4,356	UV2 (LD)	UV2 (LD)
337	PGT-1456	Kabraytar	5,188	4,914	UV2 (LD)	UV2 (LD)
338	PGT-1458	Kabraytar	5,336	5,336	UV2 (LD)	UV2 (LD)
339	PGT-1461	Kabraytar	7,283	5,405	UV2 (LD)	UV2 (LD)
340	PGT-1462	Kabraytar	7,667	7,667	UV2 (LD)	UV2 (LD)
341	PGT-1538	Kabraytar	5,367	5,367	UV2 (LD)	UV2 (LD)
342	PGT-1540	Kabraytar	43,692	43,692	UV2 (LD)	UV2 (LD)
343	PGT-1560	Kabraytar	6,900	6,900	UV2 (LD)	UV2 (LD)
344	PGT-1563	Kabraytar	17,250	17,250	E4	E4
345	PGT-1570	Kabraytar	7,665	7,665	UV2 (LD)	UV2 (LD)
346	PGT-1575	Kabraytar	3,833	3,833	E1	UV2 (LD)
347	PGT-1577	Kabraytar	6,098	6,098	UV2 (LD)	UV2 (LD)
348	PGT-1579	Kabraytar	7,667	7,667	UV2 (LD)	UV2 (LD)
349	PGT-1584	Kabraytar	5,227	5,227	UV2 (LD)	UV2 (LD)
350	PGT-1590	Kabraytar	9,583	9,583	UV2 (LD)	UV2 (LD)
351	PGT-1591	Kabraytar	4,600	4,600	NN	NN
352	PGT-1595	Kabraytar	8,433	7,405	UV2 (LD)	UV2 (LD)
353	PGT-1607	Kabraytar	58,266	58,266	UV2 (LD)	UV2 (LD)
354	PGT-161	Kabraytar	13,647	15,331	UV2 (LD)	UV2 (LD)
355	PGT-1628	Kabraytar	6,133	6,133	UV2 (LD)	UV2 (LD)
356	PGT-1630	Kabraytar	15,141	15,141	UV2 (HD)	UV2 (HD)
357	PGT-1647	Kabraytar	4,800	4,800	UV2 (LD)	UV2 (LD)
358	PGT-1651	Kabraytar	3,049	3,049	UV2 (LD)	UV2 (LD)
359	PGT-166	Kabraytar	4,983	4,983	UV2 (LD)	UV2 (LD)
360	PGT-1669	Kabraytar	17,982	17,982	UV2 (LD)	UV2 (LD)
361	PGT-167	Kabraytar	5,750	5,750	UV2 (LD)	UV2 (LD)
362	PGT-169	Kabraytar	5,750	5,750	UV2 (LD)	UV2 (LD)
363	PGT-17	Kabraytar	5,445	5,445	UV2 (LD)	UV2 (LD)
364	PGT-170	Kabraytar	16,988	16,988	E1	E1
365	PGT-1714	Kabraytar	9,967	9,967	UV2 (LD)	UV2 (LD)

Sl no	Plot_ID	Location	Net Area sqft	Map Area sqft	Existing Precinct	Proposed Precinct
366	PGT-1719	Kabraytar	5,367	5,367	UV2 (LD)	UV2 (LD)
367	PGT-172(a)	Kabraytar	33,080	33,080	E4	E4
368	PGT-172(b)	Kabraytar	22,458	22,458	E4	UV2 (LD)
369	PGT-1722	Kabraytar	13,033	13,033	UV2 (LD)	UV2 (LD)
370	PGT-1723	Kabraytar	9,583	9,507	UV2 (LD)	UV2 (LD)
371	PGT-1731	Kabraytar	3,049	3,049	E4	E4
372	PGT-1737	Kabraytar	6,517	6,517	UV2 (LD)	NN
373	PGT-1746	Kabraytar	4,217	4,217	UV2 (LD)	UV2 (LD)
374	PGT-1756	Kabraytar	3,450	2,687	UV2 (LD)	UV2 (LD)
375	PGT-1839(a)	Kabraytar	6,543	6,543	UV2 (LD)	UV2 (LD)
376	PGT-1839(b)	Kabraytar	23,825	23,825	UV2 (LD)	UV2 (LD)
377	PGT-1839(c)	Kabraytar	10,598	10,598	UV2 (LD)	E1
378	PGT-184	Kabraytar	5,227	5,227	E1	E1
379	PGT-1848	Kabraytar	12,652	12,652	E4	E4
380	PGT-1871	Kabraytar	3,833	3,833	NN	NN
381	PGT-1894	Kabraytar	5,750	5,979	UV2 (LD)	UV2 (LD)
382	PGT-19	Kabraytar	7,667	7,667	UV2 (LD)	UV2 (LD)
383	PGT-1914	Kabraytar	4,356	4,356	UV2 (LD)	UV2 (LD)
384	PGT-1940	Kabraytar	4,356	4,356	UV2 (LD)	UV2 (LD)
385	PGT-1941	Kabraytar	4,600	4,600	UV2 (LD)	UV2 (LD)
386	PGT-1960	Kabraytar	3,833	3,833	UV2 (LD)	UV2 (LD)
387	PGT-1966	Kabraytar	4,986	4,986	UV2 (LD)	UV2 (LD)
388	PGT-1979	Kabraytar	4,600	4,600	UV2 (LD)	NN
389	PGT-1983(a)	Kabraytar	14,077	14,077	E4	E4
390	PGT-1983(b)	Kabraytar	11,010	9,689	E4	E1
391	PGT-1995	Kabraytar	3,067	3,067	UV2 (LD)	UV2 (LD)
392	PGT-1996	Kabraytar	3,450	3,450	UV2 (LD)	UV2 (LD)
393	PGT-2006	Kabraytar	6,900	6,900	UV2 (LD)	UV2 (LD)
394	PGT-2010	Kabraytar	7,283	7,283	UV2 (LD)	NN
395	PGT-207	Kabraytar	4,382	4,382	UV2 (LD)	UV2 (LD)
396	PGT-208	Kabraytar	4,783	4,783	E1	E4
397	PGT-2137	Kabraytar	16,483	16,483	UV2 (LD)	UV2 (LD)
398	PGT-2221	Kabraytar	6,134	6,107	UV2 (LD)	UV2 (LD)
399	PGT-2295	Kabraytar	4,984	4,984	UV2 (LD)	UV2 (LD)
400	PGT-2301	Kabraytar	11,117	11,117	UV2 (LD)	UV2 (LD)
401	PGT-235	Kabraytar	13,068	13,068	E1	E1
402	PGT-2437	Kabraytar	10,891	10,891	E4	E1
403	PGT-2444	Kabraytar	10,891	10,891	E4	E1
404	PGT-2447	Kabraytar	15,246	15,246	E4	E1
405	PGT-2454	Kabraytar	2,614	2,614	E4	E4
406	PGT-2509	Kabraytar	5,554	5,554	E4	E4
407	PGT-256	Kabraytar	5,750	5,750	UV2 (LD)	UV2 (LD)
408	PGT-261	Kabraytar	17,250	17,250	UV2 (LD)	UV2 (LD)
409	PGT-270	Kabraytar	12,266	12,266	UV2 (HD)	UV2 (HD)
410	PGT-271	Kabraytar	5,750	5,750	UV2 (HD)	UV2 (HD)
411	PGT-272	Kabraytar	7,284	7,261	UV2 (HD)	UV2 (HD)
412	PGT-273	Kabraytar	6,116	6,116	UV2 (HD)	UV2 (HD)
413	PGT-2732	Kabraytar	9,056	9,056	E4	E4
414	PGT-2750	Kabraytar	2,178	2,178	NN	NN
415	PGT-2751	Kabraytar	4,983	4,983	UV2 (LD)	E4
416	PGT-2784	Kabraytar	4,607	4,607	UV2 (LD)	E4
417	PGT-2789	Kabraytar	4,619	4,619	UV2 (LD)	UV2 (LD)
418	PGT-2917	Kabraytar	5,863	5,863	UV2 (LD)	UV2 (LD)

Sl no	Plot_ID	Location	Net Area sqft	Map Area sqft	Existing Precinct	Proposed Precinct
419	PGT-2918	Kabraytar	5,288	5,288	UV2 (LD)	UV2 (LD)
420	PGT-2934	Kabraytar	28,314	28,314	E1	E1
421	PGT-2935	Kabraytar	6,900	6,900	UV2 (LD)	UV2 (LD)
422	PGT-2936	Kabraytar	4,983	4,983	UV2 (LD)	UV2 (LD)
423	PGT-2937	Kabraytar	7,284	7,284	UV2 (HD)	UV2 (HD)
424	PGT-2939	Kabraytar	5,750	5,750	E4	UV2 (LD)
425	PGT-2941	Kabraytar	2,178	2,178	NN	NN
426	PGT-2943	Kabraytar	5,455	5,455	E1	E1
427	PGT-2944	Kabraytar	69,746	69,746	UV2 (LD)	UV2 (LD)
428	PGT-2945	Kabraytar	6,119	6,119	E1	E1
429	PGT-2946	Kabraytar	5,698	5,698	E4	E4
430	PGT-2947	Kabraytar	5,206	5,206	E4	E1
431	PGT-2948	Kabraytar	5,110	5,110	Unavailable	E4
432	PGT-2949	Kabraytar	44,720	44,720	G2	OS-2
433	PGT-2955	Kabraytar	8,020	8,020	UV2 (LD)	UV2 (LD)
434	PGT-2967	Kabraytar	3,835	3,835	E4	E1
435	PGT-2970	Kabraytar	5,663	5,663	UV2 (LD)	UV2 (LD)
436	PGT-2971	Kabraytar	17,298	17,298	G2	OS-2
437	PGT-2972	Kabraytar	10,756	10,756	UV2 (LD)	UV2 (LD)
438	PGT-2978	Kabraytar	16,553	16,553	E1	E1
439	PGT-2979	Kabraytar	23,000	23,000	UV2 (LD)	UV2 (LD)
440	PGT-2980	Kabraytar	8,712	8,712	E4	UV2 (LD)
441	PGT-304	Kabraytar	9,967	9,687	UV2 (LD)	UV2 (LD)
442	PGT-3054	Kabraytar	7,267	7,267	E1	E1
443	PGT-3056	Kabraytar	8,947	8,947	E1	E1
444	PGT-3061	Kabraytar	4,600	4,600	UV2 (LD)	UV2 (LD)
445	PGT-3110	Kabraytar	9,583	9,583	UV2 (LD)	UV2 (LD)
446	PGT-3178	Kabraytar	9,478	9,478	UV2 (HD)	UV2 (HD)
447	PGT-338	Kabraytar	12,266	12,266	UV2 (HD)	UV2 (HD)
448	PGT-3547	Kabraytar	5,663	5,663	Unavailable	UV2 (LD)
449	PGT-3581	Kabraytar	5,663	5,663	UV2 (HD)	UV2 (HD)
450	PGT-3586	Kabraytar	18,783	21,344	UV2 (LD)	UV2 (LD)
451	PGT-3587	Kabraytar	7,667	7,667	UV2 (LD)	UV2 (LD)
452	PGT-3595	Kabraytar	4,983	4,983	UV2 (LD)	NN
453	PGT-362	Kabraytar	8,064	8,064	E4	E4
454	PGT-377	Kabraytar	3,833	3,833	UV2 (LD)	UV2 (LD)
455	PGT-3931	Kabraytar	13,068	13,068	UV2 (LD)	UV2 (LD)
456	PGT-3938	Kabraytar	5,663	5,663	UV2 (LD)	UV2 (LD)
457	PGT-3943	Kabraytar	6,534	6,516	UV2 (HD)	UV2 (HD)
458	PGT-3971	Kabraytar	5,445	5,445	UV2 (LD)	UV2 (LD)
459	PGT-3989	Kabraytar	10,400	10,400	UV2 (LD)	UV2 (LD)
460	PGT-491	Kabraytar	4,983	4,983	UV2 (HD)	UV2 (HD)
461	PGT-495	Kabraytar	7,666	7,666	UV2 (LD)	UV2 (LD)
462	PGT-500	Kabraytar	11,117	11,117	UV2 (LD)	UV2 (LD)
463	PGT-501	Kabraytar	15,682	15,682	E1	E1
464	PGT-583	Kabraytar	4,983	4,983	UV2 (LD)	UV2 (LD)
465	PGT-61	Kabraytar	10,350	10,350	E4	E4
466	PGT-612	Kabraytar	3,833	3,833	UV2 (LD)	UV2 (LD)
467	PGT-613	Kabraytar	4,983	4,983	UV2 (HD)	UV2 (HD)
468	PGT-620	Kabraytar	4,356	4,356	UV2 (LD)	UV2 (LD)
469	PGT-635	Kabraytar	5,663	5,663	UV2 (LD)	UV2 (LD)
470	PGT-637	Kabraytar	17,250	17,250	UV2 (LD)	UV2 (LD)
471	PGT-652	Kabraytar	7,667	7,667	UV2 (LD)	UV2 (LD)

Sl no	Plot_ID	Location	Net Area sqft	Map Area sqft	Existing Precinct	Proposed Precinct
472	PGT-668	Kabraytar	5,750	5,750	E4	E4
473	PGT-669	Kabraytar	5,750	5,750	E4	E4
474	PGT-670	Kabraytar	3,450	3,450	Unavailable	UV2 (LD)
475	PGT-69	Kabraytar	5,750	5,750	UV2 (LD)	UV2 (LD)
476	PGT-700	Kabraytar	4,792	4,792	UV2 (LD)	UV2 (LD)
477	PGT-717	Kabraytar	5,367	5,367	UV2 (HD)	UV2 (HD)
478	PGT-767	Kabraytar	4,983	4,983	UV2 (LD)	UV2 (LD)
479	PGT-773	Kabraytar	4,983	4,983	UV2 (LD)	UV2 (LD)
480	PGT-779	Kabraytar	5,750	5,750	E4	E4
481	PGT-781	Kabraytar	4,356	4,356	UV2 (LD)	UV2 (LD)
482	PGT-801	Kabraytar	4,356	4,356	NN	NN
483	PGT-808(a)	Kabraytar	50,011	50,011	UV2 (LD)	UV2 (LD)
484	PGT-808(b)	Kabraytar	45,438	45,438	UV2 (LD)	E4
485	PGT-809	Kabraytar	93,089	93,089	E1	E1
486	PGT-814	Kabraytar	4,600	4,600	UV2 (LD)	UV2 (LD)
487	PGT-822	Kabraytar	6,517	6,517	UV2 (LD)	UV2 (LD)
488	PGT-825(a)	Kabraytar	33,141	33,141	E1	E1
489	PGT-825(b)	Kabraytar	9,357	9,357	E1	E1
490	PGT-825(c)	Kabraytar	7,597	7,597	E1	E1
491	PGT-847	Kabraytar	5,666	5,666	UV2 (LD)	UV2 (LD)
492	PGT-849	Kabraytar	4,983	4,983	UV2 (LD)	UV2 (LD)
493	PGT-86	Kabraytar	6,325	6,325	UV2 (LD)	UV2 (LD)
494	PGT-860	Kabraytar	6,133	6,133	UV2 (LD)	NN
495	PGT-865	Kabraytar	6,517	6,517	UV2 (HD)	UV2 (HD)
496	PGT-883	Kabraytar	4,983	4,983	UV2 (LD)	UV2 (LD)
497	PGT-892	Kabraytar	6,517	6,517	UV2 (LD)	NN
498	PGT-893	Kabraytar	1,742	1,742	NN	NN
499	PGT-894	Kabraytar	1,307	1,307	UV2 (LD)	NN
500	PGT-897	Kabraytar	5,750	5,750	UV2 (LD)	UV2 (LD)
501	PGT-898	Kabraytar	8,050	8,050	UV2 (LD)	UV2 (LD)
502	PGT-905	Kabraytar	6,325	6,325	UV2 (LD)	UV2 (LD)
503	PGT-921	Kabraytar	17,250	17,250	E1	E4
504	PGT-922(a)	Kabraytar	13,622	13,622	E1	E4
505	PGT-922(b)	Kabraytar	28,951	28,951	E1	E1
506	PGT-923	Kabraytar	4,964	4,964	UV2 (LD)	UV2 (LD)
507	PGT-935	Kabraytar	5,349	5,349	E1	E4
508	PGT-937	Kabraytar	6,900	7,842	UV2 (LD)	UV2 (LD)
509	PGT-956	Kabraytar	7,074	7,074	UV2 (LD)	UV2 (LD)
510	PGT-958	Kabraytar	57,384	64,944	UV2 (LD)	UV2 (LD)
511	PGT-968	Kabraytar	5,663	5,663	UV2 (LD)	UV2 (LD)
512	PGT-969	Kabraytar	4,983	4,983	UV2 (LD)	UV2 (LD)
513	PGT-970	Kabraytar	4,983	4,983	UV2 (LD)	UV2 (LD)
514	PGT-971	Kabraytar	4,983	4,983	UV2 (LD)	UV2 (LD)
515	PGT-972	Kabraytar	4,805	4,805	UV2 (LD)	UV2 (LD)
516	PGT-973	Kabraytar	4,983	4,983	UV2 (LD)	UV2 (LD)
517	PGT-974	Kabraytar	4,983	4,983	UV2 (LD)	UV2 (LD)
518	PGT-975	Kabraytar	4,983	4,983	UV2 (LD)	UV2 (LD)
519	PGT-976	Kabraytar	6,517	6,517	UV2 (LD)	UV2 (LD)
520	PGT-985	Kabraytar	4,217	4,217	E4	E4
521	PGT-990	Kabraytar	4,983	4,983	UV2 (HD)	UV2 (HD)
522	PGT-999	Kabraytar	3,049	3,047	UV2 (LD)	UV2 (LD)
523	S 12	Kabraytar		15,011	New Plot	S1

Sl no	Plot_ID	Location	Net Area sqft	Map Area sqft	Existing Precinct	Proposed Precinct
524	S 13	Kabraytar		8,101	New Plot	S1
525	S 14	Kabraytar	42,307	42,307	S1	S1
526	S 16	Kabraytar		1,424	New Plot	S1
527	S 17	Kabraytar		1,386	New Plot	S1

9.2. APPENDIX B: LIST OF PLOTS WHOSE PROPOSED PRECINCTS WERE CHANGED AT FINAL STAGE

Sl.no	Plot_ID	Location	Proposed Precinct (Draft Stage)	Proposed Precinct (Final Stage)	Mean Slope Percentage	Hazard Category
1	Pending01	Dhamdara	E4	UV2 (LD)	58.971482	High Hazard
2	PGT-1019	Dhamdara	E4	UV2 (LD)	31.320163	Low Hazard
3	PGT-105	Dhamdara	E1	E4	65.737419	High Hazard
4	PGT-1208	Dhamdara	E4	UV2 (LD)	58.551094	High Hazard
5	PGT-1210	Dhamdara	E4	UV2 (LD)	56.96688	High Hazard
6	PGT-1212	Dhamdara	E1	E4	57.541216	High Hazard
7	PGT-1216	Dhamdara	E4	UV2 (LD)	53.752704	Medium Hazard
8	PGT-1219	Dhamdara	E4	UV2 (LD)	43.385597	Medium Hazard
9	PGT-1224	Dhamdara	E4	UV2 (LD)	41.184307	Medium Hazard
10	PGT-1248	Dhamdara	E1	E4	74.988276	High Hazard
11	PGT-1250	Dhamdara	E4	UV2 (LD)	45.474613	Medium Hazard
12	PGT-1257(a)	Dhamdara	E4	UV2 (LD)	55.471121	High Hazard
13	PGT-1257(b)	Dhamdara	E1	E4	68.487507	High Hazard
14	PGT-1294	Dhamdara	E1	E4	71.679212	High Hazard
15	PGT-1401	Dhamdara	E4	UV2 (LD)	63.981871	High Hazard
16	PGT-1521	Dhamdara	E4	UV2 (LD)	43.078064	Medium Hazard
17	PGT-1567	Dhamdara	E4	UV2 (LD)	30.209033	Medium Hazard
18	PGT-1654(a)	Dhamdara	E4	UV2 (LD)	43.859532	Medium Hazard
19	PGT-1654(b)	Dhamdara	E1	E4	73.783034	High Hazard
20	PGT-1667	Dhamdara	E4	UV2 (LD)	51.923147	Medium Hazard
21	PGT-1750	Dhamdara	E4	UV2 (LD)	62.15031	High Hazard
22	PGT-1792	Dhamdara	E4	UV2 (LD)	54.198339	High Hazard
23	PGT-1865	Dhamdara	E4	UV2 (LD)	46.313488	Medium Hazard
24	PGT-1911	Dhamdara	E4	UV2 (LD)	36.799353	Medium Hazard
25	PGT-1946	Dhamdara	E4	UV2 (LD)	40.528101	Medium Hazard
26	PGT-1982	Dhamdara	E4	UV2 (LD)	47.298542	High Hazard
27	PGT-1992	Dhamdara	E4	UV2 (LD)	36.78916	Low Hazard
28	PGT-1997	Dhamdara	E4	UV2 (LD)	44.655	Medium Hazard
29	PGT-237	Dhamdara	E4	UV2 (LD)	45.239859	High Hazard
30	PGT-238	Dhamdara	E4	UV2 (LD)	56.433546	Medium Hazard
31	PGT-2392	Dhamdara	E1	E4	60.586268	High Hazard
32	PGT-2436	Dhamdara	E4	UV2 (LD)	47.766047	Medium Hazard
33	PGT-2440	Dhamdara	E4	UV2 (LD)	54.025032	Medium Hazard
34	PGT-2507	Dhamdara	E4	UV2 (LD)	38.757737	Low Hazard
35	PGT-2538	Dhamdara	E1	E4	60.981262	High Hazard
36	PGT-2940	Dhamdara	E4	UV2 (LD)	40.451519	Medium Hazard
37	PGT-2956	Dhamdara	E4	UV2 (LD)	38.399649	Low Hazard
38	PGT-2963	Dhamdara	E4	UV2 (LD)	39.37139	Medium Hazard
39	PGT-2966	Dhamdara	E4	UV2 (LD)	53.415776	Low Hazard
40	PGT-2969	Dhamdara	E4	UV2 (LD)	57.841352	High Hazard
41	PGT-3062	Dhamdara	E4	UV2 (LD)	36.002249	Low Hazard

Sl.no	Plot_ID	Location	Proposed Precinct (Draft Stage)	Proposed Precinct (Final Stage)	Mean Slope Percentage	Hazard Category
42	PGT-3939	Dhamdara	E4	UV2 (LD)	47.426248	Low Hazard
43	PGT-3952	Dhamdara	E4	UV2 (LD)	62.834282	High Hazard
44	PGT-3953	Dhamdara	E4	UV2 (LD)	54.014097	Medium Hazard
45	PGT-62	Dhamdara	E1	E4	65.26514	High Hazard
46	PGT-649	Dhamdara	E4	UV2 (LD)	48.201301	Low Hazard
47	PGT-87	Dhamdara	E1	E4	76.465602	High Hazard
48	PGT-888	Dhamdara	E4	UV2 (LD)	39.613626	Medium Hazard
49	PGT-99	Dhamdara	E1	E4	79.832757	High Hazard
50	PU271245	Dhamdara	E4	UV2 (LD)	57.453363	High Hazard
51	LPGT-128	Kabraytar	E1	S1	21.286373	High Hazard
52	Pending03	Kabraytar	E4	E1	66.872769	High Hazard
53	PGT-1247	Kabraytar	E4	UV2 (LD)	34.596552	Low Hazard
54	PGT-1575	Kabraytar	E4	UV2 (LD)	59.287413	High Hazard
55	PGT-167	Kabraytar	E4	UV2 (LD)	33.023207	Low Hazard
56	PGT-169	Kabraytar	E4	UV2 (LD)	41.085711	Medium Hazard
57	PGT-17	Kabraytar	E4	UV2 (LD)	47.950775	High Hazard
58	PGT-1714	Kabraytar	E4	UV2 (LD)	49.667908	High Hazard
59	PGT-172(a)	Kabraytar	UV2 (LD)	E4	20.799534	Low Hazard
60	PGT-172(b)	Kabraytar	E4	UV2 (LD)	52.991328	High Hazard
61	PGT-1737	Kabraytar	UV2 (LD)	NN	21.175327	Low Hazard
62	PGT-1839(b)	Kabraytar	E4	UV2 (LD)	52.263637	High Hazard
63	PGT-19	Kabraytar	E4	UV2 (LD)	40.848744	Medium Hazard
64	PGT-1979	Kabraytar	UV2 (LD)	NN	22.154266	Low Hazard
65	PGT-208	Kabraytar	E1	E4	60.662201	High Hazard
66	PGT-2751	Kabraytar	E1	E4	61.615549	High Hazard
67	PGT-2917	Kabraytar	E4	UV2 (LD)	41.033249	High Hazard
68	PGT-2918	Kabraytar	E4	UV2 (LD)	22.711167	High Hazard
69	PGT-2946	Kabraytar	E1	E4	71.601331	High Hazard
70	PGT-2947	Kabraytar	E4	E1	53.772293	High Hazard
71	PGT-3110	Kabraytar	E4	UV2 (LD)	45.264947	High Hazard
72	PGT-362	Kabraytar	E1	E4	66.517062	High Hazard
73	PGT-3971	Kabraytar	E4	UV2 (LD)	45.1496	High Hazard
74	PGT-61	Kabraytar	E1	E4	75.256149	High Hazard
75	PGT-668	Kabraytar	E1	E4	61.37764	High Hazard
76	PGT-669	Kabraytar	E1	E4	72.59742	High Hazard
77	PGT-860	Kabraytar	UV2 (LD)	NN	23.133964	Low Hazard
78	PGT-897	Kabraytar	E4	UV2 (LD)	30.474654	Low Hazard
79	PGT-898	Kabraytar	E4	UV2 (LD)	33.53382	Medium Hazard
80	PGT-921	Kabraytar	E1	E4	46.226466	High Hazard
81	PGT-935	Kabraytar	E1	E4	59.412875	High Hazard

9.3. APPENDIX C: LIST OF PLOTS SUBDIVIDED

Sl no	Plot_ID	Tharm No	Location	Net Area sqft	Map Area sqft	Existing Precinct	Proposed Precinct	
1	Ashi Savitri(a)	58	Dhamdara	515,820	515,820	UV2 (LD)	UV2 (LD)	Parent Plot
2	Ashi Savitri(b)	58	Dhamdara	140,098	140,098	UV2 (LD)	E4	Divided
3	Ashi Savitri(c)	58	Dhamdara	47,576	47,576	UV2 (LD)	E4	Divided
4	PGT-1005(a)	3377	Dhamdara	7,749	7,749	E1	E1	Parent Plot
5	PGT-1005(b)	3377	Dhamdara	12,328	12,328	E1	E1	Divided
6	PGT-1257(a)	1581	Dhamdara	5,103	5,103	Unavailable	UV2 (LD)	Parent Plot
7	PGT-1257(b)	1581	Dhamdara	3,783	3,783	Unavailable	E4	Divided
8	PGT-1324(a)	43	Dhamdara	49,190	49,190	UV2 (LD)	UV2 (LD)	Parent Plot
9	PGT-1324(b)	43	Dhamdara	34,445	34,445	UV2 (LD)	E4	Divided
10	PGT-1654(a)	110	Dhamdara	4,008	4,008	E4	UV2 (LD)	Divided
11	PGT-1654(b)	110	Dhamdara	5,249	5,249	E4	E4	Parent Plot
12	PGT-2543 (a)	2070	Dhamdara	14,413	14,413	E4	E4	Parent Plot
13	PGT-2543 (b)	2070	Dhamdara	8,178	8,178	E4	E4	Divided
14	PGT-2583	2076	Dhamdara	4,813	4,813	E4	E4	Parent Plot
15	PGT-862 (a)	493	Dhamdara	69,675	69,675	E1	E1	Parent Plot
16	PGT-862 (b)	493	Dhamdara	11,071	11,071	E1	E4	Divided
17	PGT-862 (c)	493	Dhamdara	7,460	7,460	E1	E4	Divided
18	PGT-889(a)	1116	Dhamdara	5,430	5,430	E1	E1	Parent Plot
19	PGT-889(b)	1116	Dhamdara	1,975	1,975	E1	E1	Divided
20	PGT-1147(a)	1515	Kabraytar	24,417	23,829	E4	E4	Parent Plot
21	PGT-1147(b)	1515	Kabraytar	4,921	4,921	E4	E1	Divided
22	PGT-1237(a)	39	Kabraytar	10,400	10,400	UV2 (LD)	UV2 (LD)	Parent Plot
23	PGT-1237(b)	39	Kabraytar	6,913	6,913	UV2 (LD)	E1	Divided
24	PGT-172(a)	400	Kabraytar	33,080	33,080	E4	E4	Parent Plot
25	PGT-172(b)	400	Kabraytar	22,458	22,458	E4	UV2 (LD)	Divided
26	PGT-1839(b)	155	Kabraytar	23,825	23,825	UV2 (LD)	UV2 (LD)	Divided
27	PGT-1839(c)	155	Kabraytar	10,598	10,598	UV2 (LD)	E1	Divided
28	PGT-1983(a)	204	Kabraytar	14,077	14,077	E4	E4	Parent Plot
29	PGT-1983(b)	204	Kabraytar	11,010	9,689	E4	E1	Divided
30	PGT-808(a)	499	Kabraytar	50,011	50,011	UV2 (LD)	UV2 (LD)	Parent Plot
31	PGT-808(b)	499	Kabraytar	45,438	45,438	UV2 (LD)	E4	Divided
32	PGT-922(a)	115	Kabraytar	13,622	13,622	E1	E4	Divided
33	PGT-922(b)	115	Kabraytar	28,951	28,951	E1	E1	Parent Plot

9.4. APPENDIX D: LIST OF PLOTS WITH AREA CONTRIBUTION TO ROADS AND OTHER INFRASTRUCTURE AND PLOTS WITH EXCESS AREA

Sl no	Plot_ID	Tharm	Location	Net Area sqft	Map Area sqft	*GLD Contribution sqft
1	PGT-3053	153	Dhamdara	35,262	34,136	1126
2	PGT-1219	1553	Dhamdara	8,516	8,068	448
3	PGT-3533	2143	Dhamdara	4,813	4,431	382
4	PGT-3059	2010	Dhamdara	7,100	6,745	355
5	PGT-1616	1762	Dhamdara	11,478	11,132	346
6	PGT-3588	3245	Dhamdara	6,665	6,332	333
7	PGT-3540	3402	Dhamdara	6,534	6,207	327
8	PGT-2442	3311	Dhamdara	6,039	5,737	302
9	PGT-3541	3404	Dhamdara	4,900	4,639	261
10	PGT-1671	118	Dhamdara	7,035	6,776	259
11	PGT-134	417	Dhamdara	7,035	6,860	175
12	PGT-629	465	Dhamdara	5,554	5,394	160
13	PGT-1119	33	Dhamdara	3,703	3,555	148
14	PGT-2002	217	Dhamdara	6,665	6,531	134
15	PGT-2965	116	Dhamdara	8,323	8,207	116
16	PGT-327	449	Dhamdara	7,405	7,299	106
17	PGT-1029	1433	Dhamdara	4,813	4,736	77
18	PGT-1663	114	Dhamdara	8,381	8,308	73
19	PGT-3984	3374	Dhamdara	6,098	6,034	64
20	PGT-1027	1432	Dhamdara	4,813	4,761	52
21	PGT-2287	491	Dhamdara	9,627	9,615	12
22	PGT-1732	129	Dhamdara	2,840	3,049	-209
23	PGT-1461	1697	Kabraytar	7,283	5,405	1878
24	PGT-1983(b)	204	Kabraytar	11,010	9,689	1321
25	PGT-1595	96	Kabraytar	8,433	7,405	1028
26	PGT-1756	143	Kabraytar	3,450	2,687	763
27	PGT-1147(a)	1515	Kabraytar	24,417	23,829	588
28	PGT-304	651	Kabraytar	9,967	9,687	280
29	PGT-1456	2099	Kabraytar	5,188	4,914	274
30	PGT-1723	123	Kabraytar	9,583	9,507	76
31	PGT-2221	1949	Kabraytar	6,134	6,107	27
32	PGT-272	623	Kabraytar	7,284	7,261	23
33	PGT-3943	3312	Kabraytar	6,534	6,516	18
34	PGT-1347	48	Kabraytar	5,367	5,352	15
35	PGT-1894	178	Kabraytar	5,750	5,979	-229
36	PGT-937	26	Kabraytar	6,900	7,842	-942
37	PGT-161	416	Kabraytar	13,647	15,331	-1684
38	PGT-3586	3234	Kabraytar	18,783	21,344	-2561
39	PGT-958	1406	Kabraytar	57,384	64,944	-7560

*Note: Negative value for GLD contribution is the value for excess area for the plot.

Endnotes

1 The population change rate for Phuentsholing Thromde area calculated using 2005 census data as base population, may not be accurate as the Phuentsholing Thromde area in 2005 was much smaller compared to the Thromde area in 2017.

2, 3 Maximum population density: Only the average population density of plots with buildings meeting the maximum building height (in terms of no of floors) and coverage were taken.

4 Planned road refers to the road ROW that was planned in the existing LAP.

5 Missing carriageway width values are for rough roads or roads under construction. The minimum ROW and carriageway width of 6.2m and 3.5m respectively for tertiary road is for one land road with footpath on one side. The minimum values for 2 lane tertiary road are ROW = 8m and carriageway width = 6.6m.