TATA CONSULTING ENGINEERS LIMITED

LODHA DWELLERS PRIVATE LIMITED



PLANNING AND DETAIL ENGINEERING OF INFRASTRUCTURE FOR DEVELOPMENT OF 590 ACRES OF LAND UNDER DEVELOPMENT AT PALAVA NEAR DOMBIVALI

TRANSPORTATION PLANNING REPORT

MAY 2013

REVISION STATUS SHEET

Issue	Date	Title	Prepared By (TCE)	Checked By (TCE)	Approval By (LODHA Dwellers)
R0	23-03-2013	Planning Note - Transportation	DA	IA	
R1	05-03-2013	Planning Note - Transportation	DA	IA	
R2	06-05-2013	Planning Note - Transportation	DA	IA	
R3	13-05-2013	Planning Note - Transportation	DA	IA	
R4	14-05-2013	Planning Note - Transportation	DA	IA	
R4	21-05-2013	Planning Note - Transportation	DA	IA	

Revision Notes:-

R0- For Client Approval
R1- As per meeting held on 03-04-2013, Bus Circulation Plan has been included and another scenario with a different mode split has been run.
R2- As per meeting held on 17-04-2013, Bus Stop Design Guidelines, Traffic Circulation Plan and Traffic Signal Guidelines have been included and another scenario with a different mode split has been run.
R3- Volume/Capacity Ratios revised for both scenarios based on feedback from Lodha.
R4- Additional road through the Gauchar added.
R4- Review and analysis of revised Avenue road layout and entry/exit options sent by PBB on 16-05-2013, included.

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ABBREVIATIONS

FSM	-	Four Step Model
DU	-	Dwelling Unit
LOS	-	Level of Service
PCU	-	Passenger Car Unit
MLCP	-	Multi Level Car Park
IRC	-	Indian Road Congress

SITE VISIT NOTE -TRANSPORTATION
FOR DEVELOPMENT OF 590 ACRES LAND OF PALAVA

1 INTRODUCTION

Lodha Dwellers Private Limited (Lodha) has appointed Tata Consulting Engineers Limited (TCE) to provide consulting engineering services for the "Planning and Detail Engineering of Infrastructure for development of 590 acres of land development".

1.1 Project Background

Lodha has identified almost 2200 acres for planned development of the "Palava city", about 8 kms south of Dombivli. Half of this land (near about 1100 acres) is marked as the first parcel of development out of which Lodha plans to take up 590 acres on priority. This land is to be developed by 2030 years in phases.
Following recent developments, the FSI of the area has increased to 1.7. New Master Plan for the 590 acres township has been prepared in January 2013.
A workshop in this regard was called by Lodha on 4th to 6th Feb 2013. Infrastructure goals, utility management philosophies, security and smart city intent for 590 acres (Palava) township were discussed. Preliminary inputs required for planning have been formulated on basis of this workshop. The Preliminary Planning Notes are prepared in this regard.

2 TRAVEL DEMAND MODELING

2.1 Objective

Travel demand modeling for Palava aims to establish the spatial distribution of travel, from the site explicitly by means of an appropriate system of zones. Modeling of flows will predict the travel decisions the residents are expected to make given the generalized travel cost of each alternative. The base decisions include the choice of destination, the choice of the mode, and the choice of the route. The classical transport model popularly known as four-step model (FSM) is adopted for this project

2.2 Approach

The general form of the four stage model is given in **Figure 2.1**. The classic model presented as a sequence of four sub models:

I. Trip generation
II. Trip distribution
III. Modal split
IV. Trip assignment

The model starts with defining the study area and dividing the area into a number of zones, and considering the entire transport network in the system. The database also include the current (base year) population, economic activity like employment, shopping space, educational, and recreational facilities of each zone.

The trip generation model is evolved based on the above data to estimate the total number of trips generated and attracted by each zone.

The next step is the allocation of these trips from each zone to various other destination zones in the study area using trip distribution models. The output of the above model is a trip matrix which denotes the trips from each zone to every other zone.

In the succeeding step the trips are allocated to different modes based on the modal attributes using the modal split models. This essentially slices the trip matrix for various modes to generate a mode specific trip matrix.

Finally, each trip matrix is assigned to the route network of that particular mode using the trip assignment models. The output indicates loading on each link of the network.

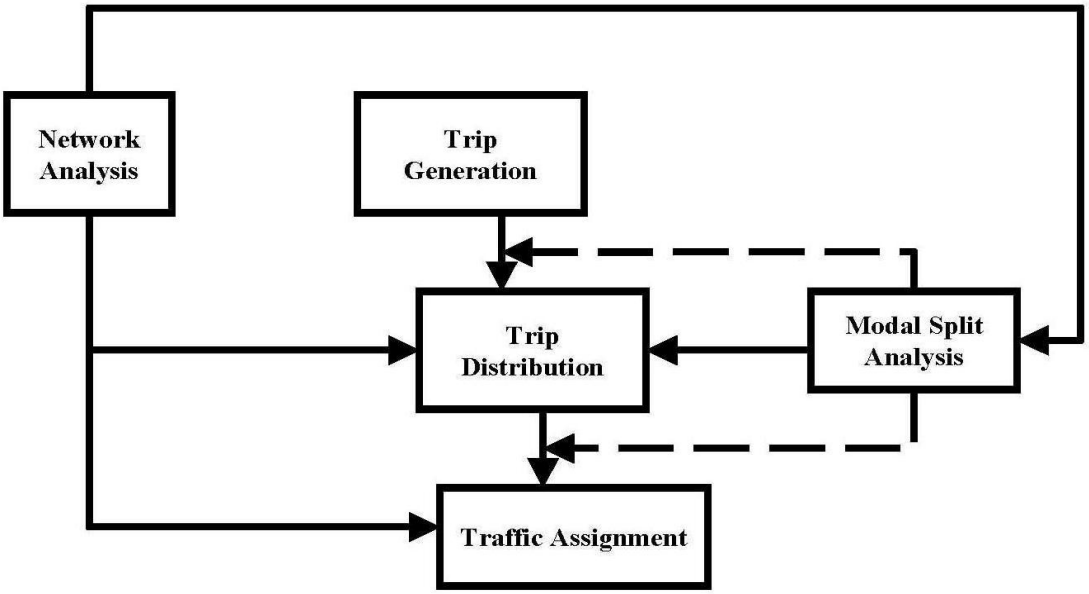


Figure 2.1 General form of Four Step Model

2.3 Methodology

The methodology adopted in this study is also in conjunction with the traditional four step model as shown in **Figure 2.2**; Aim is to identify the intersection volumes in the morning peak hour. The current model answers the following questions (decisions):

I. How many trips are generated?
II. Where they are going?
III. On what mode they are going?
IV. Which route they are adopting?

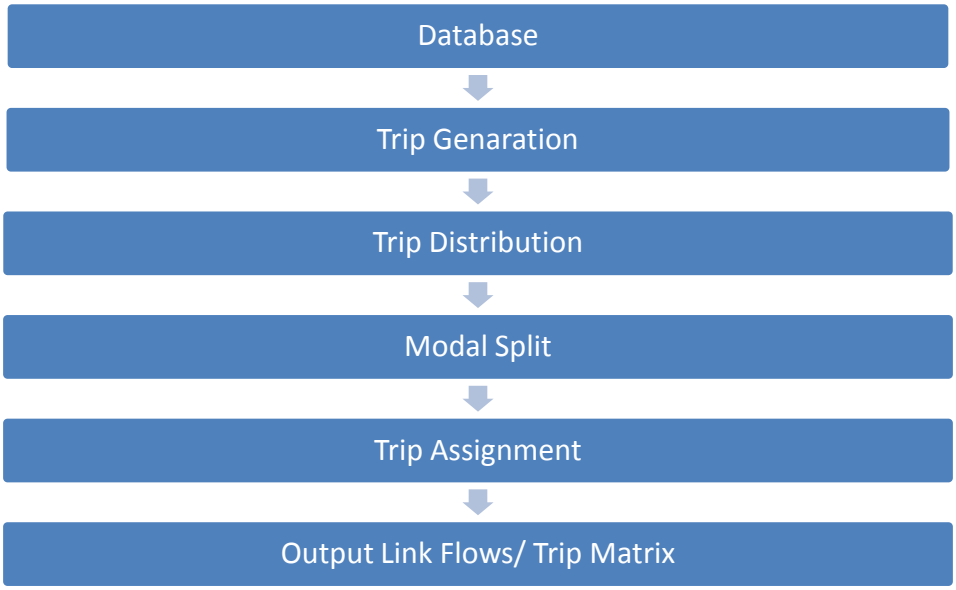


Figure 2.2 Methodology of the current Four Step Model

2.3.1 Basis

Based on the consultants experience in projects of similar nature and discussion with the client in the meeting held on 17/04/2013 at the Lodha office, the following basis is proposed for the Palava Travel Demand Model:

- 80% of all households will be occupied and 1.25 persons per household will be employed.
- 70% of those employed will leave home during the morning peak period (8 a.m. to 9:30 a.m.)
- The site is divided into 9 internal zones. Each MLCP is assumed to be the zone centroid of the internal zones, from where the trips originate/end. Residential blocks are allotted to each zone based on its proximity to the MLCP subject to a maximum walk distance of 350m as shown in Figure 2.3
- Six external zones have been created for the purpose of this study in order to maximize the accuracy of outgoing trip estimate. **Figure 2.3** shows each zone. It is only required to identify the output flow along the periphery of the proposed development. These zones are as follows:

I. Zone 13 – going towards Badlapur
II. Zone 14 – Commercial zone north of the MIDC pipeline road
III. Zone 15 – Commercial zone south of the MIDC pipeline road
IV. Zone 16 – going towards Thane/Navi Mumbai/ Mumbai.
V. Zone 17 – going towards Nilje station
VI. Zone 18 – going south on the Taloja Bypass

- Internal bus traffic – During peak hours will primarily be due to Palava residents working at commercial space on the north. Assume 50% of total seats at Palava commercial space occupied by residents. For calculating bus traffic, subtract the

residents who are within 10 minute walking distance to the commercial space. Following scenario has been analyzed

I. 80% of residents who do not walk to commercial space take the bus. 20% use personal transport

- Table 3.1, Table 3.2, Table 3.3, Table 3.4, Table 3.5, Table 3.6 show the Trip Distribution, Mode Share, Vehicle Occupancy and PCU Factors (As per IRC 106 – 1990) considered for the analysis.

Table 2.1 Trip Distribution

Trip Distribution	%
Zone 13 (To Badlapur)	3
Zone 14 (Commercial North)	47
Zone 15 (Commercial South)	21
Zone 16 (Thane/Navi Mumbai)	14
Zone 17 (Nilje Station)	13
Zone 18 (Taloja MIDC)	2

Table 2.2 Modal Split (Scenario 1)

Modal Split (Avg.)	%
Car	18%
2 Wheeler	17%
IPT	5%
Bus	53%
Walk	7%

Table 2.3 Modal Split (Scenario 2)

Modal Split (Avg.)	%
Car	20%
2 Wheeler	20%
IPT	5%
Bus	47%
Walk	7%

Table 2.4 Vehicle Occupancy Table

Mode	Occupancy
Car	1.5
2 Wheeler	1.5
IPT	1.5
Bus	50

Table 2.5 PCU Factors

Mode	PCU
Car	1
2 Wheeler	0.75
IPT	1.2
Bus	3.7

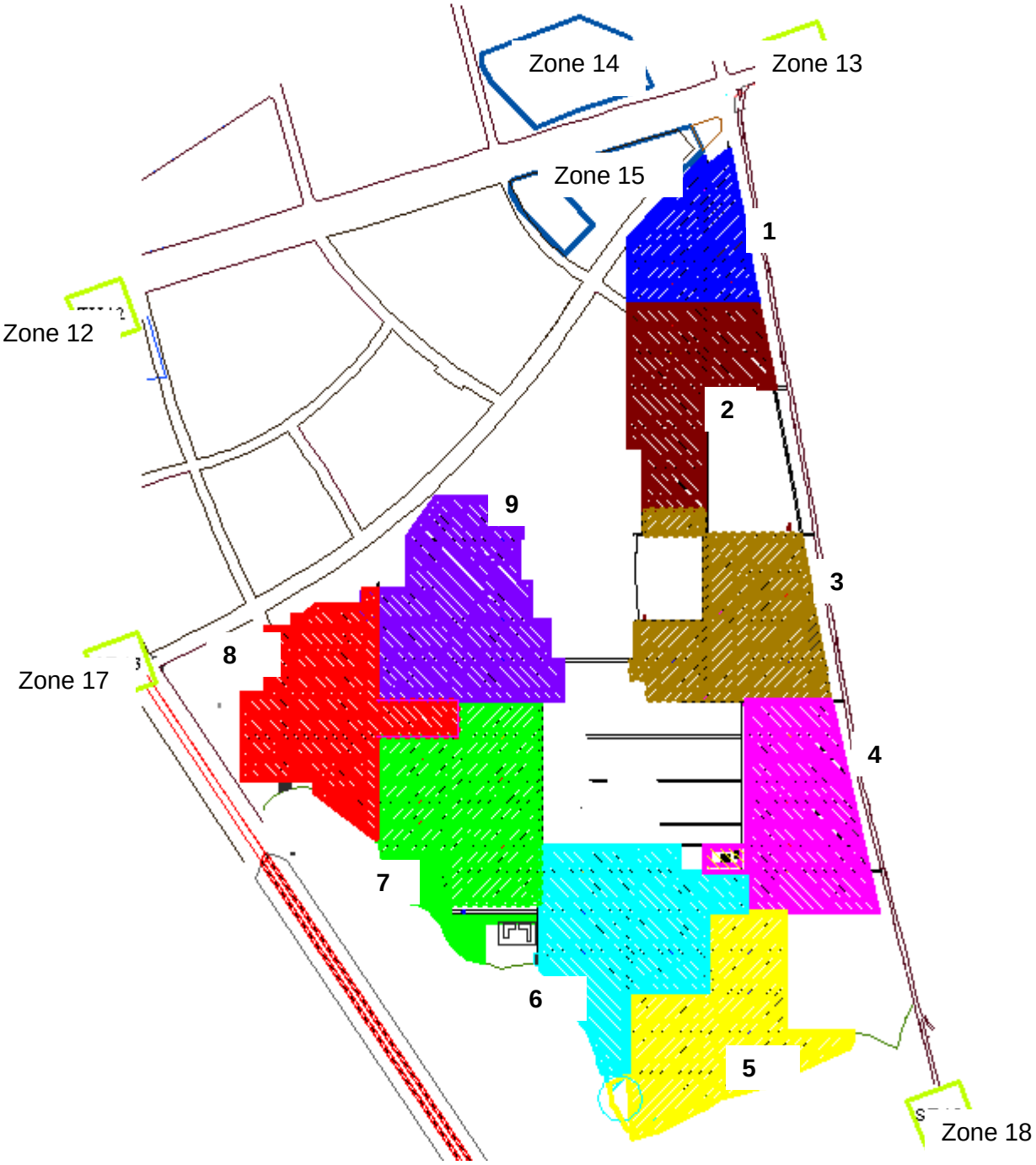


Figure 2.3 Division of Zones in the Proposed Development

2.4 Review of Avenue options and Entry/Exit options sent by PBB on 16-05-2013

Revised options for the Avenue and the entry/exit options at the north have been provided by PBB on 16-05-2013 and the same are required to be reviewed by analyzing using the travel demand model described earlier.

2.4.1 Review of Avenue options

All revised Avenue options sent by PBB, dated 16-05-2013, have been reviewed and volume by design service volume ratios have been calculated for each link on the Avenue, on the most preferred option.

Option 1 as sent by PBB is the most recommended option out of the three since the avenue provides direct connectivity to the Taloja Bypass on the South-east. Thus Option 1 as sent by PBB has been analyzed using a travel demand model explained in the earlier sections.

As described earlier, it is desired to find the volume by design service volume ratios across each links on the internal roads of the proposed development. Based on the trips assigned on the network, the flows across each links have been evaluated.

As per IRC 106: 1990, 'Guidelines for Capacity of Urban Roads in Plain Areas', on two-way undivided roads, the traffic carrying capacity is relatively independent of the directional distribution of traffic and design is based on two-way flows. While, on dual or divided carriageways, the capacity is dependent on directional split of traffic flow and the design should therefore be based on the peak hour traffic in the busier direction of travel. However, it is recommended that normally LOS C be adopted for design of urban roads. At this level the volume of traffic will be around 0.7 times the maximum capacity and this be taken as the 'Design Service Volume' for the purpose of adopting design values.

As per IRC 106:1990, the Design Service Volume for two lane – two way roads is 900 PCU's/hour and that for two lane – one way roads is 1400 PCU's/hour, for collector roads with frontage access and parking spaces along the approach.

Note that as advised by the client, the bus occupancy has been assumed as 50..
The Outputs for the desired scenario is as illustrated in Figure 2.4.

Traffic has been assigned on the route based on the following assumptions

I. All Bus trips have been assigned on the main internal road network.
II. All other trips have been assigned on the shortest path from origin to destination. This is based on the assumption that a trip maker chooses a route which has minimum time and the route with the shortest path is assumed to be the minimum path route assuming constant speed. Given that this model has been developed on excel, other assignment algorithms cannot be applied to assign trips, manually thus the trip assignment used in this analysis is only computational and the most conservative.

Figure 2.4 shows the Volume by Design Service Volume across each link on the network. Higher V/C ratios are being observed in this case across each link. This can be attributed to the assumption that the each trip maker chooses the shortest route to reach their

destination and thus every trips from units in the south west exit through the only access route on the southwest connecting the DP road

Also, flows on the link will be higher since the floating population - inbound and the internal – internal trips have not been included.

2.4.2 Review of Entry/Exit Options

Figure 2.5 shows the recommended entry/exit option from those suggested by PBB. Option 2 is a better option in terms of geometry, as illustrated. Also, the adjoining green area could be used for landscaping.

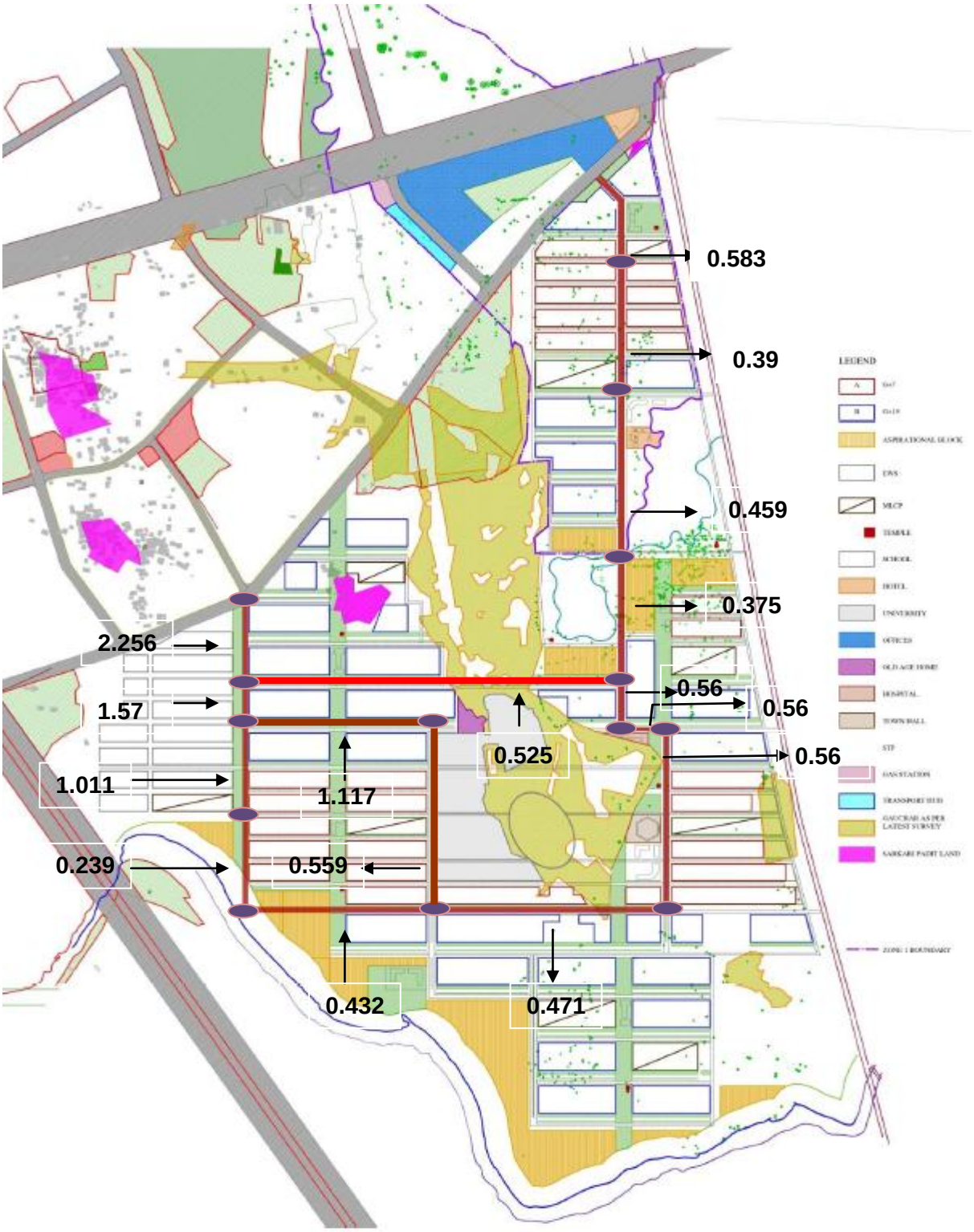


Figure 2.4 V/C ratios at each link in the proposed development (Scenario 1)

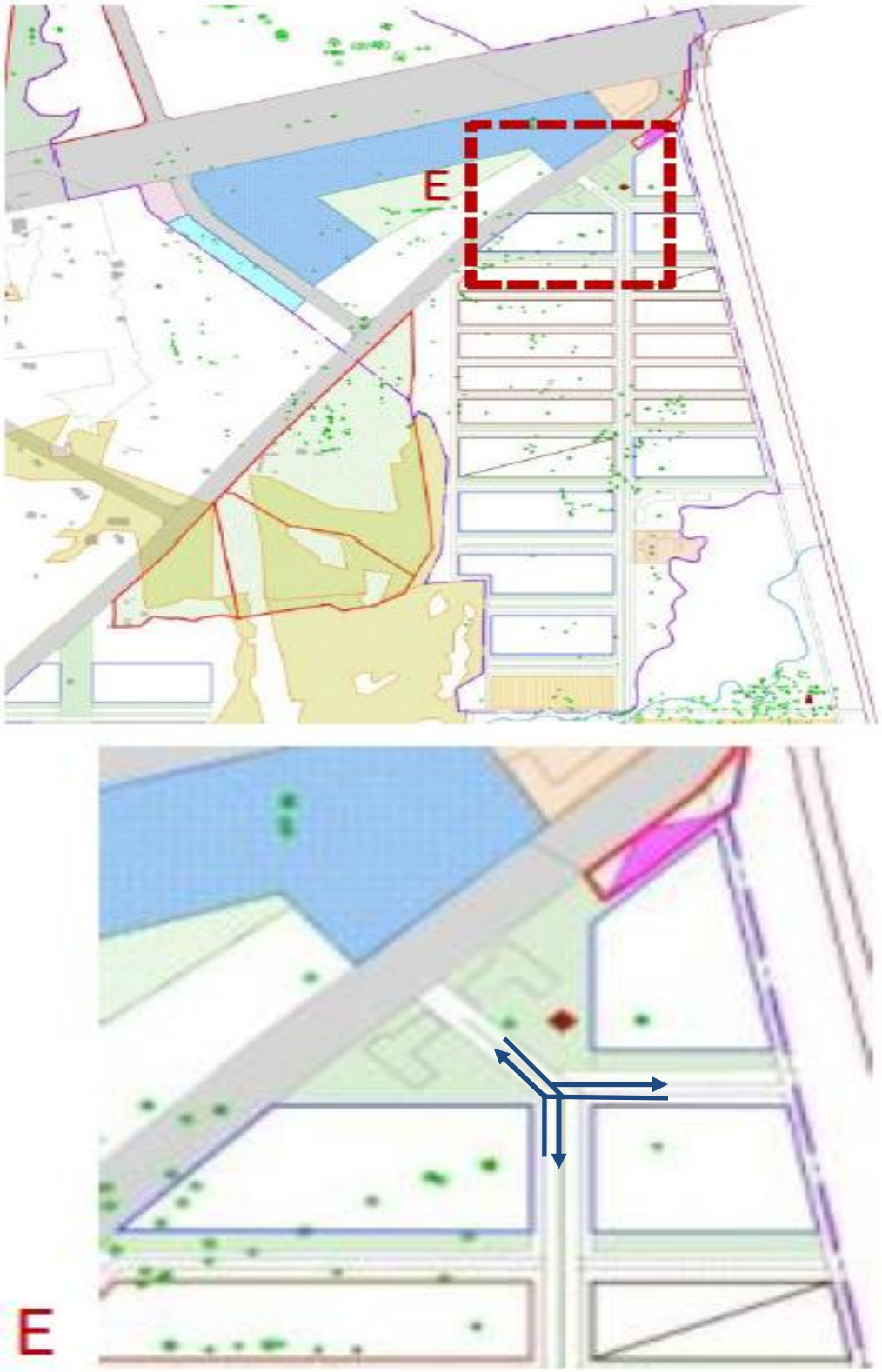


Figure 2.5 Recommend Entry – Exit Option (Option 1)

2.5 Bus Stop Design Guidelines

It is desired to promote usage of public transportation in the proposed development and thus plan the infrastructure accordingly.

2.5.1 Bus Circulation Plan

A bus circulation plan is proposed based on the following assumptions:

I. Buses will only run along the main road in the proposed development.
II. Nilje station which is expected to become operational as a commercial station, the commercial zone and Palava University will be directly connected by bus.
III. Bus connectivity to the other three external zones will be from the Transport Hub.

Based on the philosophy mentioned above, Figure 2.6 shows the proposed clockwise and anti-clockwise bus circulation routes to cater to the entire population within the proposed development. These routes will also cater the internal-internal trips (Including Bus trips to the Commercial Zone) apart from providing connectivity to the Transport Hub for bus connectivity to Mumbai, Navi Mumbai, Thane, Badlapur etc.

In addition to this, Figure 2.11 shows the proposed bus circulation routes to provide connectivity to Nilje and Diva Station from within the proposed development, with high frequency during the peak hour.

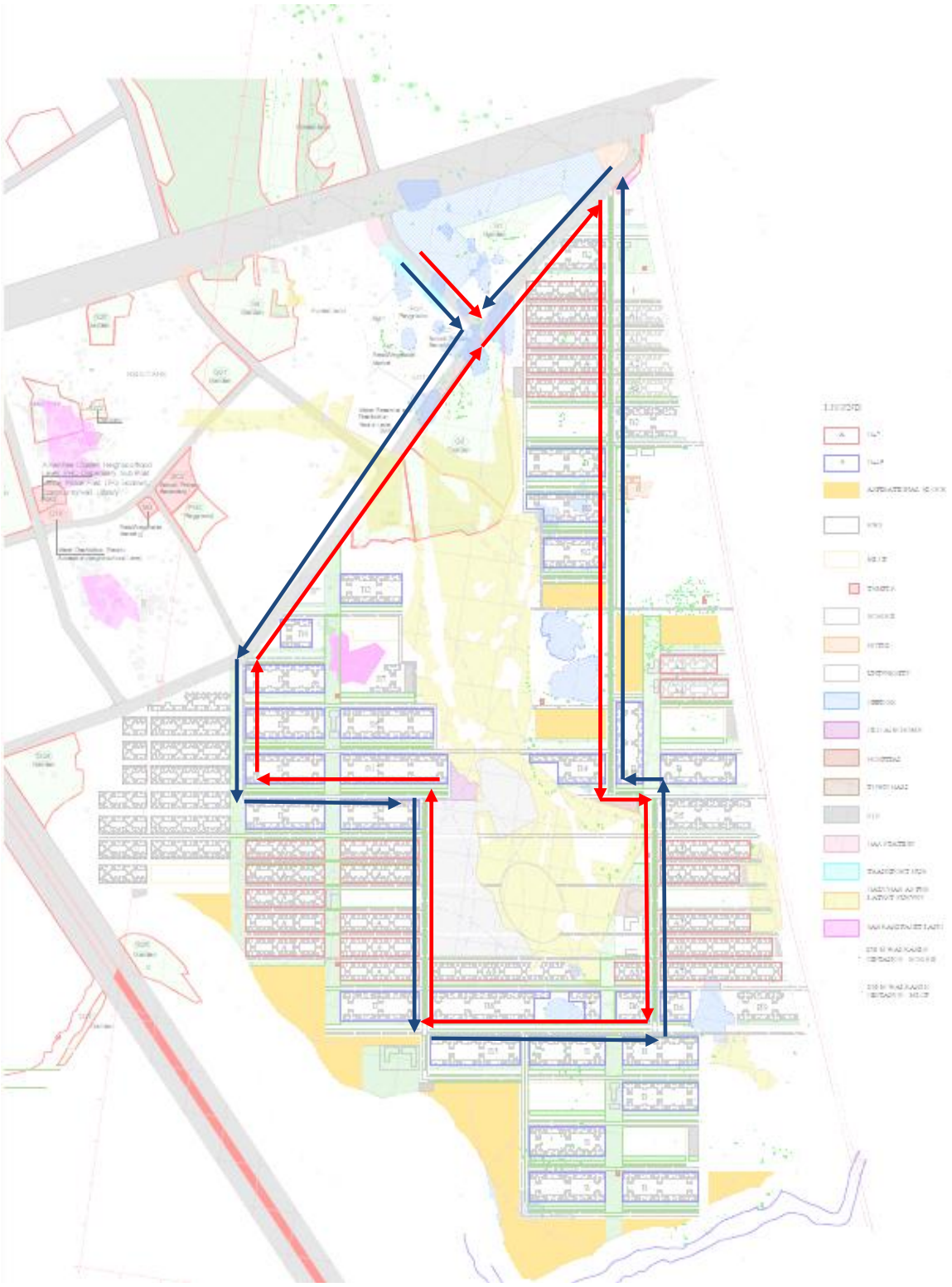


Figure 2.6 Internal Bus Circulation Route

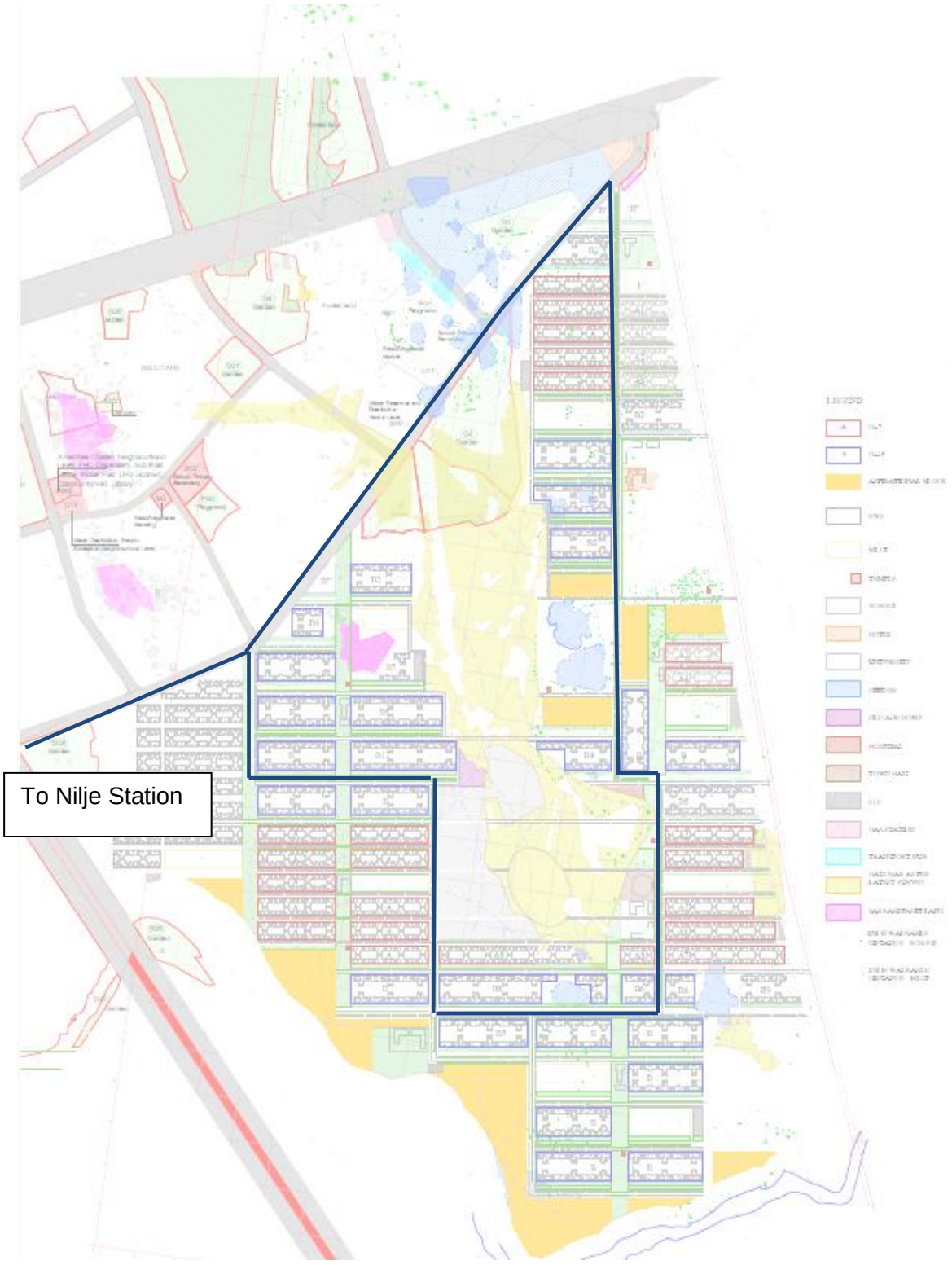


Figure 2.7 Internal Bus Circulation Route (Nilje Station Connectivity)

2.5.2 Bus Stop Location

Bus stops should be located to allow passengers to board and alight safely and conveniently. Ideally the bus stops should be located as close as possible to destinations such as schools, shops, libraries, hospitals, residential places etc. Key considerations for the bus stop locations are shown in Figure 2.8

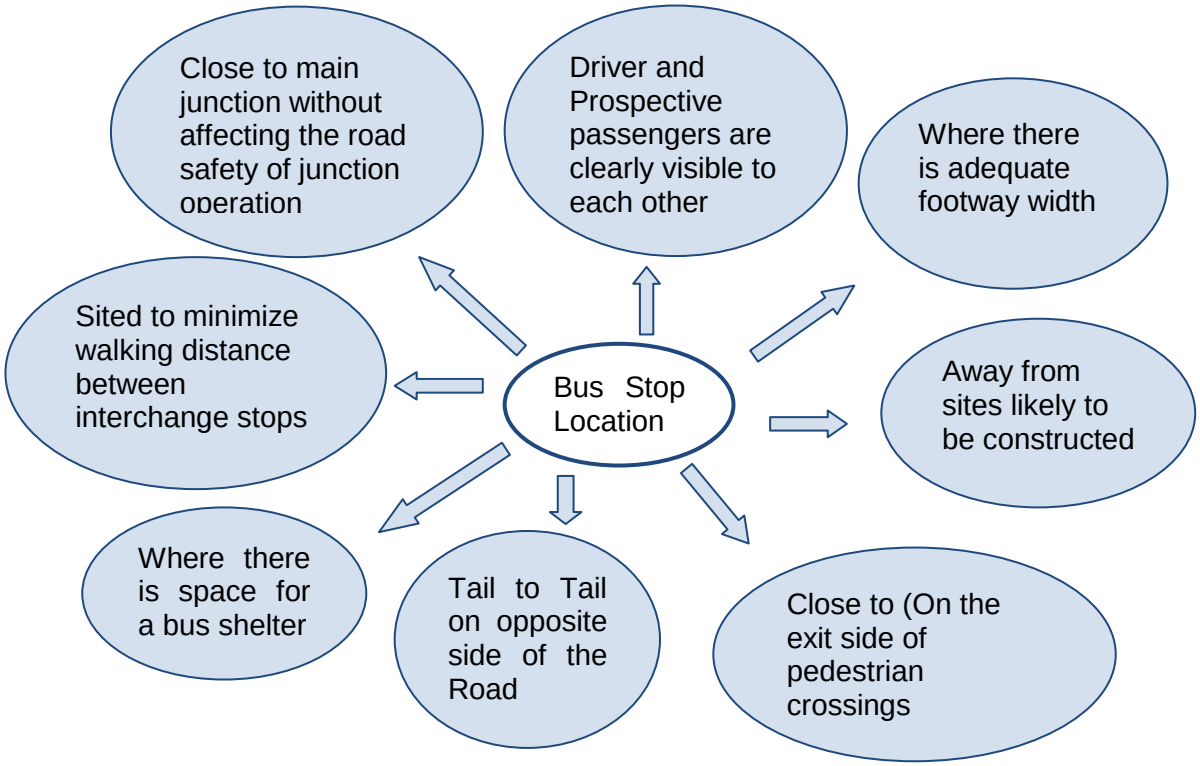


Figure 2.8 Considerations for Bus Stop Locations

Consideration needs to be given to the routes taken by the passengers to and from the bus stops. Given the high population density that is expected in Palava, it is desired to have a bus stop spacing of 350m along each approach on the main road. Figure 2.9 shows the tentative bus stop locations along the main road.

Note: Revised Master Plan, as discussed earlier is awaited

2.5.3 In-street Design

The primary area within the street devoted to bus movements is the bus zone, which allows the vehicle to pullover to the kerb for the purpose of loading and unloading of passengers. The geometry of the street should accommodate both transit and general traffic. Bus transit requires a stop location within the roadway that provides the vehicle sufficient space for deceleration and acceleration, and with a clear area to discharge and receive passengers efficiently and safely. Bus stops unobstructed by kerbside activity are rare and usually necessary to find a means to sufficiently encourage motorists to keep the bus stops clear.

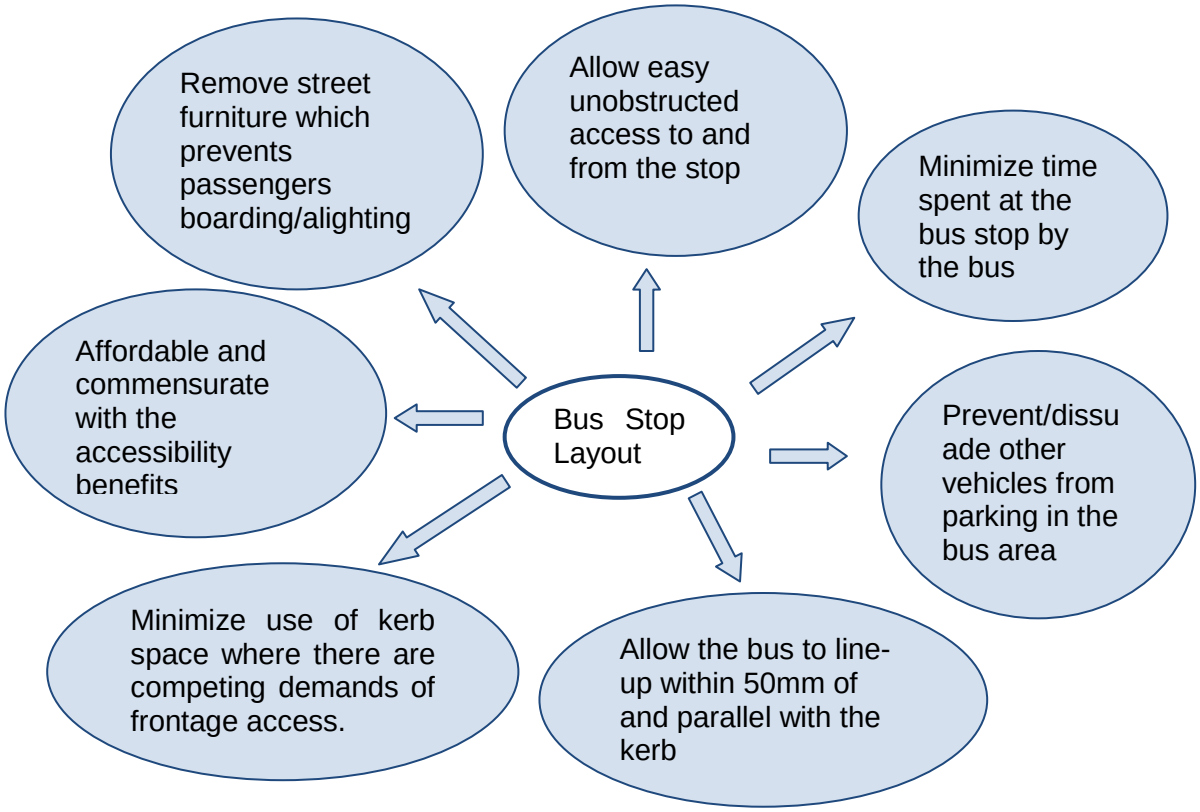


Figure 2.9 Considerations for Bus stop layout

Figure 2.10 illustrates an in-line kerbside stop. Bus zone is located in the road (in a parking area), with a typical width of 3m. The parking lane is required to be marked in order to identify the loading and maneuvering area for the transit vehicle. The bus zone treatment typically includes painted roadway markings and a sign marking the area a “no stopping” or “no parking” location. Typical kerbside bus zone details are as illustrated in Figure 2.10.

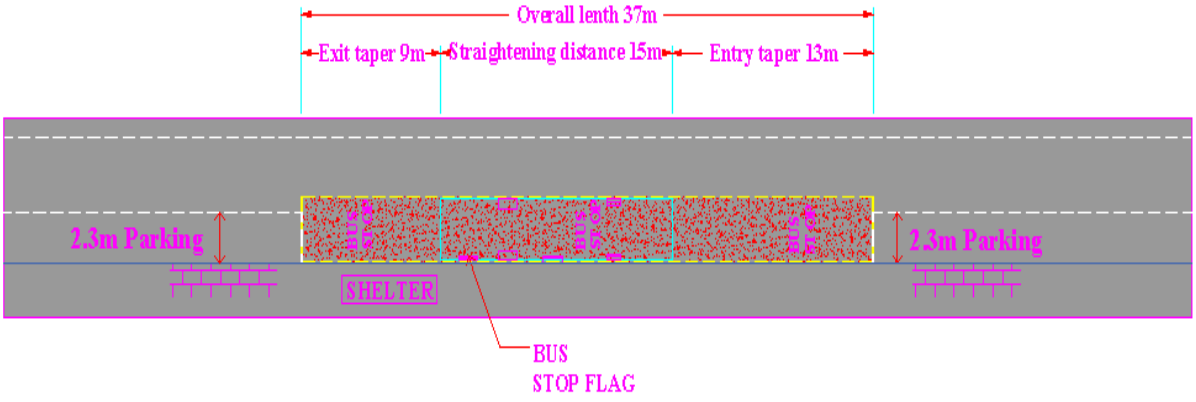


Figure 2.10 Kerb side stop with parking on approach and exit

Figure 2.11 shows a kerbside stop on the exit side of the junction. Problems can occur as a result of vehicles stopping between the bus zone and the junction, even with kerbside restrictions. However, in practice marker bus zones with stopping restrictions can be more effective at discouraging vehicles stopping within this area and also easier to implement.

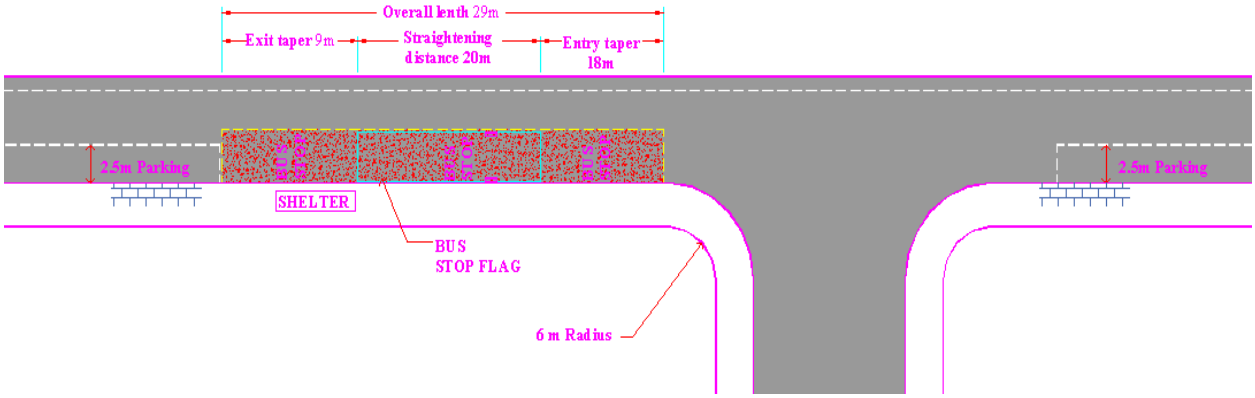


Figure 2.11 Exit side of the junction (kerbside design)

Figure 2.12 shows a kerbside stop at the mid-block. It is desired to provide bus stops as tail to tail on opposite sides of the road with a 3m buffer between the tail end of the bus and the crosswalk for safety purpose.

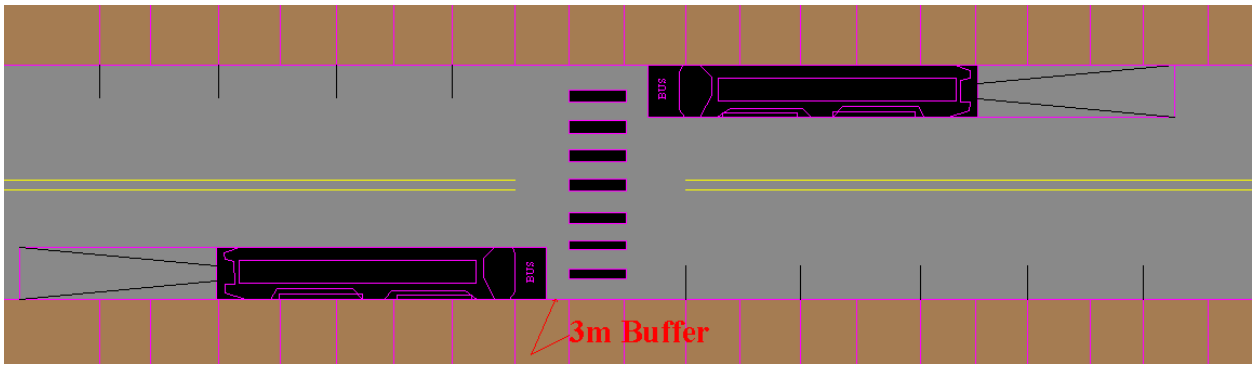


Figure 2.12 Midblock location of bus stop (Kerbside)

Kerbside stops can be integrated into the current design scheme for Palava effectively provided speed of the stream of general traffic is less. Disadvantages of the kerbside stop are that it may reduce roadway capacity by interrupting the general traffic (driver dependant)

Figure 2.13 illustrates a bus bay/turnout. The bus bay/turnout location is offline with respect to the travel lanes, with a special kerbed pullout for the buses. The bus bay allows the general traffic to pass around a loading bus and interferes less with left turning

vehicles at the intersection. It can be easily incorporated into site design where high volume loading is anticipated. Typical details are shown in figure 2.13

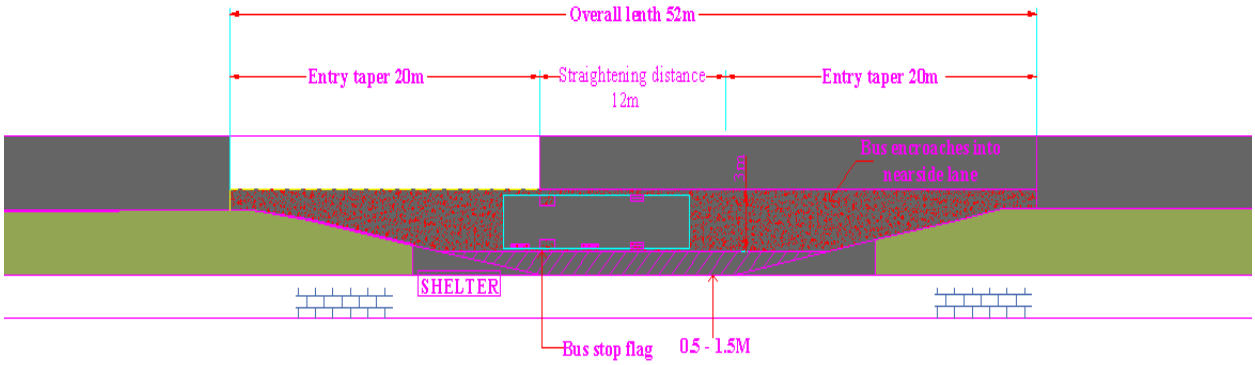


Figure 2.13 Bus bay layout of bus stop

Advantages in using this configuration are where an intersection presents a particular hazard or conflict with transit operation. It can be most effectively used as a system layover stop.

2.5.4 Summary of In-street Design

Table 2.7 shows the summary of usage guidelines for Bus stop In-street design layouts described above.

Table 2.6 Summary of Bus stop layouts

Layout	Advantages	Disadvantages
Kerbside	• Can be used at intermediate locations where there is less stoppage time and parking along the main street. • Footpath width not compromised.	• May reduce the capacity of the roadway. • Cost of construction is low as compared to the Bus Bay layout
Bus Bay	• Can be effectively used as a system layover stop, • Does not reduce the capacity of the roadway	• Reduced footpath space at the location of the bus bay layout. • Cost of construction is high.

Figure 2.11 and Figure 2.12 show the kerbside designs for bus stop locations at the exit side of the junction and at mid-block. Similarly, based on the typical bus bay layout as shown in Figure 2.13, bus bay layouts can be applied on mid-block or the exit side of the junction as required.

Note that the Bus bay layout is proposed to be used at location of system layover i.e. where the bused are expected to have a higher waiting time whereas the kerbside layout can be used for intermediate Bus-stops.

2.6 Traffic Circulation

The circulation network provides linkage between different land uses and facilities, access to home, shopping, jobs, school and recreation. Proper planning will ensure that there is sufficient roadway capacity to accommodate traffic anticipated by the future development.

Following are the desired guiding policies.

I. Provide a safe and efficient vehicular circulation, with minimum conflicts.
II. Provide a wide variety of transportation alternatives and modes to service all residents and businesses to enhance the quality of life.
III. Strive to improve accessibility to shops, schools, parks and employment centers and reduce total vehicle kms. travelled per household to minimize vehicle emissions and save energy.
IV. Improve the scenic characters of the transportation corridors of the proposed development.

A detailed study has been carried out with a traffic management perspective, to understand the possible circulation alternatives given the proposed layout.

Note that, the traffic along each road is going to be two-way.

Also, the latest master plan has not been sent in the CADD format and thus some circulations recommendations are based on the previous master plan dated 20.01.2013

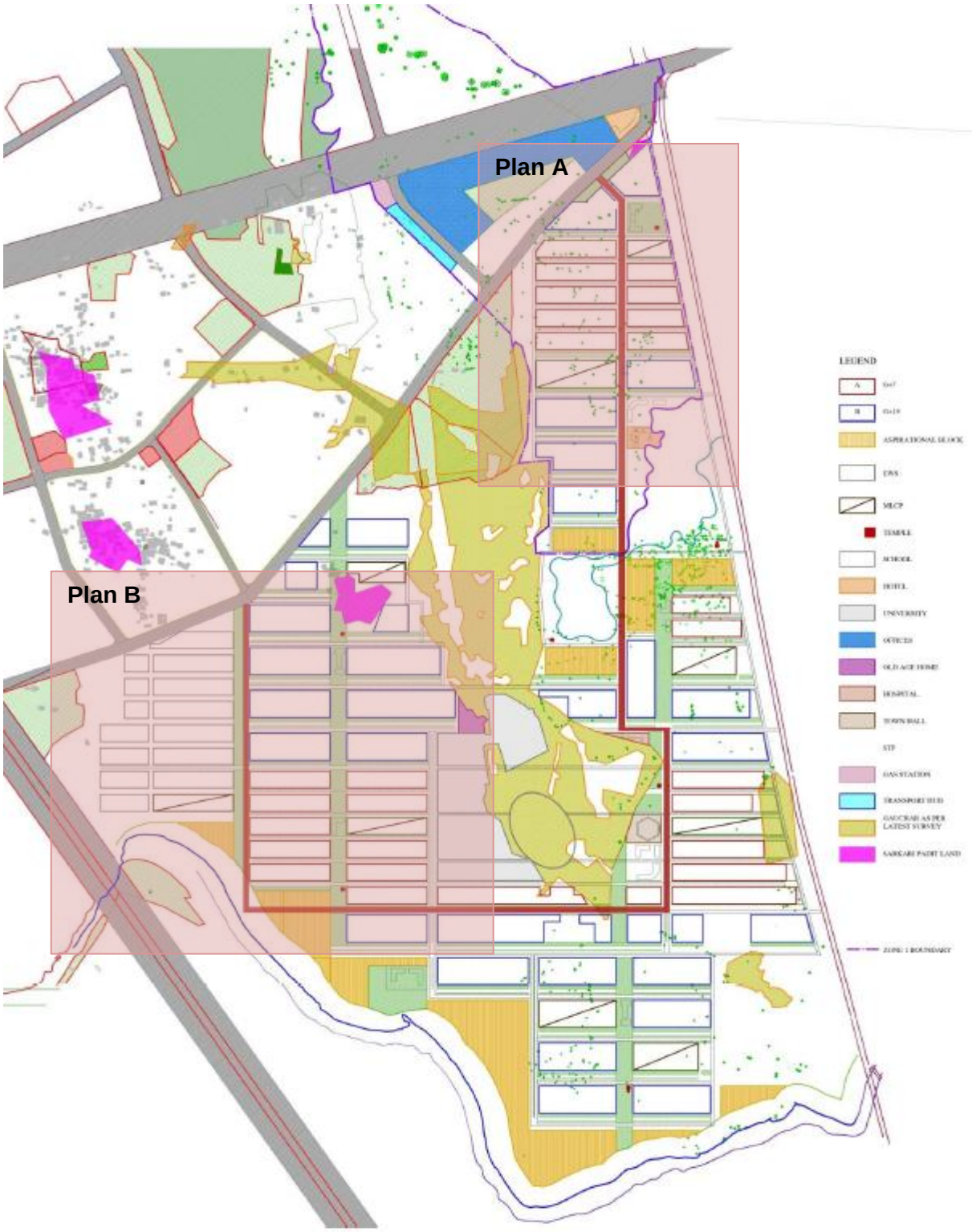


Figure 2.14 Traffic Circulation Plan

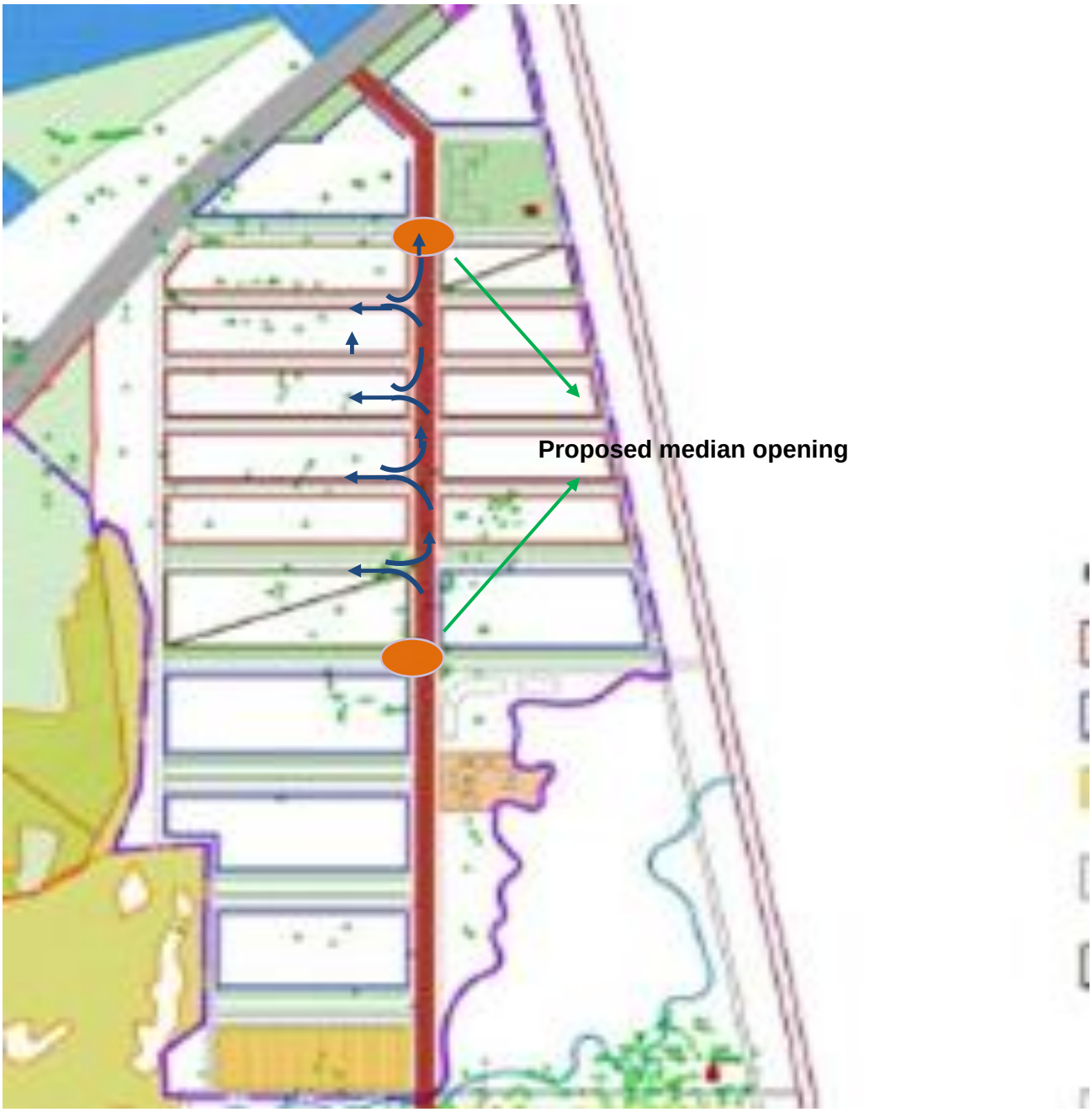


Figure 2.15 Traffic Circulation - Plan A (Typical Left in Left Out Movement)

Figure 2.15 shows the typical *'Left In Left Out'* circulation that will minimize conflict at the intermediate junctions. It is desired to reduce major conflicts, shown in Figure 2.15, for safe and efficient movement of vehicles in and out of the junctions. Thus a typical left-in left-out movement is the most desired movement.

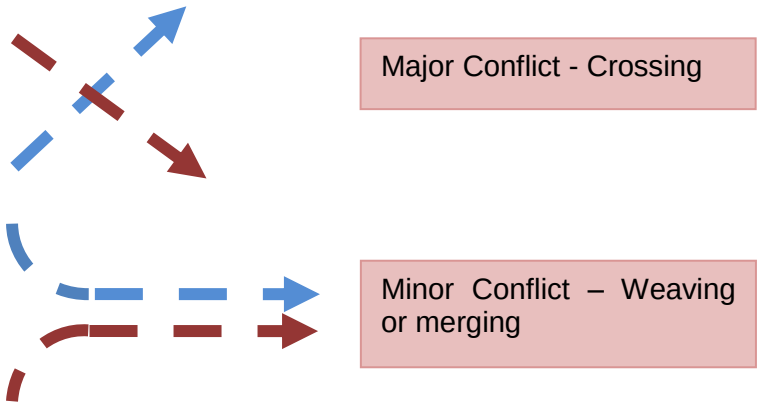


Figure 2.16 Conflicts

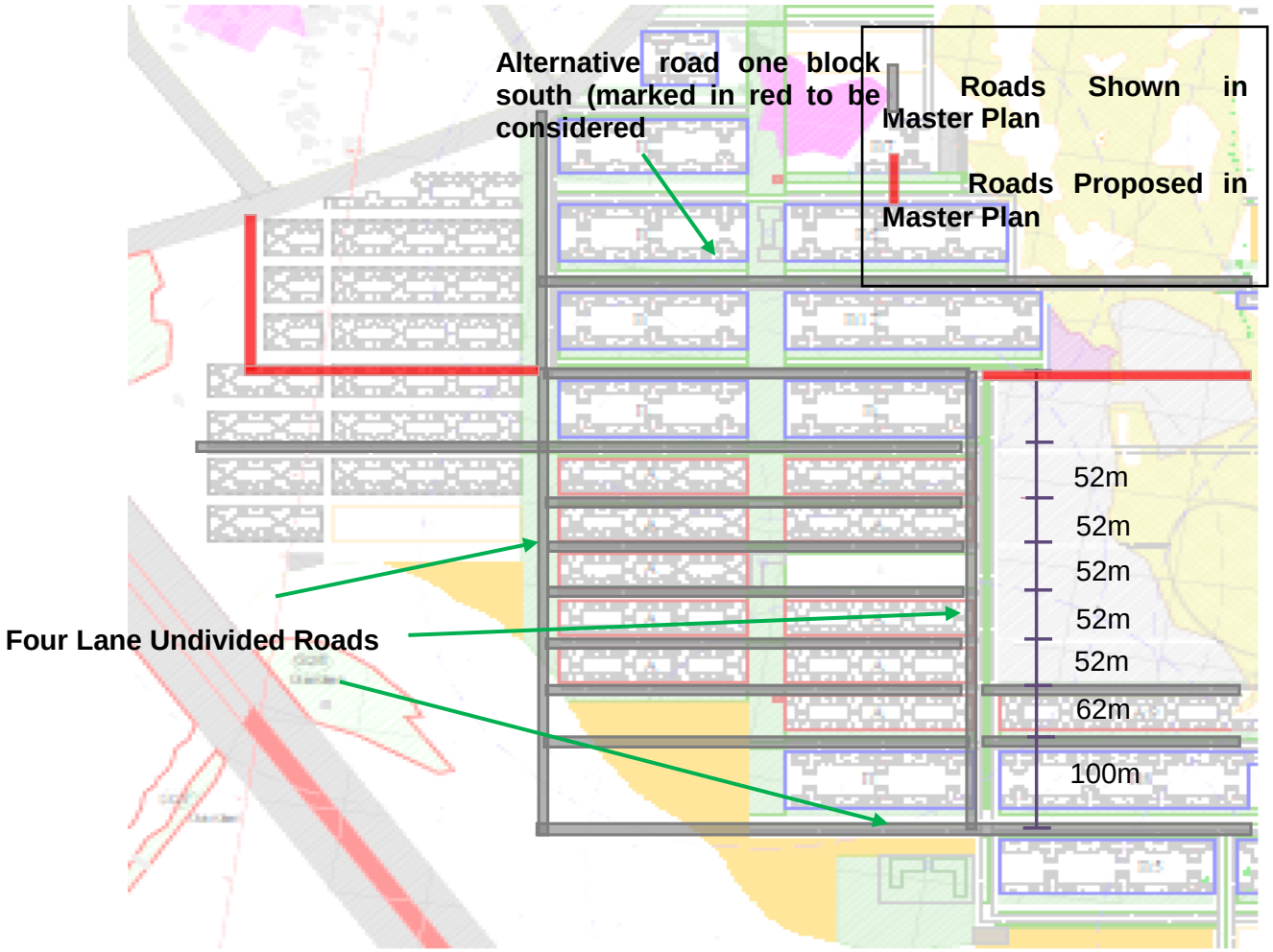


Figure 2.17 Traffic Circulation - Plan B

Figure 2.17 shows the road layout in Plan B as indicated in Figure 2.14. Alternative 1 is to provide median openings at each junction so as to allow right turning. However, in this case there will be both major and minor conflicts at each intermediate junction.

It is recommended that the road passing through the gauchar land be moved south and extended so as to provide an additional entry/exit route to the proposed development such that congestion on the only route planned as of now, can be mitigated and vehicles can be distributed out of the proposed development with lesser delay. Other advantages of the road through gauchar are that the road, if pushed south will act as a clear east-west road which will encounter lesser junctions at the east west road thereby reducing delay.

It is also recommended that the roads highlighted as four lane undivided, be maintained. Advantage of doing so is that during the peak hour there will be mostly unidirectional traffic and an undivided carriageway means that one lane on the non-peak approach can act as a contraflow lane thereby increasing capacity. Also, if at some point in the future flow increases beyond permissible delays, they can be converted into one-ways and traffic can be circulated accordingly.

Looking at the master plan (dated 21-01-2013), most service lanes cannot be turned into one-way lanes given the land use constraints. It is therefore recommended to provide at-least 5.50m of carriageway width in the service lane for efficient two-way movement into the out of the parking spaces. Also, as illustrated in Figure 2.22, the adjacent area can have parking at only one side of the road and it is also recommended to provide walkway for those that park.

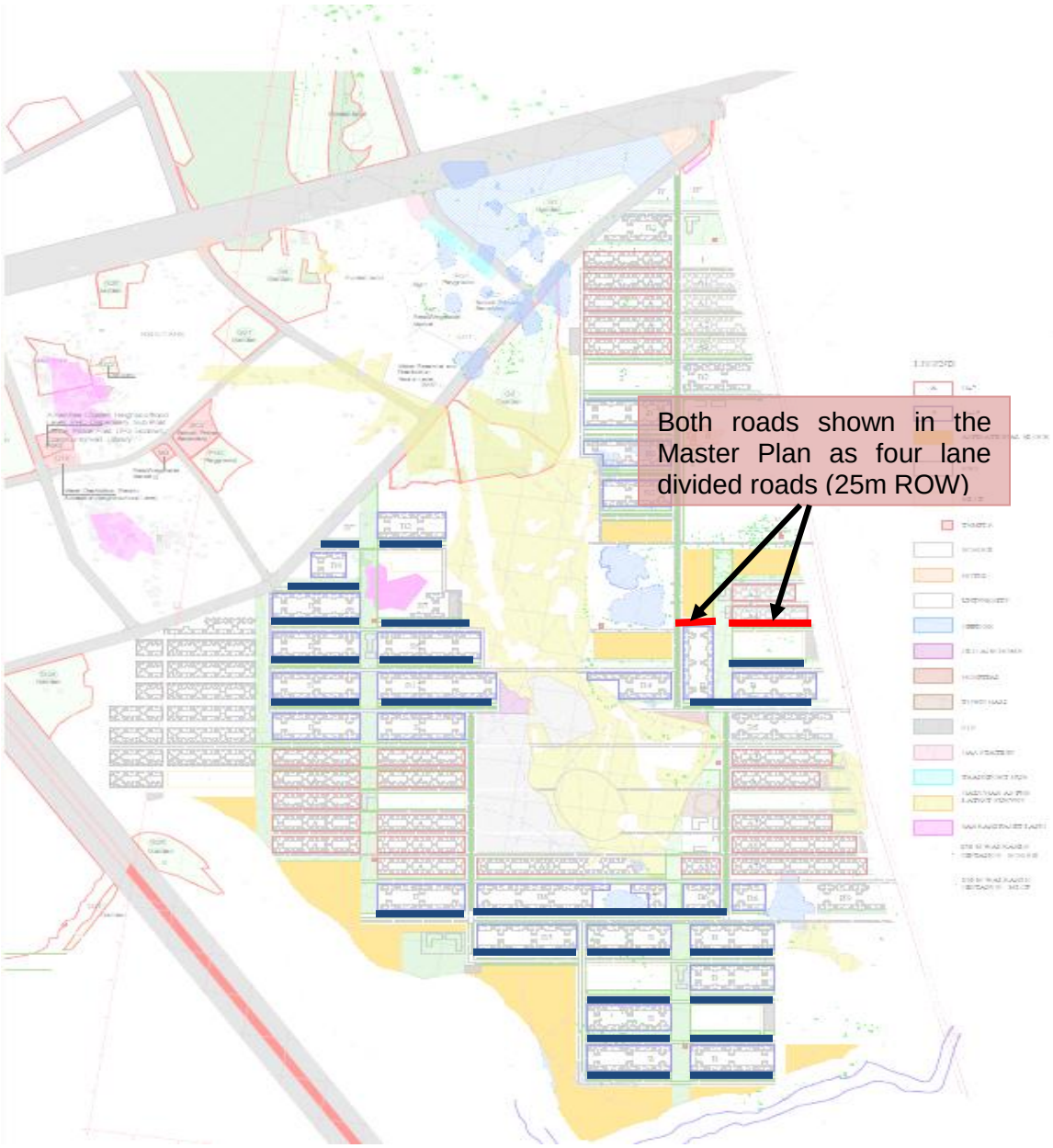


Figure 2.18 Master Plan showing 39m ROW roads

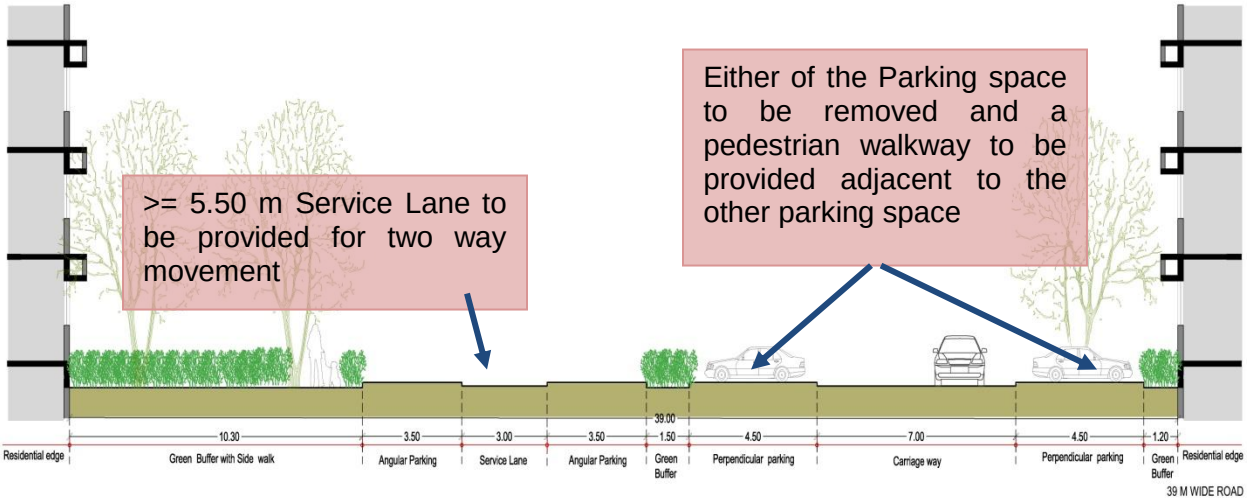


Figure 2.19 Cross Section – 39m ROW (Provided by Client)

2.7 Traffic Signal Guidelines

Traffic signals are an indispensable part of a modern road system. If used properly, they benefit safe, convenient, and efficient travel by reducing certain types of accidents and minimizing unnecessary delays to users. If installed inappropriately, a signal will increase accidents and traffic delays and contribute to congestion. However, a comprehensive investigation of traffic conditions and physical characteristics of location is required to determine the necessity for a signal installation. The traffic signals should be installed if any one or more of the signal warrants specified below are met. Although warrant analysis process is just one of the tools to be used in determining if a traffic signal is warranted. Engineering judgment should be exercised in making the final determination.

Five traffic signal warrants that appear in the Traffic Signal Warrant as mentioned in **IRC: 93 – 1985 – Guidelines on Design and Installation of Road Traffic Signals**. The investigation of the need for a traffic control signal shall include an analysis of the applicable factors contained in the following traffic signal warrants and other factors related to existing operation and safety at the study location. Following are the Warrants for Traffic Signals Installation

2.7.1 Warrant 1- Minimum Vehicular Volume

This warrant is intended for application where the volume of intersecting traffic is the principal reason for consideration of signal installation.

2.7.2 Warrant 2 - Interruption of Continuous Traffic

This warrant is applied to operating conditions where the traffic volume of major Street is so heavy that traffic on the minor intersecting street suffers excessive delay or hazard in entering or crossing the major street.

2.7.3 Warrant 3 – Minimum Pedestrian Volume

The minimum pedestrian volume warrant is satisfied when for each of any 8 hours of an average day, the following traffic volumes exist:

I. On the major street, 600 or more vehicles per hour enter the intersection (total of both approaches) or where there is raised median island 1.5 meter or more in width, 1000 or more vehicles per hour (total of both approaches) enter the intersection on major street.

II. During the same 8 hours as in para. (i) above, there are 150 or more pedestrians per hour on the highest volume cross-walk crossing the major street.

2.7.4 Warrant 4 – Accident Experience

The accident experience warrant is satisfied when adequate trial or less restrictive remedies with satisfactory observance and enforcement have failed to reduce the accident frequency.

2.7.5 Warrant 5 – Combination of Warrants

In exceptional cases, signals may be justified occasionally where no signal warrant is satisfied but where two or more of warrants 1,2 and 3 are satisfied to the extent of 80% or more of stated volume.

2.8 Recommendation and Further Scope

Based on the results obtained in the analysis as illustrated in Figure 2.4, and considering an efficient traffic circulation, additional roads have been recommended and analysis of the same has been carried out based on the assumptions mentioned earlier. Trips have been assigned to the recommended roads as well based on the same philosophy mentioned earlier. Figure 2.20 illustrates the same. It can be observed that the congestion on the only access to the south west has been mitigated by distributing the traffic out of the proposed development on the south-west. Also, if the gauchar road can be moved one block south, there will be further incentive for trip makers to traverse that route going to Zones 13, 14 and 15 thereby de-congesting the links on the south-west.

Figure 2.22 shows a summary of the study conducted and recommendations made based on the travel demand model and proposed traffic circulation.

It is of prime importance to provide an efficient bus system thereby encouraging public transport ridership. Detailed analysis of the same will be carried out in the next deliverable.

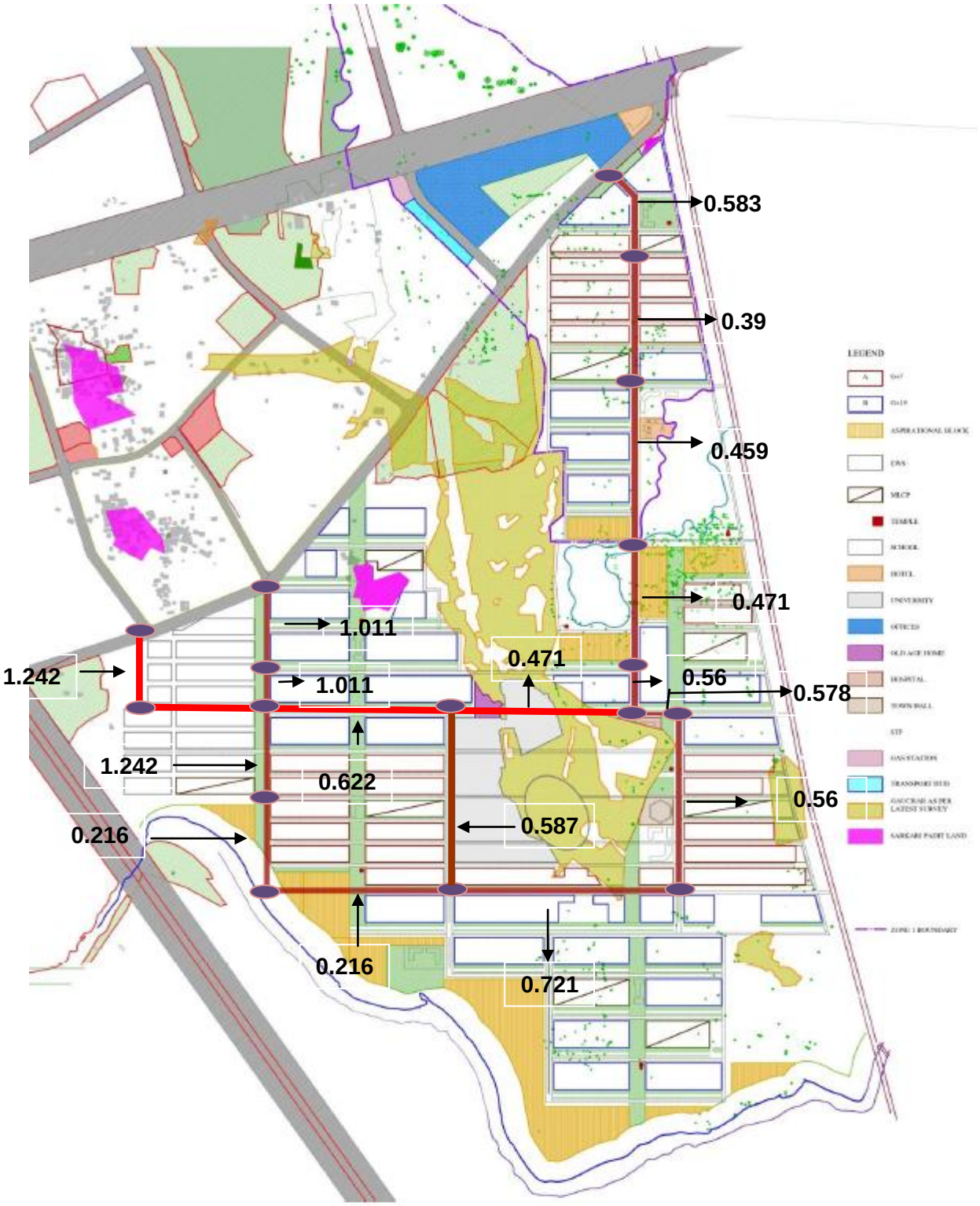


Figure 2.20 V/C Analysis based on recommendations

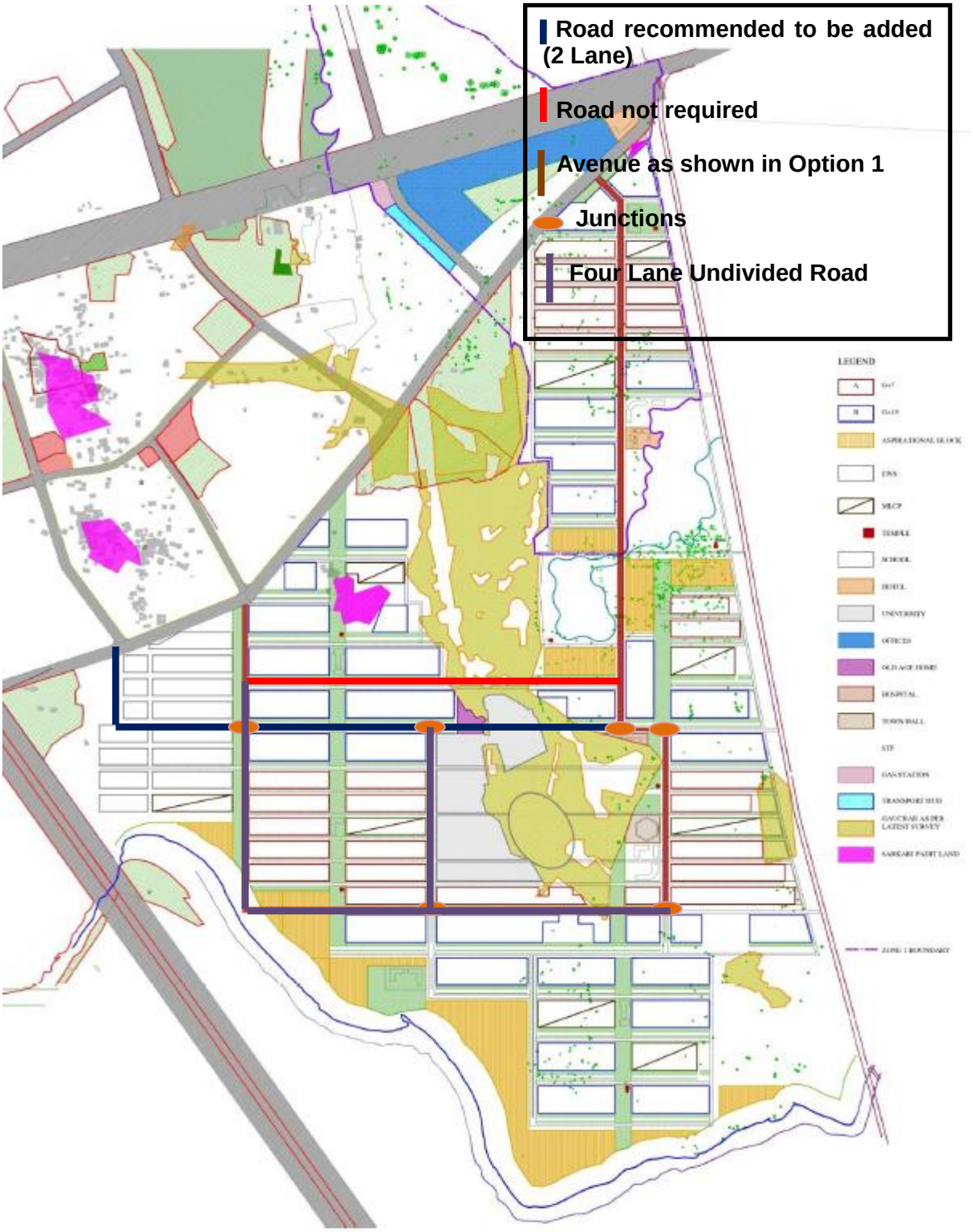


Figure 2.21 Recommended Option for the Avenue (25m) (Option 1) including Other recommendations