ADB

Asian Development Bank

# Karachi BRT
# Conceptual Plan & Design

Final Report

April 2015


ITDP | Institute for Transportation & Development Policy

*Promoting sustainable and equitable transportation worldwide.*


KMC
BRT

TA-8189 REG: Implementation of Sustainable Transport in Asia and the Pacific - New Approaches to Implement Sustainable Low Carbon Transport in Asia and the Pacific Region (Subproject 5) Karachi BRT (45105-003)

Karachi Bus Rapid Transit (BRT) Conceptual Design & Plan

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Jakarta, April 2015

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## Glossary

| | |
|---|---|
| ADB | Asian Development Bank |
| BRT | Bus Rapid Transit |
| Chinchi | Motorized Three-Wheeler Vehicle *(sometimes also written Xingxi*) |
| Chowrangi | Junction/Intersection |
| GoS | (Provincial) Government of Sindh |
| ITDP | Institute for Transportation & Development Policy |
| ITS | Intelligent Transportation System |
| JICA | Japan International Corporation Agency |
| KBOA | Karachi Minibus Owner Association |
| KTI | Karachi Transport Ittehad |
| KMC | Karachi Municipal Corporation |
| KMTC | Karachi Mass Transit Cell |
| KRC | Karachi Circular Railway |
| KTIP | Karachi Transportation Improvement Project |
| MRT | Mass Rapid Transit |
| OEM | Original Equipment Manufacturer |
| PDA | Project Design Advance |
| PPP | Public Private Partnership |
| PPTA | Preparatory Project Technical Assistance |
| Rs | Pakistani Rupees |
| RTA | Regional Transport Authority |

*Currency Exchange assumption: 1 USD = 101.89 PKR (unless stated otherwise)*

# 1 Introduction

## 1.1 Background

ITDP are commissioned by The Asian Development Bank (ADB) to develop conceptual design and plan for Bus Rapid Transit (BRT) system in the city of Karachi, Pakistan. The work primary objective is to develop a BRT design that is workable and can be implemented in Karachi.

ITDP began the work in Karachi in August, by conducting the first site visit from 8 - 15 August 2014, and during that time ITDP also conducted meetings and technical discussions with PPP Unit of the Government of Sindh and Karachi Mass Transit Cell (KMTC). Additional site visits were conducted throughout September 2014 to January 2015, and meetings with various stakeholders were held to get better understanding of Karachi public transport situation.

## 1.2 Objectives

The objective of this Conceptual Plan and Design Report is to provide design and plan for BRT implementation in Karachi, which includes corridor selection process; technical design of the BRT infrastructure and costing; stakeholder analysis to help the bus industry transition for the BRT project.

The work that has been done for this report is a series of work involving relevant data collection, visual observation of the corridor, analysis of current public transport condition along the potential corridor, as well as local condition along the potential corridor.

Although the Terms of Reference (ToR) document for this work specifies the government's preference for corridor that needs to be built by ADB, the objective of this work is to find the most suitable BRT corridor that can be implemented in Karachi which will bring significant benefit for the public transport users, which is essentially the objective of any BRT project in the world.

Nevertheless, it does not mean that government's corridor preference is not considered during the selection process. It still plays an important role as a background to identify the BRT corridor in Karachi, along with other relevant factors to be considered.

## 1.3 Scope and Limitation of the Report

It should be noted that the BRT conceptual design and Plan is developed to give the initial concept of the BRT. Although some of the design and plan are provided in a more detail, it is not the final technical design that can be used directly to implement the BRT. More detailed design should be sought in the Project Preparatory Technical Assistance stage and the Project Design Advance stage of the project, with the conceptual design as a basis for the design.

## 1.4 Site Visit, Meetings and Key Experts

The project started on 6th August 2014 and the 3 site visits to Karachi were conducted immediately from August 2014to January 2015 by the following experts:

- Yoga Adiwinarto (Team Leader & Transport Planner)
- Faela Sufa (Deputy Team Leader & Public Transport Expert)
- Stevanus Ayal (Traffic Engineer & Survey Specialist)
- Priscilla Fabiola (BRT Station Design and Stakeholder analyst)
- Ria Roida Minarta (Transport Survey Coordinator)
- Bella Aryani (Public Transport Surveyor)
- Udaya Laksmana Halim (Non-Motorized Expert)
- Bram van-Ooijen (Parking Expert)

During the visits, various meetings and workshops were conducted with the PPP Unit of the Sindh Government (GoS); Karachi Mass Transit Cell (KMTC); Transport and Finance Secretary of the GoS; Karachi Commissioner and Karachi Administrator. Local expert Mr Malik Zaheer Ul-Islam also assists ITDP team member on the stakeholder analysis of the local bus industry. Meeting with Karachi Transport Iteehad and other Transporters were conducted during ITDP site visit to Karachi. Local survey team are from Think Transport, who are also based in Karachi.

# 2 Benefits of BRT &'Direct-Service' Concept

This section explains the benefits of BRT and few approach to design BRT Operational Model. BRT Masterplan which was produced by JICA, identifies 6 BRT lines and 2 MRT lines for future Mass Transit Corridor in Karachi. Although the Masterplan did not explain in detail the background in selecting the mode (MRT/BRT) for each mass transit corridor, it is noted that these corridors represent major movements in the city.

In BRT operation across the globe, there are couple of operational model applied, notably the 'Trunk-Feeder' system and 'Direct -Service' operation. The difference for each operational system is explained in the following section of this chapter. In conducting this study, ITDP look at the possibilities to exercise both 'Trunk-Feeder' model or 'Direct-Service' model for BRT in Karachi.

## 2.1 Benefits of BRT

Bus Rapid Transit (BRT) system is designed to give priority to public transport passengers. Normally, the BRT infrastructure is built in a corridor where most public transport users travel and suffers long delay due to high traffic. By separating the buses from the regular vehicle lanes, it is expected that the dedicated BRT lane can increase bus travel speed significantly. In Guangzhou for example, after the BRT, the bus average speed increased from 18km/h to 25 km/h.

## 2.2 'Direct-Service' Concept and Benefits

### 2.2.1 'Trunk – Feeder', 'Direct-Service' and 'Trunk - Only' Operation

The Transmilenio Bogota system by far has the biggest 'Trunk-Feeder' BRT network in the world. It is one of the most successful BRT system implemented, in terms of capacity, ridership and sustainability of the system.

Bogota has 8 trunk corridors as of 2014 and each of the corridor ends at terminal. In these terminals, most passengers transfer to the feeder bus service, which will bring passengers to their final destination on the residential areas. These feeder services are free, and it is claimed that the cost to operate these feeder services is included in the Transmilenio BRT fare. This is proven to work well as most of the feeder passengers will transfer to Transmilenio BRT. However, this also mean that during the peak hour, there are thousands of passengers transfer at terminal, which requires the terminal to be built in high capacity, not only to accommodate passengers, but also to accommodate buses which need to arrive simultaneously.

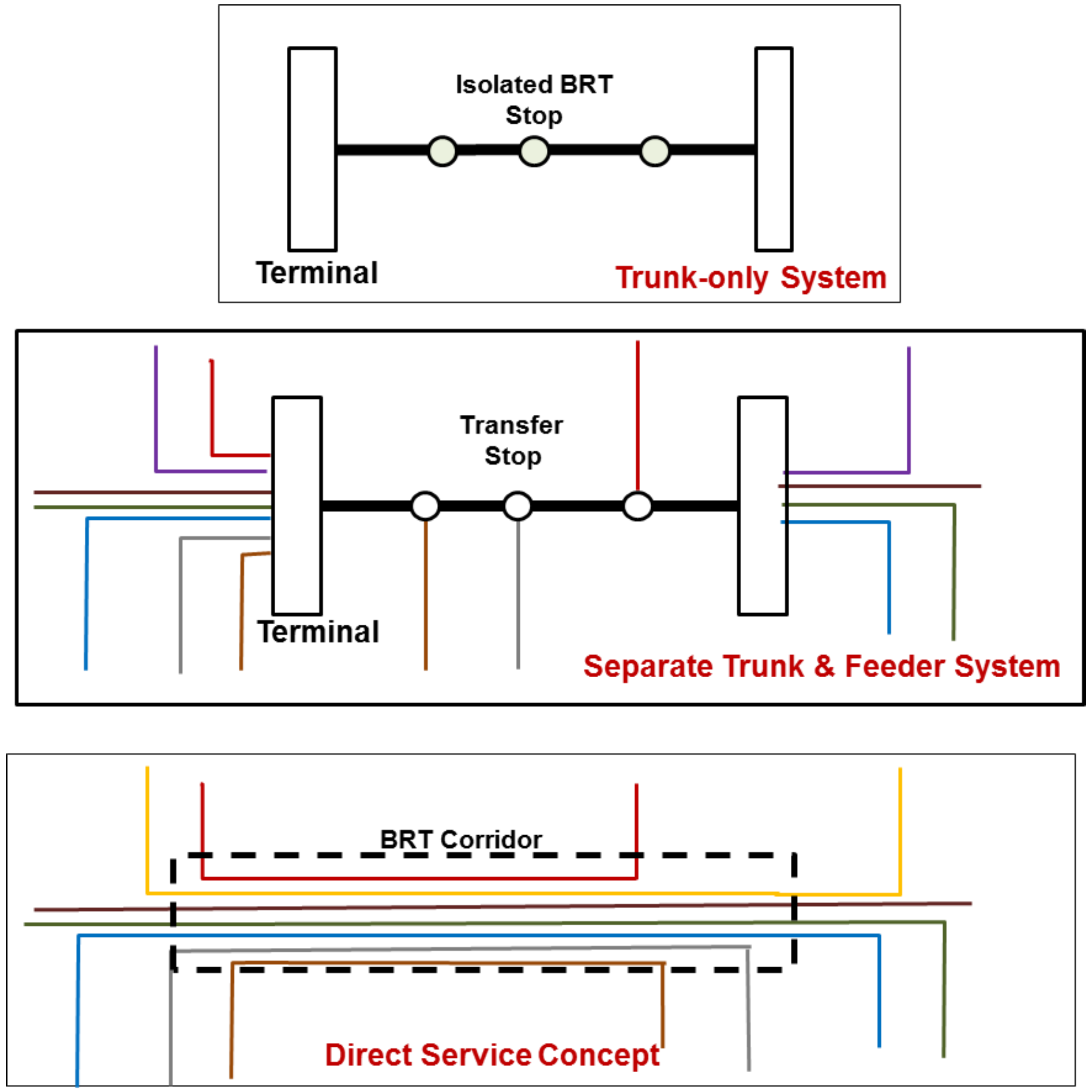



*Figure 2.1'Trunk-Only', 'Trunk-Feeder'&'Direct-Service' Concept*

This 'Trunk-Feeder' operation, although proven to be successful in Bogota, requires a massive land acquisition and investment to build the terminal. **Figure 2.2** shows the size of 'Trunk-Feeder' terminal for Transmilenio in Americas Terminal, which requires 65,000 $m^2$ of land to build the terminal. More often, big and populated cities like Karachi and Jakarta do not have the luxury to find available and affordable space close to residential neighborhood. Even if possible to find, the investment needed to acquire the land and build such infrastructure might be costly, and might be cost effective to build more BRT stations.

From passenger point of view, 'Trunk-Feeder' approach has major disadvantage where practically all passengers are forced to transfer from the feeder to the trunk buses. This transfer creates discomfort for passengers who has to spend another time to wait for the trunk bus, in addition to the waiting time for feeder buses in front of their house/residents. This extra waiting time, plus walking from the feeder bus to the trunk bus has increased their generalized cost of travel with BRT, which might eventually push them to leave the BRT and shift to other mode. This transfer penalty is so critical that Transmilenio compensate them with free fare for the feeder, or otherwise their BRT system might not be attractive for commuters.

With the reason above, the other approach called 'Direct-Service' system is introduced, and possibly be suggested for the Karachi BRT. With the 'Direct-Service' operation system, passengers are able to travel without having to transfer at major terminal or interchange, and if they require to change the bus, this can be done in the BRT stations along the corridor, which provides free transfer for them.

***Figure 2.2Americas Terminal in Bogota which Requires 65,000 m² of land for the terminal***


***Figure 2.3 Passengers Waiting to Transfer to Feeder Buses***

Another model that needs to be avoided is the 'Trunk-Only' operation, like the one operated in Transjakarta. This 'Trunk-Only' operation has been proven not to be effective to boost ridership, as the system limits its capacity and coverage area of the network. With 'Trunk-Only' system, the BRT does not run efficiently as it only travels within the corridor, and still forcing the passengers to transfer from the non-BRT buses at BRT Terminals. Unlike Transmilenio which provides free feeder service, these Jakarta non-BRT buses have separate fare with BRT and are not integrated with BRT in any possible aspects.

However, it should be noted that Transjakarta initially was not designed as 'Trunk-Only' system. Copying most of the technical design from Transmilenio, the designer and engineers of Transjakarta initially hoped that their 'feeder' service will be implemented at the later stage of the project, and at the initial stage of the BRT, focusing first on the trunk line. Their main concern at that time is that feeder will involve a lot of negotiation with the informal operators of the non-BRT buses, something that the government of Jakarta prefers to avoid.


***Figure 2.4 Transjakarta 'Trunk-Only' Operation, Neglecting Integration with Non BRT Buses***

9 years after its operation, no 'Trunk-Feeder' system were implemented in Jakarta, despite many studies and failed pilot projects to support this system. In its 10th years, Transjakarta, with the input from ITDP decided to test the 'Direct-Service' model to its operation in 1 corridor, and proven effective to boost ridership in that particular corridors in relatively short time .

### 2.2.2 ITDP Approach for 'Direct–Service'

Although there were many reasons that Transjakarta 'Trunk-Only' operation in Transjakarta did not work well, the main reason of the failure is the resistance from the government to deal with the existing informal operators from the beginning. Transjakarta corridor 1 involved a long negotiation process with the major bus operators, who have better management and financial capacity to become BRT operator. However, this success of transformation was not followed by transforming the informal non-BRT bus industry, which has individual ownership structure, low financial capacity and unstructured revenue stream, which are similar with the minibus industry situation in Karachi.

ITDP approach in implementing 'Direct-Service' would be first to observe the existing operator routes. This is mainly to see the major corridor movements of public transport passengers. In a city with high ownership of private motorcycle and easy access to own a motorcycle, the bus industry is struggling to cope with declining ridership, where many passengers have now shifted to motorcycle. Therefore, it is important that the main objective to implement the BRT is to provide benefit and priority for public transport passengers, and the best way to reward them is to provide priority infrastructure on a road and corridors mostly used by public transport passengers.

### 2.2.3 Illustration of 'Direct-Service' in Karachi

In creating the BRT plan with 'Direct-Service' concept, ITDP also considers the existing operator routes to be part of the BRT system, especially the most frequency and popular routes. This will not only reward benefit for the passengers, but also help the government to transform the bus industry along with the BRT implementation, rather than deal with them separately or avoid them completely like Jakarta government did. Some cities in Indonesia also tried another approach where they run the BRT corridor parallel to existing bus routes, hoping that passengers will shift from regular bus to the BRT. Often, on day one of the operation, their BRT buses were smashed with rocks by these existing operators during protests against BRT, fearing that they might lose their passengers and lose their business with BRT's existence.

Looking at how similar the bus industry between Karachi and Jakarta, it is therefore recommended that transition work of the informal bus industry should be part of the BRT implementation work. While the transition work is outside the scope of this study, preliminary stakeholder mapping of the industry is presented in this report.

# 3 Corridor Selection & Identification

## 3.1 General Observation of Public Transport Condition


*Minibus coach (capacity 50 passengers inside)*

*Big Bus (Capacity 80 passengers)*

*Minivan (capacity 15 passengers)*

*Chinchi (Capacity 8 passengers)*

***Figure 3.1 Different Public Transport Vehicles in Karachi***

Majority of passengers are currently taken by Minibus coaches, but the declining bus ridership has forced some routes to stop running, and these inactive routes are lately been replaced by Chinchi, which has smaller capacity but more frequent. Despite being an informal transport, Chinchi's popularity is increasing, which makes it difficult for the government to ban them from the road.

## 3.2 Bus Frequency-Occupancy Count

The visual bus frequency-occupancy counts were carried out in several locations as shown in figure below. The surveys were performed during peak hour and the following results were derived:

- Frequency of minibuses and coaches were much higher than the big buses.
- Maximum frequency of 42 buses/hour/direction (1 bus every 85 seconds) was recorded for route Marwat, and average bus frequency is 9.5 buses/hour/direction (1 bus every 6 minutes)
- As observed in August 2014, there are currently 105 active routes
- Some corridors have a high frequency of Chinchi (motorized rickshaw). For current analysis, Chinchi is not included.

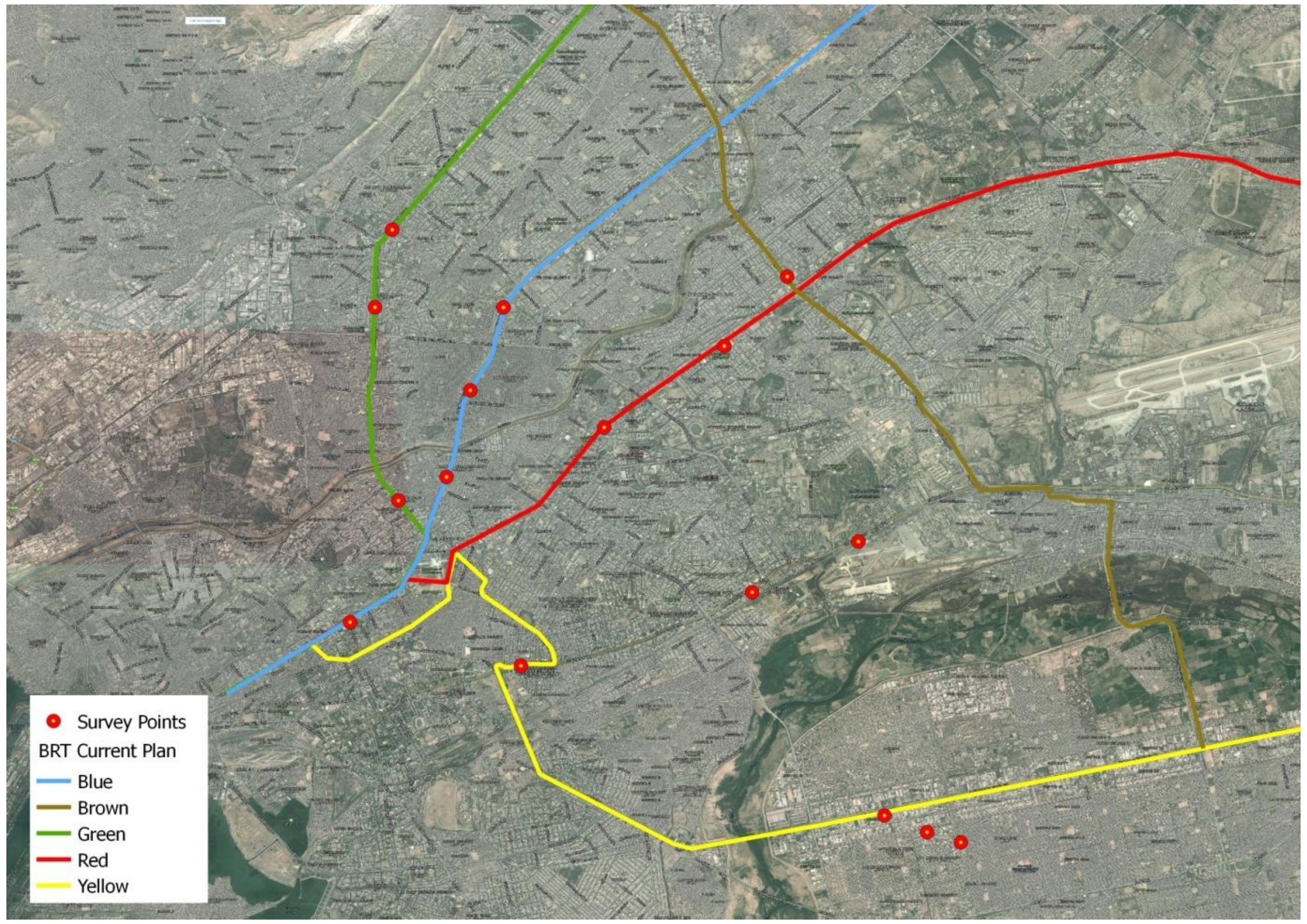



***Figure 3.2 Bus Frequency-Occupancy Counts Locations***

***Table 3.1 Frequency and Occupancy Counts Data***

| Road Name | Survey Point | Maximum | |
|---|---|---|---|
| | | **Frequency (Bus/Hr/Dir)** | **Occupancy (Pax/Hr/Dir)** |
| Shahrah e Faisal | Karsaz Bus Stop | 148 | 5402 |
| Shahrah e Faisal | Shahrah e Faisal | 124 | 5920 |
| Shahrah e Faisal | Ibrahim Trade Tower | 118 | 4680 |
| Korangi Rd | Connection Rd | 108 | 4448 |
| Rashid Minhas Rd | Gulshan Chowrangi Bus Stop | 108 | 3250 |
| University Rd | New Town Police Stn | 104 | 4140 |
| Jehangir Sethna Rd | Habib Bank | 96 | 5500 |
| MA Jinnah Rd | MA Jinnah Road | 88 | 3650 |
| Jehangir Sethna Rd | Jehangir Sethna Rd (South) | 86 | 4370 |
| University Rd | Urdu College Bus Stop | 80 | 3266 |
| Korangi Rd | Set Back Road Korangi | 66 | 3342 |
| Jehangir Sethna Rd | Jehangir Sethna Road (North) | 60 | 2872 |
| Shahrah e S Suri | Shahrah e S Suri | 60 | 2084 |
| Landhi Road | Landhi Road | 58 | 3100 |
| Shahrah e S Suri | Petrol Pump Bus Stop | 46 | 2868 |
| Shahrah e S Suri | Lasbella Bridge | 34 | 1910 |

Highest frequency was recorded in Shahrah e Faisal road, with 5,920 passengers per hour per direction, and frequency of 148 buses per hour per direction (1 bus every 24 seconds). This high frequency bus corridor is one of many indicators of a good BRT corridor in Karachi. The corridor with high bus frequencies should be put as priority in the BRT development.

Frequency graph for bus routes in Karachi is shown in Figure overleaf. There are many bus routes with high frequency, which can be considered as BRT routes. They are running on the same corridor with the BRT corridor.

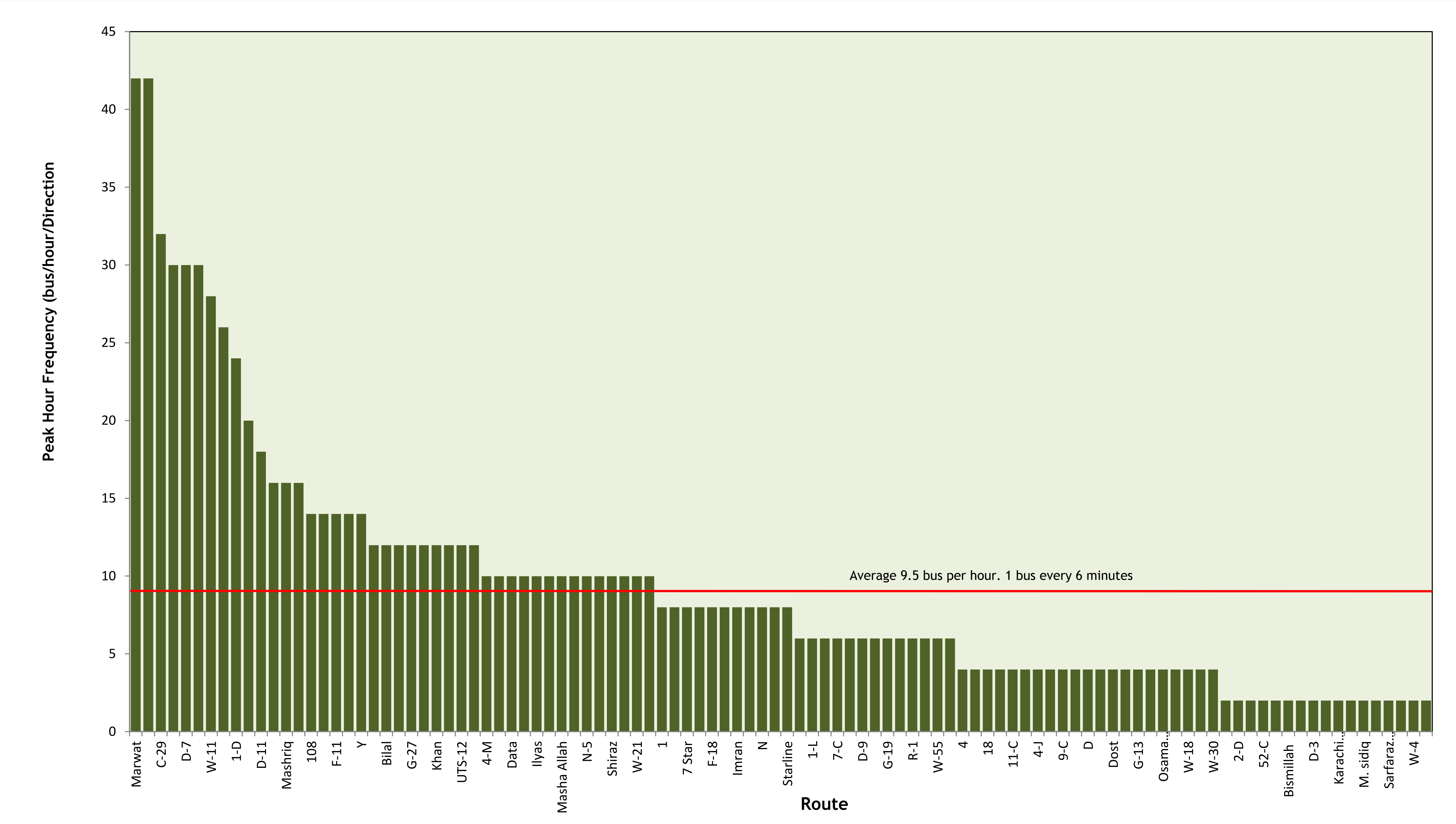



***Figure 3.3 Bus Frequency Data per Route in Karachi***

## 3.3 Bus Routes & Frequency Map

### 3.3.1 Bus Routes Map

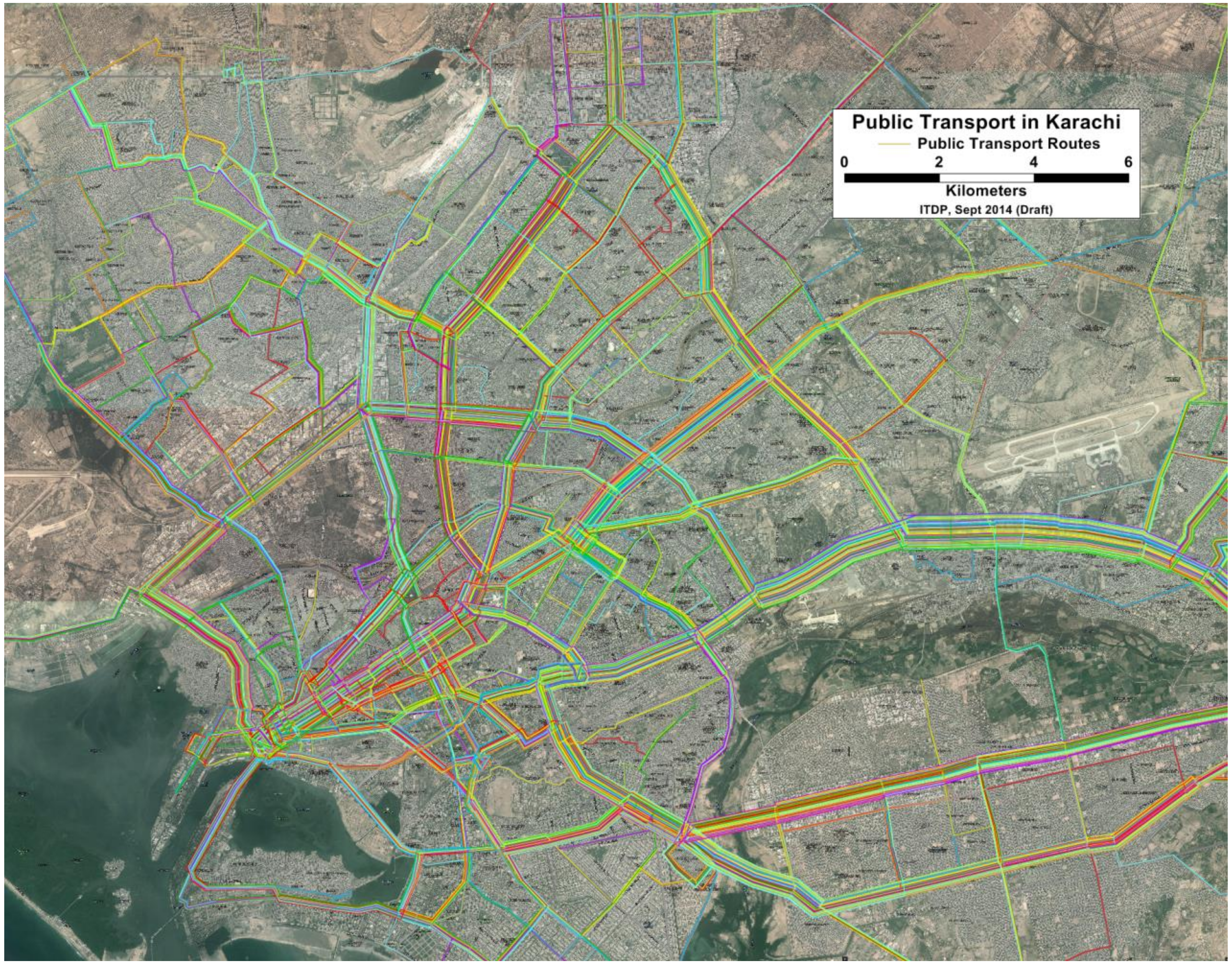



*Figure 3.4 Public Transport Routes in Karachi*

From August to September 2014, ITDP were able to map 105 of active public transport routes, mostly big bus and minibus coaches.

Few minivan routes and Chinchi routes were also captured and mapped, but only to give quick understanding of where these types of public transport operate.

### 3.3.2 Bus Frequency Map

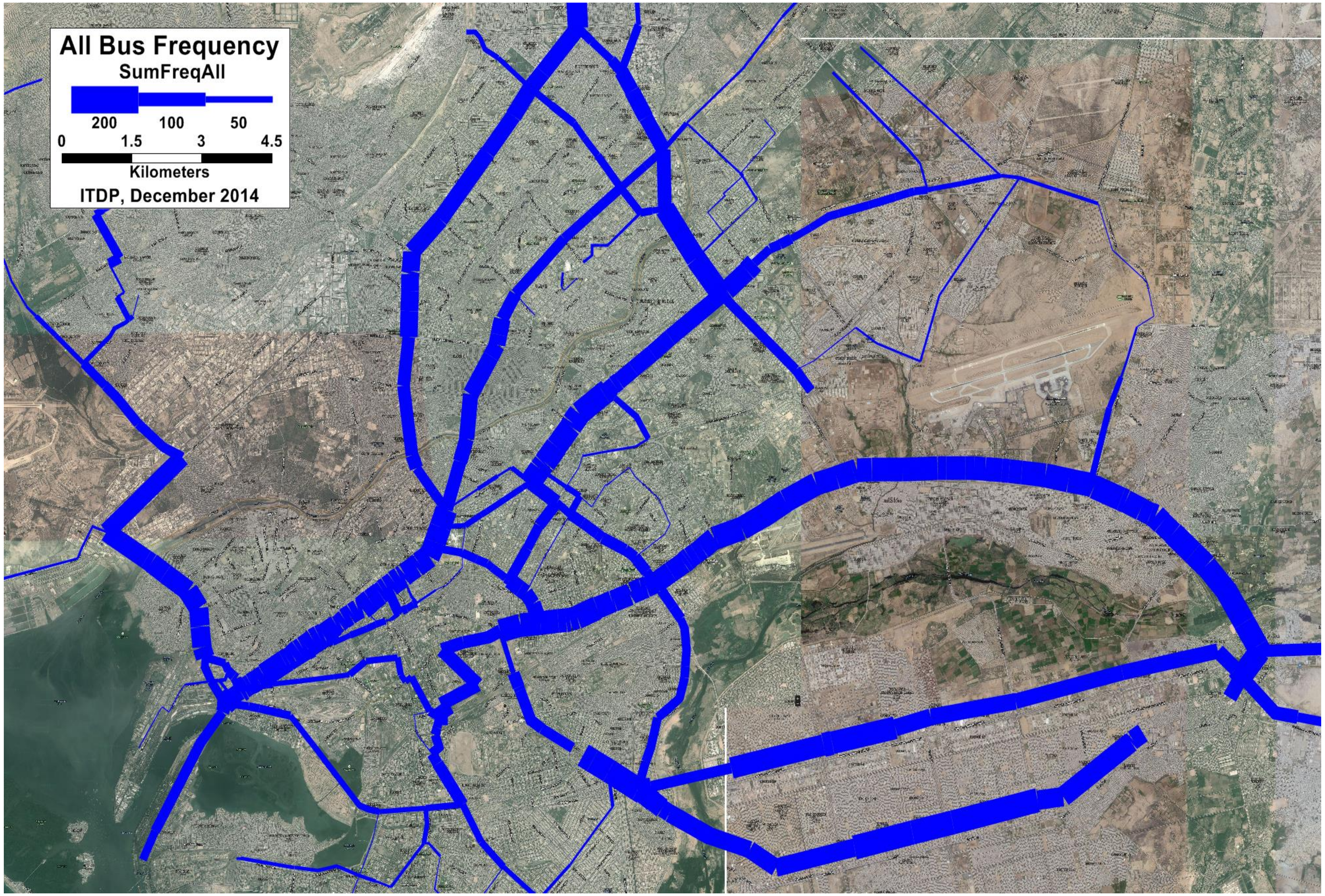



*Figure 3.6 Public Transport Route Frequency Map in Karachi*

The frequency map of these routes are shown in the graph on the left, where many high frequency routes pass Shahrah e Faisal, University Road and MA Jinnah Road.

Korangi Road, where the Yellow Line corridor will be built on, also has relatively high frequency buses, although some of these are minivan routes.

The frequency map is also beneficial to show where the potential good BRT corridors are.

*Table 3.2 List of Route with Frequency >10 Bus/Hour/Direction*

| Route Name | Frequency (Bus/Hour/ Direction) | Volume (passenger/ hour/ Direction) | Peak Hour Occupancy |
|---|---|---|---|
| Marwat | 42 | 1410 | 67% |
| Suzuki | 42 | 532 | 25% |
| C-29 | 32 | 560 | 103% |
| 16 | 30 | 1290 | 86% |
| D-7 | 30 | 1076 | 72% |
| H-4 | 30 | 480 | 32% |
| W-11 | 28 | 1514 | 108% |
| Muslim | 26 | 950 | 73% |
| 1-D | 24 | 1448 | 71% |
| X-10 | 20 | 794 | 79% |
| D-11 | 18 | 466 | 52% |
| 4-K | 16 | 970 | 71% |
| Mashriq | 16 | 664 | 83% |
| New Afridi | 16 | 818 | 102% |
| 108 | 14 | 516 | 74% |
| A-3 | 14 | 500 | 71% |
| F-11 | 14 | 670 | 96% |
| W-22 | 14 | 628 | 90% |
| Y | 14 | 484 | 69% |
| 4-L | 12 | 900 | 88% |
| Bilal | 12 | 490 | 82% |
| D-1 | 12 | 436 | 73% |
| G-27 | 12 | 290 | 48% |
| G-3 | 12 | 550 | 92% |
| Khan | 12 | 600 | 100% |
| Safari | 12 | 460 | 77% |
| UTS-12 | 12 | 1120 | 187% |
| X-23 | 12 | 490 | 82% |

## 3.4 Corridor Analysis and Selection

Corridor selection is an important process on the BRT planning and design. The success of BRT implementation and its sustainability depends on the road and area covered by the BRT corridor. This section provides analysis on selecting the corridors and factors affecting corridor selection for BRT. This section provides brief description on each priority corridor plus the Shahrah e Faisal Road, as from the preliminary data, this road qualifies as a mass transit corridor, despite the current plan to put back the Circular Railway.

A Masterplan for BRT corridor in Karachi has been developed by JICA, who suggests 5 priority corridors (Blue, Brown, Green, Red and Yellow). In addition to this, the Masterplan also suggests to revitalize the Karachi Circular Railway (KCR) which run parallel Shahrah e Faisal Road.

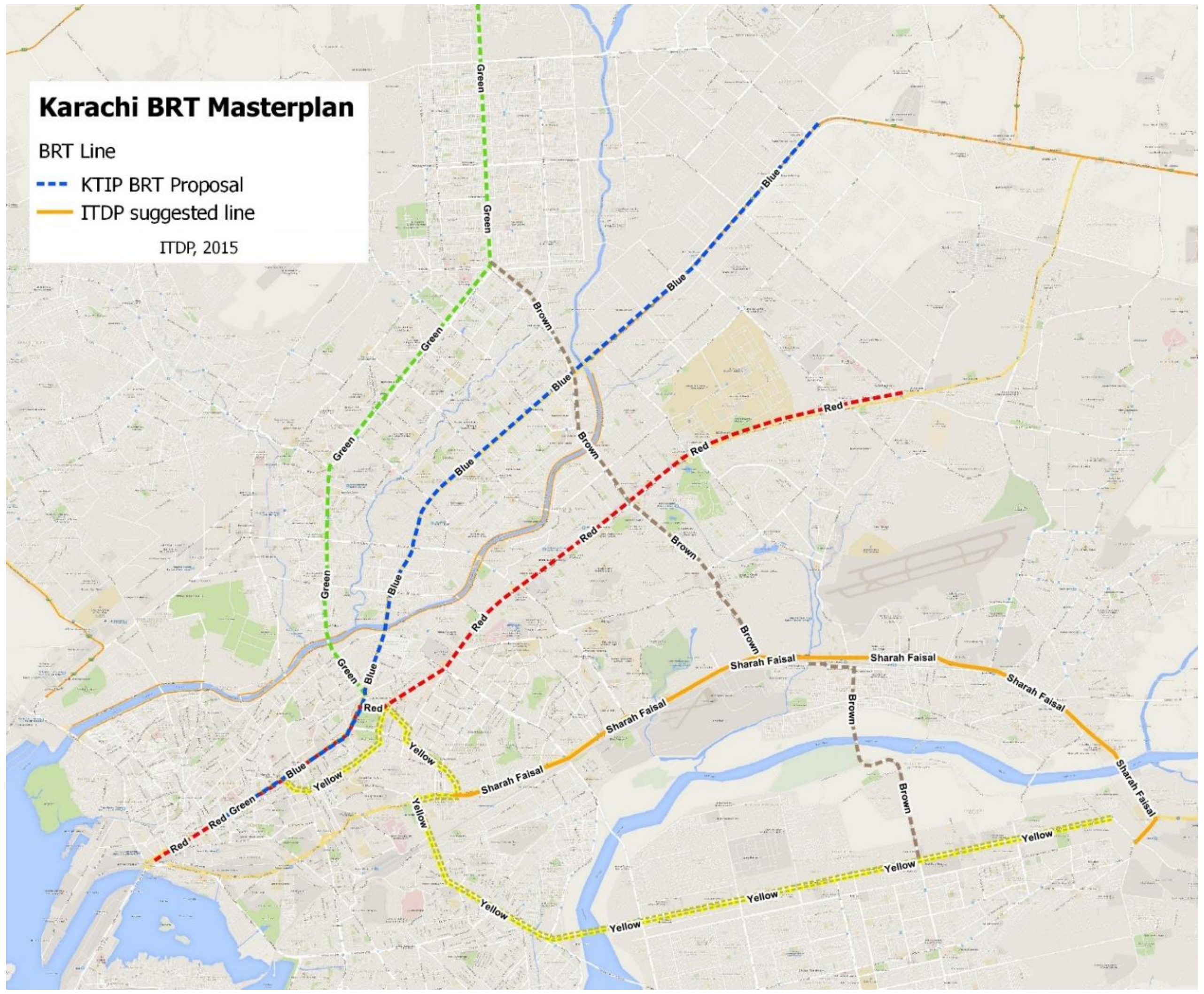



*Figure 3.7 Karachi BRT Masterplan*

Five BRT lines, shown in dotted line, are the BRT plan as proposed in JICA Masterplan, and one solid line, shown at Shahrah e Faisal, is the proposed BRT line as suggested by ITDP.

### 3.4.1 Issues on the Current BRT Plan

The current BRT plan, as shown earlier poses some serious issues. Firstly, the plan only considers trunk-corridor BRT development, and neglecting the feeder problem. This is a mistake that should be avoided before developing the BRT further. Existing bus routes are often neglected when proposing the corridor, and many people thought that the competing bus routes running parallel with the BRT corridor will eventually "go away" due to their demand shifted to BRT. In reality, after few years of BRT operation, many of them would still exist and stay in operation with BRT in operation. Thus it is very important to consider them into the BRT plan

Second issue on the current BRT plan is the connectivity between corridors. Currently, red line and green line will meet with Blue line at Guru Mandir, where all those 3 lines join, and passengers from red and green line will have to move to the blue line to continue their journey to Merewether Tower. Problem such as overcrowding and long waiting time at Guru Mandir station could occur, particularly if the BRT frequency on each line is quite low. This would make the BRT journey not attractive, as passengers need to make a transfer and wait for the next bus. If this condition remains, BRT will not be favored and public transport passenger would still choose city buses, minibuses and coaches to travel.

### 3.4.2 Land-use Analysis

Overall, the land-use the on outer part of all corridors are dominated by residential and housings. More diverse land-use is normally observed along the mid-section of the corridor, such as commercial and residential. On the city center area, more commercial and offices area can be found. Land-use map of red line can be seen on the right.

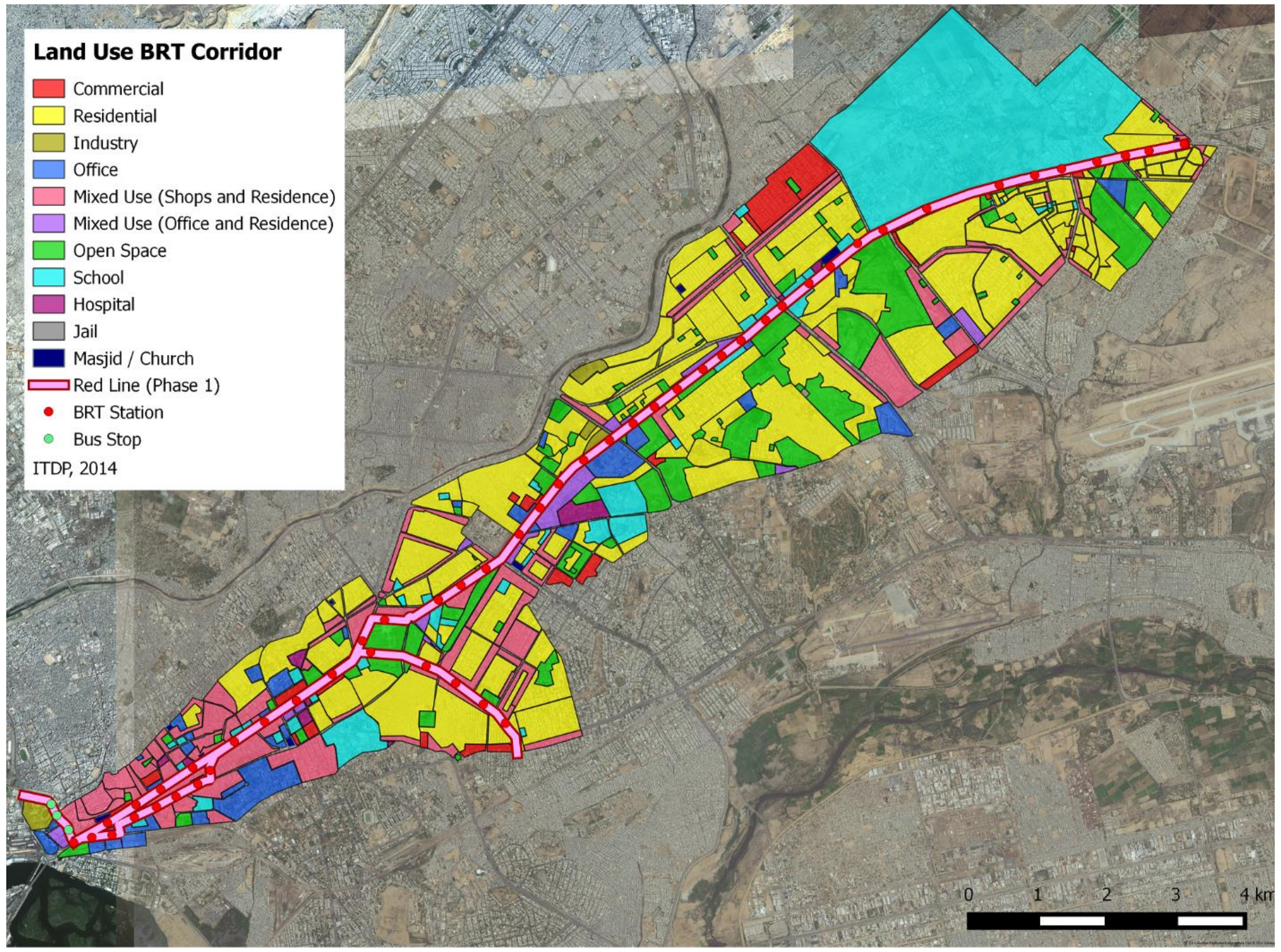



*Figure 3.8 Landuse Map along Red line Corridor*

### 3.4.3 Blue Line

North Part of Shahrah-e-Pakistan (Blue Line) with multi stories building

Busiest Section of Shahrah-e-Pakistan with Market and high boarding volume

Mid Section of Shahrah-e-Pakistan with Shops and commercial

Narrowest section on the south part with only 33 meter wide

***Figure 3.9 Road Condition along Blue Line Corridor***

***Blue Line Highlights***

- *Some high density residential on the northern part*
- *Relatively high bus passenger volume*
- *Many long flyovers and elevated road along the corridor*
- *Narrow section on the south part of the corridor*

### 3.4.4 Green Line

North Part of Green line on Shahrah e Shershah Suri Road (84.2meter)

Mid Segment of Green Line on Shahrah e Shershah Suri Road (77.3 meter)

Green Line on Nawab Siddique Ali Khan Rd on Sunday Morning (top) and evening peak hour Monday (bottom) [32.6 meter]

*Figure 3.10 Road Condition along Green Line Corridor*

***Green Line Highlights***

- *Wide road on the north part of corridor*
- *Low bus frequencies and bus volume along corridor*
- *North Part has big residential complexes*
- *Road on the south part of the corridor are occupied by parking for tuktuk's spare part and sanitary market*

### 3.4.5 Red Line

**Northern part of the corridor at Safoora with busy passenger demand**

**Outer Part of University Road with low density environment**

**Middle Part of University Road with many public transport activities**

**South part of Red Line with on-street parking issue**

***Figure 3.11 Road Condition along Red Line Corridor***

***Red Line Highlights***

- *Northern part is quite busy residential area (Safoora)*
- *The University section has very low density environment*
- *Middle section has diverse land-use, with high bus passengers activity*
- *Some parking issue occurs on the New MA Jinnah Road at the car dealer area*

### 3.4.6 Brown Line

**Mid Section of Brown line with on-going development**

**North Section of Brown line with low activity and low density**

**Mid Section of Brown line with on-going development**

**Mid-South Section of brown line with some medium built-up area**

***Figure 3.12 Road Condition along Brown Line Corridor***

***Brown Line Highlights***

- *Relatively low density along the corridor*
- *Wide road for many of the section*
- *Low bus frequency along the corridor*

### 3.4.7 Shahrah e Faisal

Eastern Section of the Sharah-E-Faisal Road with high volume of bus passengers

More Built-up area on the Western section of the Sharah-E-Faisal Corridor

Mid Section of Sharah-E-Faisal Road near Military Base Area

Shara-E-Qaideen Road near downtown area

*Figure 3.13 Road Condition along Shahrah e Faisal Corridor*

***Shahrah e Faisal Highlights***

- *Corridor with highest bus frequency and passenger volume*
- *Busy residential area on the east part of the corridor with high passenger activity*
- *Middle section along the airport and military complex has relatively low activity*
- *Road width is sufficient for BRT*

## 3.5 Multi Criteria Analysis

The three main criteria for corridor selection are physical space, presence of congestion, and high transit demand. A critical item when selecting corridor is to take into account the bus frequency and route overlap with the corridor. A multi-criteria analysis was performed to analyze different corridors possible for BRT. Since the Yellow Line is already under the bidding process, it is omitted from the analysis.

In addition to the existing bus frequency and route overlap, analysis of land-use and development around the corridor was also performed. Land-use on the corridor frontage was observed during site visits and was identified to see the relevance of land-use activities to support BRT development. BRT projects can trigger development along the corridor, thus potential for transit-oriented development (TOD) along the BRT corridor is also a factor in corridor selection. Analysis of potential further development was carried out to identify whether the corridor might have potential to be developed after the implementation of BRT.

***Table 3.3 Corridor Selection Analysis Table***

| No. | Features | Parameter | Blue | Brown | Greeen | Red | Shahrah e Faisal |
|---|---|---|---|---|---|---|---|
| 1 | Public Transport | Number of routes above threshold (overlapped more than 30% with corridor, Frequency 12 bus/hr) | 11 | 2 | 2 | 4 | 12 |
| 2 | | Highest Bus Frequency/Hour/Dir | 96 | 108 | 88 | 104 | 148 |
| 3 | | Highest Bus Occupancy/Hour/Dir | 5,500 | 3,250 | 3,650 | 4,140 | 5,920 |
| 4 | | Number of Paratransit (Chinchi) Routes along the corridor | 14 | 7 | 25 | 9 | N/A |
| 5 | | Highest Frequency of Paratransit modes (Chinchi) | 75 | 72 | 100 | 130 | N/A |
| 6 | Land use & Future Development | Landuse Characteristics | - Traditional market, shop and terminal (active activity alongside the road). Residential and Mixed use area on the north part.<br>- Mixed Income Residence, suggesting that many public transport users coming from the area | Shop and active area on the north part, low density on some part. South Part has dense residential, but mostly empty land<br>- Some new developments are being built on middle section of the corridor | - Mix multiple stories offices and shops with setback and high density residential area behind (second layer)<br>- Higher Income Residence. Not public transport users | - Shopping area on the west part and University complex and residential on the east<br>- Most eastern part of the area is low density and low activity (empty land etc.) | - Mix multiple stories offices and shops on the west close to city centre,<br>- Military complex area further east (north and south part of the road - inactive area)<br>- On the eastern part of the corridor, Mix multiple stories offices and shops, mostly are located on the south side the corridor, on the north side of the road is the airport, prohibiting from future development.<br>- The eastern area is high density residential area with busy boarding and alighting bus passengers |
| 7 | | Potential Development Along Corridor | North Part of the corridor has great potential to develop. Market which is located in the mid-section of the Corridor could also be transformed into TOD area | Some new developments are being built on the middle section of the corridor, could potentially generate traffic | North part of the corridor have new development and potential new developments to be developed in the future | There are some land available on the east part of the corridor | West Part of the corridor could potentially be developed with mixed use and high density residential area, with Possible TOD. Middle section is difficult to develop |
| 8 | Road Physical Condition | Minimum Cross Section Width (m) | 27.25 | N/A | 31.3 | 46.2 | 35.4 |
| 9 | | Obstacles along Corridor | Some small narrow section exist in the corridor on the mid-south part (27.5 meter) | Nothing Major | Bottleneck on the mid-south part of the corridor along tiles market and tuktuk's spare part market (31 meter) | Nothing Major | Some 3 kilometers area near Military base might be restricted for future expansion |

*Table 3.4 Corridor Selection Scoring System*

| No | Features | Paramater | Rank [Score] | | | | |
|---|---|---|---|---|---|---|---|
| | | | First [5] | Second [4] | Third [3] | Fourth [2] | Fifth [1] |
| 1 | Public Transport | Number of routes above threshold (overlapped more than 20% with corridor, Frequency 10 bus/hr) | Shahrah e Faisal | Blue | Red | Brown | Green |
| 2 | Public Transport | Highest Bus Frequency/Hour/Dir | Shahrah e Faisal | Brown | Red | Blue | Green |
| 3 | Public Transport | Highest Bus Occupancy/Hour/Dir | Shahrah e Faisal | Blue | Red | Green | Brown |
| 4 | Land use & Future Development | Landuse Characteristics | Blue | Shahrah e Faisal | Green | Red | Brown |
| 5 | Land use & Future Development | Potential Development Along Corridor | Blue | Green | Shahrah e Faisal | Brown | Red |
| 6 | Road Physical Condition | Minimum Cross Section Width (m) | Red | Shahrah e Faisal | Green | Blue | Brown |
| 7 | Road Physical Condition | Least Obstacles along Corridor | Red | Brown | Shahrah e Faisal | Green | Blue |

A simple scoring system on each feature was applied to choose the corridor options

For each feature, the corridors were ranked based on the likelihood of having a successful BRT in that particular corridor (i.e. highest bus frequency; have potential good development; have least obstacles)

Once ranked, each corridor was then scored based on the position in the rank (5 score for first rank, 1 score for fifth rank). The results of the score can be seen in the following table.

## 3.6 Scoring Results

The final result of the scoring system is shown on a table below.

*Table 3.5 Corridor Final Score*

| Corridor Option | Score |
|---|---|
| Shahrah e Faisal | 29 |
| Red | 22 |
| Blue | 21 |
| Green | 15 |
| Brown | 13 |

Shahrah e Faisal corridor has the highest score, compared with other corridors. With highest number of overlapped routes, highest number of bus frequency and passenger volume, BRT implementation Shahrah e Faisal would generate the biggest passenger time savings. Although there is a section in Shahrah e Faisal with high military restrictions, most areas along the corridor are conducive to the BRT implementation. Dense residential area on the east part of the corridor and commercial and office area on the west part of the corridor would generate passengers for the BRT.

Red Line is the second best option for BRT corridor, and Blue line is the third best BRT option.

### 3.6.1 Concerns on the Preferred Corridor

In preparing the BRT Conceptual Plan and Design, various consultations were conducted with the Karachi government, the ADB and JICA (through ADB). During the consultation process, initial result of the corridor selection to be chosen by the ADB as also consulted.

There were some concerns expressed by the government and JICA that Shahrah e Faisal BRT corridor as the preferred corridor which will overlap with the Karachi Circular Railway (KCR) and that it will take the KCR demand when it is implemented.

In reality, the BRT will not be overlapped on the KCR. With the 'Direct-Service' BRT concept, the BRT would serve demand way beyond the coverage of KCR, as illustrated in the figure below. The 'Direct-Service' routes which are serving the BRT corridor will go beyond the BRT corridor and will not overlap with the KCR.

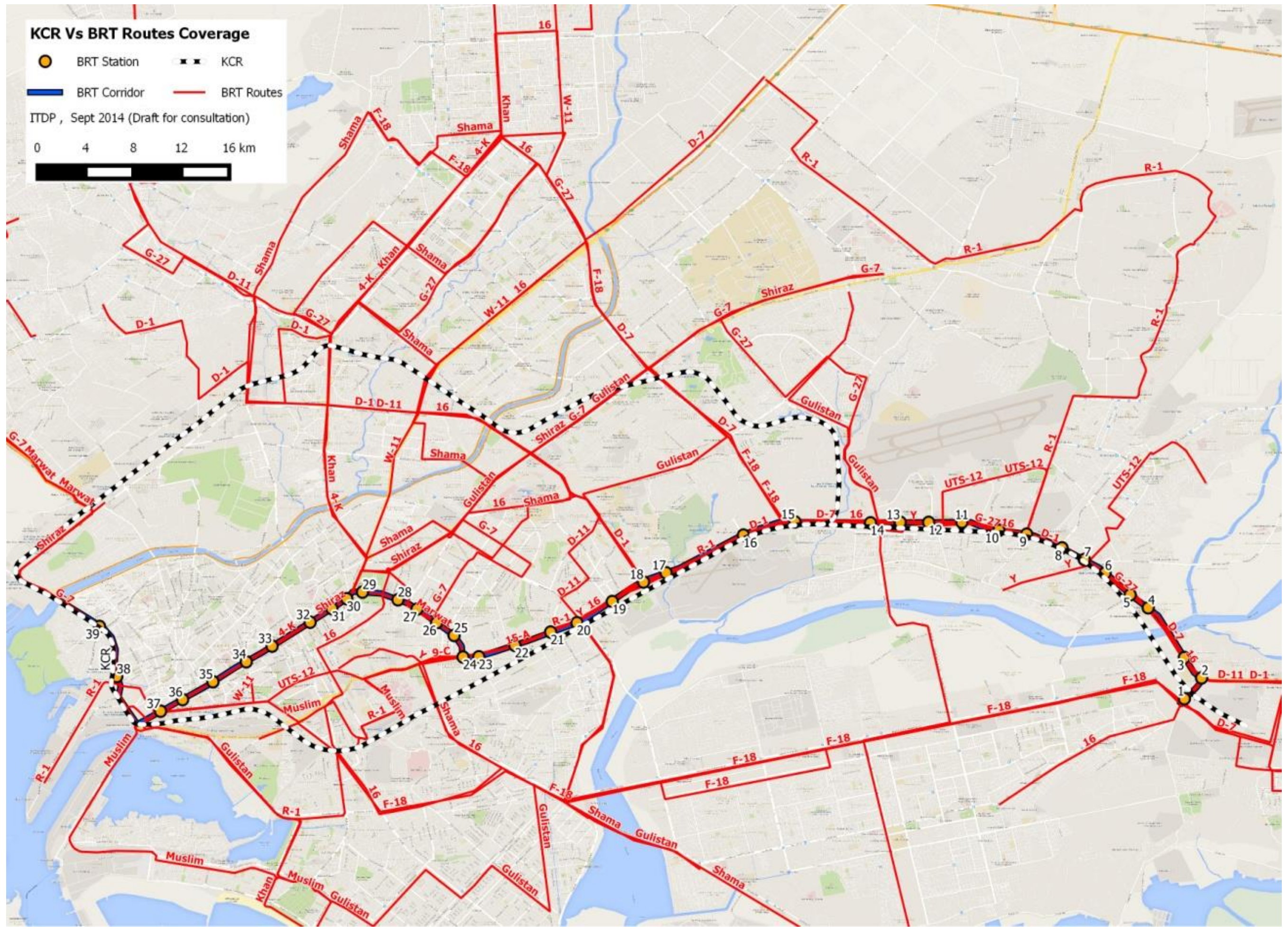



*Figure 3.14 KCR Corridor and Proposed BRT 'Direct-Service' Routes on Shahrah e Faisal*

Having the BRT corridor overlap with the KCR on some section would eventually benefits the KCR, as distance between stations with in BRT is shorter, and the coverage of the BRT bus routes are wider than the KCR corridor. Integrating the two mass transit systems at few stations would help the city's effort to increase the overall public transport share in Karachi. Due to the concerns and objections made on the Shahrah e Faisal option, it was then decided that second-best option corridor to be sought for the final Karachi BRT design.

## 3.7 BRT Corridor Development Phase

It is therefore proposed that the BRT development in Karachi to be divided into two phase, namely the Red Line as the first phase, and Shahrah e Faisal corridor as the second phase. Red Line as the Phase 1 corridor will begin from Safoora to Merewether Tower through University Road, with some extension branch on the Shahrah e Quaideen road up to Nursery. This extension is also to accommodate the yellow line, who will run on the same road at Shahrah e Quaideen, and the PPP Unit of the Sindh Government, who is in charge of this corridor, has agreed to use ITDP design for this section of the yellow line. Phase 2 BRT will run from Korangi near Quaidabad, and run through Shahrah e Faisal road until Nursery, where it will join the Phase 1 BRT corridor.

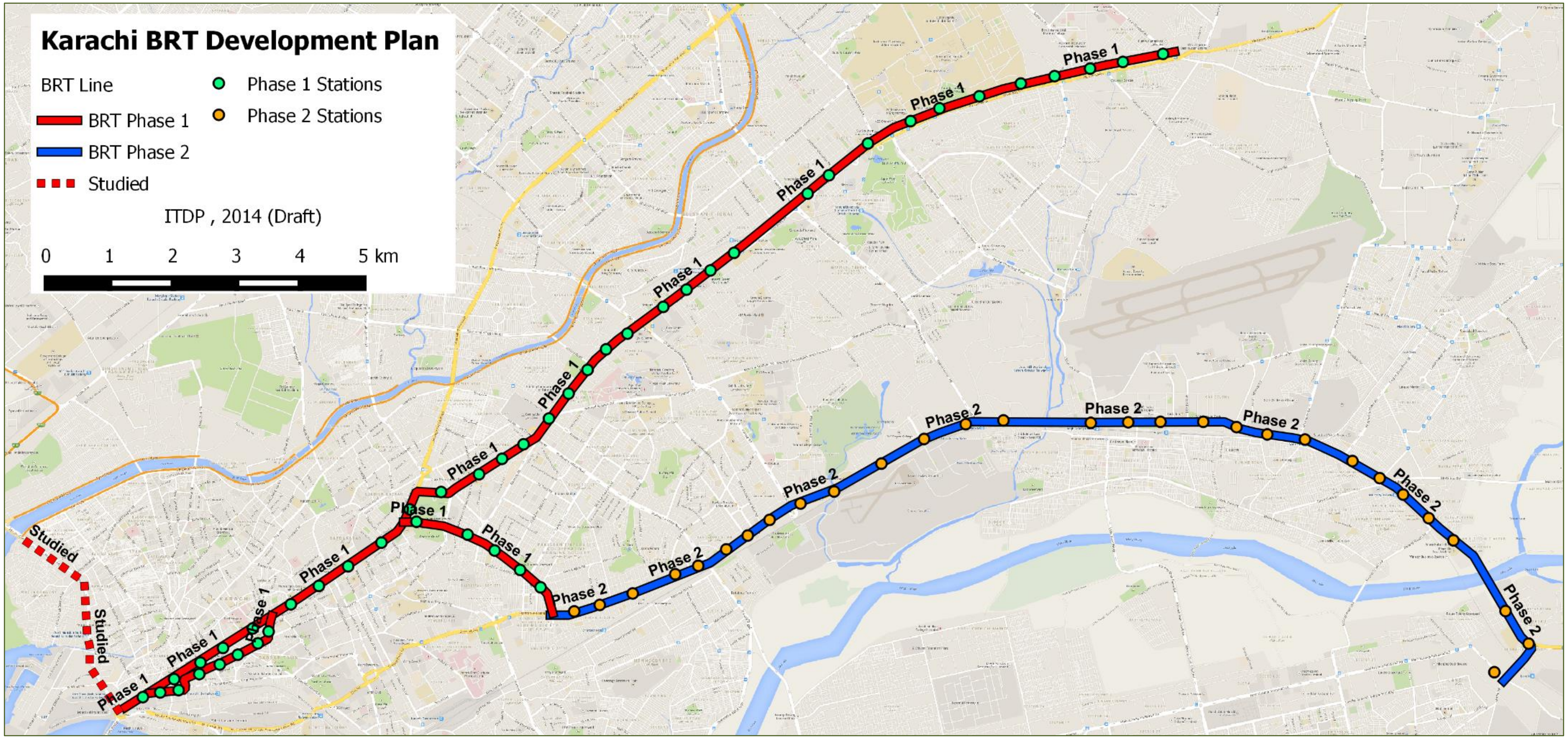



*Figure 3.15 Karachi BRT Development Phase*

***Red Line BRT Corridor***

Red Line which is the Phase 1 BRT corridor is 27.5 km long with 43 stations, where 38 stations will be located on the main corridor from Safoora to MA Jinnah, and 5 BRT stations located on the extension branch at Shahrah e Quaideen. The distance between stations is designed between 500 and 600 meter, although on some part could be further due to physical obstruction such as flyovers.

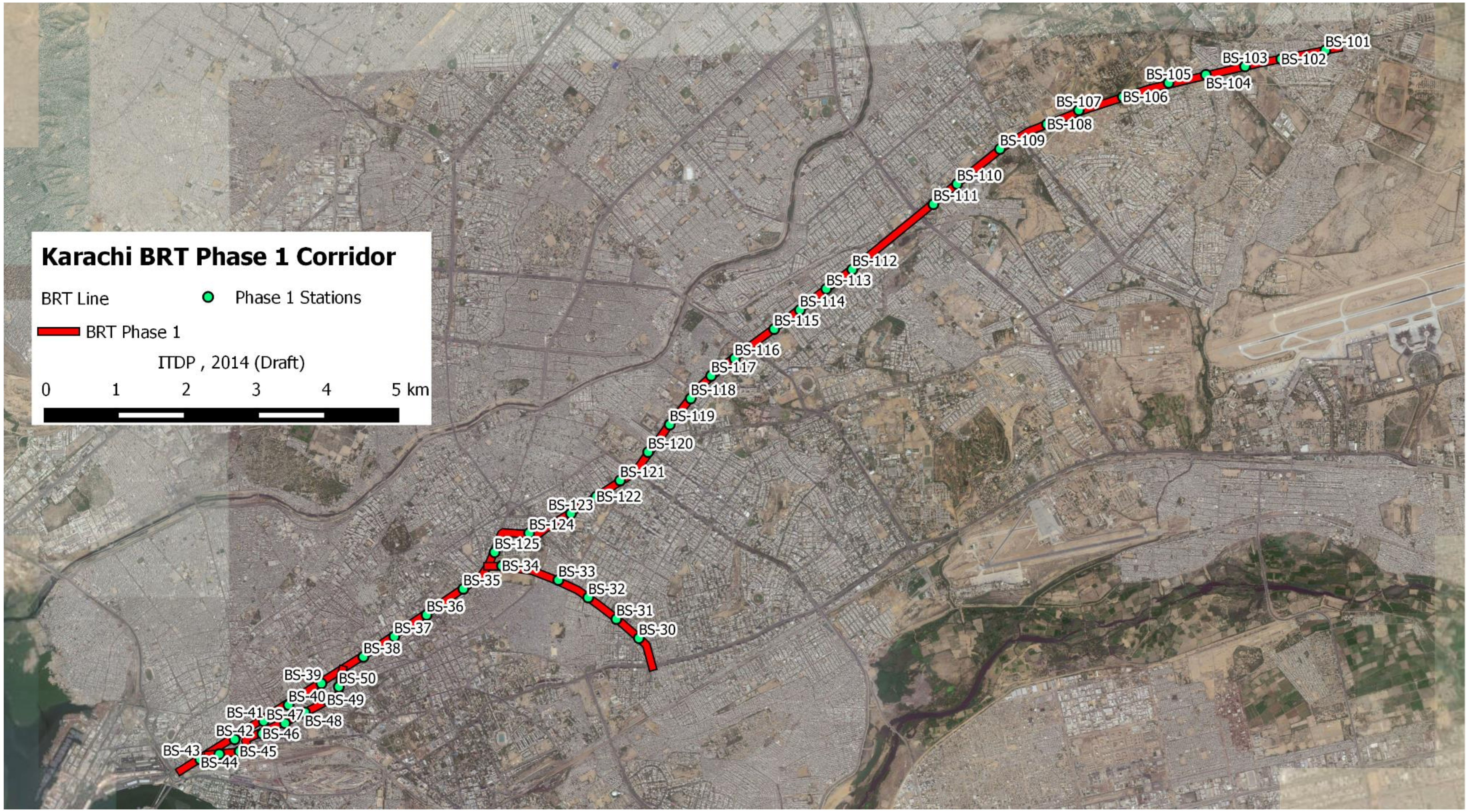



*Figure 3.16 Proposed Red Line BRT Corridor as Phase 1*

## 3.8 BRT Route Selection

BRT routes selection is as important as the BRT corridor selection. With 'Direct-Service' BRT operation, although the system only have 1 physical corridor built, the routes operated under the BRT will be multiple routes, serving different origin and destination pattern. The BRT routes are taken from the existing bus routes who has sizable overlap with BRT corridor, so that passengers will get the benefit of faster travel time, and passed certain frequency threshold, to ensure the routes still carry high passenger volume. Below is the plot of every route against the frequency and the percentage overlap with the BRT Phase 1 corridor.

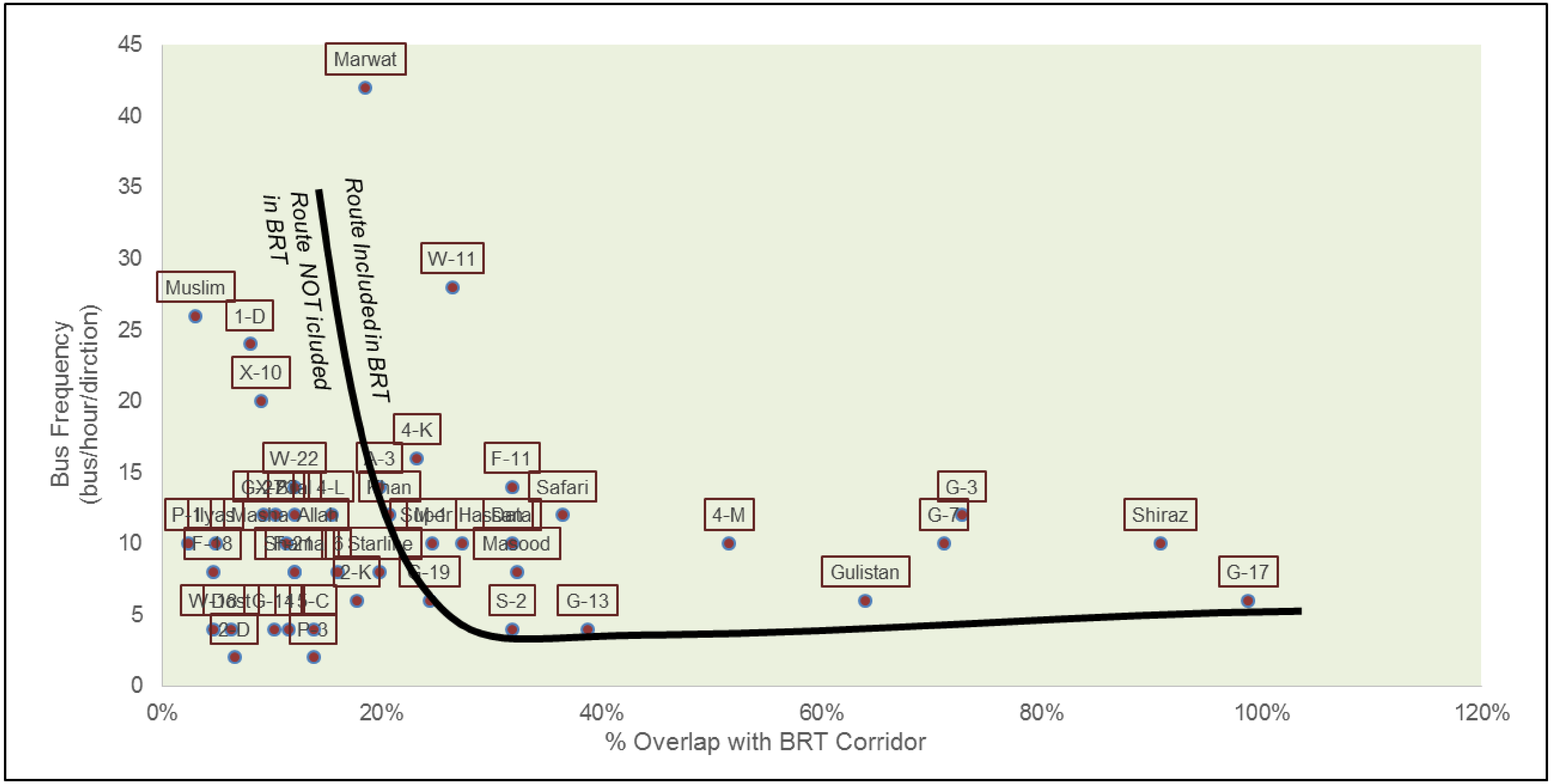



*Figure 3.17 Route plot of Bus Frequency and Percentage Overlap with Corridor*

BRT routes selection is determined by applying a threshold of frequency > 4 per hour in one direction (15 minutes headway) and overlapping with BRT corridor in more than 15% of the total BRT Corridor. 23 routes are qualified to be included as BRT routes in red line. For phase 1, these routes will be transformed into BRT routes, where the buses can travel on BRT corridor and beyond the corridor.

***Table 3.6 'Direct-Service' Route List***

| No | Route | Bus Frequency | Overlap with BRT Corridor |
|---|---|---|---|
| 1 | 6 | 8 | 16% |
| 2 | 4-K | 16 | 23% |
| 3 | 4-L | 12 | 15% |
| 4 | 4-M | 10 | 52% |
| 5 | A-3 | 14 | 20% |
| 6 | Data | 10 | 32% |
| 7 | F-11 | 14 | 32% |
| 8 | G-13 | 4 | 39% |
| 9 | G-17 | 6 | 99% |
| 10 | G-19 | 6 | 24% |
| 11 | G-3 | 12 | 73% |
| 12 | G-7 | 10 | 71% |
| 13 | Gulistan | 6 | 64% |
| 14 | Khan | 12 | 21% |
| 15 | M-1 | 10 | 25% |
| 16 | Marwat | 42 | 19% |
| 17 | Masood | 8 | 32% |
| 18 | S-2 | 4 | 32% |
| 19 | Safari | 12 | 36% |
| 20 | Shiraz | 10 | 91% |
| 21 | Starline | 8 | 20% |
| 22 | Super Hassan | 10 | 27% |
| 23 | W-11 | 28 | 26% |

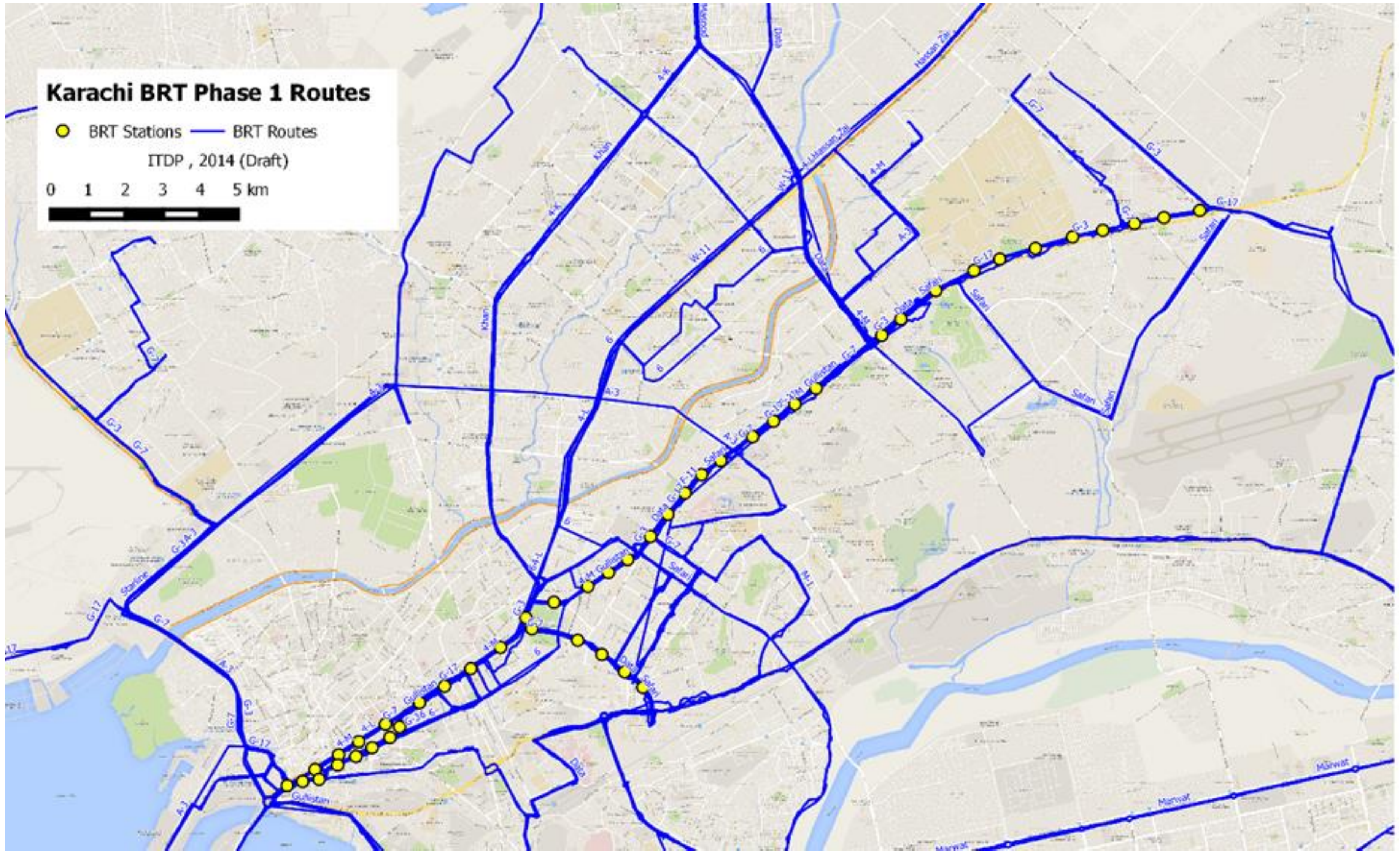



***Figure 3.18 Phase 1 BRT Routes Map***

Routes which are selected for BRT will be transformed into a 'Direct-Service' BRT routes. The routes, which will be upgraded with new fleet suitable for BRT, will serve a segment of BRT corridor, and continues the journey beyond the corridor to reach its destination. With 'Direct-Service' BRT routes, some stations will have more route serving the stations, such as in the city centre area, where 15 routes will be travelling along MA Jinnah BRT stations

The inclusion of existing bus routes into a BRT 'Direct-Service' route would also help to avoid friction from bus operator, who in the past has rejected the BRT proposal, due to no clear plan for them after the BRT. With 'Direct-Service' concept, they will have a chance to become the BRT operator, should they wish to follow the BRT requirement set by the government.

# 4 BRT 'Direct-Service' Operation

## 4.1 BRT Benefits

The proposed BRT Corridor from Red Line corridor to Tower via MA Jinnah could increase speed at some key locations, such as NIPA, north and east part of Mazar e Quaid (Mausoleum) and south part of MA Jinnah.

Current bus speed along the corridor is 18 km/hour during peak hour. With BRT average speed of 20 km/hour, BRT will bring travel time savings of 12 minutes per bus trip (14% time savings) along the full corridor.

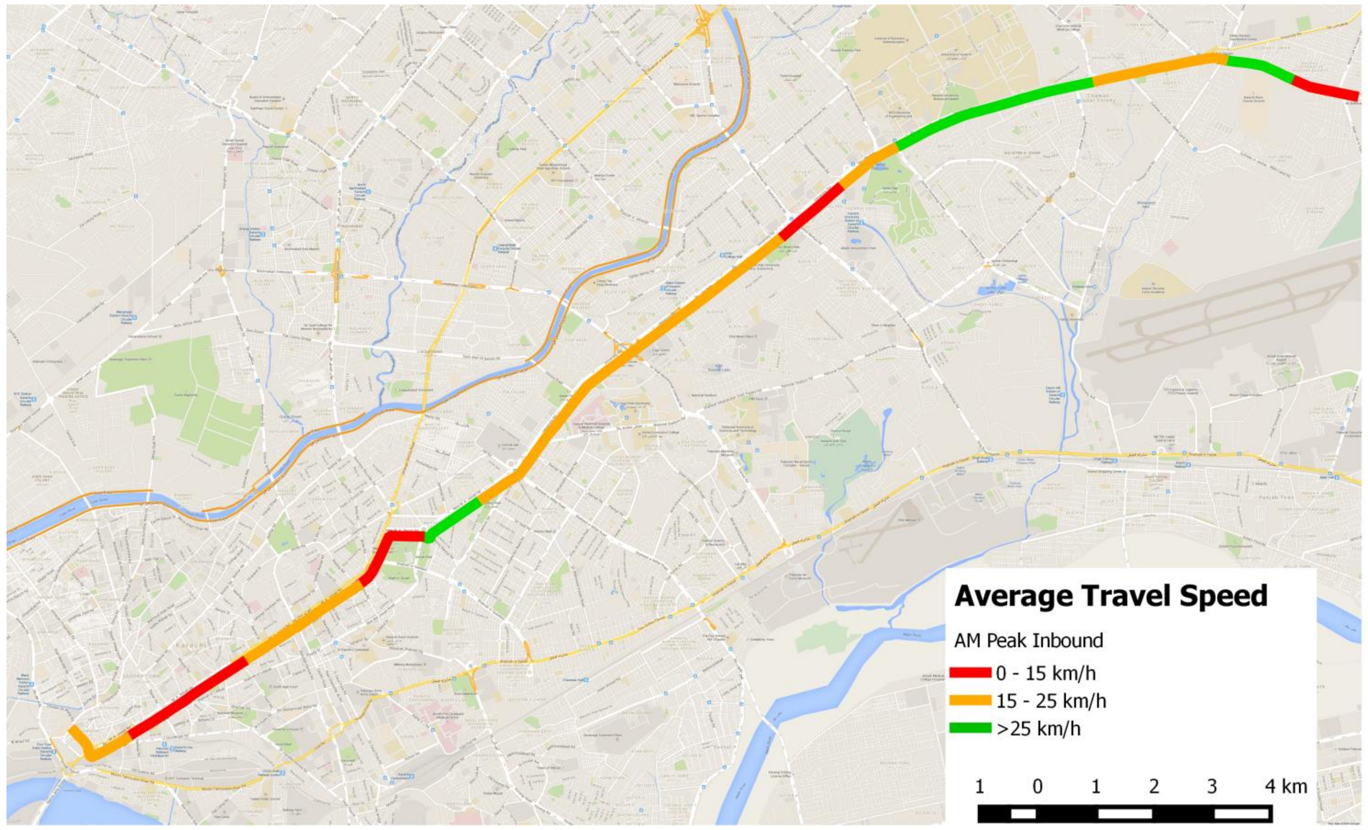



*Figure 4.1 Bus Average Travel Speed during Peak Hour*

Benefit of travel time savings for all 23 BRT routes are 336 minutes or 5.6 hours per peak hour return trip per bus for total 23 routes. This equals to 5% time savings during peak hour for all routes.

*Table 4.1 Travel Time Savings on BRT Routes*

| No | Route | Travel Time Savings per cycle (minutes) |
|---|---|---|
| 1 | 6 | 20 |
| 2 | 4-K | 13 |
| 3 | **4-L** | 5 |
| 4 | 4-M | 40 |
| 5 | A-3 | 6 |
| 6 | Data | 10 |
| 7 | F-11 | 8 |
| 8 | G-13 | 16 |
| 9 | G-17 | 37 |
| 10 | G-19 | 10 |
| 11 | G-3 | 54 |
| 12 | G-7 | 46 |

| No | Route | Travel Time Savings per cycle (minutes) |
|---|---|---|
| 13 | Gulistan | 2 |
| 14 | Khan | -1 |
| 15 | M-1 | 15 |
| 16 | Marwat | 5 |
| 17 | Masood | -2 |
| 18 | Safari | 6 |
| 19 | S-2 | 9 |
| 20 | Shiraz | 33 |
| 21 | Starline | 3 |
| 22 | Super Hassan | -2 |
| 23 | W-11 | 4 |
| **Total travel time savings (minutes)** | | **336** |

## 4.2 BRT Route Frequency, Volume and Demand

Understanding the need for capacity before designing the infrastructure is important. One way to help to understand the size of BRT infrastructure is through bus frequency, passenger volume and demand. This will determine the station size and the requirement for the passing lanes

### 4.2.1 BRT Route Frequency

The bus frequency map of the 20 BRT bus routes is shown below. The highest frequency section is found around MA Jinnah, where more than 160 buses per hour per direction will pass the corridor. The midsection at University road will also have relatively high frequencies, with more than 100 buses per hour per direction will pass the corridor from different routes.

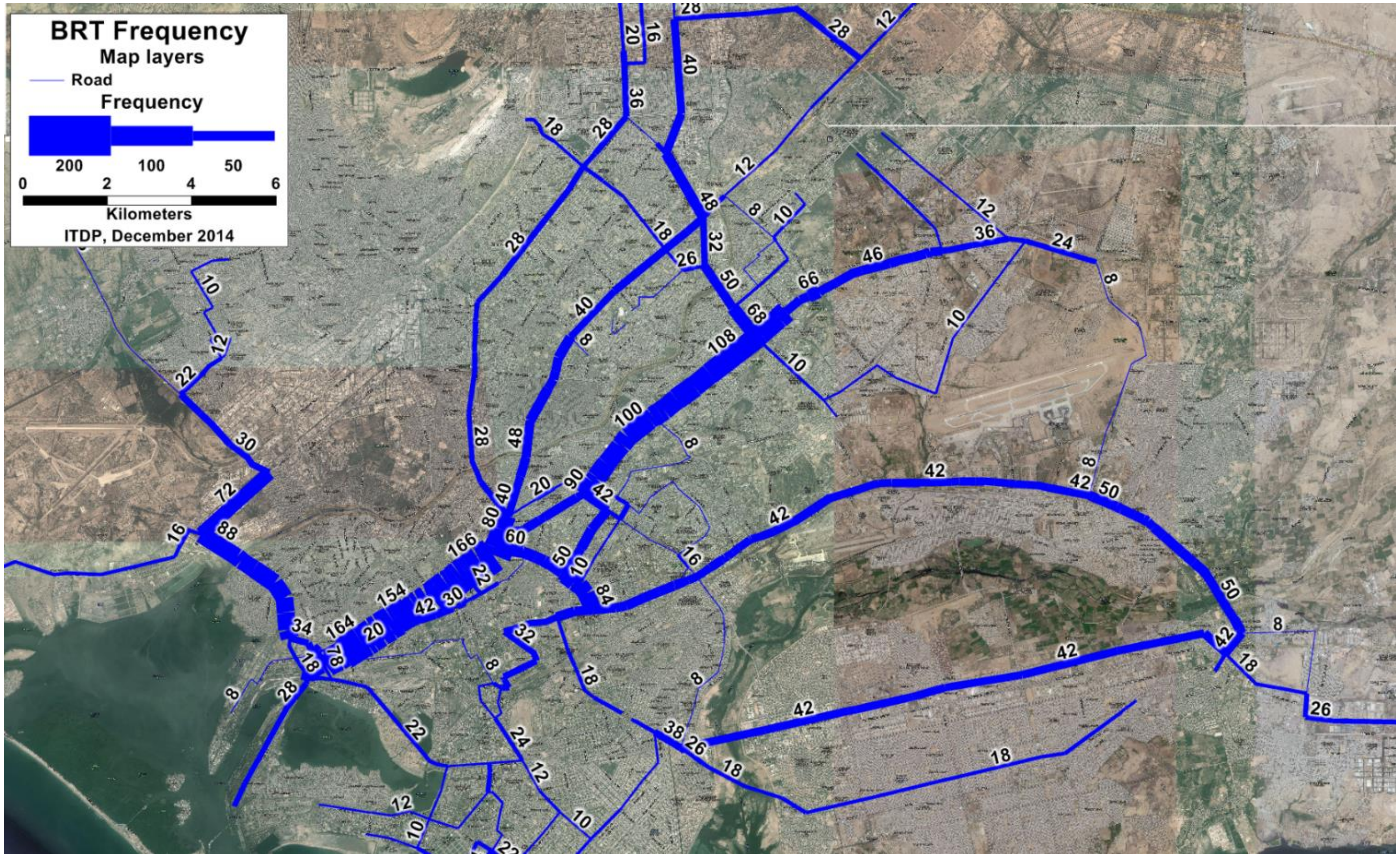



*Figure 4.2 BRT Route Frequency Map*

### 4.2.2 BRT 'Direct-Service' Routes

Out of 23 BRT routes for Phase 1, many routes pass the corridor between Rashid Minhas Road and Jail Chowrangi. MA Jinnah as the busiest section of the corridor has the most BRT routes, with 15 routes passing the corridor.

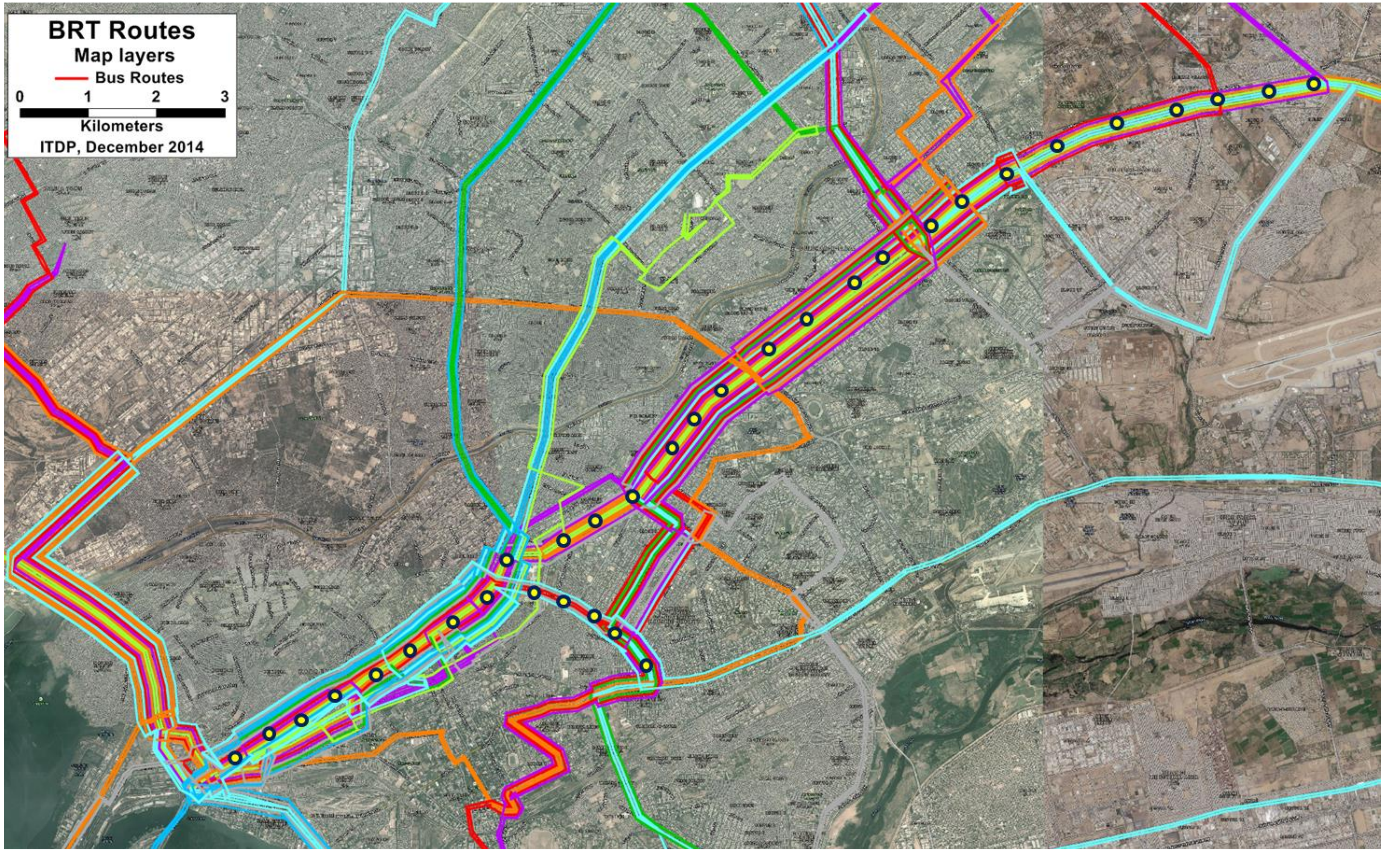



*Figure 4.3 BRT 'Direct-Service' Routes*

To illustrate how 'Direct-Service' BRT routes work on the Red Line BRT, the figures overleaf show the operational route of BRT route Gullistan, G-17 and G-3. There are different kinds BRT routes that operate in the BRT. For example, Gullistan BRT route will join the BRT on the middle section of the BRT and follows the corridor until the last station at Tower, and continue the routes to Clifton, beyond the BRT corridor. Another route, G-17 will join the BRT from the first station until the last station, and continues the journey beyond corridor. These different types of BRT 'Direct-Service' operation will allow flexible operation and promote wider coverage of the BRT system, without necessarily bound to the physical corridor.

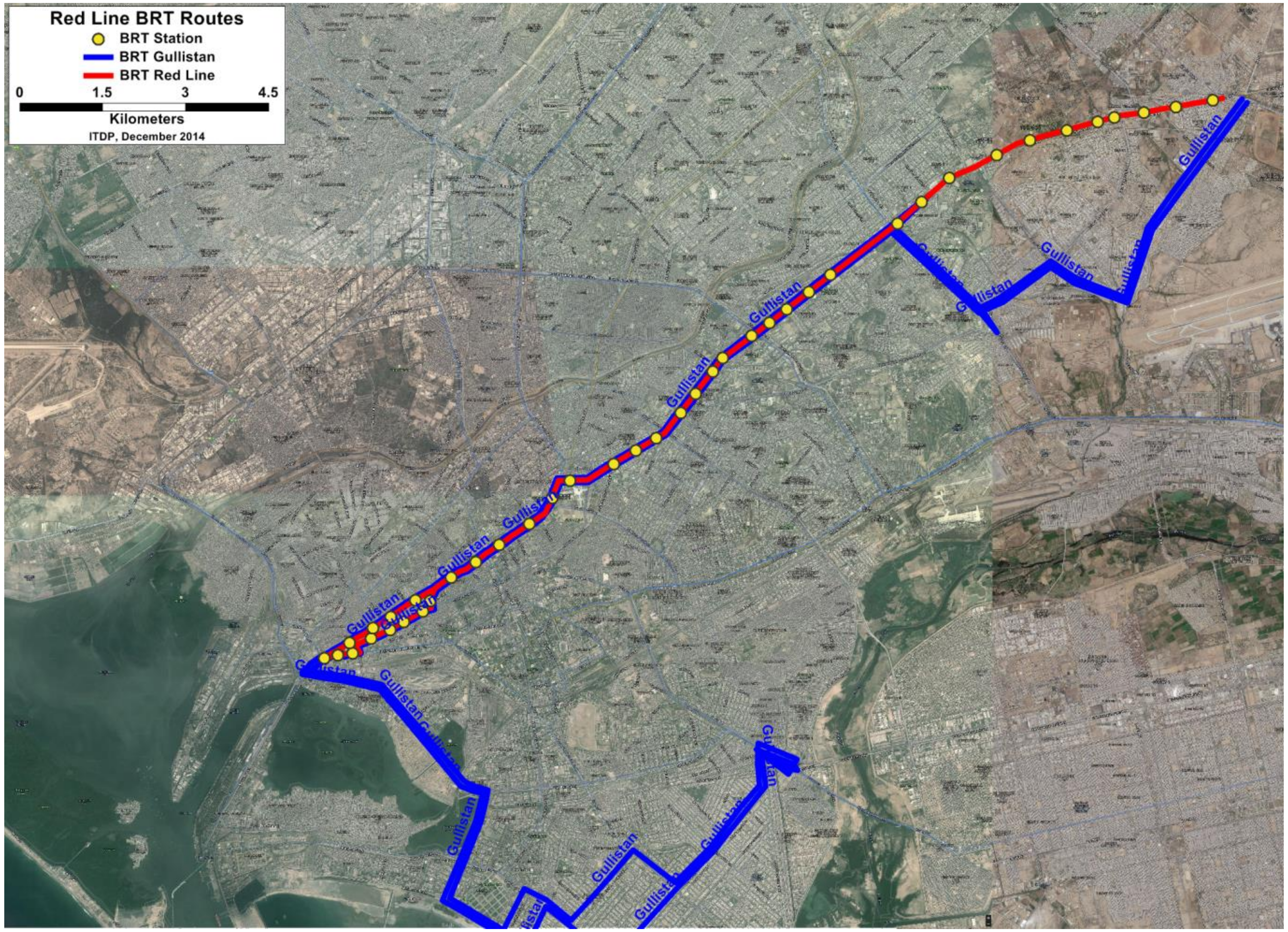



*Figure 4.4 Operational Route Gullistan*

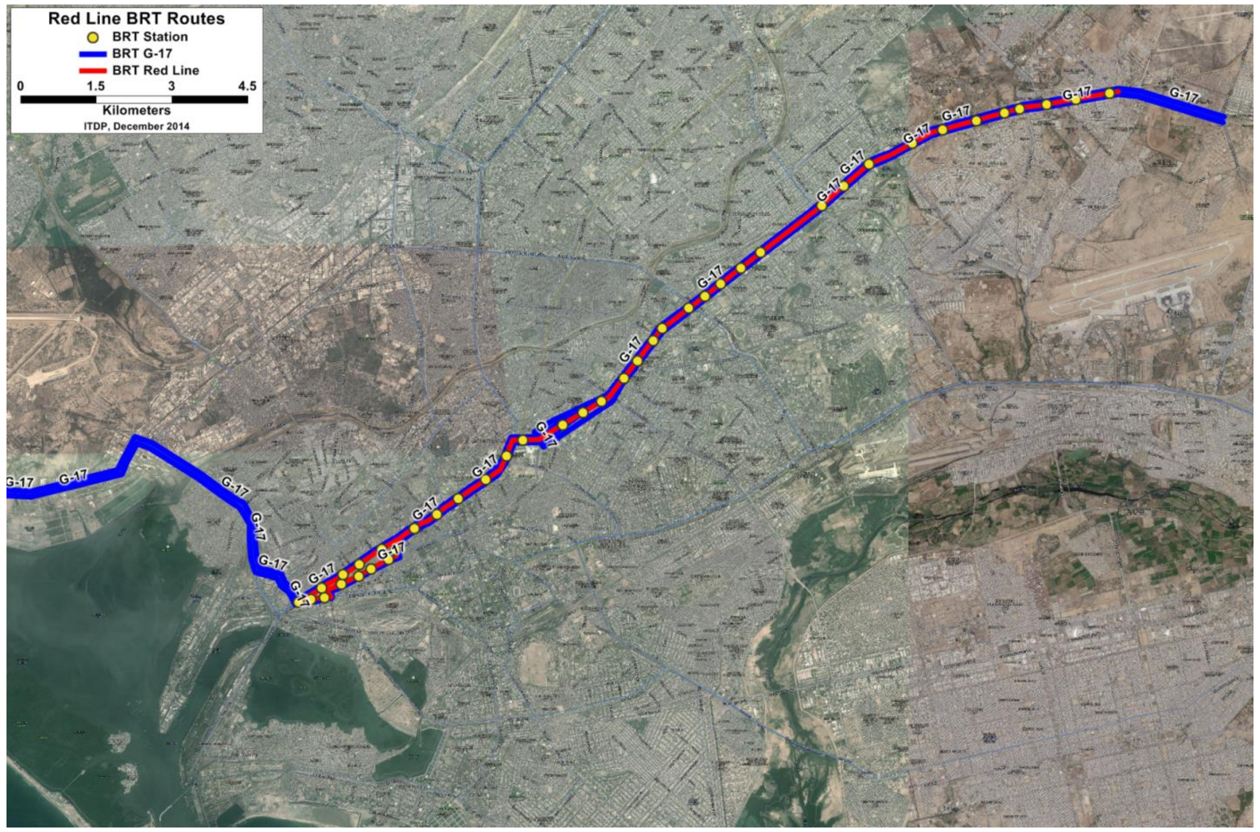



*Figure 4.5 Operational Route G-17*

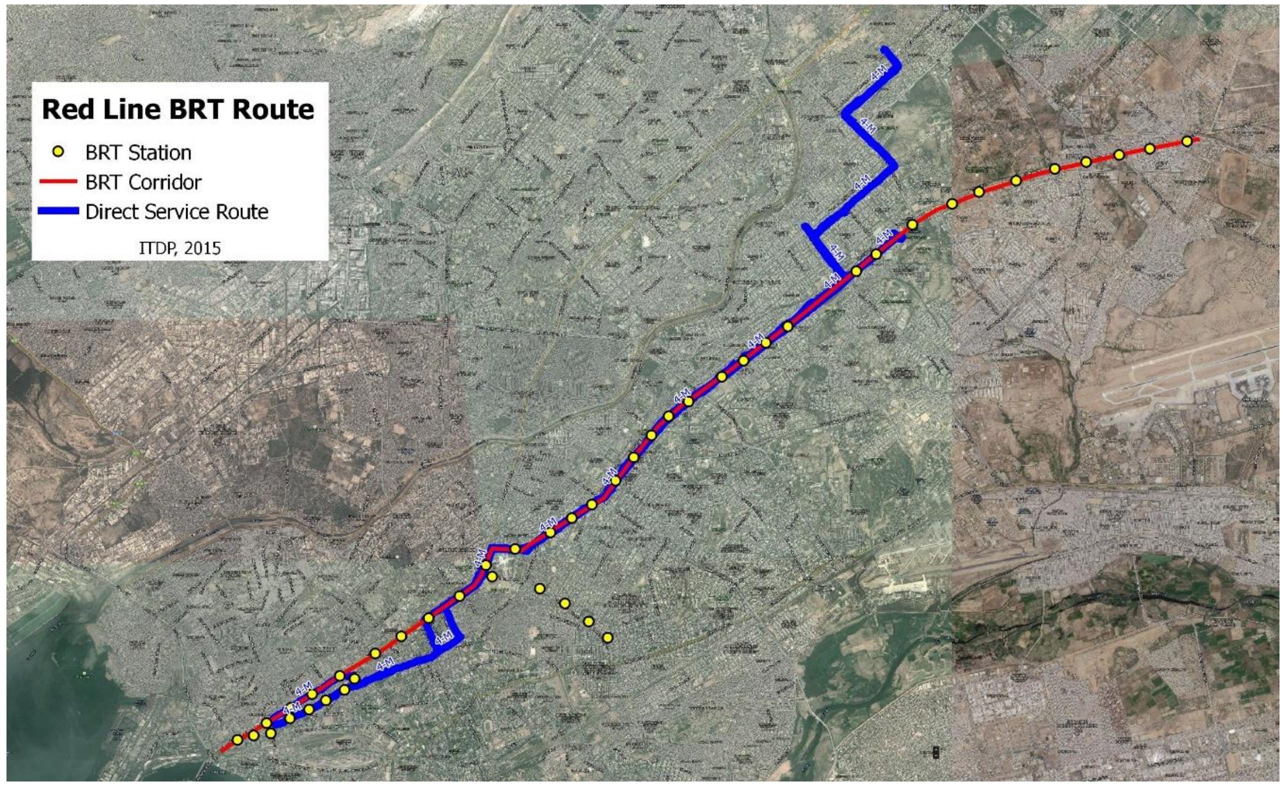



*Figure 4.6 Operational Route 4-M*

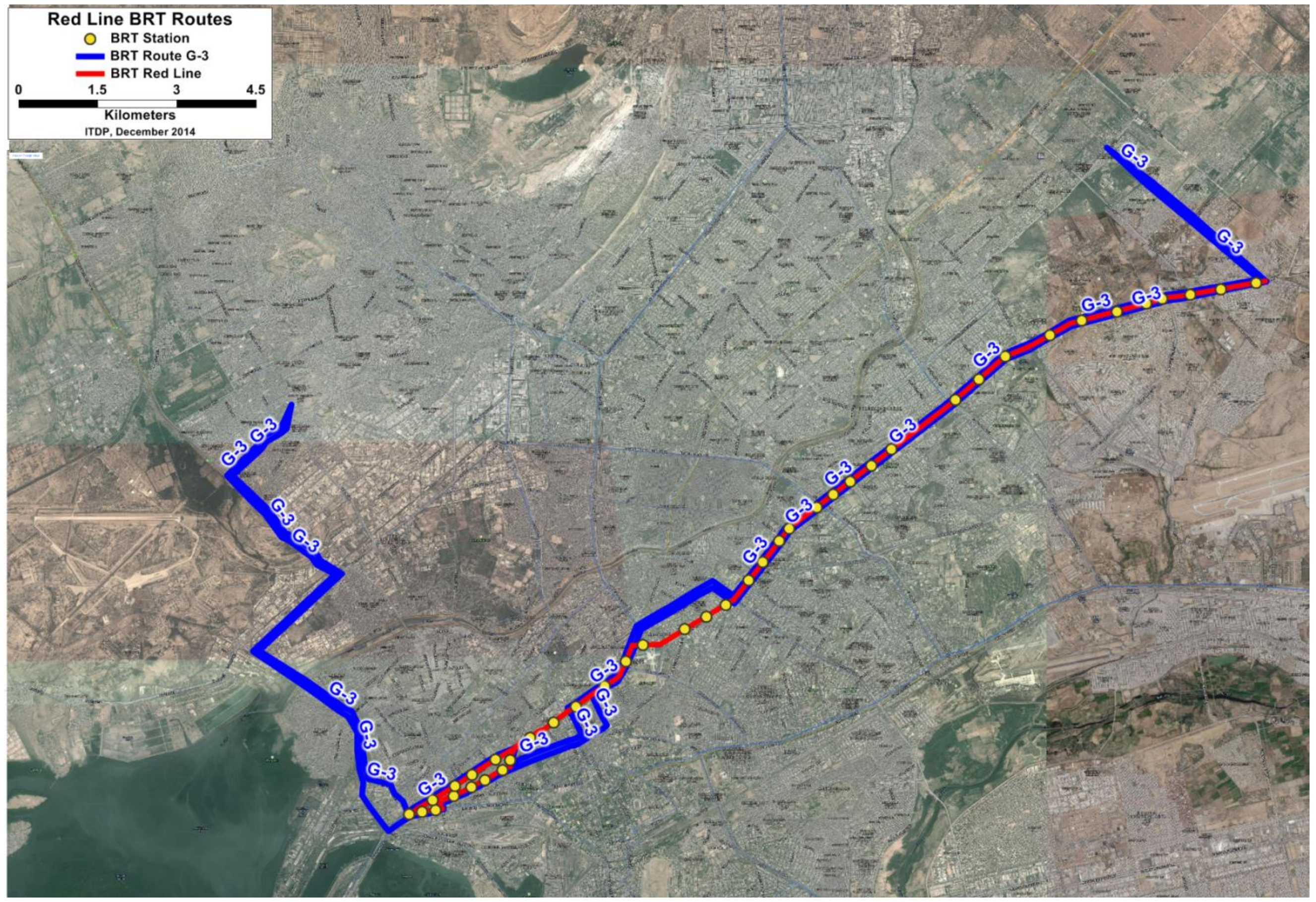



*Figure 4.7 Operational Route G-3*

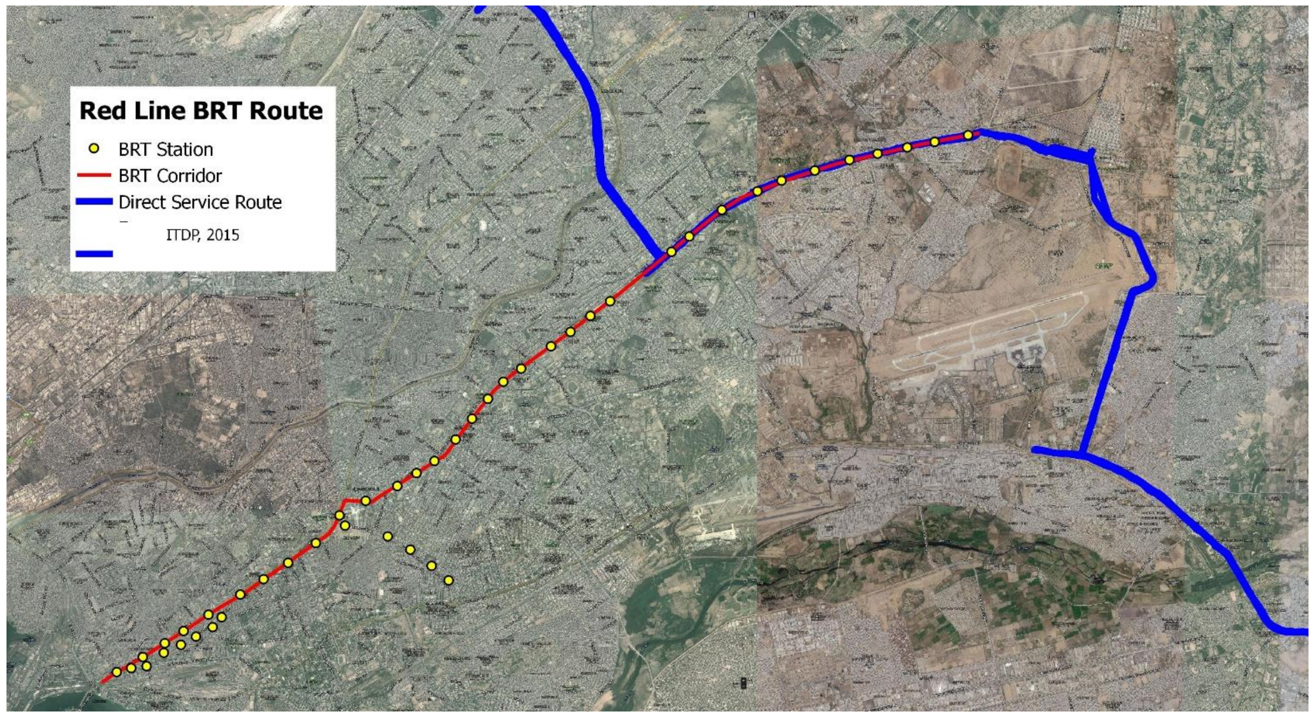



*Figure 4.8 Operational Route Masood*

## 4.3 Operational Model

Flexible operation will be made possible through direct service operation system. With direct service operation, bus frequency and number of bus routes could be different for each segment. For example, the mid segments of BRT on the University road would have bus frequency of 150 buses per hour per direction, whereas on the northern segment of the corridor would only have frequency of 46 buses per hour in one direction

During the off-BRT segment, BRT bus will operate similar like the current situation, i.e. on mixed traffic and pick up passenger from the curb side bus stop. Once joins the BRT corridor, the bus will use the right-side door to allow passenger boarding and alighting from BRT stations.

When running on the BRT corridor, passenger can only get on the bus from BRT stations, and not from the curbside.

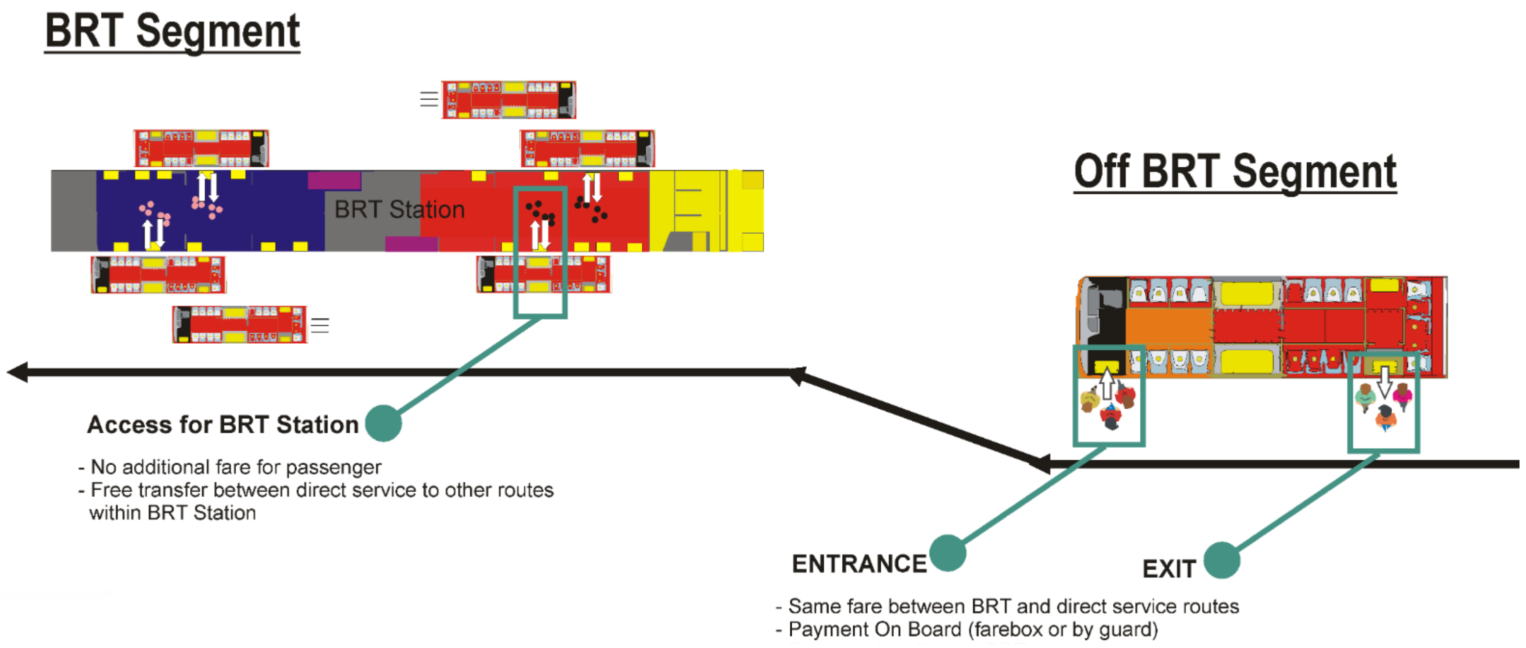



*Figure 4.9 Operational Design and Payment Method for 'Direct-Service' BRT System*

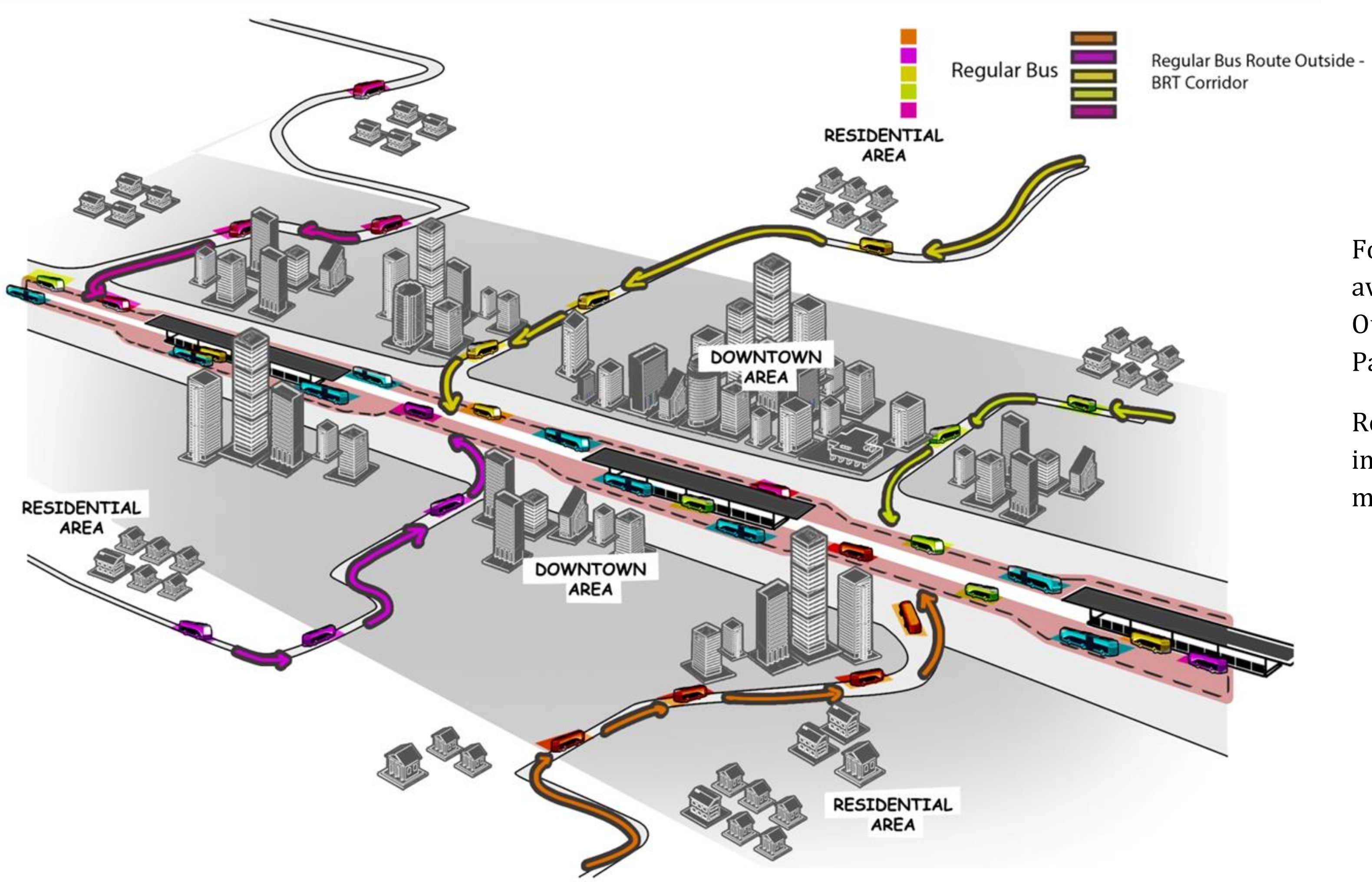



*Figure 4.10 Illustration of 'Direct-Service' Operational System*

For payment, single fare system will be used, if possible with electronic ticketing system to avoid cash transaction. It will allow passengers for free transfer, should they wish to do so. Outside BRT corridor, payment will be made on-board to fare-box or pay to bus guard. Passengers boarding from the BRT station need to pay before entering the BRT station.

Revenues which are collected on segment outside the BRT corridor will go directly to individual route operators, whereas revenues which are collected at BRT stations will be managed by the BRT regulator.

## 4.4 Demand Estimates

### 4.4.1 Boarding-alighting

Preliminary demand estimates for Karachi BRT is provided in this section. Peak hour boarding-alighting surveys were performed on the BRT routes to get more accurate estimate based on existing condition.

BRT Passenger demand is estimated for both passenger boarding from BRT stations, and for the entire system covering BRT and off-BRT segment as well. In addition to demand estimates, boarding-alighting data is also used to estimate station saturation, which will be discussed on the next chapter.

For 2015, it is estimated that current peak hour passenger boarding from BRT station is **17,303 passengers per hour**, and for the entire BRT system is **45,207 passengers per hour**. As for daily ridership estimate, it is estimated that **244,149 passengers** will board from the BRT stations daily, and **637,873 passengers** for the entire BRT system.

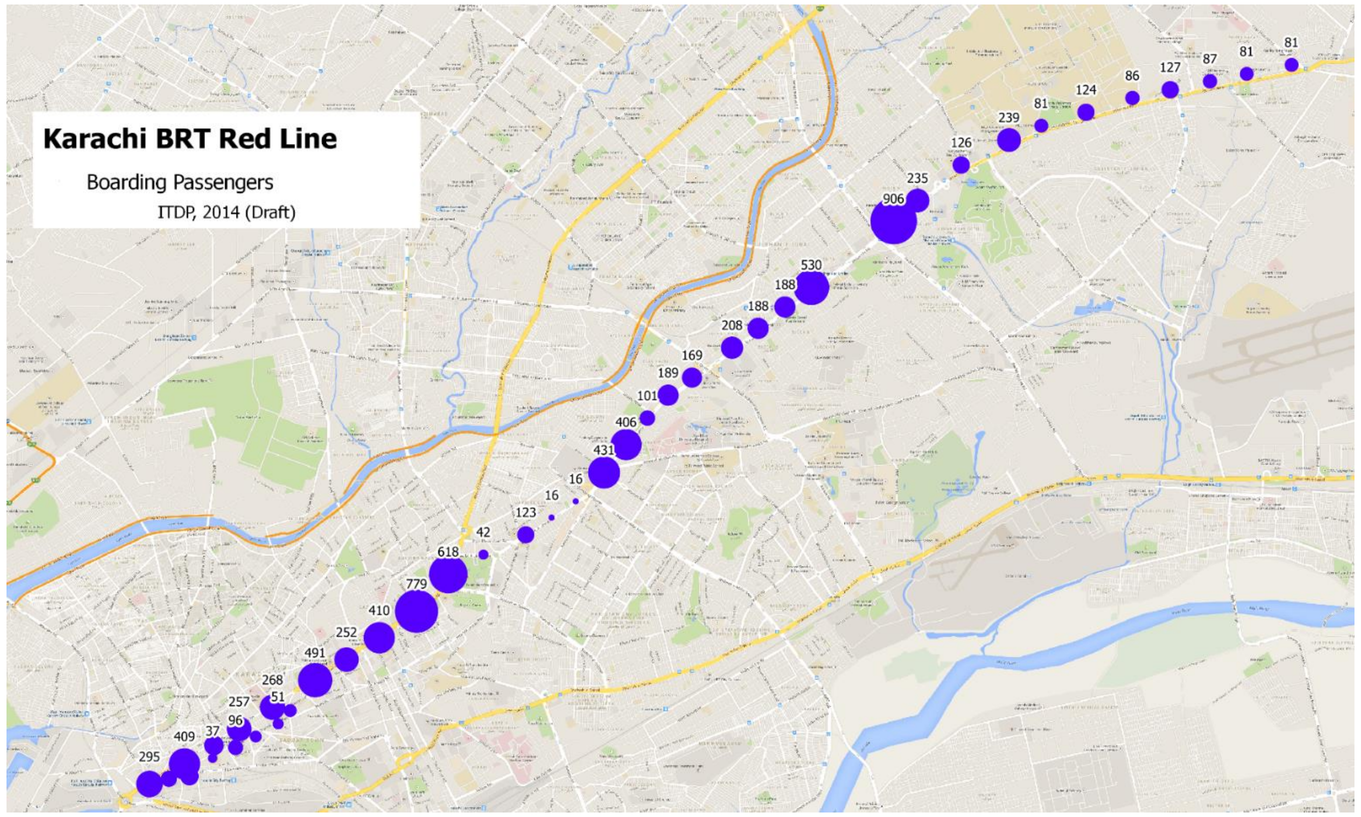



*Figure 4.11 Current Peak Hour Boarding Passenger (AM Peak)*

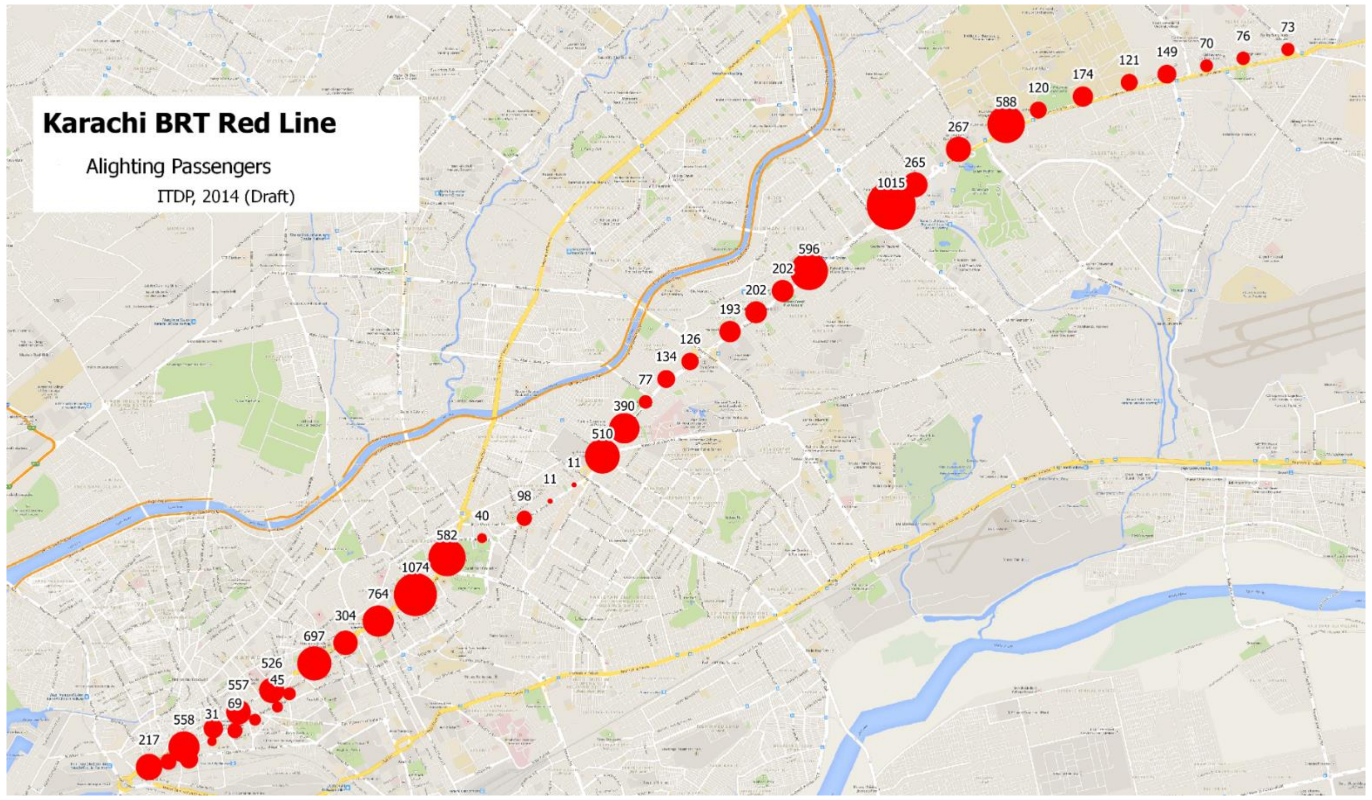



*Figure 4.12 Current Peak Hour Alighting Passenger (AM Peak)*

By applying simple growth factor, future 5 year BRT demand is also estimated. After 5 year in operation**, 317,801 passengers** are estimated to board from the BRT stations daily, and the entire BRT system daily ridership is estimated at **829,372 passengers**.

These estimates are only quick preliminary estimates to illustrate the scale of the ridership of the system, and used as a basis in designing the BRT infrastructure. These estimates are not meant to be used to develop financial model and to assess the financial feasibility of the BRT, as more detailed and comprehensive surveys and modeling need to be carried out for that purpose.

*Table 4.2 Estimate of Current BRT Demand*

| Route | Total BRT Inbound | | Total BRT Outbound | | Max Volume | Total Boarding Per Route |
|---|---|---|---|---|---|---|
| | Boarding | Alighting | Boarding | Alighting | | |
| 6 | 124 | 209 | 29 | 22 | 610 | 928 |
| 4-K | 117 | 987 | 239 | 96 | 970 | 2,432 |
| 4-L | 160 | 866 | 100 | 55 | 900 | 1,512 |
| 4-M | 336 | 257 | 260 | 215 | 300 | 1,180 |
| A-3 | 112 | 126 | 91 | 70 | 500 | 1,925 |
| Data | 110 | 130 | 37 | 50 | 306 | 1,163 |
| F-11 | 280 | 189 | 112 | 294 | 670 | 2,772 |
| G-13 | 490 | 351 | 327 | 474 | 104 | 1480 |
| G-17 | 315 | 352 | 140 | 325 | 160 | 1011 |
| G-19 | 152 | 176 | 128 | 210 | 150 | 944 |
| G-3 | 490 | 509 | 327 | 474 | 550 | 1,480 |
| G-7 | 327 | 540 | 323 | 517 | 300 | 2,030 |
| Gulistan | 78 | 78 | 66 | 97 | 234 | 831 |
| Khan | 38 | 117 | 173 | 162 | 600 | 1,972 |
| M-1 | 49 | 84 | 77 | 67 | 290 | 1,125 |
| Marwat | 427 | 1,141 | 339 | 390 | 1410 | 11,109 |
| Masood | 97 | 91 | 35 | 106 | 200 | 1,028 |
| S-2 | 152 | 152 | 72 | 90 | 180 | 1584 |
| Safari | 152 | 152 | 72 | 90 | 460 | 1,176 |
| Shiraz | 511 | 550 | 272 | 540 | 470 | 1,715 |
| Starline | 225 | 218 | 56 | 75 | 360 | 877 |
| Super Hassan | 94 | 79 | 25 | 30 | 346 | 1,405 |
| W-11 | 102 | 525 | 441 | 212 | 1514 | 3,528 |
| Peak Hour Boarding From BRT | | 17,303 | Peak Hour Boarding All Routes | | | 45,207 |
| **Daily Boarding From BRT** | | **244,149** | **Daily Boarding all Routes** | | | **637,873** |

*Table 4.3 Estimate of Future BRT Demand in 5 Years after Operation*

| Routes | Total BRT Inbound | | Total BRT Outbound | | Max Occupancy | Total Boarding Per Route |
|---|---|---|---|---|---|---|
| | Boarding | Alighting | Boarding | Alighting | | |
| 6 | 161 | 272 | 38 | 29 | 793 | 1,207 |
| 4-K | 153 | 1,283 | 311 | 126 | 1,261 | 3,162 |
| 4-L | 208 | 1,126 | 130 | 72 | 1,170 | 1,966 |
| 4-M | 437 | 335 | 338 | 280 | 390 | 1,534 |
| A-3 | 146 | 164 | 119 | 91 | 650 | 2,503 |
| Data | 143 | 169 | 48 | 65 | 398 | 1,513 |
| F-11 | 364 | 246 | 146 | 383 | 871 | 3,604 |
| G-13 | 637 | 457 | 426 | 617 | 136 | 1,924 |
| G-17 | 410 | 459 | 182 | 423 | 208 | 1,315 |
| G-19 | 198 | 229 | 166 | 273 | 195 | 1,228 |
| G-3 | 637 | 662 | 426 | 617 | 715 | 1,924 |
| G-7 | 426 | 702 | 421 | 672 | 390 | 2,639 |
| Gulistan | 102 | 102 | 86 | 126 | 305 | 1,081 |
| Khan | 50 | 153 | 225 | 211 | 780 | 2,564 |
| M-1 | 64 | 109 | 101 | 88 | 377 | 1,463 |
| Marwat | 556 | 1,484 | 441 | 507 | 1,833 | 14,442 |
| Masood | 127 | 119 | 46 | 138 | 260 | 1,337 |
| S-2 | 198 | 198 | 94 | 117 | 234 | 2,060 |
| Safari | 198 | 198 | 94 | 117 | 598 | 1,529 |
| Shiraz | 664 | 715 | 354 | 703 | 611 | 2,230 |
| Starline | 293 | 283 | 73 | 98 | 468 | 1,140 |
| Super Hassan | 122 | 103 | 33 | 39 | 450 | 1,827 |
| W-11 | 133 | 683 | 574 | 276 | 1,969 | 4,587 |
| Peak Hour Boarding From BRT | | 22,523 | Peak Hour Boarding All Routes | | | 58,779 |
| **Daily Boarding From BRT** | | **317,801** | **Daily Boarding all Routes** | | | **829,372** |

### 4.4.2 Passenger Throughput Estimate


*Figure 4.13 AM Peak Inbound Passenger Throughput Estimates*

As shown in the figure above, the highest passenger throughput on the BRT corridor is on the MA Jinnah section with **6,153 passengers per hour per direction**. On this section, there are more than 10 BRT routes passing this corridor, thus passing lanes might be required at the stations.

## 4.5 BRT Fleet

### 4.5.1 Fleet Requirement

***Table 4.4 Karachi BRT Fleet Requirement***

| Route | Bus Type | Max Volume | Frequency / Hour | Headway (Minutes) | Total 2 way Route (km) | BRT Route (km) | Cycle Time (Hour) | Existing Travel Speed (km/h) | New Cycle Time | Fleet Requirement |
|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 9m | 793 | 21 | 2.86 | 31 | 4.59 | 3.78 | 8.25 | 3.44 | 88 |
| 4-K | 12m | 1261 | 17 | 3.53 | 45 | 9.05 | 3.29 | 13.60 | 3.04 | 64 |
| **4-L** | 12m | 1170 | 16 | 3.75 | 31 | 6.36 | 1.95 | 15.86 | 1.84 | 39 |
| 4-M | 9m | 390 | 11 | 5.45 | 40 | 20.97 | 3.27 | 12.28 | 2.52 | 35 |
| A-3 | 9m | 650 | 17 | 3.53 | 52 | 8.05 | 3.27 | 15.92 | 3.13 | 65 |
| Data | 9m | 398 | 11 | 5.45 | 78 | 12.94 | 4.89 | 15.86 | 4.67 | 61 |
| F-11 | 9m | 871 | 23 | 2.61 | 89 | 12.94 | 5.43 | 16.46 | 5.23 | 142 |
| G-13 | 9m | 135 | 4 | 15.00 | 71 | 15.73 | 4.72 | 14.99 | 4.39 | 21 |
| G-17 | 9m | 208 | 6 | 10.00 | 76 | 40.30 | 4.98 | 15.30 | 4.18 | 31 |
| G-19 | 9m | 195 | 6 | 10.00 | 78 | 9.89 | 5.21 | 14.93 | 5.00 | 35 |
| G-3 | 9m | 715 | 19 | 3.16 | 72 | 29.72 | 5.76 | 12.48 | 4.73 | 107 |
| G-7 | 9m | 390 | 11 | 5.45 | 77 | 29.07 | 5.89 | 13.06 | 4.98 | 65 |
| Gulistan | 9m | 304 | 8 | 7.50 | 81 | 25.80 | 4.13 | 19.49 | 3.98 | 39 |
| Khan | 9m | 780 | 21 | 2.86 | 74 | 8.58 | 3.59 | 20.71 | 3.57 | 90 |
| M-1 | 9m | 377 | 10 | 6.00 | 45 | 8.76 | 3.48 | 12.87 | 3.20 | 40 |
| Marwat | 12m | 1833 | 24 | 2.50 | 103 | 7.70 | 6.27 | 16.43 | 6.15 | 172 |
| Masood | 9m | 260 | 7 | 8.57 | 103 | 13.10 | 4.84 | 21.26 | 4.82 | 41 |
| Safari | 9m | 598 | 16 | 3.75 | 104 | 14.81 | 5.84 | 17.79 | 5.69 | 107 |
| S-2 | 9m | 234 | 7 | 8.57 | 78 | 12.94 | 4.83 | 16.20 | 4.62 | 39 |
| Shiraz | 9m | 611 | 16 | 3.75 | 77 | 37.05 | 4.98 | 15.47 | 4.27 | 81 |
| Starline | 9m | 468 | 13 | 4.62 | 89 | 8.69 | 4.93 | 18.14 | 4.84 | 75 |
| Super Hassan | 9m | 450 | 12 | 5.00 | 71 | 11.07 | 3.36 | 21.00 | 3.33 | 48 |
| W-11 | 18m | 1968 | 16 | 3.75 | 61 | 8.32 | 3.57 | 17.05 | 3.46 | 67 |
| | | | | | | | | | **Total** | **1,549** |

BRT fleet requirement is estimated to cater demand for the next 5 years, with 85% occupancy level during peak hour, thus allowing 15% spare space to accommodate further growth, and adding 10% reserved for maintenance.

In the calculation, the average speed after BRT is assumed at 22 km/hour at the BRT corridor segment, and remain unchanged for the non-BRT corridor.

For Karachi, 9-meter and 12-meter bus types will be used in most routes, and only route W-11 requires 18-meter buses. For the future, more 18-meter buses can be introduced for more routes, when the demand picks up and station become more saturated.

There were concerns that 18-meter buses might not be suitable for Karachi, due to road size. Preliminary investigation on the road in Karachi suggests that most roads and junctions in Karachi can accommodate the turning radius for 18-meter buses.

The total number of fleet for 23 routes are 1,549 buses, with 1 route using 18-meter buses, 3 routes using 12 meter buses, and 19 routes using the 9 meter buses.

## 4.5.2 9-meter Fleet Design

Low-floor buses will be used (entry 30 cm from ground) for all of BRT buses in Karachi. For 9-meter bus type, 1 door on BRT side and 2 doors on road-side will be made available.

The 12-meter bus type will have 2 doors on each side, and for 18-meter bus type, 3 doors on each side will be made available. Fleet capacity is designed for 45 passengers for 9-meter bus, 85 passengers for 12-meter bus, and 150 passengers for 18-meter bus.

To promote better emission level for BRT, the recommended engine specifications for these buses should be EURO IV at the minimum. As for the fuel type, diesel fuel is strongly recommended.

Although CNG might be better for local pollution, the use of CNG is not recommended for the BRT buses. CNG tank with low capacity would require 2 gas refilling process per day (compare to 1 with diesel), and with current CNG supply problem in Karachi, this could make the BRT operation inefficient.

There are many bus manufacturers which can provide such requirement for Karachi BRT. For example, European bus manufacturers such as Scania, Volvo, Mercedes-Benz or MAN might have buses that match the specifications. From China, ANKAI, Yutong, Youngman or even Sunwin buses, which are used by Lahore BRT could be sought.

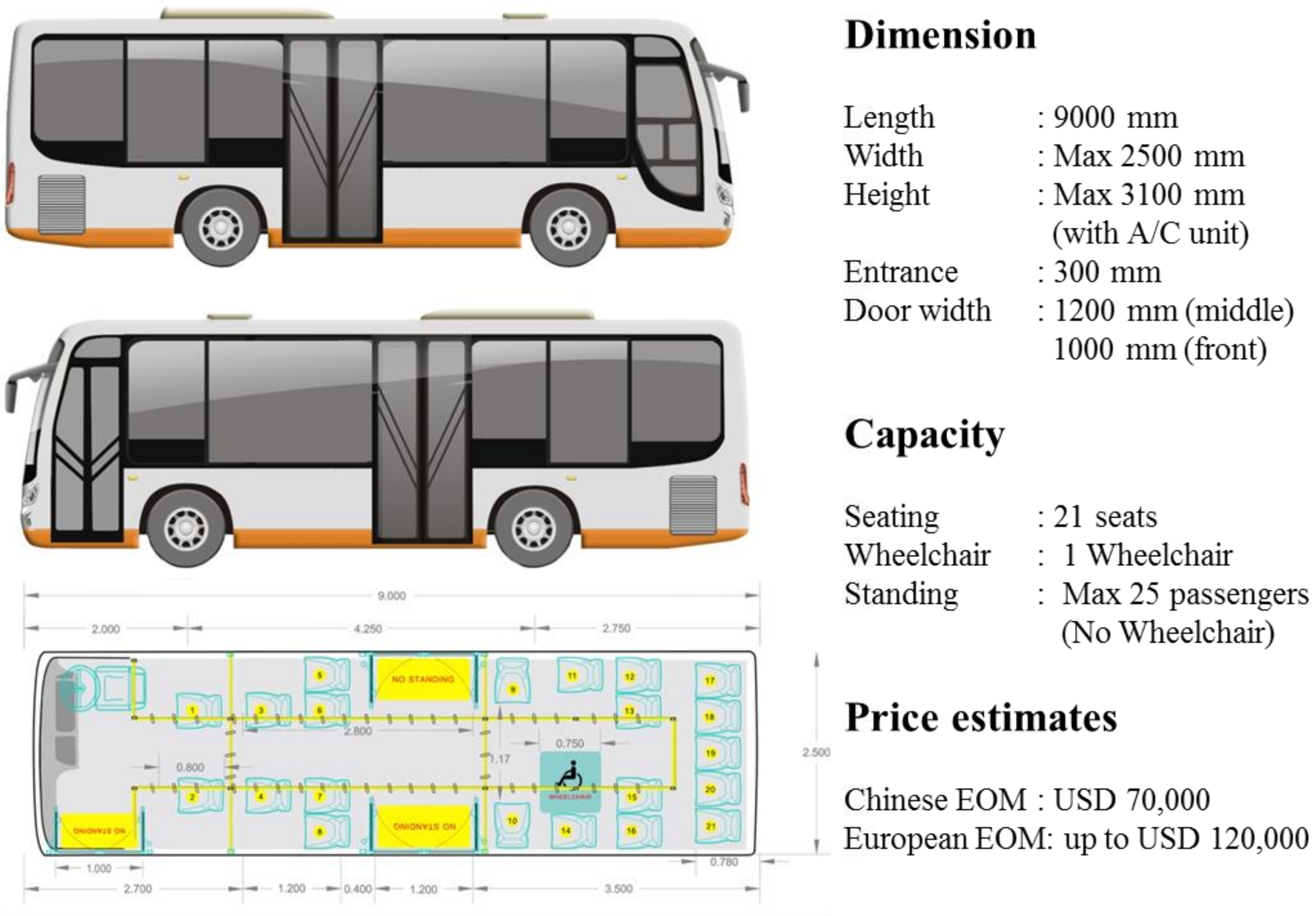
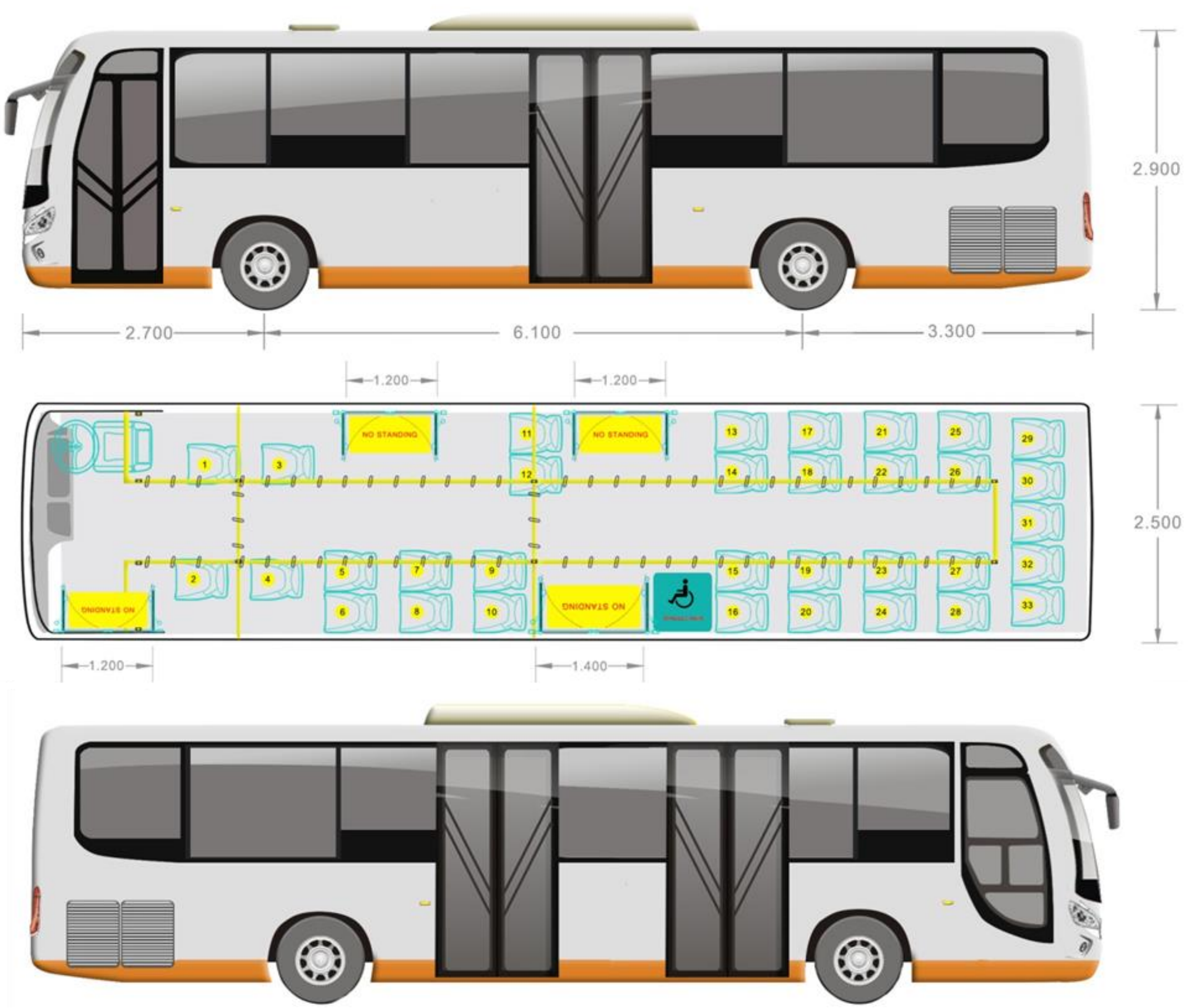



*Figure 4.14 Vehicle Design for 9-meter Bus Type*

An important aspect when procuring these buses is the need to ensure full after service warranty for 10 years on spare-part, service, and technical support. This is critical to maintain the performance of the BRT buses throughout the contract.
Price for these buses varies between USD 70,000 for 9-meter bus and USD 100,000 to USD 120,000 for 12-meter bus. The lower price is quoted for the Chinese bus, whereas the higher price is quoted for the European brand. For 18-meter bus, price range is between USD 330,000 (China) and USD 550,000 (Europe)

### 4.5.3 12-meter Fleet Design




## Dimension

| | |
|---|---|
| Length | : 12000 mm |
| Width | : Max 2500 mm |
| Height | : Max 3100 mm (with A/C unit) |
| Entrance | : 300 mm |
| Door width | : 1200 mm (middle right)<br>1400 mm (middle left)<br>1000 mm (front left) |

## Capacity

| | |
|---|---|
| Seating | : 33 seats |
| Wheelchair | : 1 Wheelchair |
| Standing | : Max 55 passengers (No Wheelchair) |

## Price

| | |
|---|---|
| Chinese EOM | : USD 160,000 |
| British/European EOM | : USD 250,000 |

*Figure 4.15 Vehicle Design for 12-meter Fleet Type*

### 4.5.4 18-meter Fleet Design


## Dimension

Length : 18000 mm
Width : Max 2500 mm
Height : Max 3100 mm (with A/C unit)
Entrance : 300 mm
Door width (right): 1200 mm (mid+ rear)
(left): 1000 mm (front),
1400 mm (mid + rear)

## Capacity

Seating : 39 seats
Wheelchair : 1 Wheelchair
Standing : Max 120 passengers (No Wheelchair)

## Price

Chinese EOM : USD 330,000
British/European EOM : up to USD 580,000

*Figure 4.16 Vehicle Design for 18-meter Bus Type*

# 5 BRT Infrastructure Design Concept

## 5.1 Station Saturation & Station Size

### 5.1.1 Station Saturation

Station saturation were calculated by using current bus frequency, occupancy, boarding and alighting passengers, which were inflated by a growth factor to anticipate growth in 5 years (1.6% growth per annum). For several high-frequency and high-occupancy routes, bus size is also adjusted to bigger capacity buses (12-meter and 18-meter) to reduce saturation. Most of the stations for Karachi BRT have 2 sub-stops, and only a few with 1 sub-stop.

To anticipate the worst-case scenario on saturation number, express and limited stop services are not yet taken into account. Routes with express and limited stop services can be determined later during the detailed operational plan design. The design for station with 1 sub-stop, however, is provided with passing lane to allow the operation of express and limited stop services.

### 5.1.2 Station Saturation Map

Station saturation and size for Phase 1 BRT is shown below:

*Table 5.1 Station Saturation & Size*

| Station Code | Station Name | Bus Frequency | Number of Routes | Saturation | Number of Sub Stop |
|---|---|---|---|---|---|
| 101 | SAFOORA | 54 | 5 | 0.16 | 1 |
| 102 | BLOCK 7 | 54 | 5 | 0.16 | 1 |
| 103 | SHUMAIL COMPLEX | 54 | 5 | 0.17 | 1 |
| 104 | MOSAMYAT WESTBOUND | 69 | 7 | 0.21 | 1 |
| 105 | SHEIKH ZAYED ISLAMIC CENTER | 69 | 7 | 0.21 | 1 |
| 106 | BLOCK 1 | 69 | 7 | 0.21 | 1 |
| 107 | UNIVERSITY OF KARACHI | 69 | 7 | 0.21 | 1 |
| 108 | NED | 69 | 7 | 0.25 | 1 |
| 109 | SAFARI PARK | 79 | 7 | 0.25 | 1 |
| 110 | FATMA CHARITABLE AND MATERNITY HOME | 161 | 13 | 0.49 | 2 |
| 111 | NIPA | 169 | 14 | 0.66 | 2 |
| 112 | URDU COLLEGE | 174 | 14 | 0.56 | 2 |
| 113 | FUTURE PARK | 174 | 14 | 0.52 | 2 |
| 114 | KARACHI EXPO CENTER | 174 | 14 | 0.51 | 2 |
| 115 | CIVIC CENTER | 140 | 11 | 0.41 | 2 |
| 116 | DARUL ULOOM GHOSIA TRUST | 140 | 11 | 0.4 | 2 |
| 117 | PIB COLONY | 140 | 11 | 0.46 | 2 |
| 118 | CENTRAL JAIL | 140 | 11 | 0.47 | 2 |
| 119 | MIR USMAN PARK | 41 | 4 | 0.12 | 1 |
| 120 | DAWOOD UNIV OF ENGINEERING AND TECHNOLOGY | 41 | 4 | 0.13 | 1 |
| 121 | NORTH MAZAR E QUAID | 41 | 4 | 0.12 | 1 |
| 122 | WAZIR OTC HOSPITAL | 151 | 10 | 0.54 | 2 |
| 123 | DAEWOO CITY TERMINAL | 219 | 15 | 0.77 | 2 |
| 124 | PRINCE CINEMA | 208 | 14 | 0.69 | 2 |
| 125 | RIMPA PLAZA | 168 | 12 | 0.5 | 2 |
| 126 | NJV SCHOOL | 135 | 9 | 0.46 | 2 |
| 127 | THE GHULAM HUSSAIN KHALIQ DINA LIBRARY | 198 | 14 | 0.65 | 2 |
| 128 | KMC (Karachi Municipal Corporation) | 198 | 15 | 0.66 | 2 |
| 129 | DENSO HALL | 219 | 15 | 0.72 | 2 |
| 130 | NEW MEMON MASJID | 219 | 15 | 0.74 | 2 |
| 131 | TOWER | 184 | 13 | 0.56 | 2 |
| 132 | STATE BANK OF PAKISTAN | 131 | 9 | 0.35 | 1 |
| 133 | SINDH POLICE HEADQUARTERS | 139 | 10 | 0.37 | 1 |
| 134 | SINDH MUSLIM SCIENCE COLLEGE | 204 | 14 | 0.54 | 2 |
| 135 | FAKHRI TRADE CENTER | 204 | 14 | 0.56 | 2 |
| 136 | HEMANI CENTER | 204 | 14 | 0.55 | 2 |
| 137 | ARAM BAGH | 204 | 14 | 0.55 | 2 |
| 138 | METROPOLIS SECONDARY SCHOOL | 172 | 12 | 0.46 | 2 |

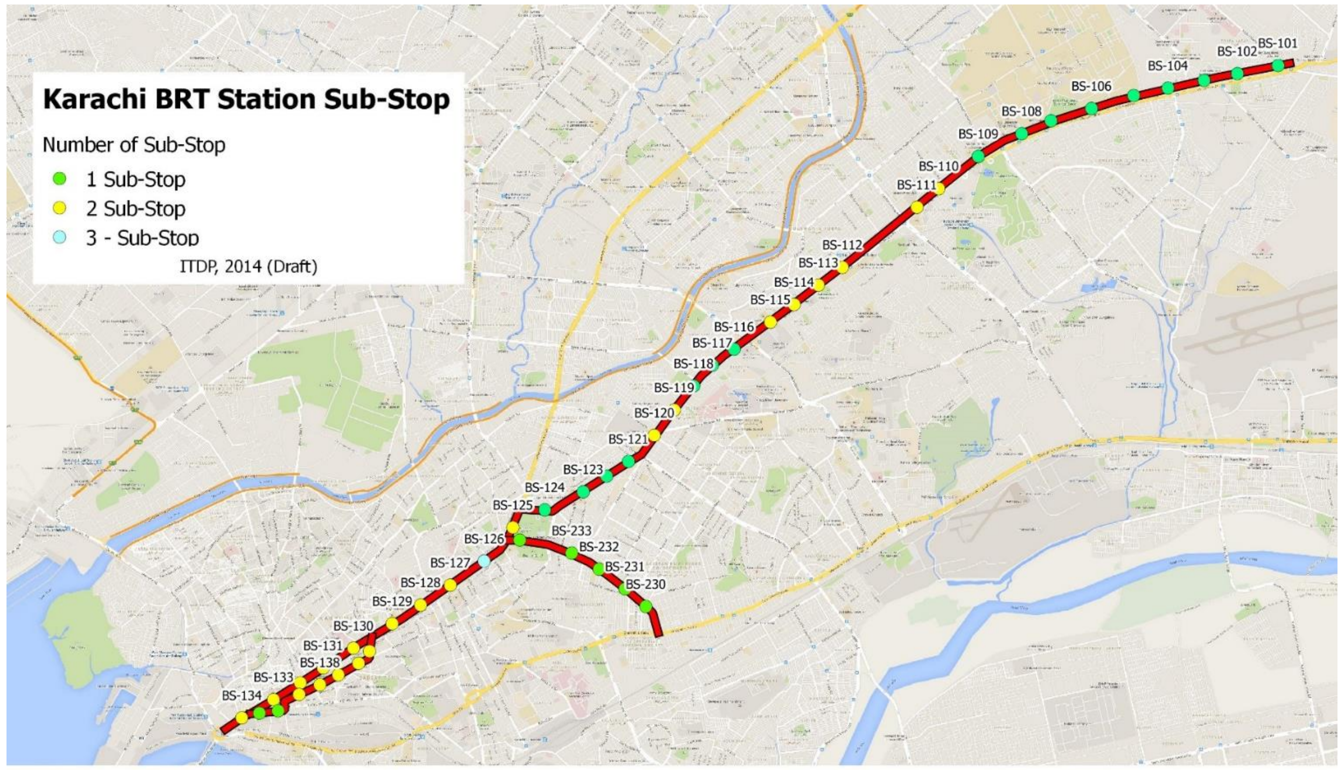



*Figure 5.1Station Size Map*

## 5.2 Station Configuration

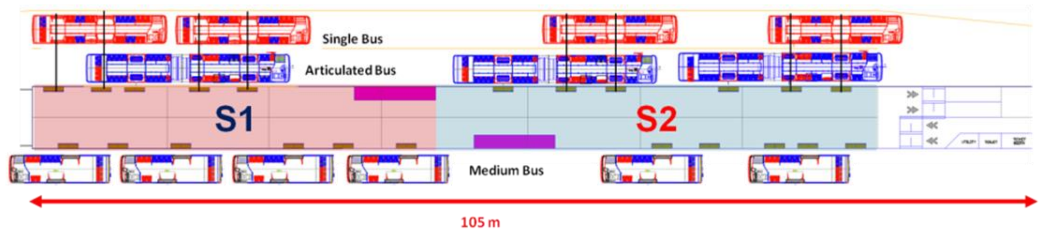
There are 4 station designs which are designed for Karachi BRT. The stations are designed in modular for the ease of construction. For station building area, 10 meter modular design is used, whereas for fare collection and ticket office, 15 meter modular design is used.

Typical station width is 6 meter, and 5 meter on MA Jinnah with 1 direction BRT. The design also takes into account the 18-meter buses that is initially is introduced for route W-11, but later can be used in more routes.

This design also takes into account the integration with other corridors, such as Yellow line at Shahrah e Quaideen and Red Line at MA Jinnah.

To understand the station concept that allow multiple buses stopping at the same time, the following introduction about sub-stop might help to illustrate how sub-stop works.

### 5.2.1 Sub-stop Concept




Sub-Stop Illustration

Application of Sub-stop in Guangzhou BRT

Sub-stop in Transmilenio BRT

*Figure 5.2 Sub-stop Illustration and Application*

- *How Sub-Stop Works*

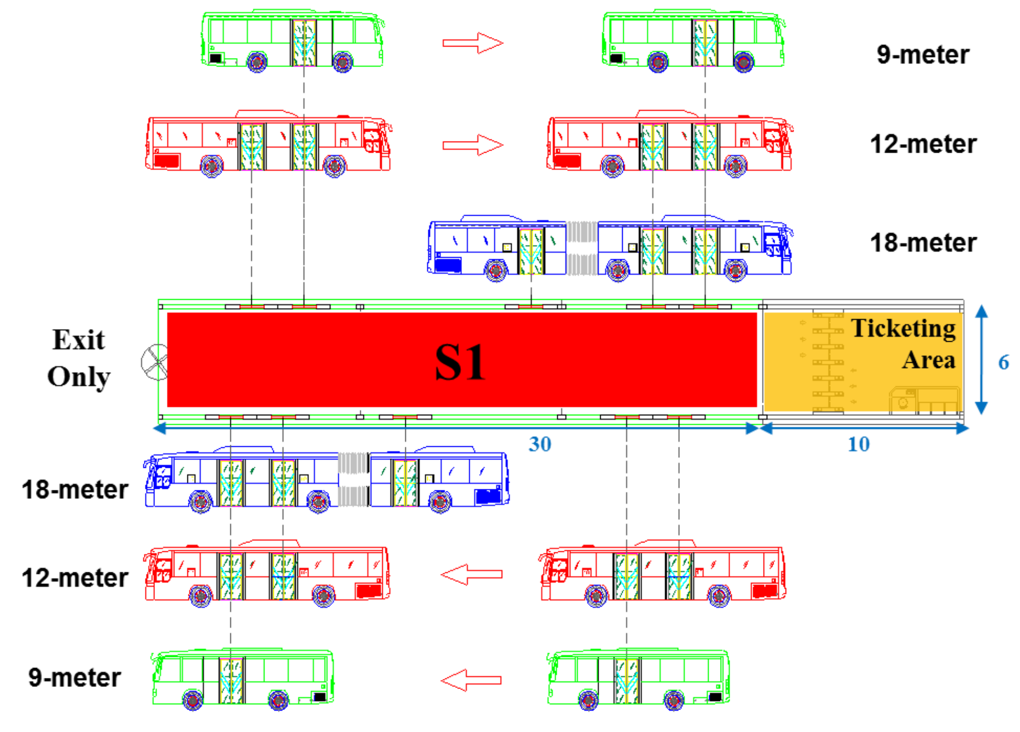
With sub-stop, stations can have multiple individual stops. Sub-stop allows a group of individual routes to be assigned in different sub-stop, thus allowing multiple buses stopping at the same time. With the provision of passing lane, buses stopping at the second sub-stop can pass the buses at the sub-stop in front, thus increases the BRT system capacity.

For Karachi, stations are designed with 1 and 2 sub-stops, which differ according to the station saturation.

### 5.2.2 Station Module Design

The 3 types of station Module design for BRT Karachi are shown below. For Station with 1 sub-stop and 2 sub-stops, each sub-stop can accommodate one 18-meter bus, or two 12-meter buses or two 9-meter buses per sub-stop, with sub-stop length is 30 meter per sub-stop. There is also another type of station with two sub-stops that can accommodate two 18-meter buses, or three 12-meter buses or two 9 meter buses per sub-stop, with sub-stop length 40 meter.

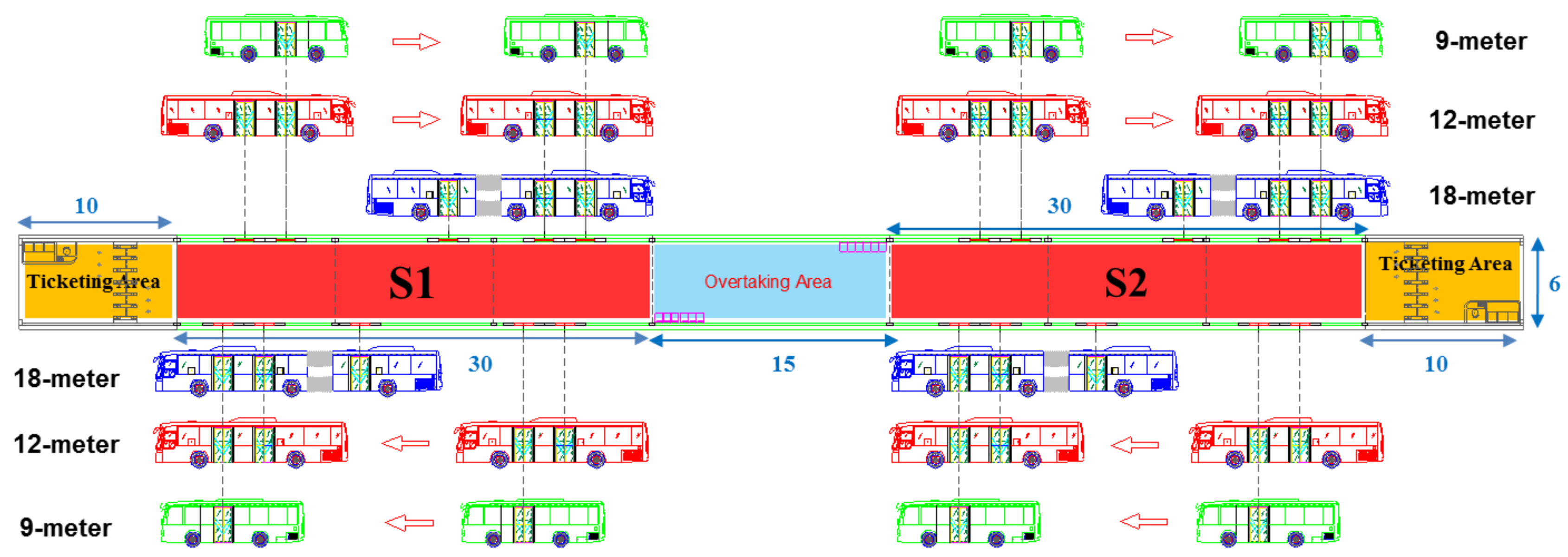
The stations are designed with access on both sides, to allow easy and quicker access to the station. For station with 1 sub-stop, access on another side is provided for exit only. Overtaking lane of 15 meter is needed to allow the maneuver of 18-meter bus. The recommended width for station is 6 meter, although on some stations, 5 meter width is also acceptable.




Stopping Configuration

| No | Front | Rear |
|---|---|---|
| 1 | 18-m | - |
| 2 | 18-m | 12-m |
| 3 | 18-m | 9-m |
| 4 | 12-m | 12-m |
| 5 | 12-m | 9-m |
| 6 | 9-m | 12-m |
| 7 | 9-m | 9-m |

*Figure 5.3 Station Module Type 1 with 1 Sub-Stop (40 x 6 m)*



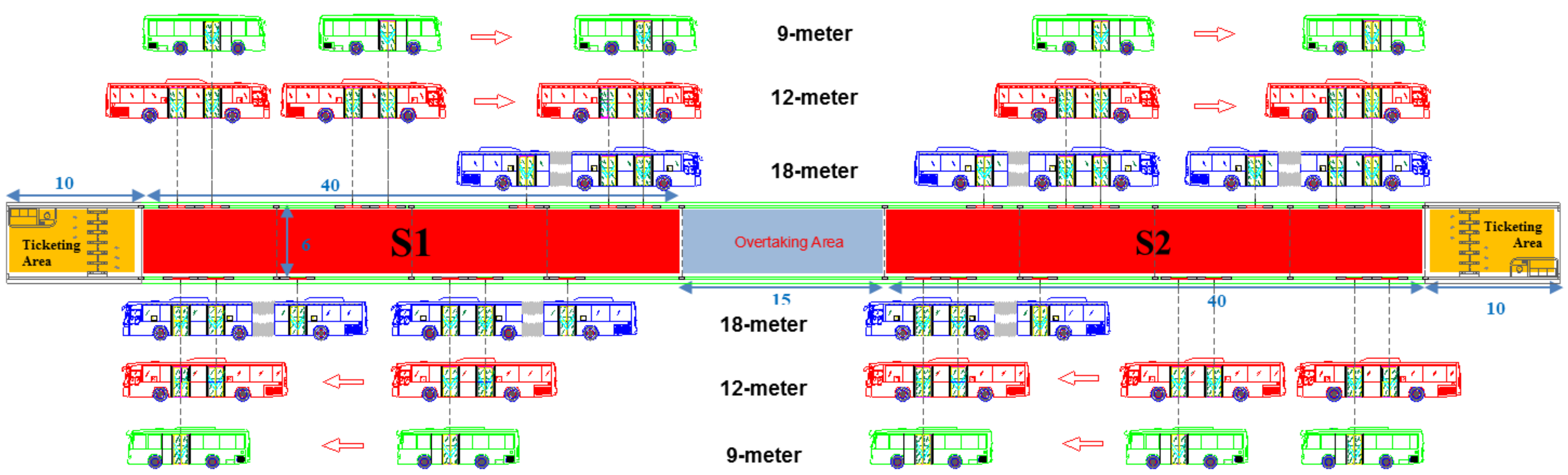

S1 Stopping Configuration

| No | Front | Rear |
|---|---|---|
| 1 | 18-m | - |
| 2 | 18-m | 12-m |
| 3 | 18-m | 9-m |
| 4 | 12-m | 12-m |
| 5 | 12-m | 9-m |
| 6 | 9-m | 12-m |
| 7 | 9-m | 9-m |

S2 Stopping Configuration

| No | Front | Rear |
|---|---|---|
| 1 | 18-m | - |
| 2 | 18-m | 12-m |
| 3 | 18-m | 9-m |
| 4 | 12-m | 12-m |
| 5 | 12-m | 9-m |
| 6 | 9-m | 12-m |
| 7 | 9-m | 9-m |

*Figure 5.4 Station Module Type 2 with 2 Sub-Stop (95 x 6 m)*




**S1 Stopping Configuration (Left Direction)**

| No | Front | Rear |
|---|---|---|
| 1 | 18-m | 18-m |
| 2 | 18-m | 12-m |
| 3 | 18-m | 9-m |
| 4 | 12-m | 18-m |
| 5 | 12-m | 12-m |
| 6 | 12-m | 9-m |
| 7 | 9-m | 18-m |
| 8 | 9-m | 12-m |
| 9 | 9-m | 9-m |

| No | Front | Middle | Rear |
|---|---|---|---|
| 1 | 18-m | 12-m | 12-m |
| 2 | 18-m | 12-m | 9-m |
| 3 | 18-m | 9-m | 12-m |
| 4 | 12-m | 12-m | 12-m |
| 5 | 12-m | 12-m | 9-m |
| 6 | 12-m | 9-m | 9-m |
| 7 | 9-m | 12-m | 12-m |
| 8 | 9-m | 12-m | 9-m |
| 9 | 9-m | 9-m | 12-m |
| 10 | 9-m | 9-m | 9-m |

*Figure 5.5 Station Module Type 3 with 2 Longer Sub-Stop (115 x 6 m)*

*Table 5.2 Station Types and Dimension*

| Station Type | No of Sub-stop | Dimension (L x W) |
|---|---|---|
| **Type 1** | 1-SS | 40m x 5m |
| **Type 2** | 1-SS | 40m x 6m |
| **Type 3** | 2-SS | 95m x 5m |
| **Type 4** | 2-SS | 95m x 6m |
| **Type 5** | 3-SS | 115m x 5m |
| **Type 6** | 3-SS | 115m x 6m |

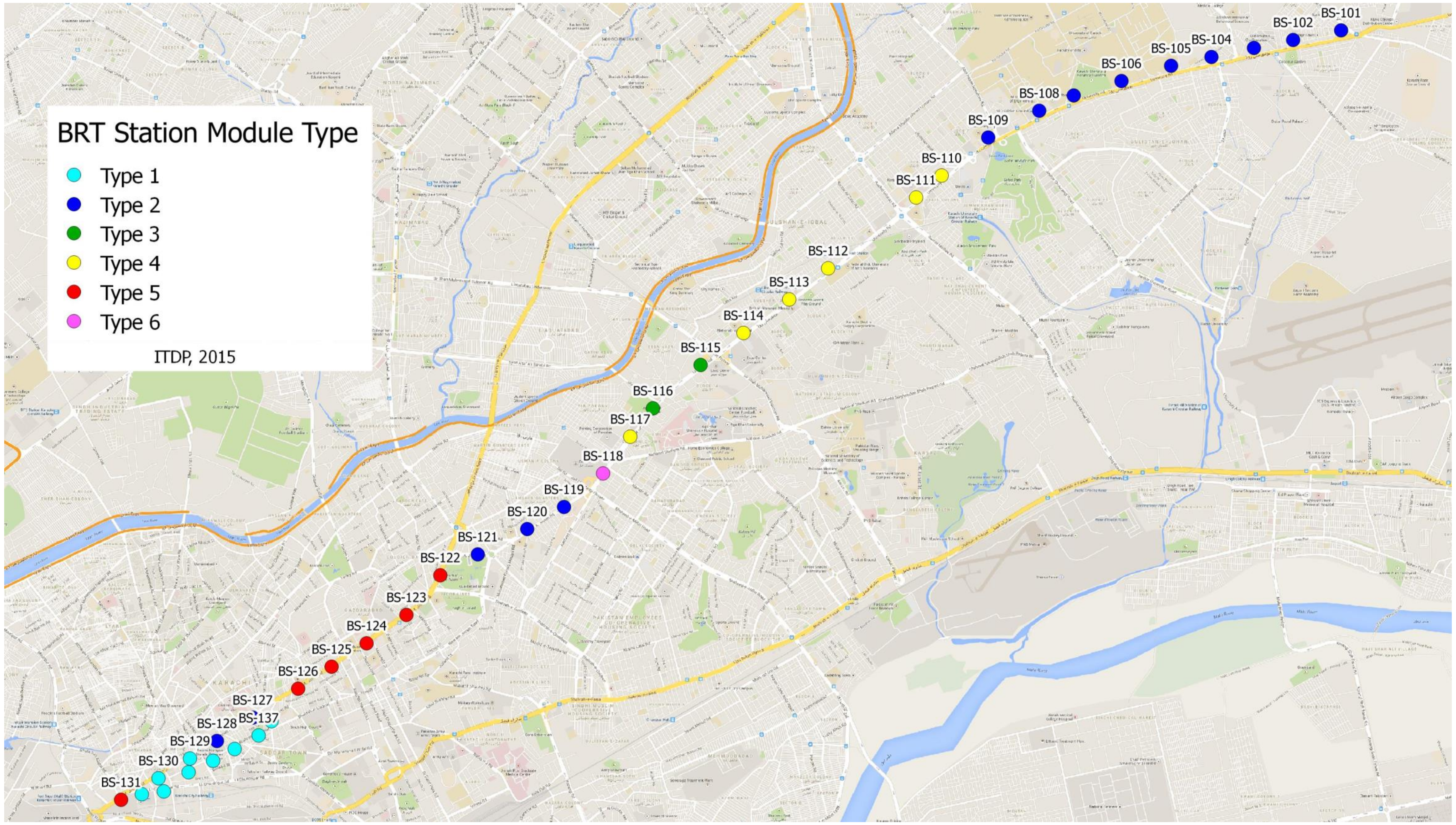



*Figure 5.6 BRT Station Length Map*

### 5.2.3 Station Details

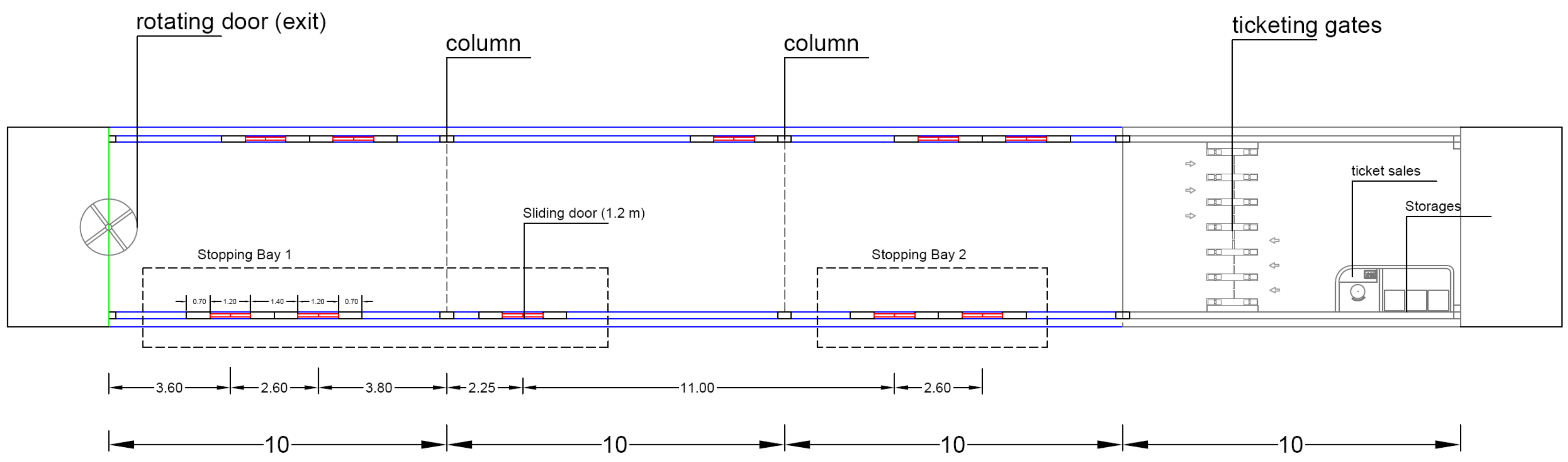
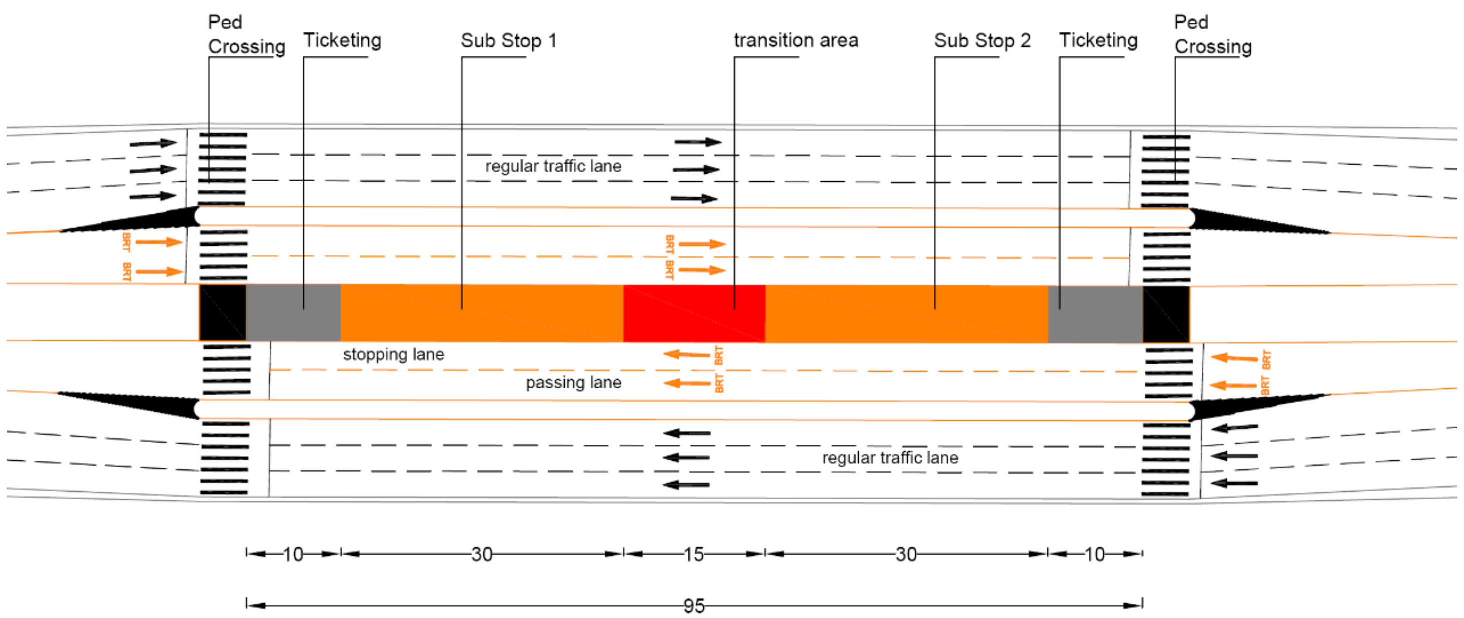



*Figure 5.7 Station Door Examples*

Detail of station with 1 sub-stop. 2 stopping bays in 1 sub-stop, with station door width of 1.2 meter, with height of 1.1 meter. Sliding doors used at the station will have housing of 70 cm each. Example of the door, as used in Guangzhou BRT is shown above. In this 1 sub-stop, all vehicles can stop at stopping bay 1, and for stopping bay 2, only 12 and 9 meter vehicles. Columns are placed between 10 meters to give clear visual from inside the station. Buses cannot overtake between stopping bays and the door allocation is provided on the first come first serve basis. Thus, the role of passenger information system to show which buses to arrive at stopping bay 1 and stopping bay 2 is important.




### 5.2.4 Passing Lanes

Passing lane is provided for station with 2 and 3 sub-stops. Passing lane is critical to increase the BRT capacity. Passing lane is provided for buses stopping on the rear sub-stop to pass buses stopping at the front sub-stop, without being delayed. Passing lane is only provided at the station since this is the location where it is needed the most. Between stations, only 1 lane is provided.

The role of passing lane at the station is much more effective than the use of bus priority signal. Many traffic engineers believe that bus priority signal is a must to ensure smooth flow of BRT at junction. This might be relevant for BRT system with 1 bus every 10 minutes. For Karachi with more than 100 buses per hour, bus priority signal will only make junction fail to work for the other traffic.

## 5.3 Architectural Design

One essential element of the modern BRT design is the station architectural design. Station is a great way to show good BRT brand, and with good BRT station design, it will attract public attention as well as attracting passengers to use the BRT. In recent years, ITDP has been promoting a station design that is distinctive and can be a signature design for cities like Guangzhou, Lanzhou, Yichang, Jakarta, Ulan Bataar, Johor Bahru, and many major cities currently implementing BRT.

For Karachi, the BRT station architectural design takes into account the local architecture and building pattern, such as dome, Islamic pattern and many more. In addition to this, climate is also an important factor to consider during the design. The architectural design of the BRT station considers the 'High-Roof' concept. This is designed not only to adjust with local building pattern, but also to allow good air circulation, especially during summer, where hot air could dissipate through the funnel placed on top of the roof.

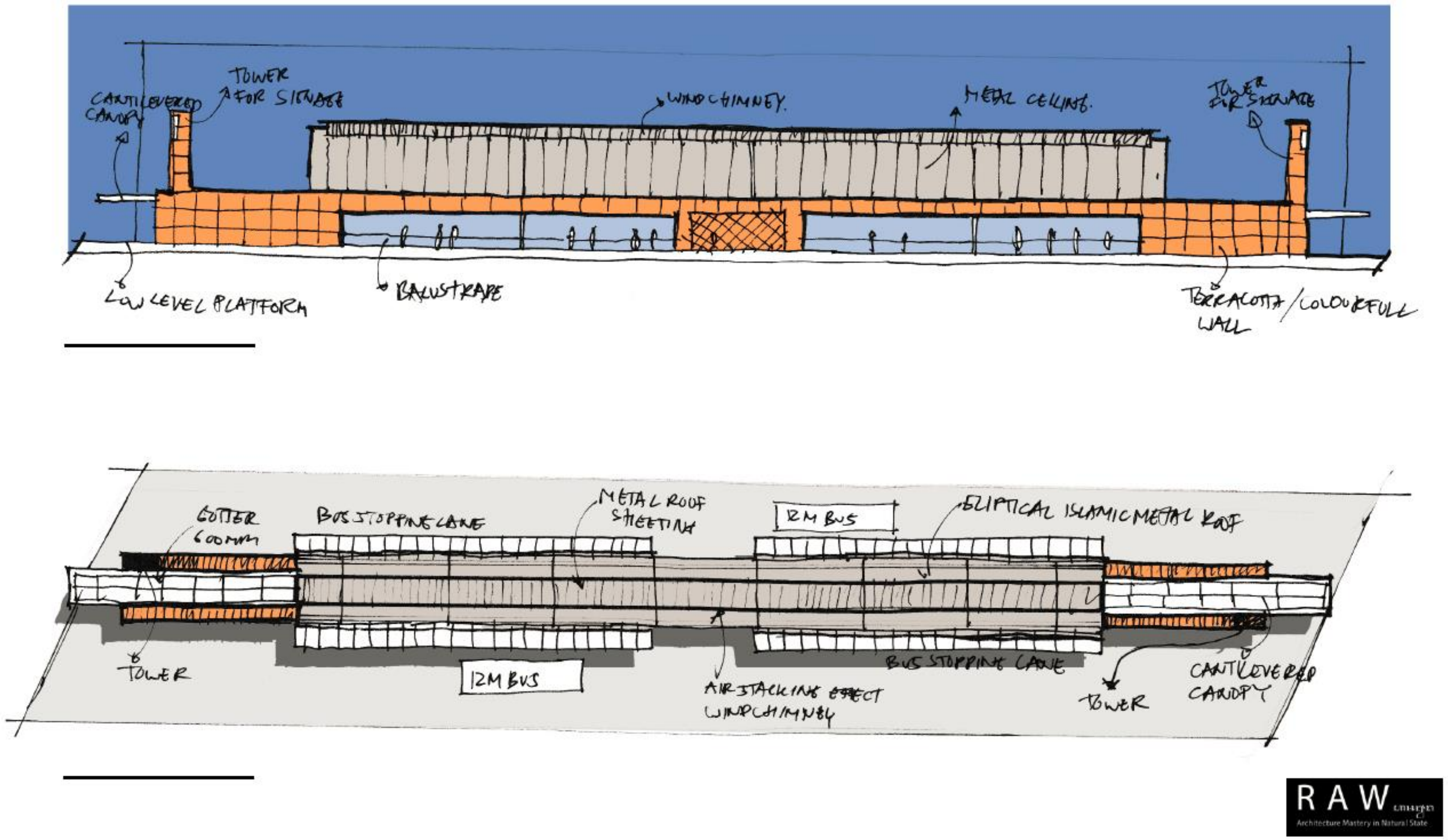



*Figure 5.10 BRT Station Layout*

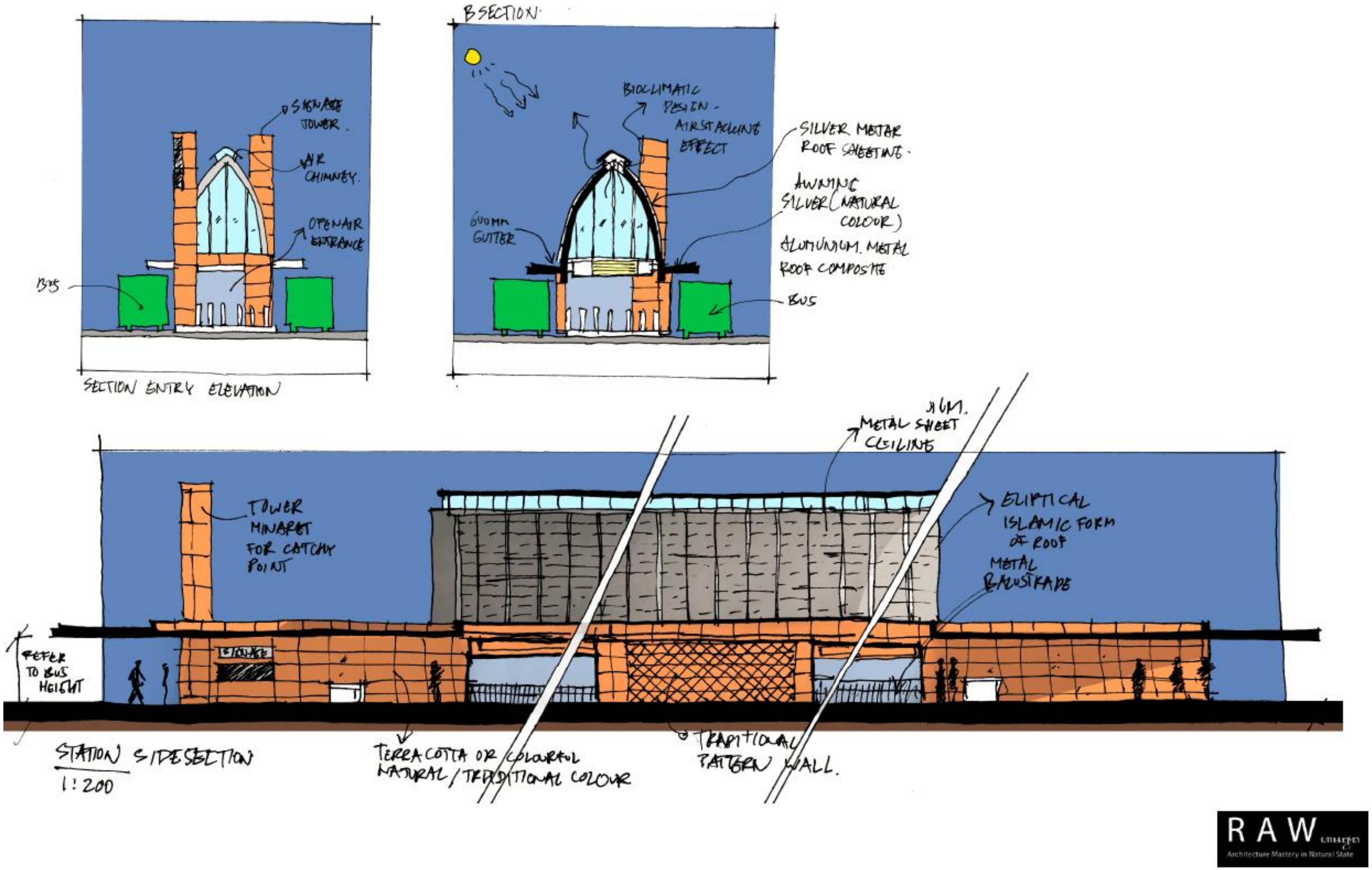
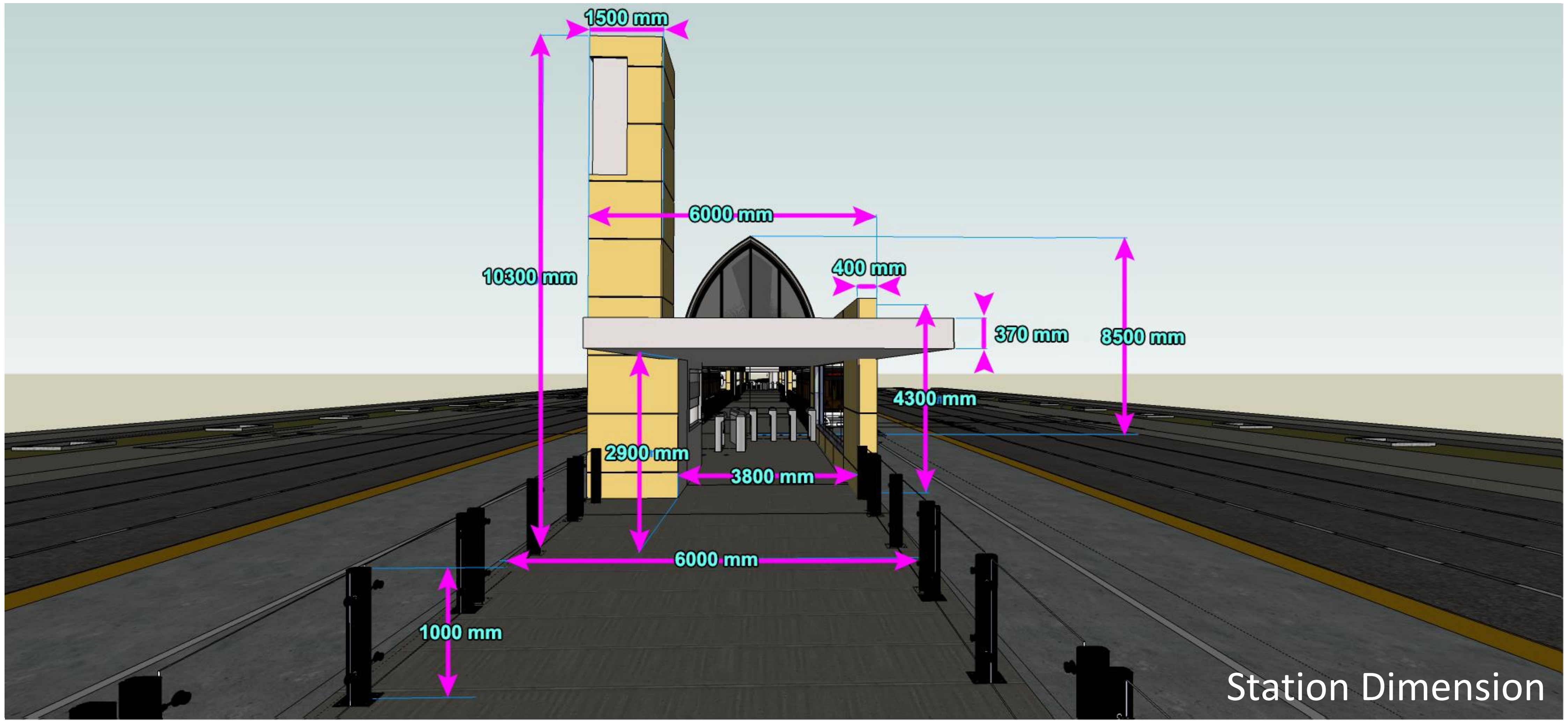



***Figure 5.11 BRT Station Cross Section***



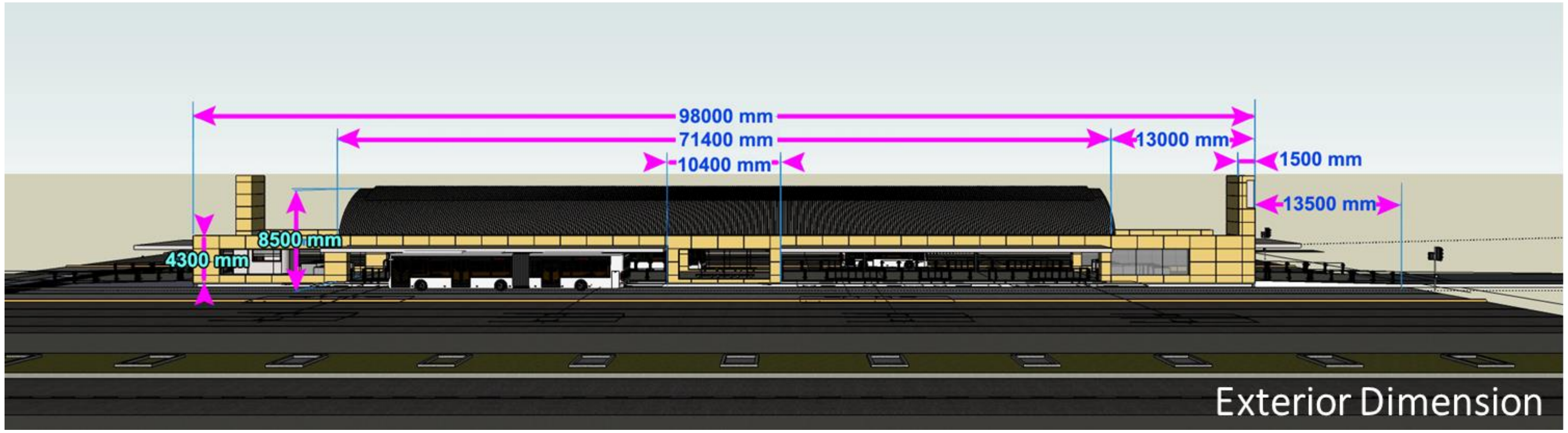
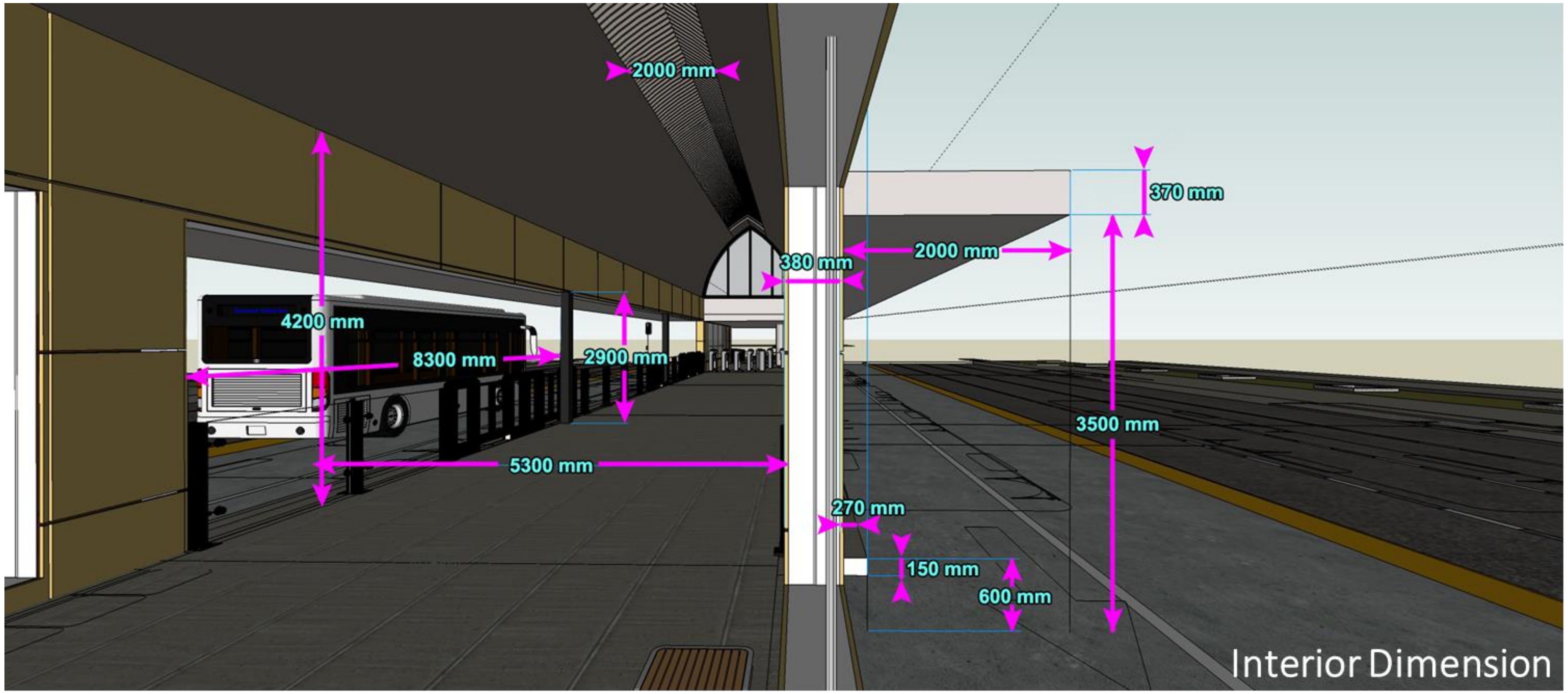




*Figure 5.12 Station Dimension*



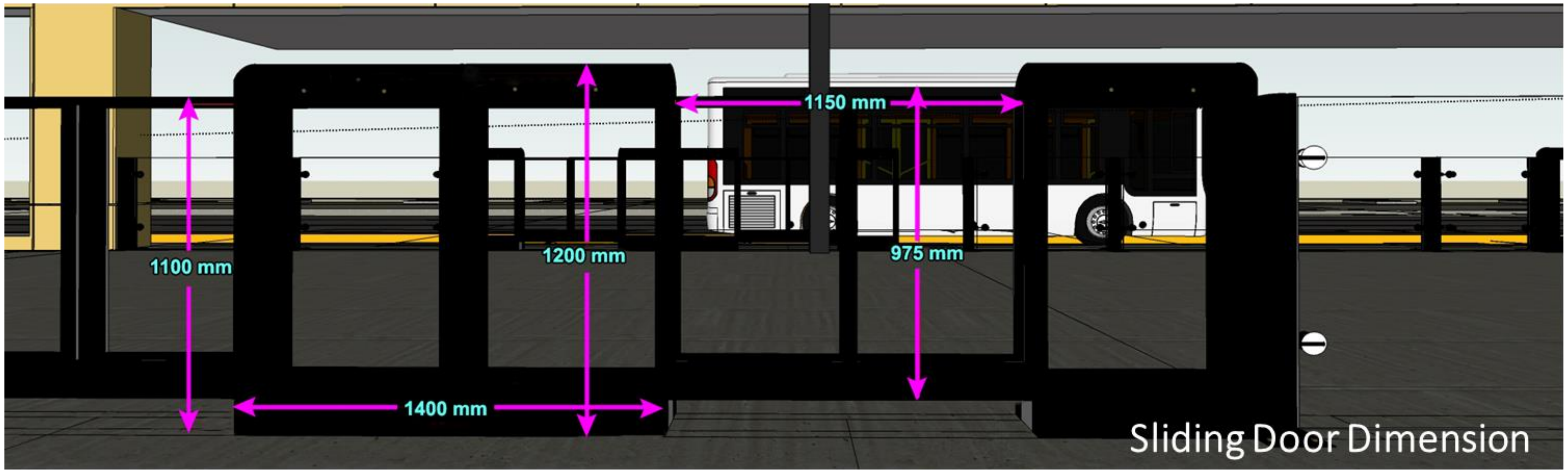




*Figure 5.13 Interior Dimension*

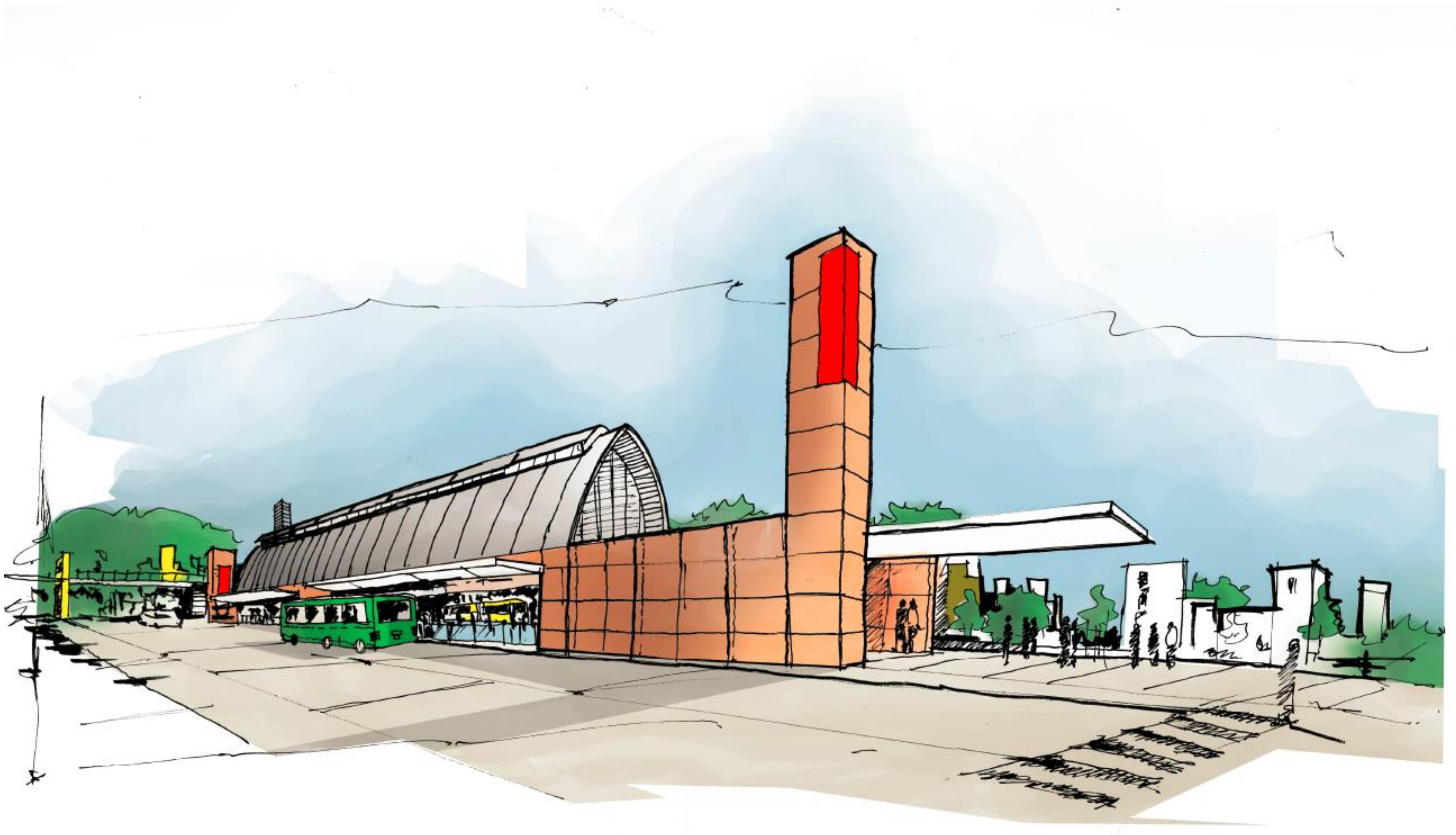


*Figure 5.14 BRT Station Perspective Rendering*


***Figure 5.15 BS 114 Existing***


*Figure 5.16 BS 114 - Karachi Expo Centre Station*

*Figure 5.17KMC Existing*


*Figure 5.18 BS 128 KMC Station*


***Figure 5.19 Denso Hall Existing***


***Figure 5.20 BS 129 Denso Hall Station***


*Figure 5.21 New Memon Masjid Existing*


*Figure 5.22 BS 130 New Memon Masjid BRT*


***Figure 5.23 Nursery Existing***


*Figure 5.24 BS 228 Nursery BRT Station*


*Figure 5.25 BRT Station Interior Design*

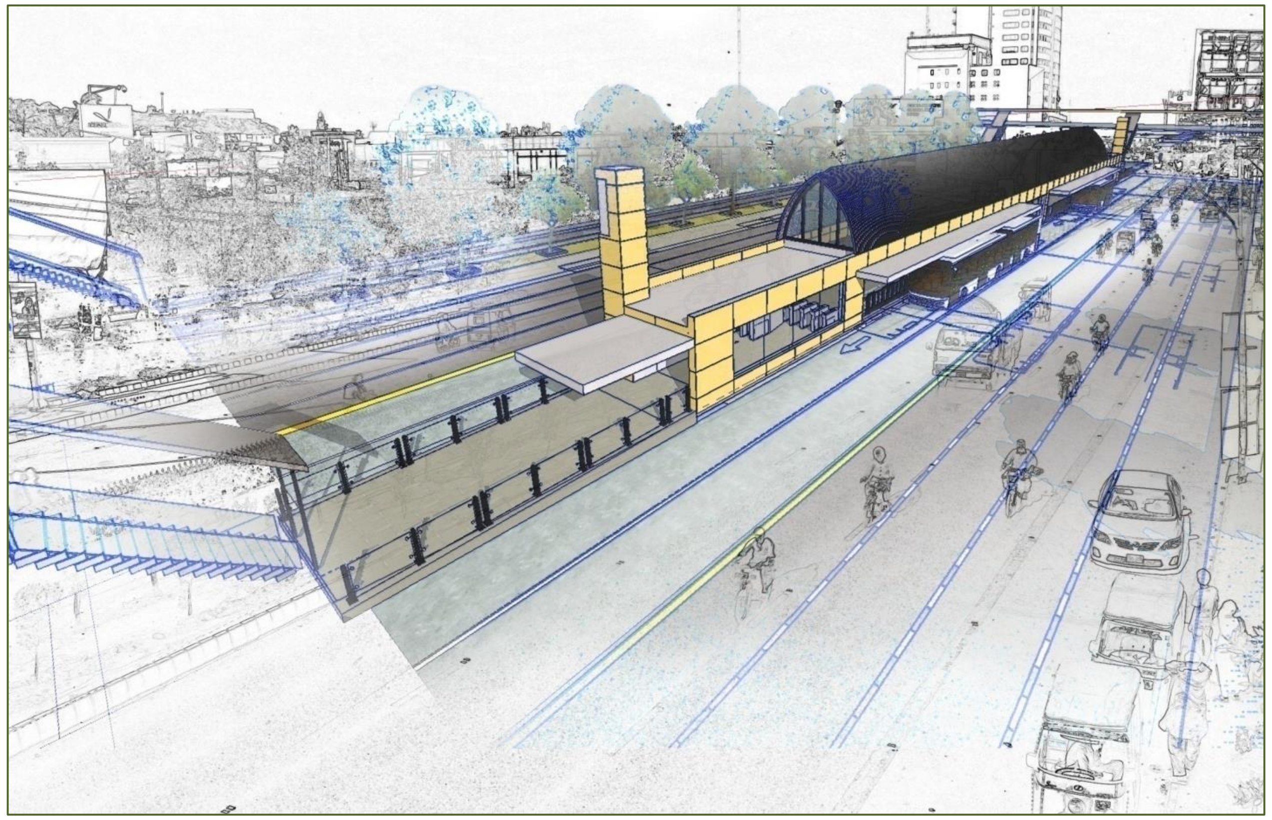


***Figure 5.26 BRT Station 3D Sketch***

## 5.4 Elevated BRT VS At-grade BRT

The BRT design proposed by ITDP in this study does not consider elevated BRT structure along red line from Safoora until Merewether Tower. The corridor will be located at-grade, with access through pedestrian bridge or at-grade crossing. However, design proposed by another consultant for Blue line BRT corridor, which will have few overlaps with the red line at MA Jinnah, suggest that elevated BRT structure to be built at MA Jinnah.

The biggest problem with elevated structure is that it makes the BRT operation not flexible. With elevated structure, only few exit and entry ramps will be provided (if any) along the corridor. 'Direct-Service' BRT operation cannot be accommodated by this type of structure. Flexibility is a key aspect in BRT operation. By having the BRT routes joining the corridor in the middle, it will capture more demand and extend the BRT route coverage.

The other issue with elevated BRT structure, especially for MA Jinnah section is that it will take up most airspace in a relatively narrow corridor at MA Jinnah. With wall-to-wall of only 20 meter wide, having elevated structure with cross section of 14 meter wide at MA Jinnah would leave the space between the elevated structure and the building window less than 3 meter each side. Noise, air pollution and visual obstruction would be few of many problems poses by people in MA Jinnah road should the elevated BRT structure is built.

***Figure 5.27 Illustration of Elevated Structure at MA Jinnah***

# 6 Station Design

## 6.1 Station Location

There are 38 BRT stations on the main BRT corridor from Safoora to Tower, and 5 stations on the extension branch at Shahrah e Quaideen. Most stations serve for both directions, and several stations at MA Jinnah and Shahrah e Liquat only serve one direction.

***Table 6.1 BRT Station List***

| Station Code | Station Name |
|---|---|
| 101 | SAFOORA |
| 102 | BLOCK 7 |
| 103 | SHUMAIL COMPLEX |
| 104 | MOSAMYAT WESTBOUND |
| 105 | SHEIKH ZAYED ISLAMIC CENTER |
| 106 | BLOCK 1 |
| 107 | UNIVERSITY OF KARACHI |
| 108 | NED |
| 109 | SAFARI PARK |
| 110 | FATMA CHARITABLE AND MATERNITY HOME |
| 111 | NIPA |
| 112 | URDU COLLEGE |
| 113 | FUTURE PARK |
| 114 | KARACHI EXPO CENTER |
| 115 | CIVIC CENTER |
| 116 | DARUL ULOOM GHOSIA TRUST |
| 117 | PIB COLONY |
| 118 | CENTRAL JAIL |
| 119 | MIR USMAN PARK |
| 120 | DAWOOD UNIV OF ENGINEERING AND TECHNOLOGY |
| 121 | NORTH MAZAR E QUAID |
| 122 | WAZIR OTC HOSPITAL |
| 123 | DAEWOO CITY TERMINAL |
| 124 | PRINCE CINEMA |
| 125 | RIMPA PLAZA |
| 126 | NJV SCHOOL |
| 127 | THE GHULAM HUSSAIN KHALIQ DINA LIBRARY |
| 128 | KMC (Karachi Municipal Corporation) |
| 129 | DENSO HALL |
| 130 | NEW MEMON MASJID |
| 131 | TOWER |
| 132 | STATE BANK OF PAKISTAN |
| 133 | SINDH POLICE HEADQUARTERS |
| 134 | SINDH MUSLIM SCIENCE COLLEGE |
| 135 | FAKHRI TRADE CENTER |
| 136 | HEMANI CENTER |
| 137 | ARAM BAGH |
| 138 | METROPOLIS SECONDARY SCHOOL |
| **Shahrah e Quaideen Branch** | |
| **Station Code** | **Station Name** |
| 229 | SIRAJ |
| 230 | ALLAH WALI |
| 231 | SOCIETY OFFICE |
| 232 | KHUDADABAD COLONY |
| 233 | MAZAR E QUAID |

### 6.1.1 BS101 – BS103

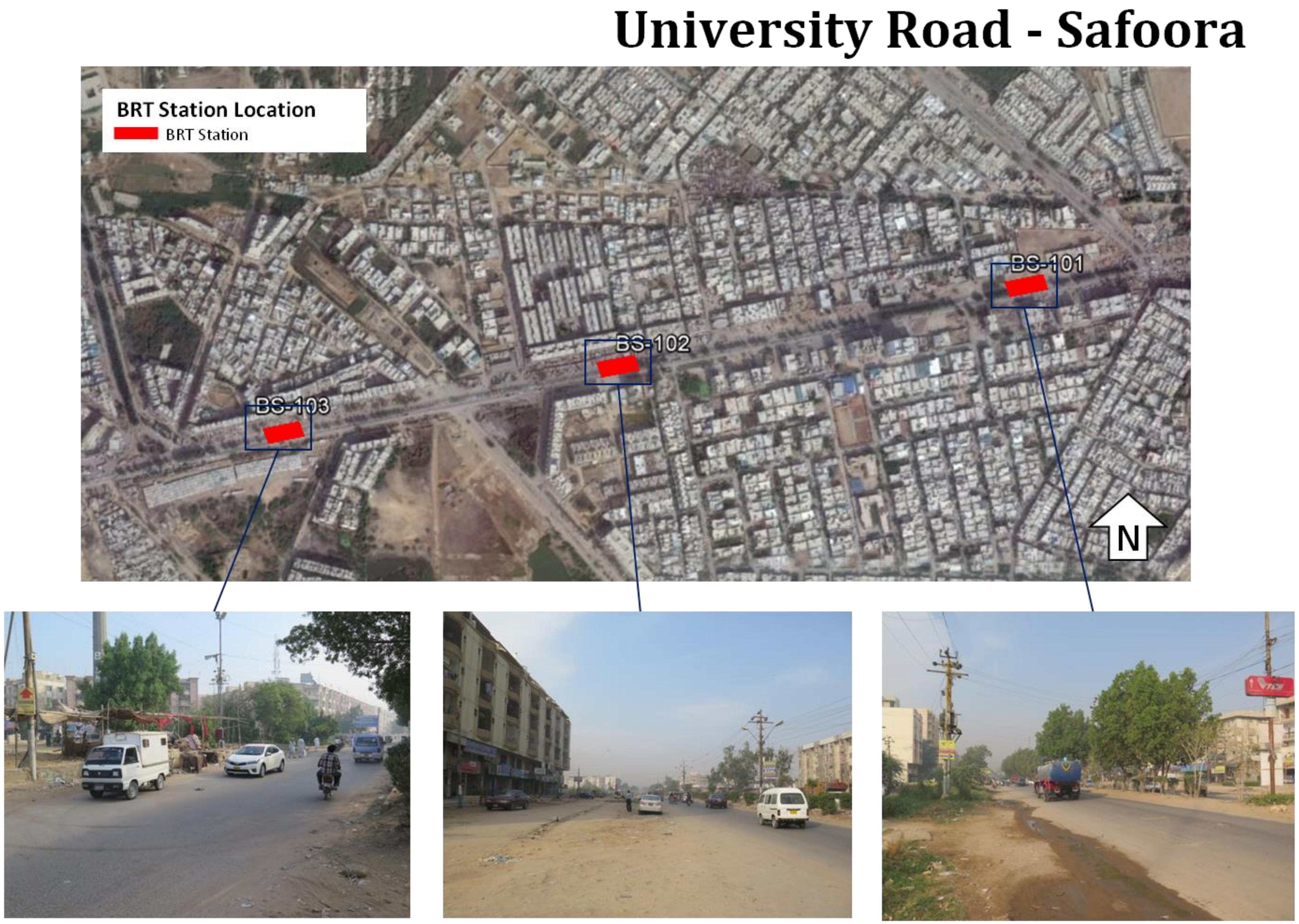



*Figure 6.1 Location of BRT Station 101 to 103*

### 6.1.2 BS104 – BS107


*Figure 6.2 Location of BRT Station 104 to 107*

### 6.1.3 BS108 – BS111


*Figure 6.3 Location of BRT Station 108 to 111*

### 6.1.4 BS112 – BS115


*Figure 6.4 Location of BRT Station 112 to 115*

### 6.1.5 BS116 – BS119

# University Road – Civic Center / Jail Chowrangi

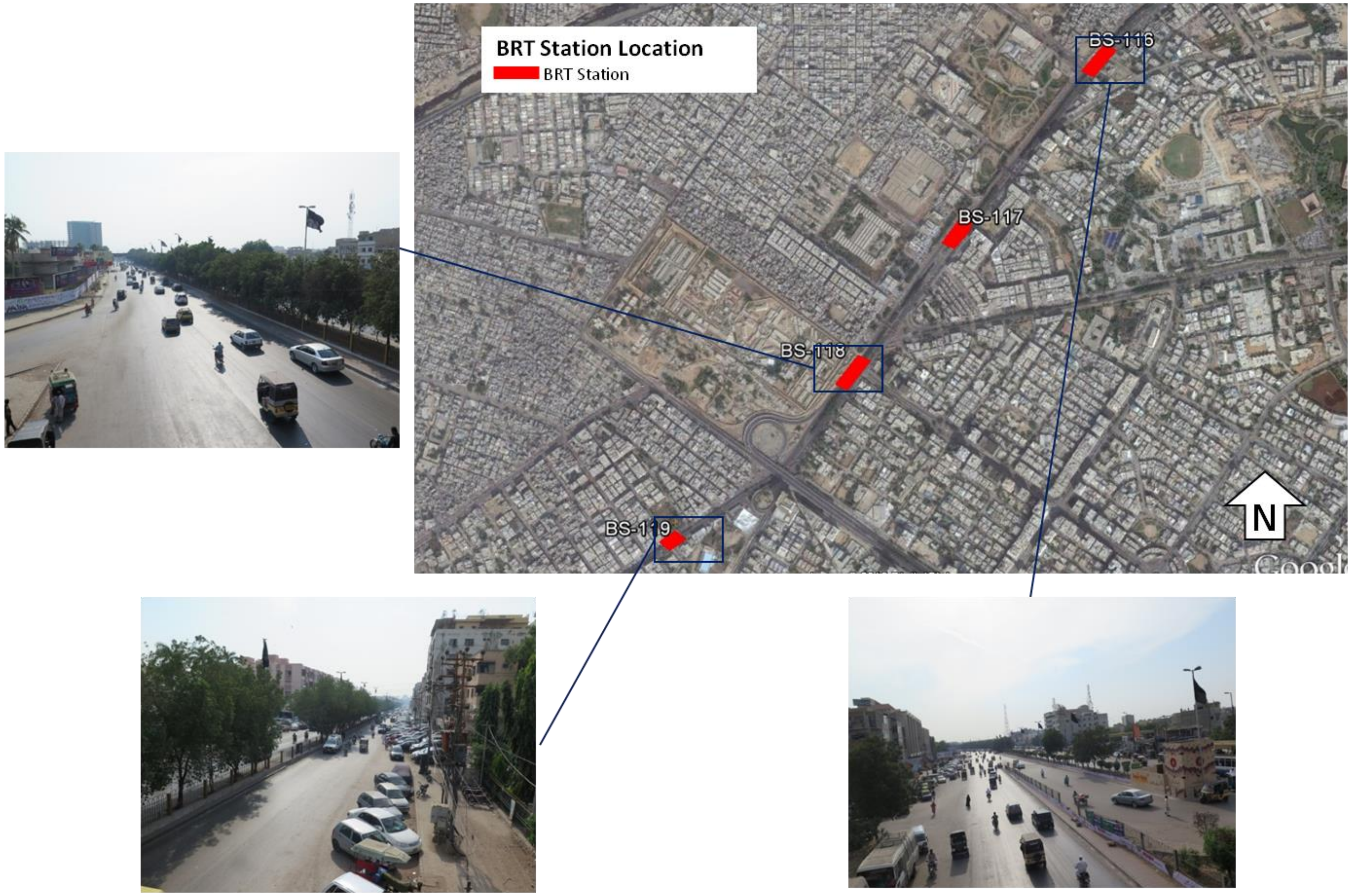



*Figure 6.5 Location of BRT Station 116 to 119*

### 6.1.6 BS120 – BS123

## New MA. Jinnah Road – M.A Jinnah

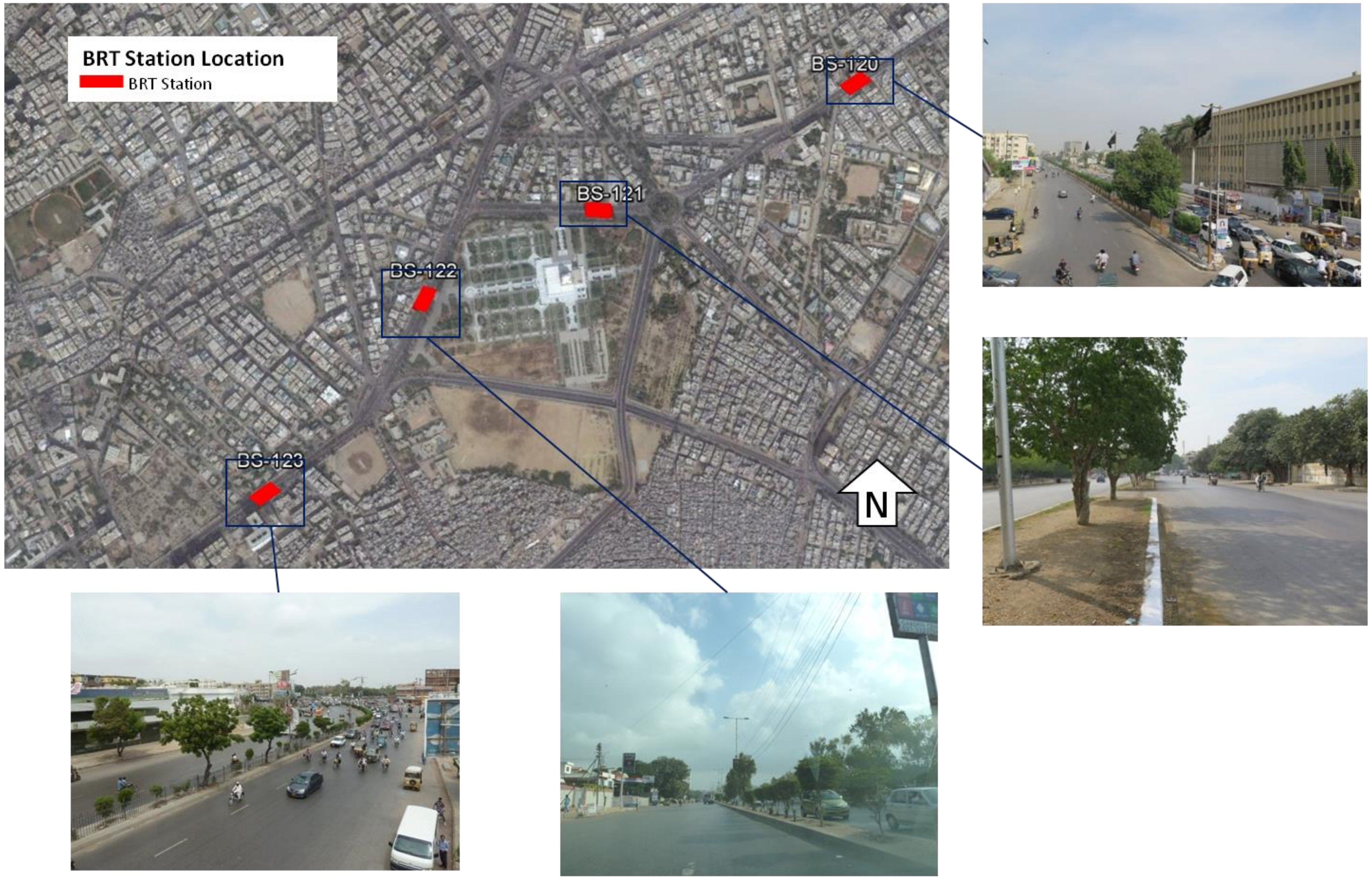



*Figure 6.6 Location of BRT Station 120 to 123*

### 6.1.7 BS124 – BS126

## MA. Jinnah Road – Numaish Chowrangi


*Figure 6.7 Location of BRT Station 124 to 126*

### 6.1.8 BS127 – BS128 & BS135-BS138

## MA. Jinnah Road – Shahrah e Liaquat


*Figure 6.8 Location of BRT Station 127 to 128 and 135 to 138*

### 6.1.9 BS129 – BS134

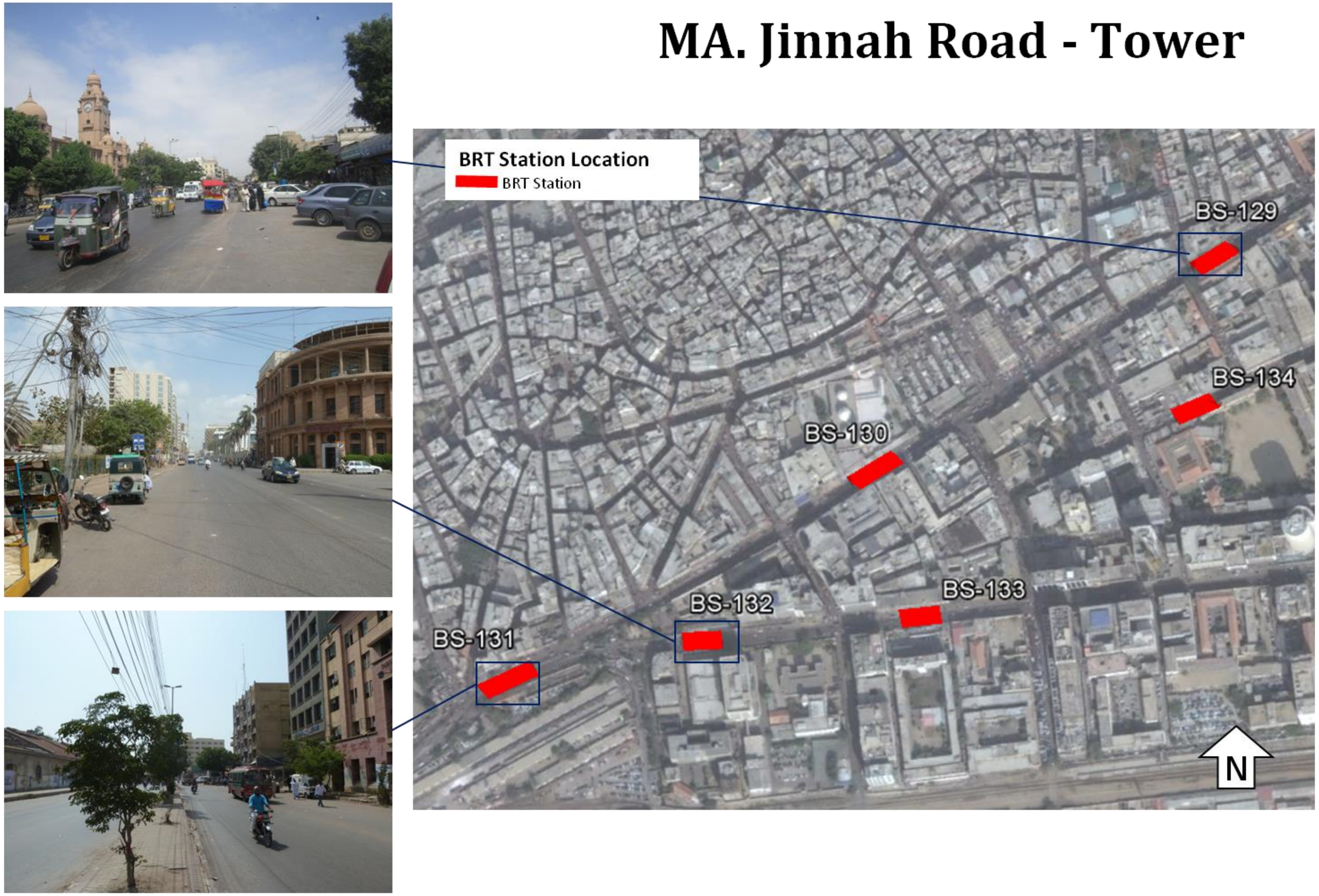



*Figure 6.9 Location of BRT Station 129 to 134*

### 6.1.10 BS229 – BS233

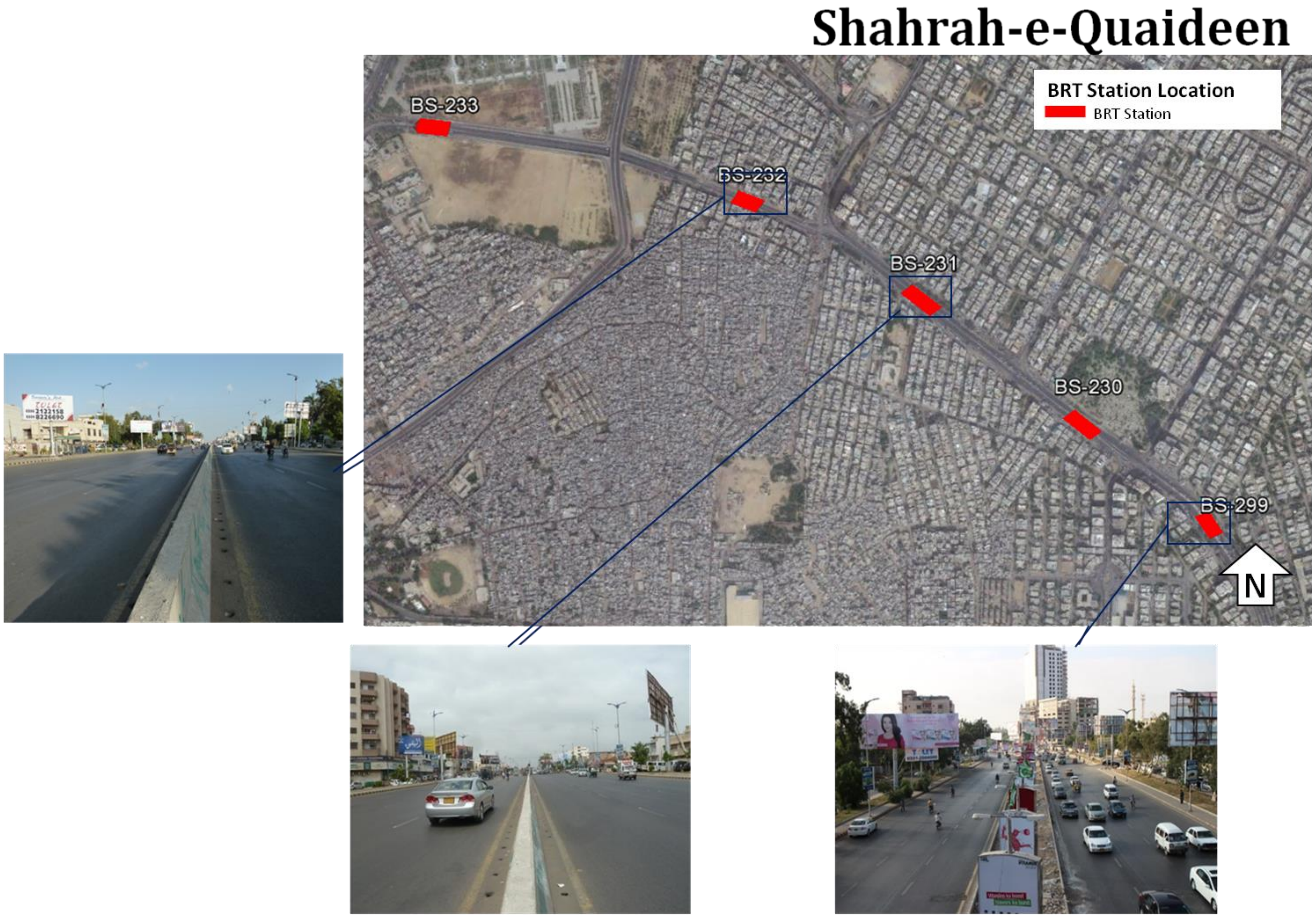



*Figure 6.10 Location of BRT Station 229 to 233*

## 6.2 Road Cross Section

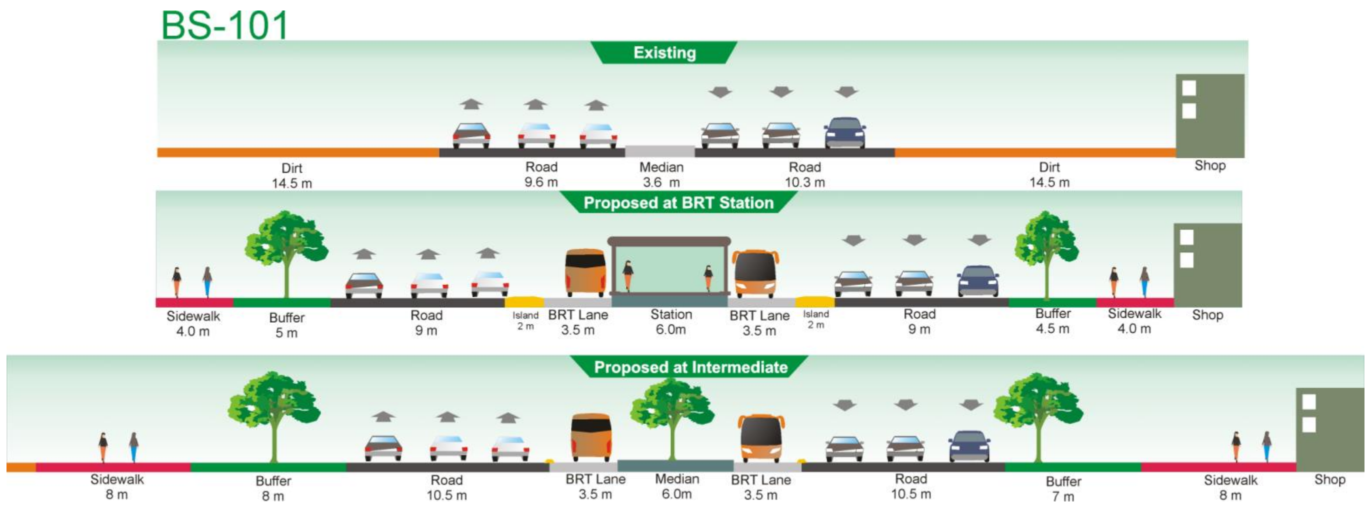



*Figure 6.11 BS 101 Cross Section*

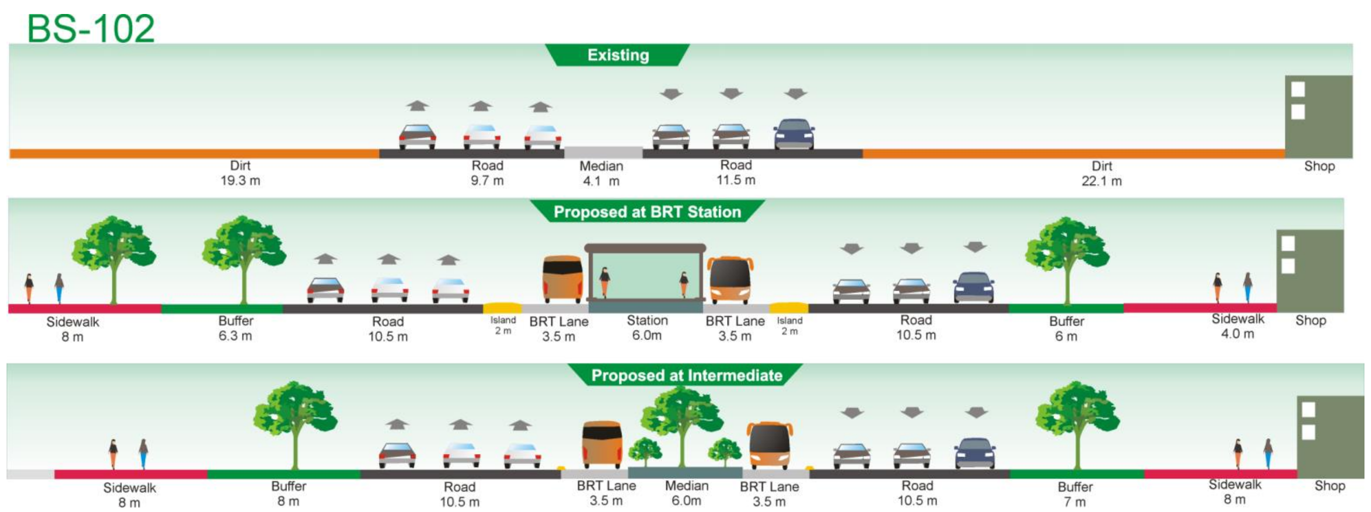



*Figure 6.12 BS 102 Cross Section*

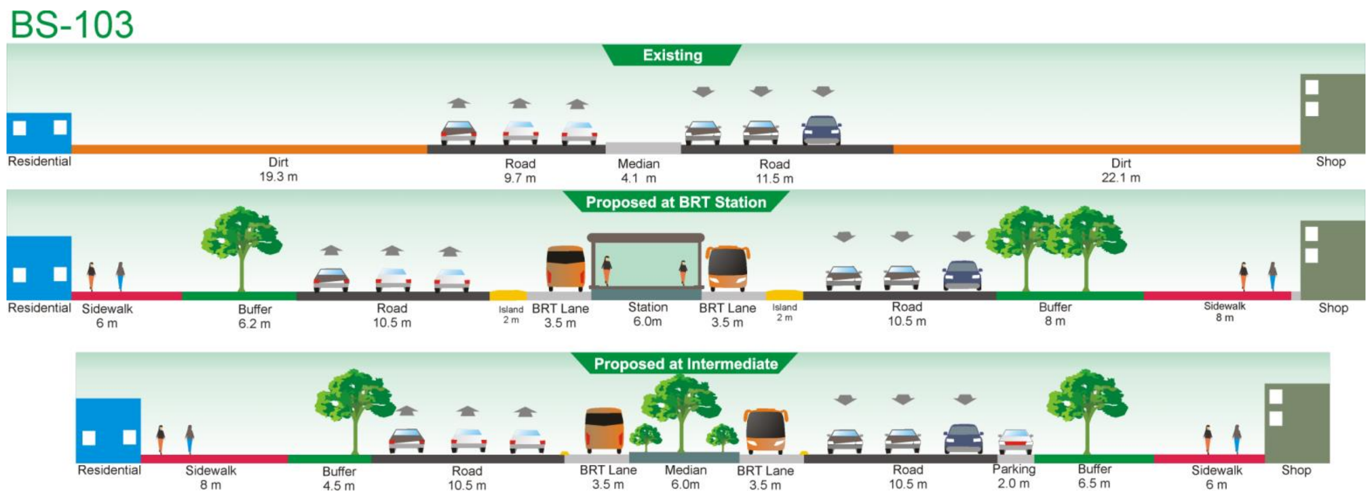



*Figure 6.13 BS 103 Cross Section*

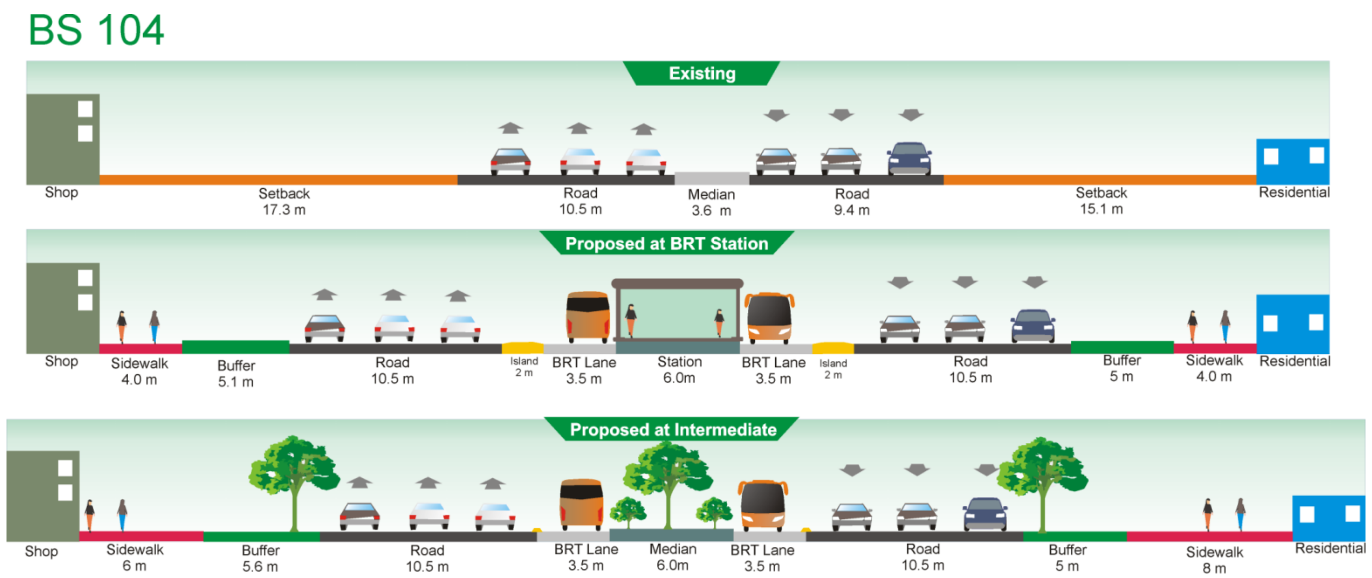



*Figure 6.14 BS 104 Cross Section*

## BS 105

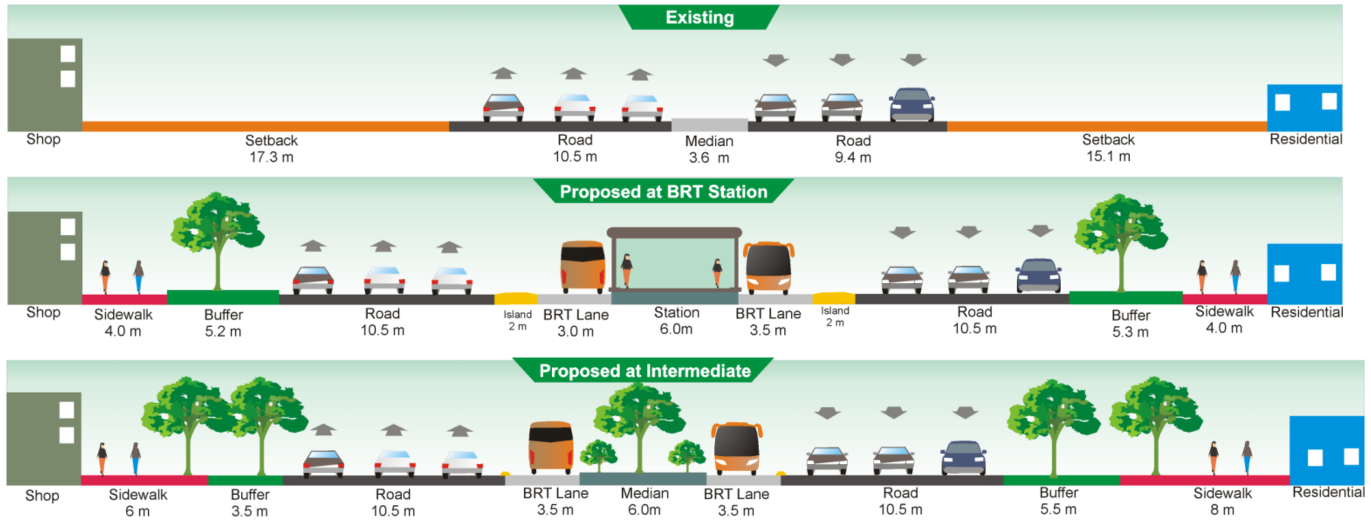



*Figure 6.15 BS 105 Cross Section*

## BS 107

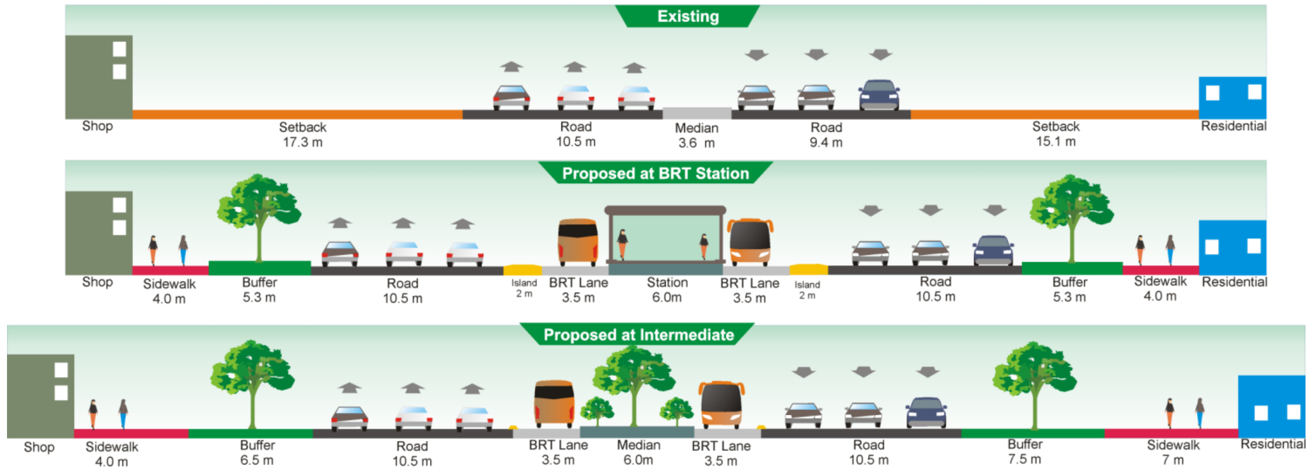



*Figure 6.17 BS 107 Cross Section*

## BS 106

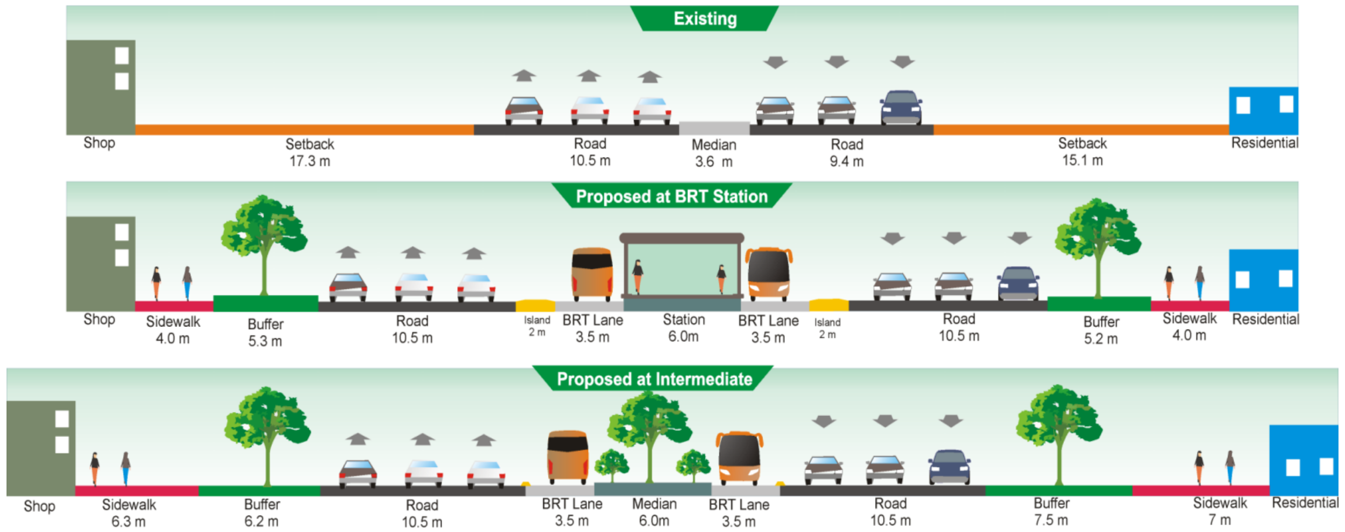



*Figure 6.16 BS 106 Cross Section*

## BS-108

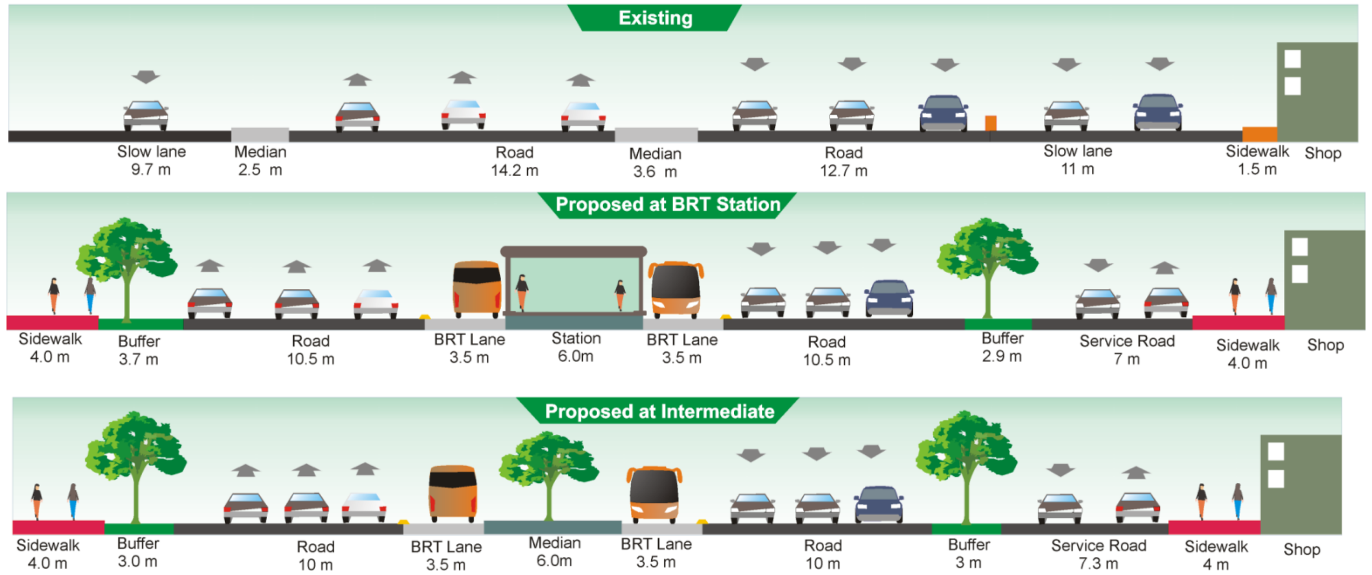



*Figure 6.18 BS 108 Cross Section*

## BS-109

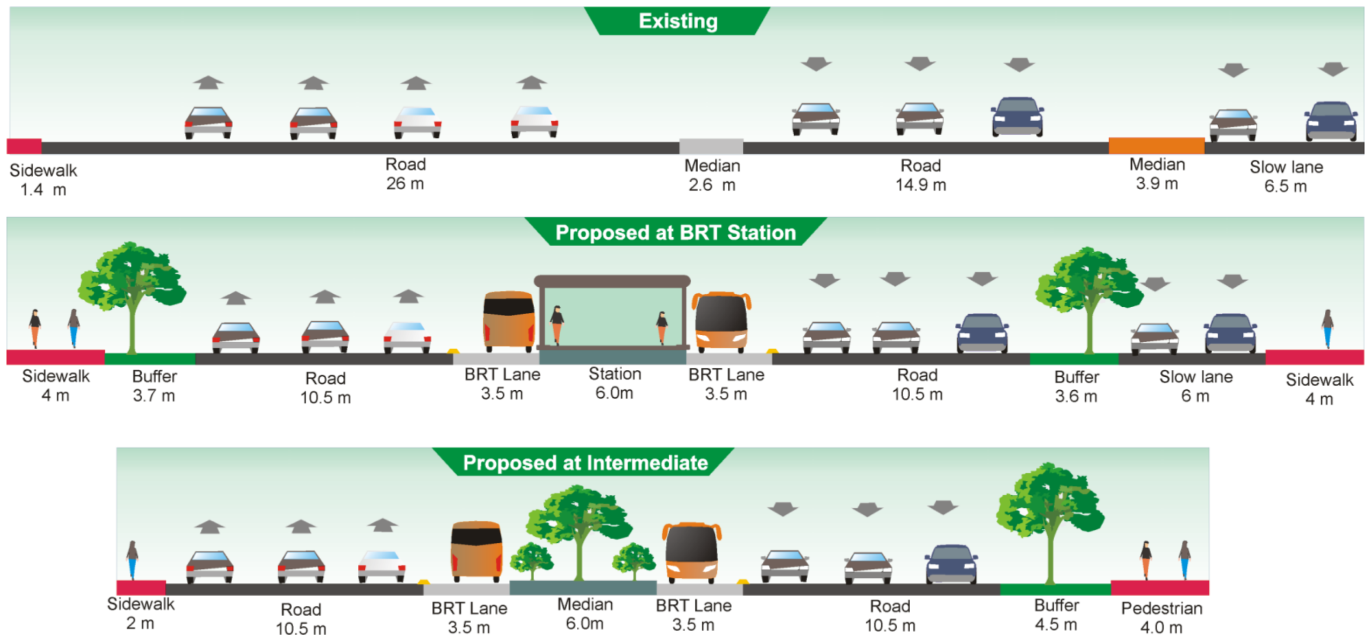



*Figure 6.19 BS 109 Cross Section*

## BS-110

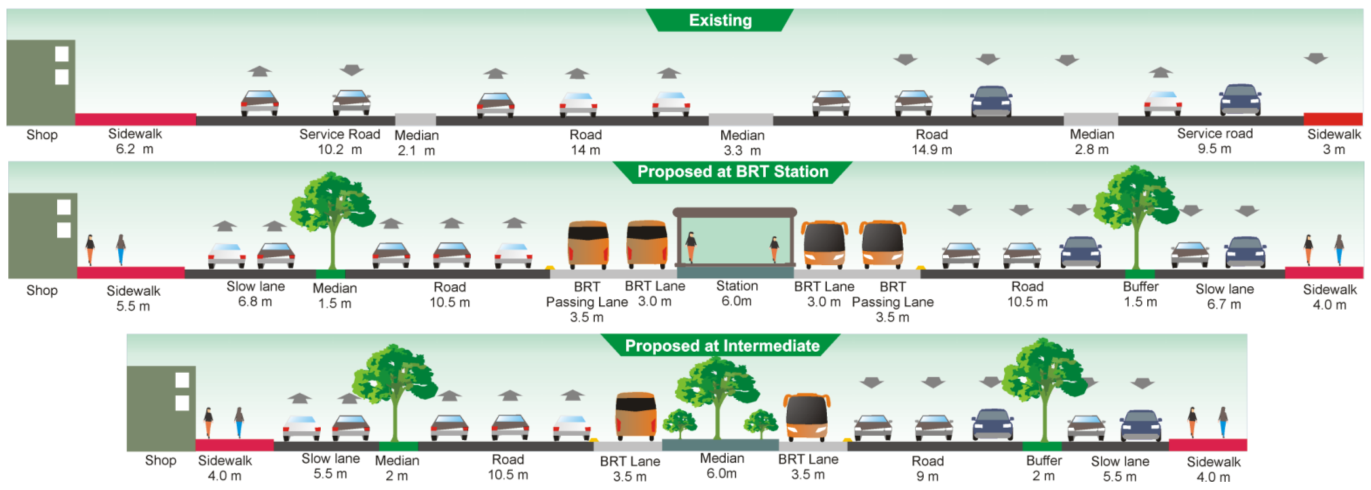



*Figure 6.20 BS 110 Cross Section*

## BS-111

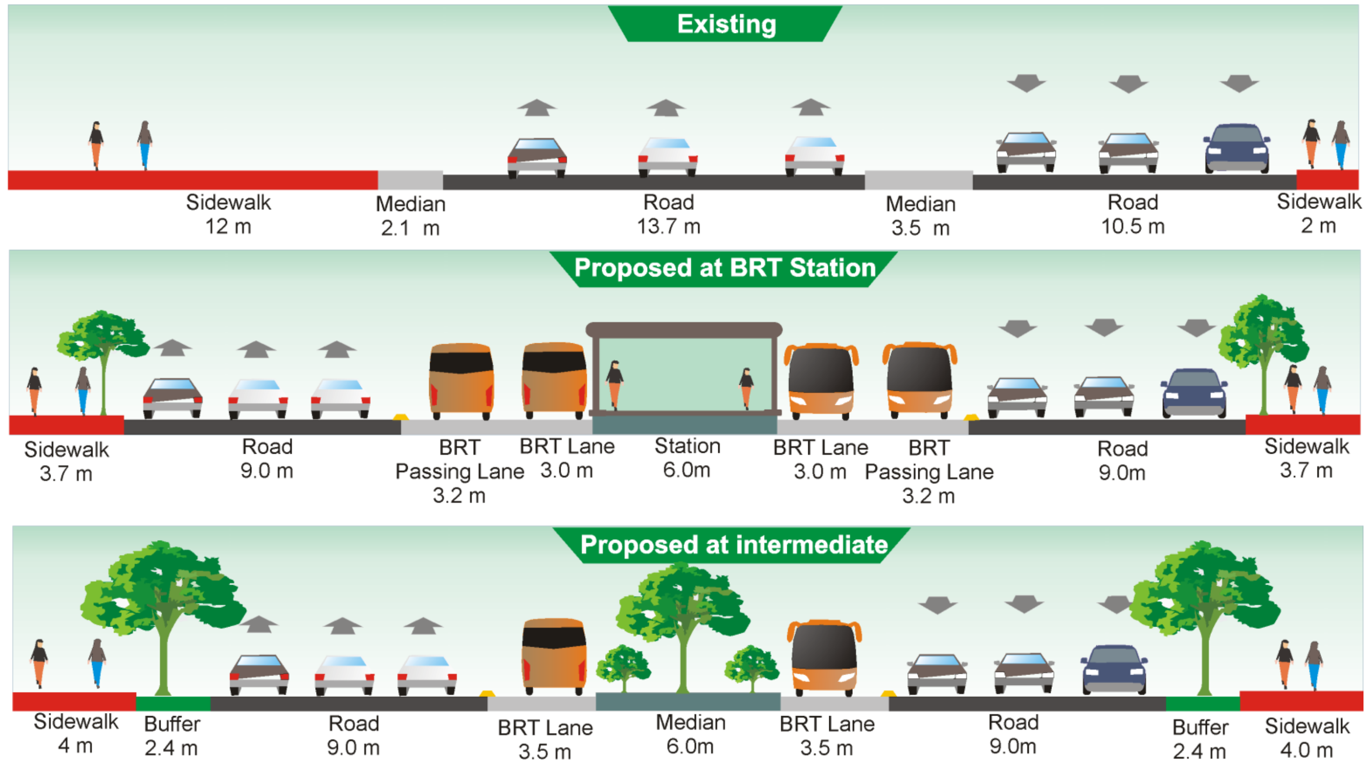



*Figure 6.21 BS 111 Cross Section*

## BS-112

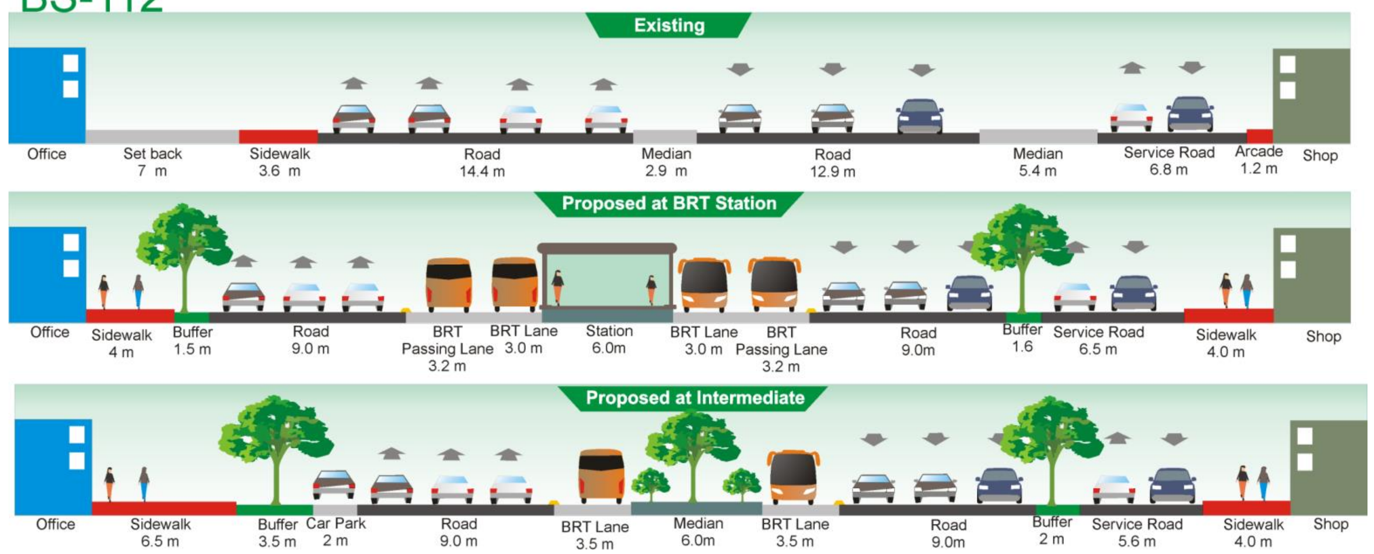



*Figure 6.22 BS 112 Cross Section*

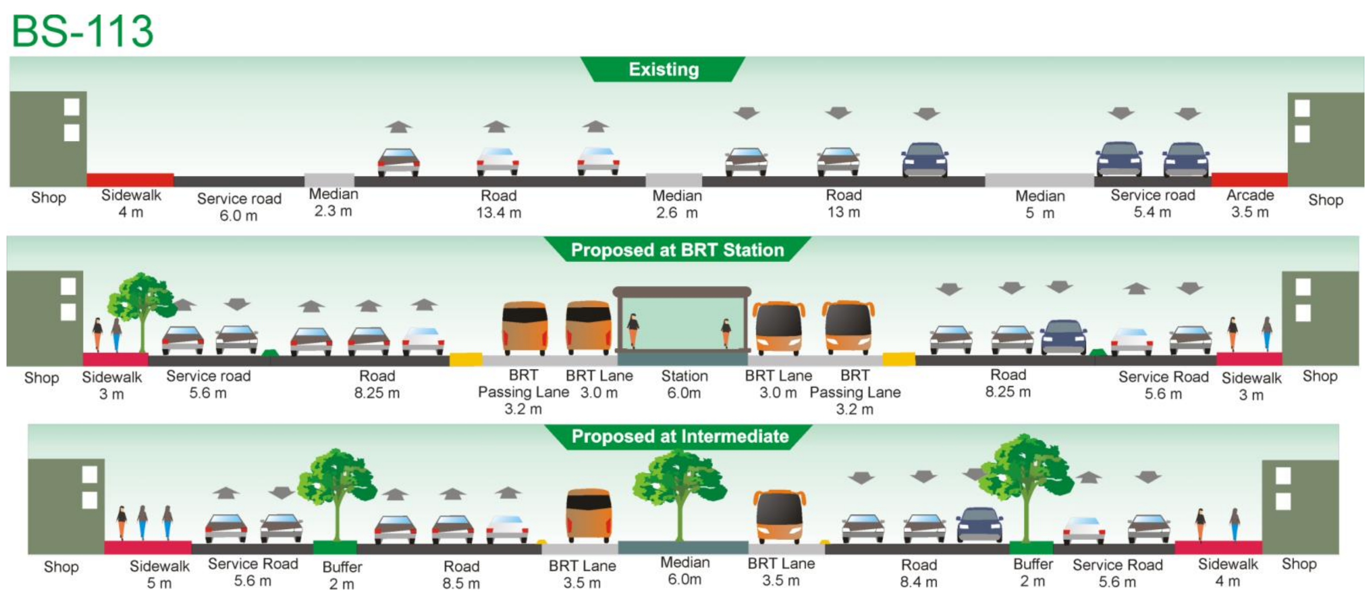



*Figure 6.23 BS 113 Cross Section*

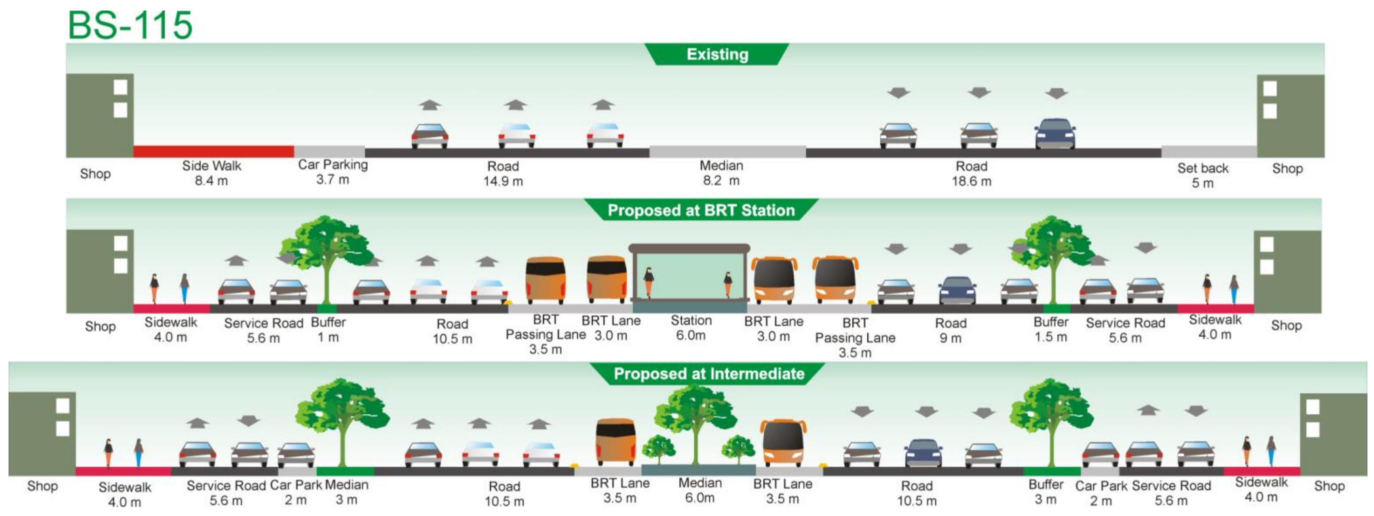



*Figure 6.25 BS 115 Cross Section*

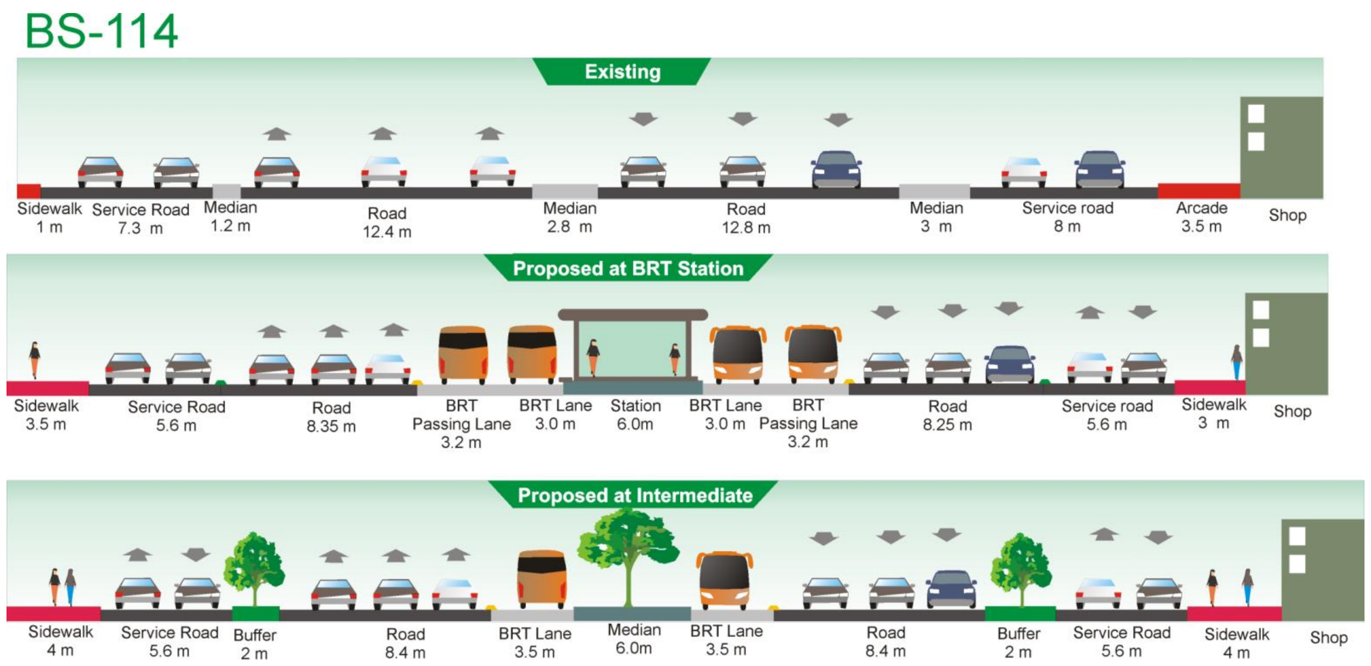



*Figure 6.24 BS 114 Cross Section*

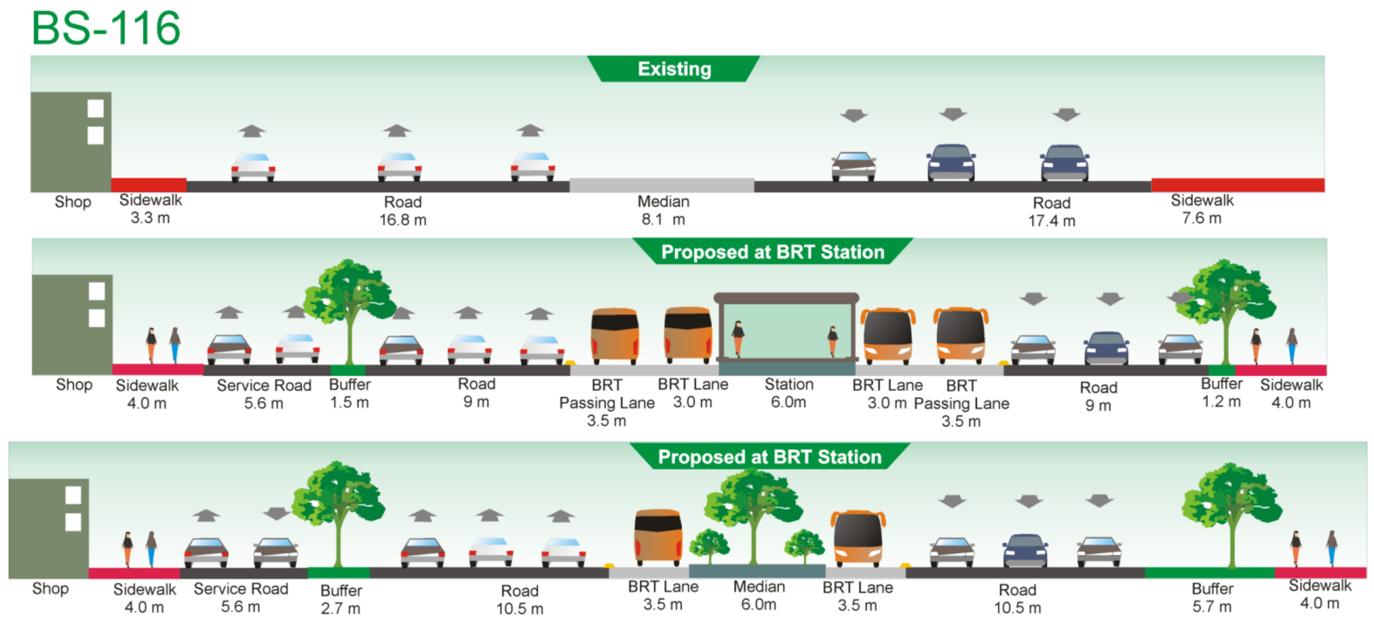



*Figure 6.26 BS 116 Cross Section*

## BS 117

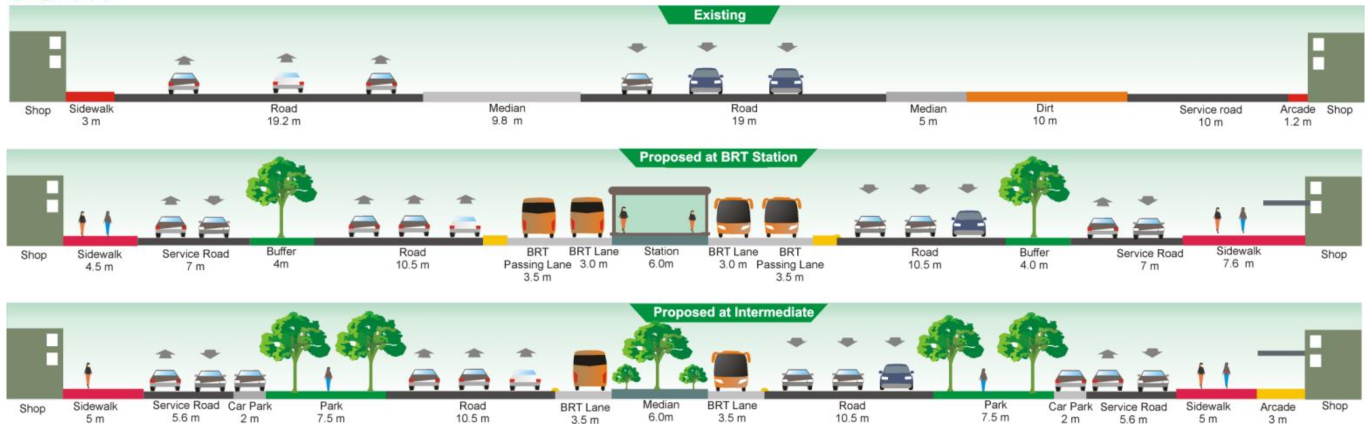



*Figure 6.27 BS 117 Cross Section*

## BS-119

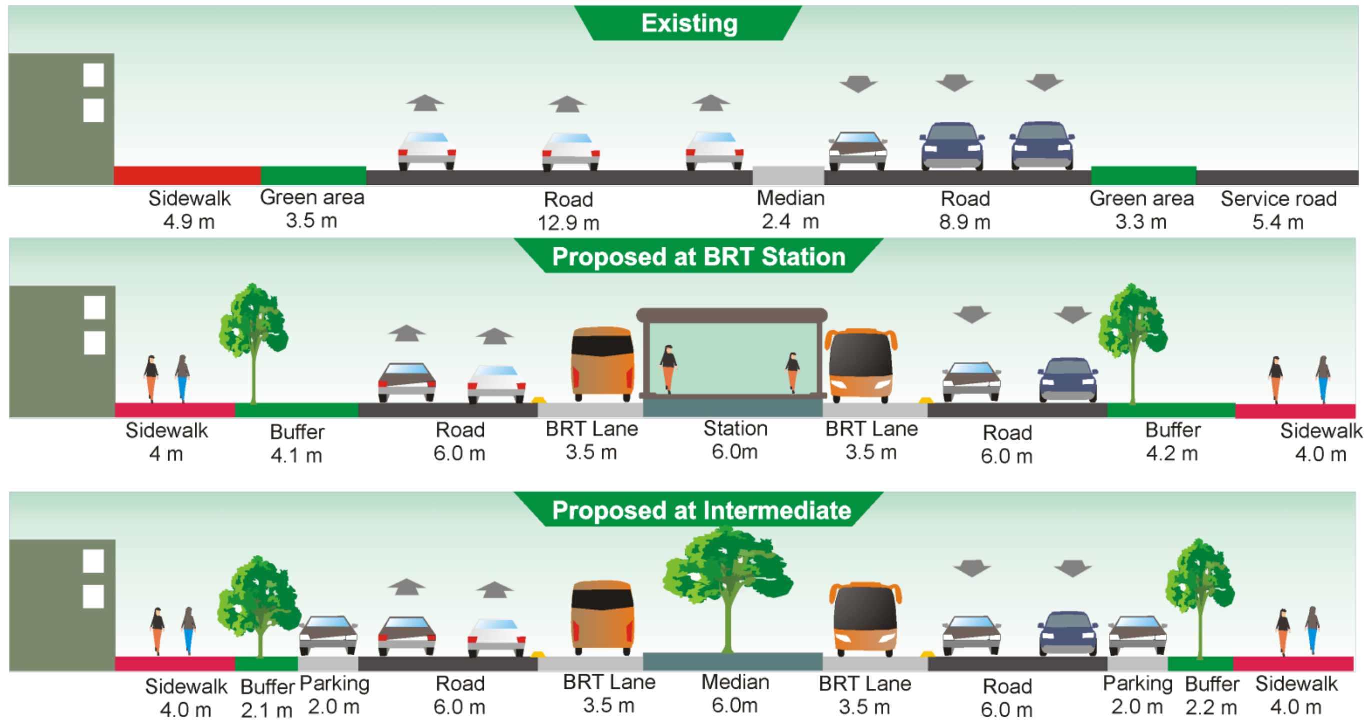



*Figure 6.29 BS 119 Cross Section*

## BS 118

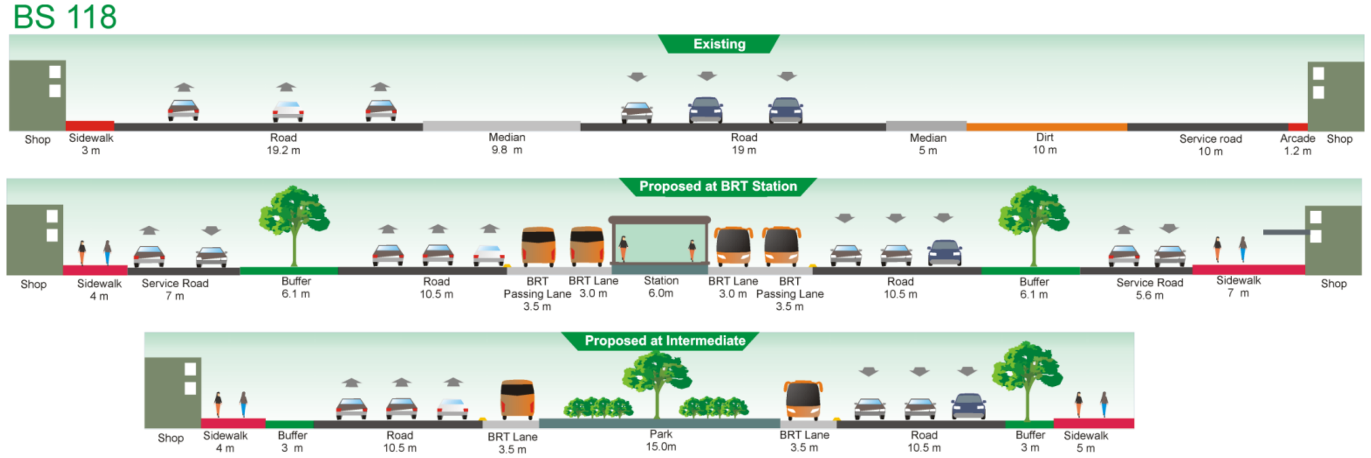



*Figure 6.28 BS 118 Cross Section*

## BS-120

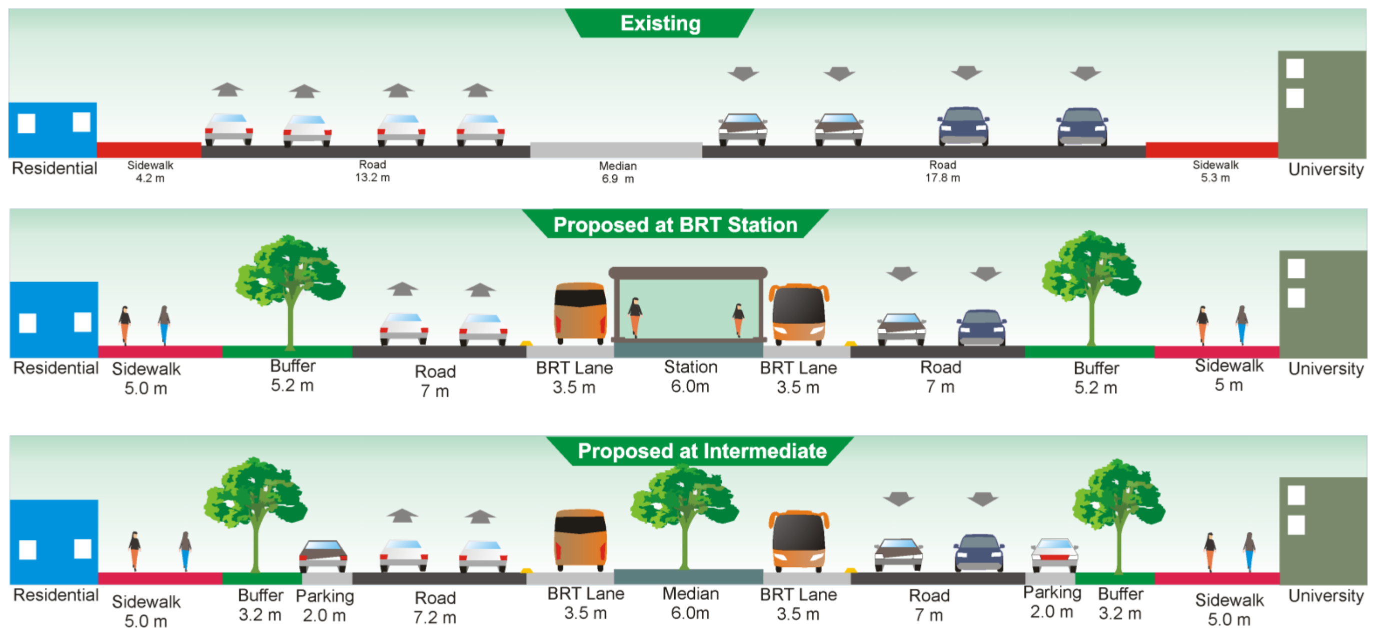



*Figure 6.30 BS 120 Cross Section*

## BS-121

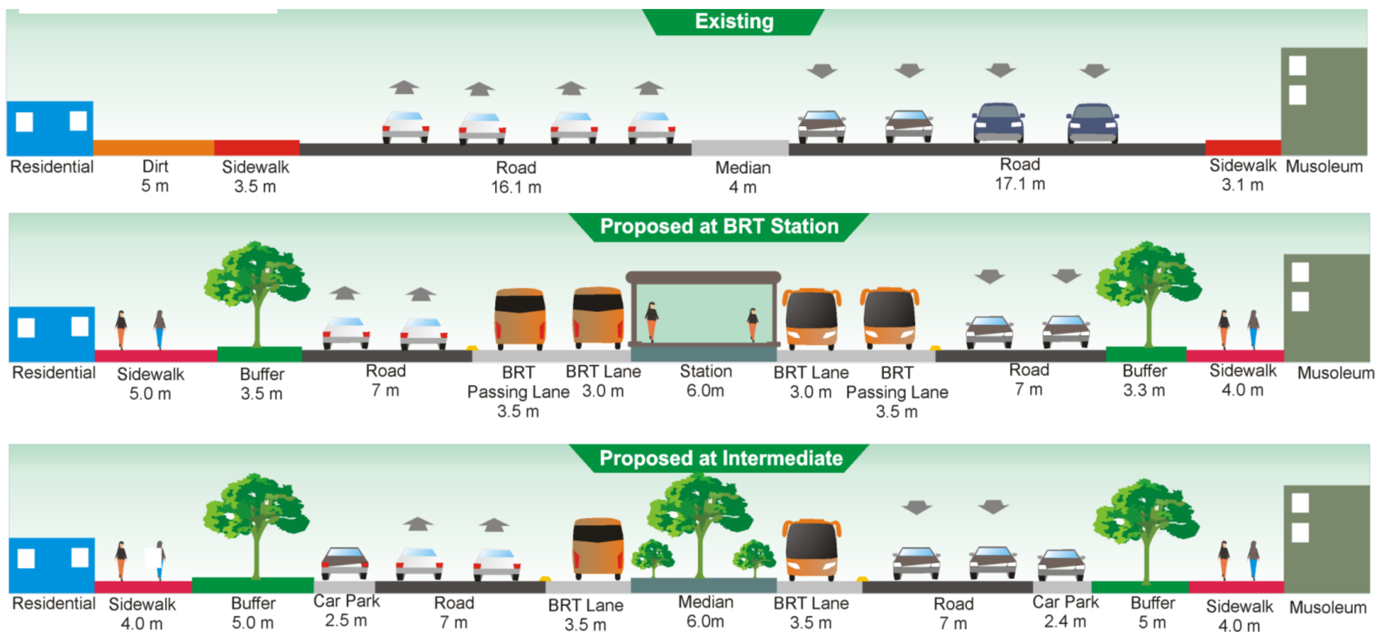



*Figure 6.31 BS 121 Cross Section*

## BS-123

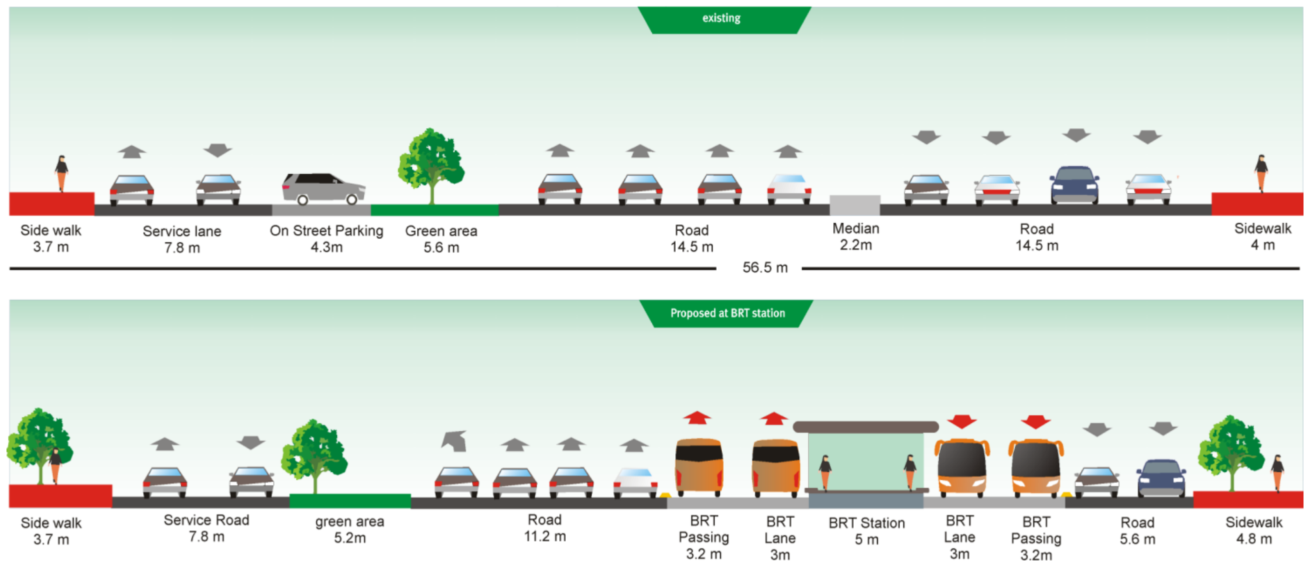



*Figure 6.33 BS 123 Cross Section*

## BS-122

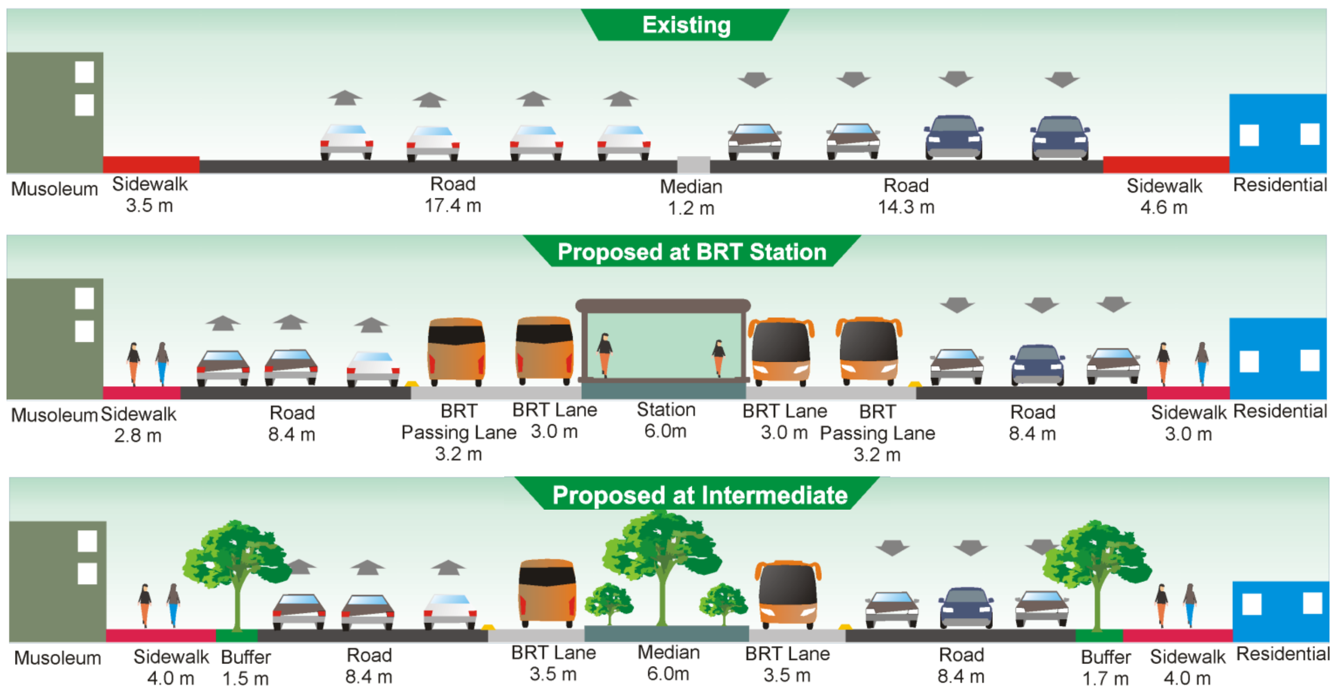



*Figure 6.32 BS 122 Cross Section*

## BS 124

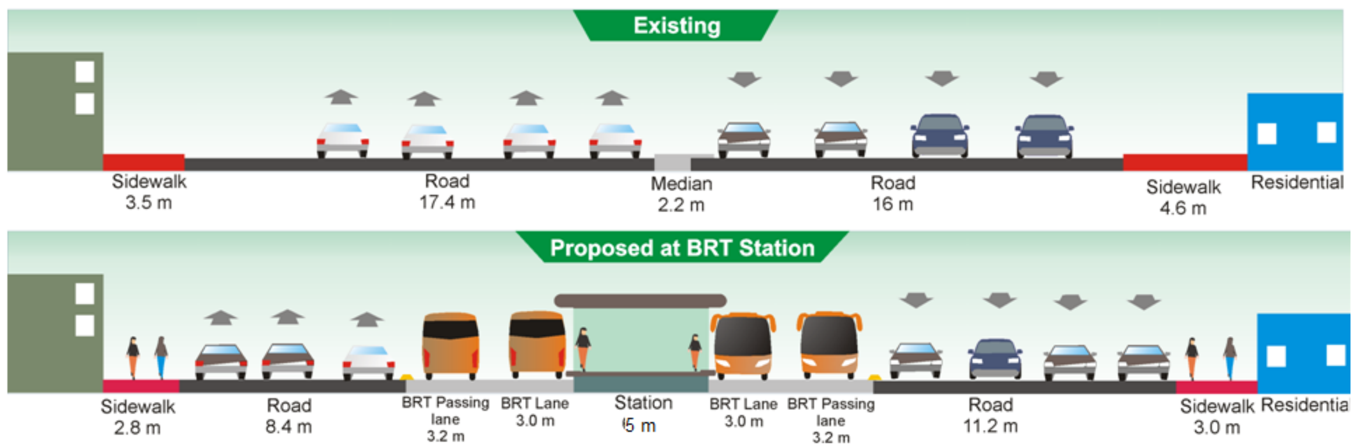



*Figure 6.34 BS 124 Cross Section*

## BS 125 -126

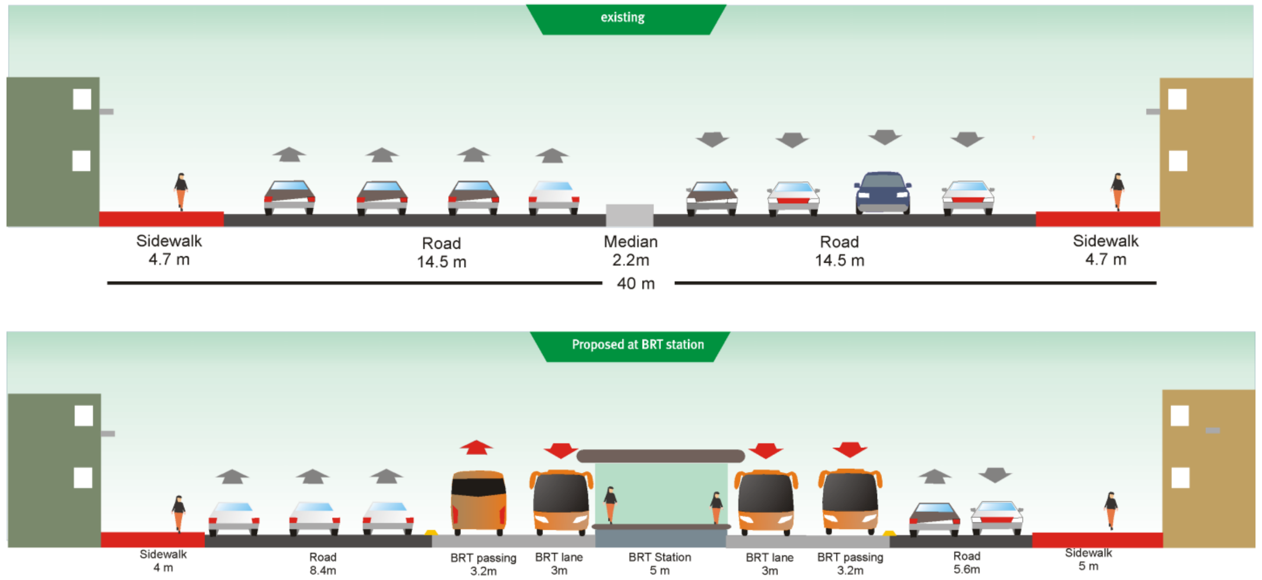



*Figure 6.35 BS 125-126 Cross Section*

## BS128

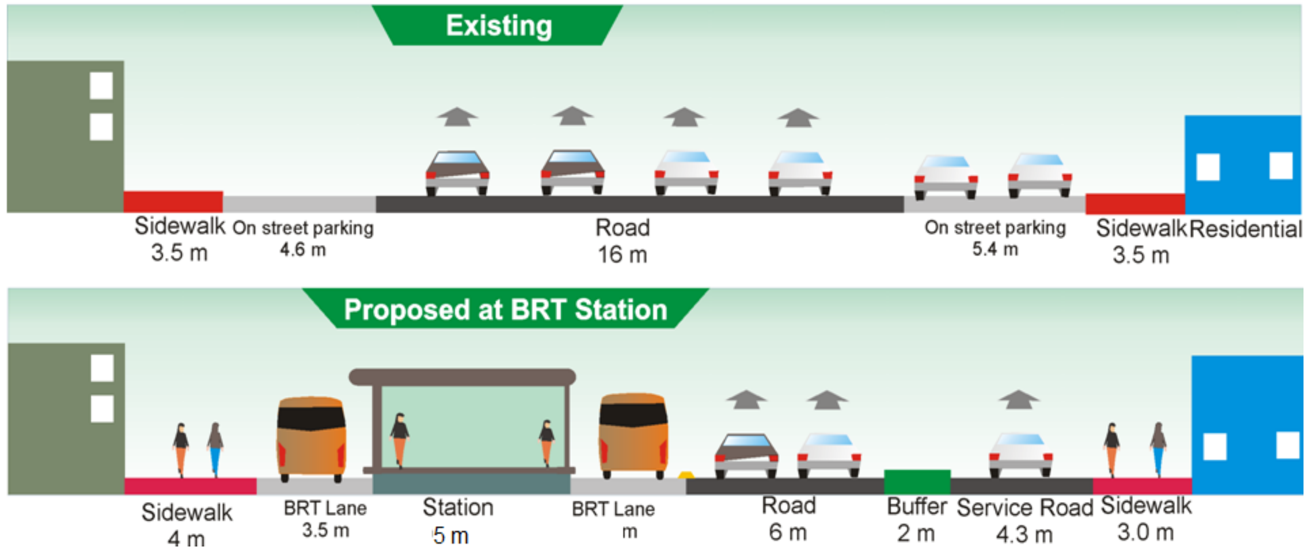



*Figure 6.37 BS 128 Cross Section*

## BS-127

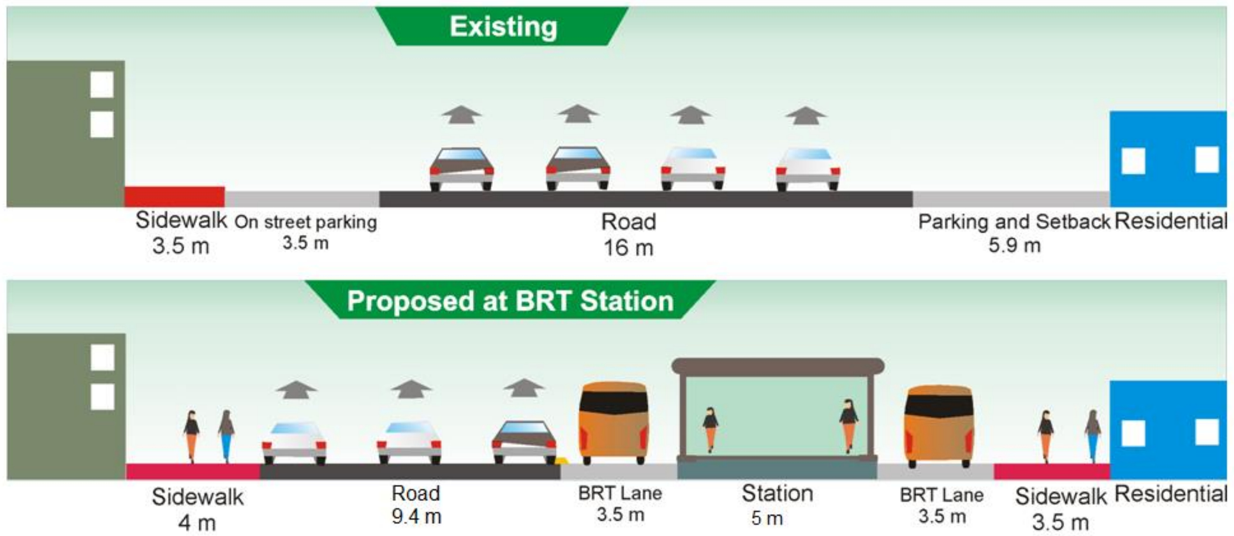



*Figure 6.36 BS 127 Cross Section*

## BS129-130

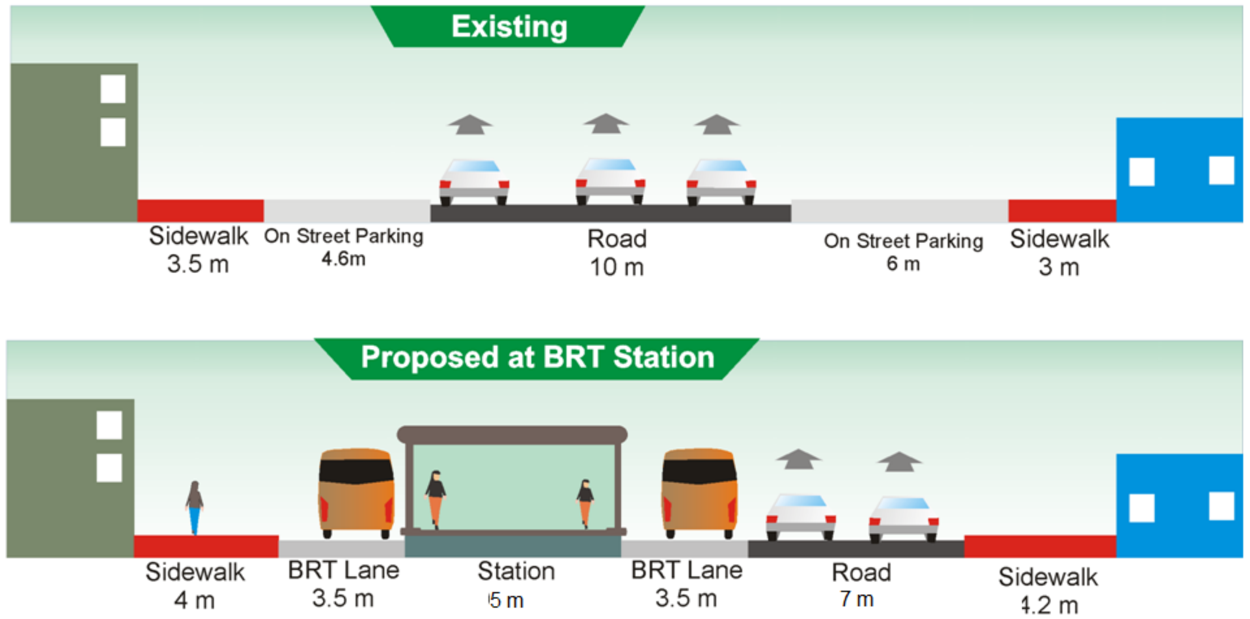



*Figure 6.38 BS 129-130 Cross Section*

## BS-131

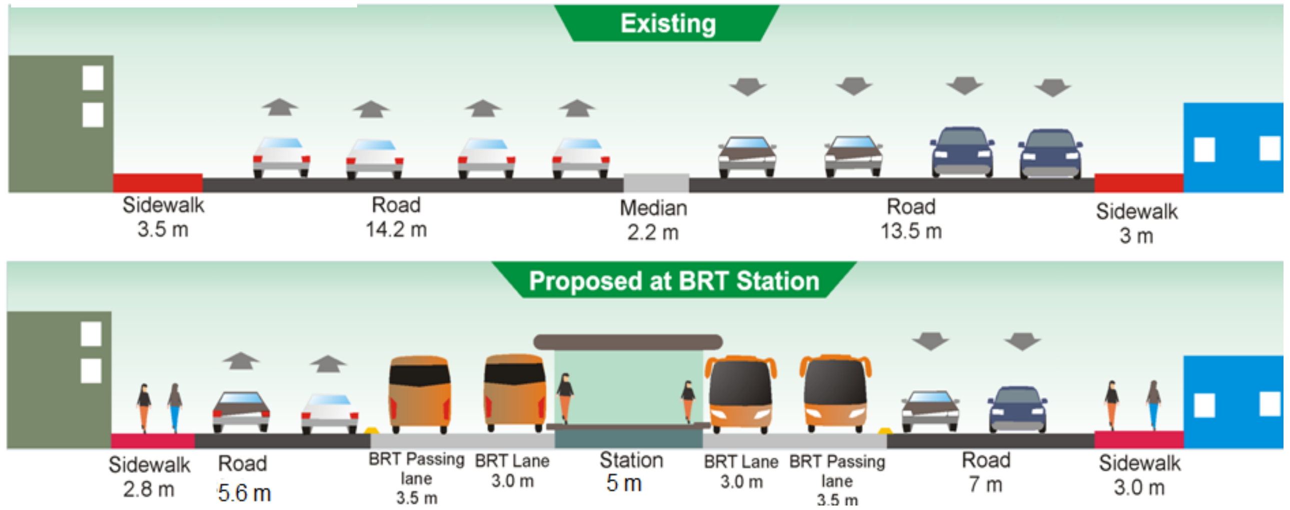



*Figure 6.39 BS 131 Cross Section*

## BS 134-137

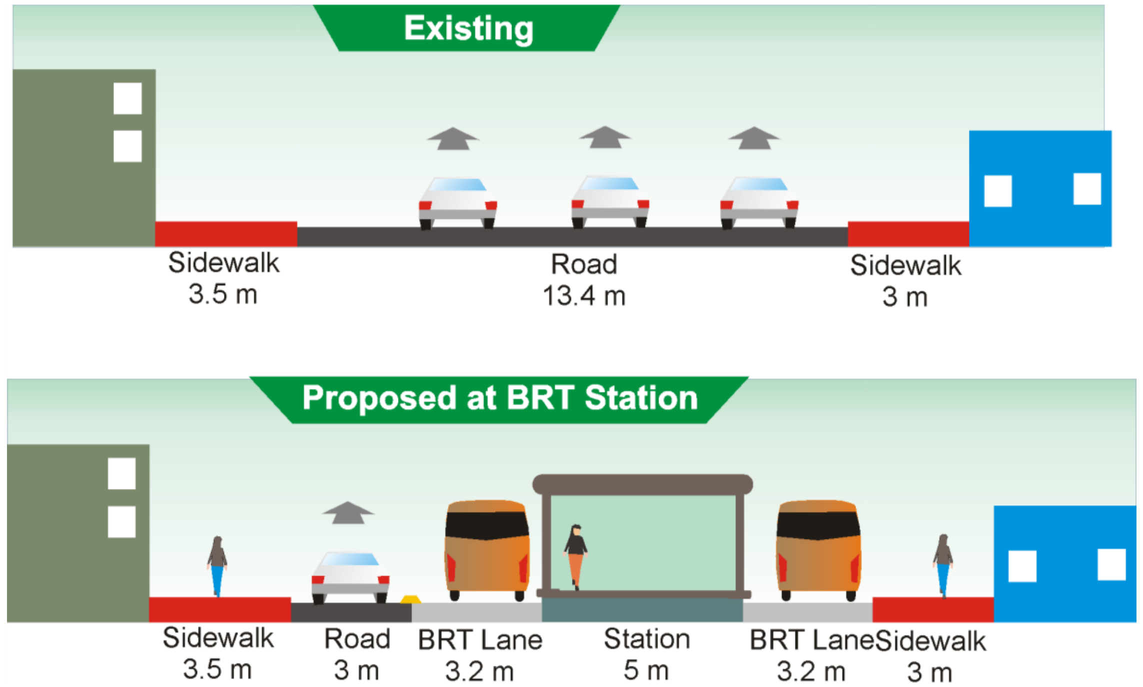



*Figure 6.41 BS 134-137 Cross Section*

## BS 132-133

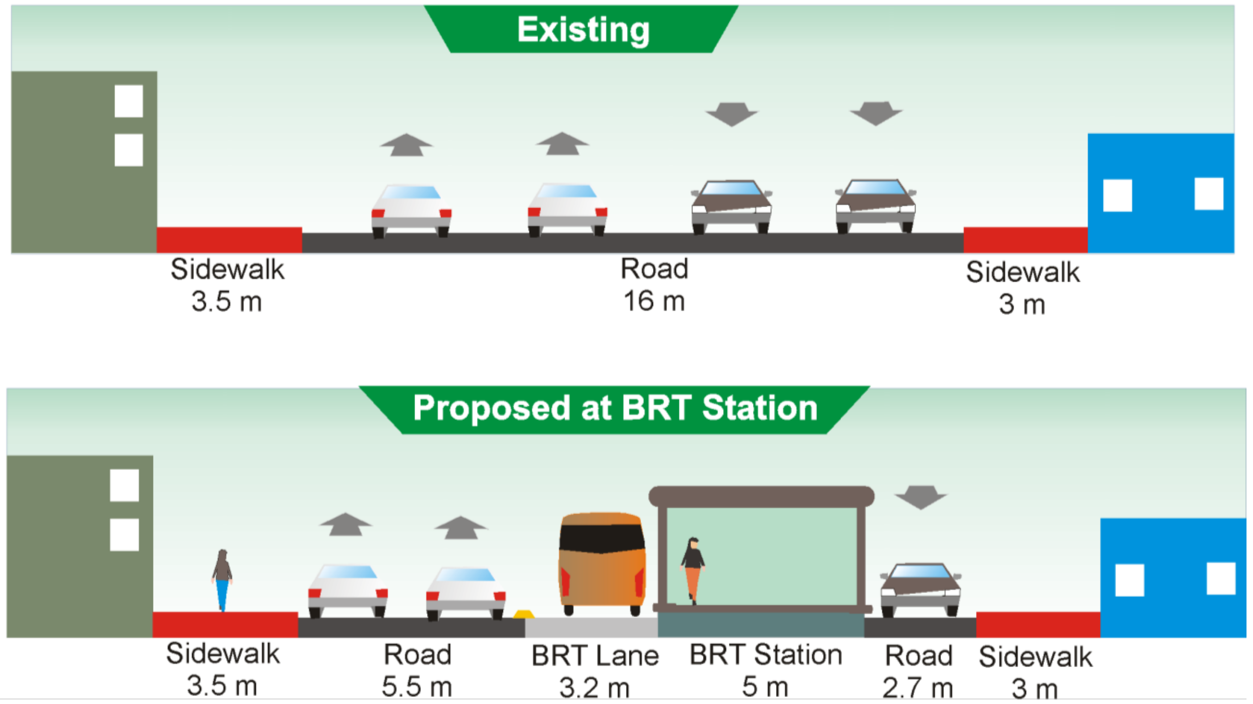



*Figure 6.40 BS 132-133 Cross Section*

## BS-138

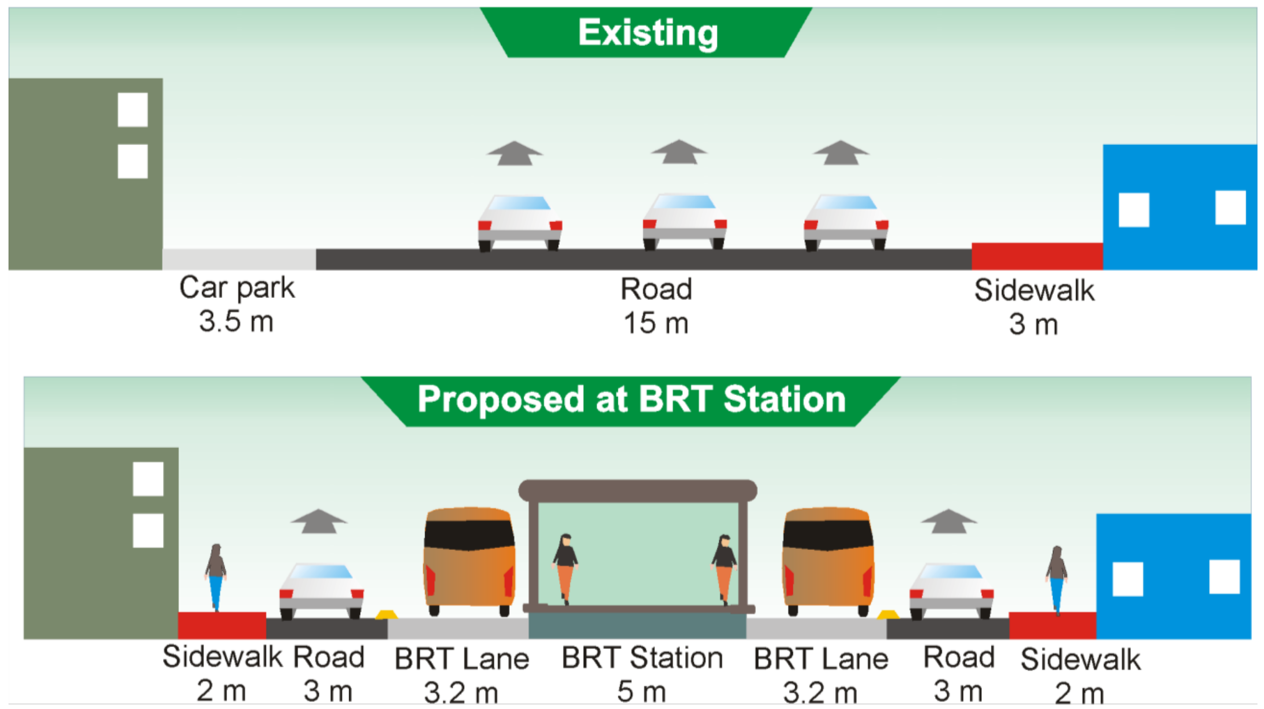



*Figure 6.42 BS 138 Cross Section*

## BS 229

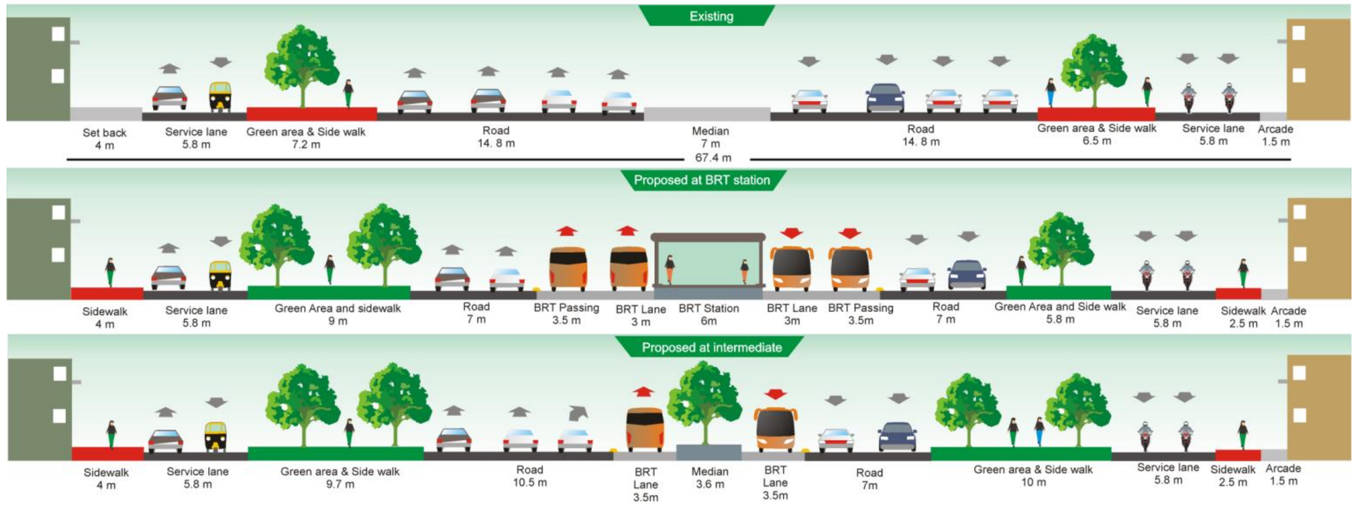


*Figure 6.43 BS 229 Cross Section*

## BS 230

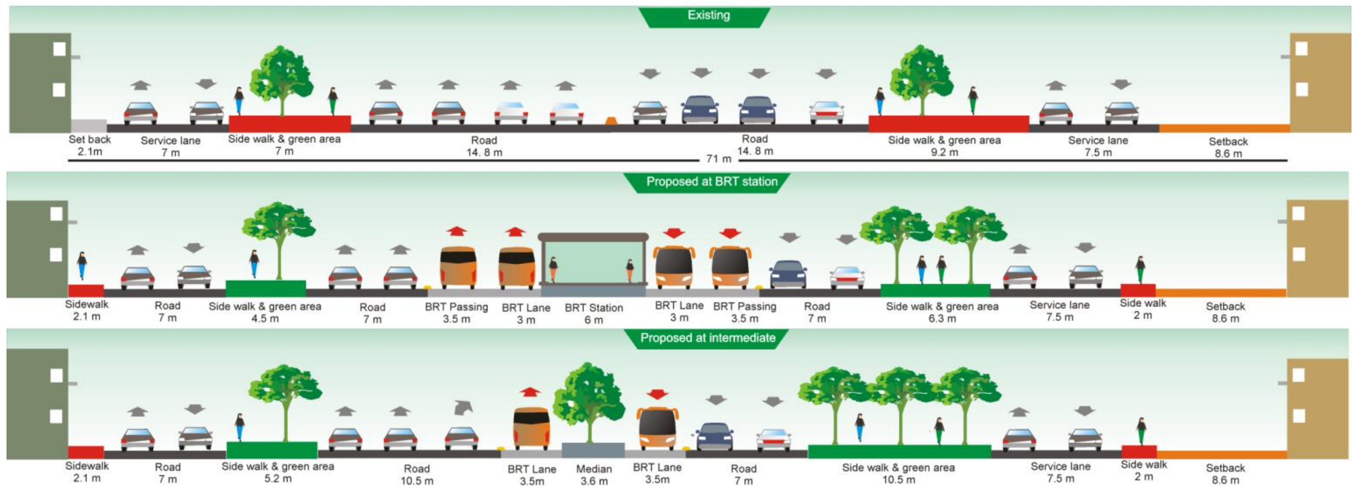


*Figure 6.44 BS 230 Cross Section*

## BS 231

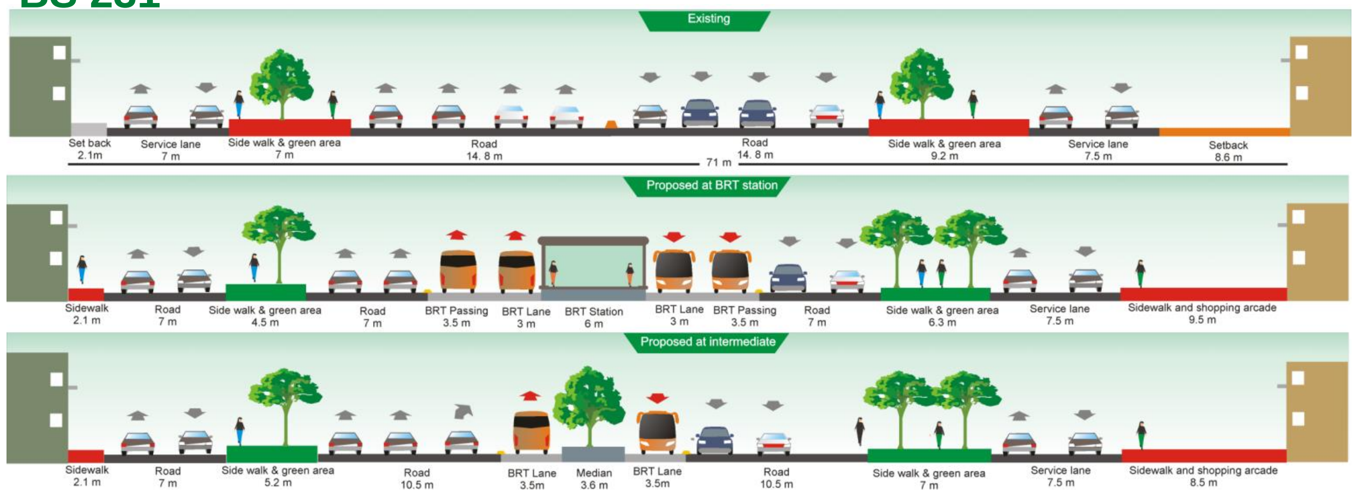


*Figure 6.45 BS 231 Cross Section*

## BS 232

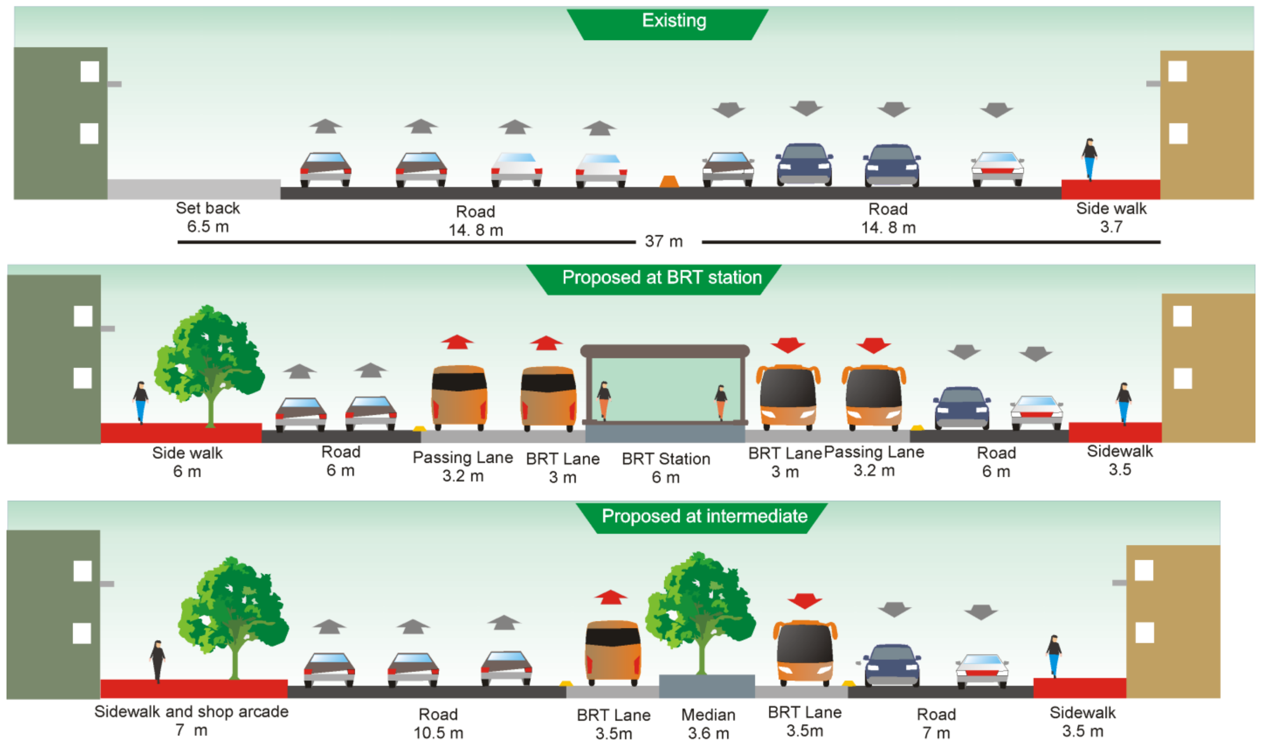



*Figure 6.46 BS 232 Cross Section*

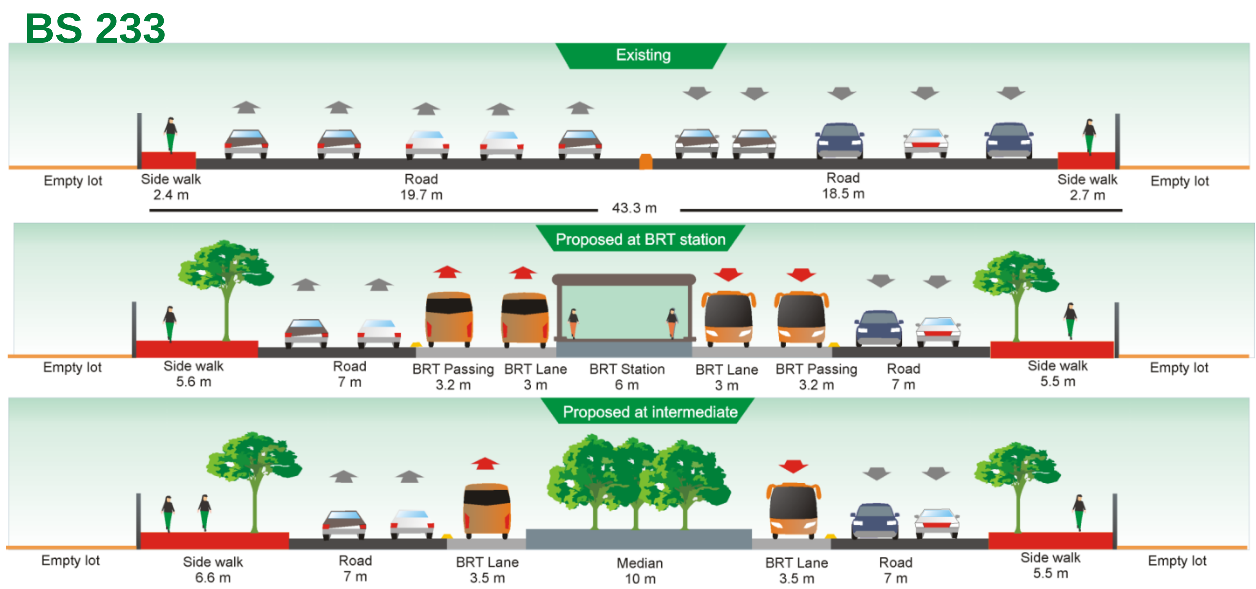



*Figure 6.47 BS 233 Cross Section*

## 6.3 Station Layout

Station layout for Phase 1 Karachi BRT is presented in the appendix. It shows the road layout and configuration at the station as well as at intermediate, based on the cross section designed.

The appendix also shows the station layout for Phase 2 Karachi BRT on Shahrah e Faisal, which might be useful for future development.

## 6.4 Lane Separator

In order to ensure the dedicated BRT lane will be not used by the mixed traffic, we recommend putting the same type of physical separators between bus lane and mixed traffic lanes like Bogota did for the TransMilenio system.

There are 2 types of separators. Larger separators (concrete) can effectively prevent mixed traffic entering the bus lane, and about 200 meter intervals smaller separators(plastic) around 30m long are used for allowing the direct service BRT bus to exit bus lane.


*Figure 6.48 BRT Lane Separator*

## 6.5 Accessibility

The access to stations is mostly available from both ends of the station to save passenger time in accessing the station. Some stations which are located near the intersection only have one access, combined with pedestrian crossing at junction.

In general, two types of access will be used: at-grade crossing with signal and pedestrian bridge. At some stations on University Road, at-grade crossing with signal is combined with U-Turn to allow U-Turn for car. At-grade crossings are preferred as it provides easy access for passengers and saves passenger time.

For pedestrian bridge, stairs and ramps are provided on each side. This is to allow universal access to BRT as well as providing quicker access from both sides of the bridge.

***Table 6.2 Accessibility Type for Karachi BRT Phase 1***

| Station No | Station | Access Type |
|---|---|---|
| 101 | SAFOORA | at grade |
| 102 | BLOCK 7 | at grade combined with U turn |
| 103 | SHUMAIL COMPLEX | at grade |
| 104 | MOSAMYAT WESTBOUND | at grade combined with U turn |
| 105 | SHEIKH ZAYED ISLAMIC CENTER | at grade |
| 106 | BLOCK 1 | at grade |
| 107 | UNIVERSITY OF KARACHI | at grade combined with U turn |
| 108 | NED | bridge |
| 109 | SAFARI PARK | bridge |
| 110 | FATMA CHARITABLE AND MATERNITY HOME | bridge |
| 111 | NIPA | bridge |
| 112 | URDU COLLEGE | bridge |
| 113 | FUTURE PARK | at grade combined with U turn |
| 114 | KARACHI EXPO CENTER | bridge |
| 115 | CIVIC CENTER | bridge |
| 116 | DARUL ULOOM GHOSIA TRUST | bridge |
| 117 | PIB COLONY | at grade combined with U turn |
| 118 | CENTRAL JAIL | bridge |
| 119 | MIR USMAN PARK | at grade |
| 120 | DAWOOD UNIV OF ENGINEERING AND TECHNOLOGY | at grade combined with U turn |
| 121 | NORTH MAZAR E QUAID | at grade |
| 122 | WAZIR OTC HOSPITAL | at grade |
| 123 | DAEWOO CITY TERMINAL | bridge |
| 124 | PRINCE CINEMA | at grade |
| 125 | RIMPA PLAZA | at grade |
| 126 | NJV SCHOOL | at grade |
| 127 | THE GHULAM HUSSAIN KHALIQ DINA LIBRARY | at grade |
| 128 | KMC (Karachi Municipal Corporation) | at grade |
| 129 | DENSO HALL | at grade |
| 130 | NEW MEMON MASJID | at grade |
| 131 | TOWER | at grade |
| 132 | STATE BANK OF PAKISTAN | at grade |
| 133 | SINDH POLICE HEADQUARTERS | at grade |
| 134 | SINDH MUSLIM SCIENCE COLLEGE | at grade |
| 135 | FAKHRI TRADE CENTER | at grade |
| 136 | HEMANI CENTER | at grade |
| 137 | ARAM BAGH | at grade |
| 138 | METROPOLIS SECONDARY SCHOOL | at grade |
| 230 | SIRAJ | at grade |
| 231 | ALLAH WALI | at grade |
| 232 | SOCIETY OFFICE | at grade |
| 233 | KHUDADABAD COLONY | at grade |
| 234 | MAZAR E QUAID | at grade |

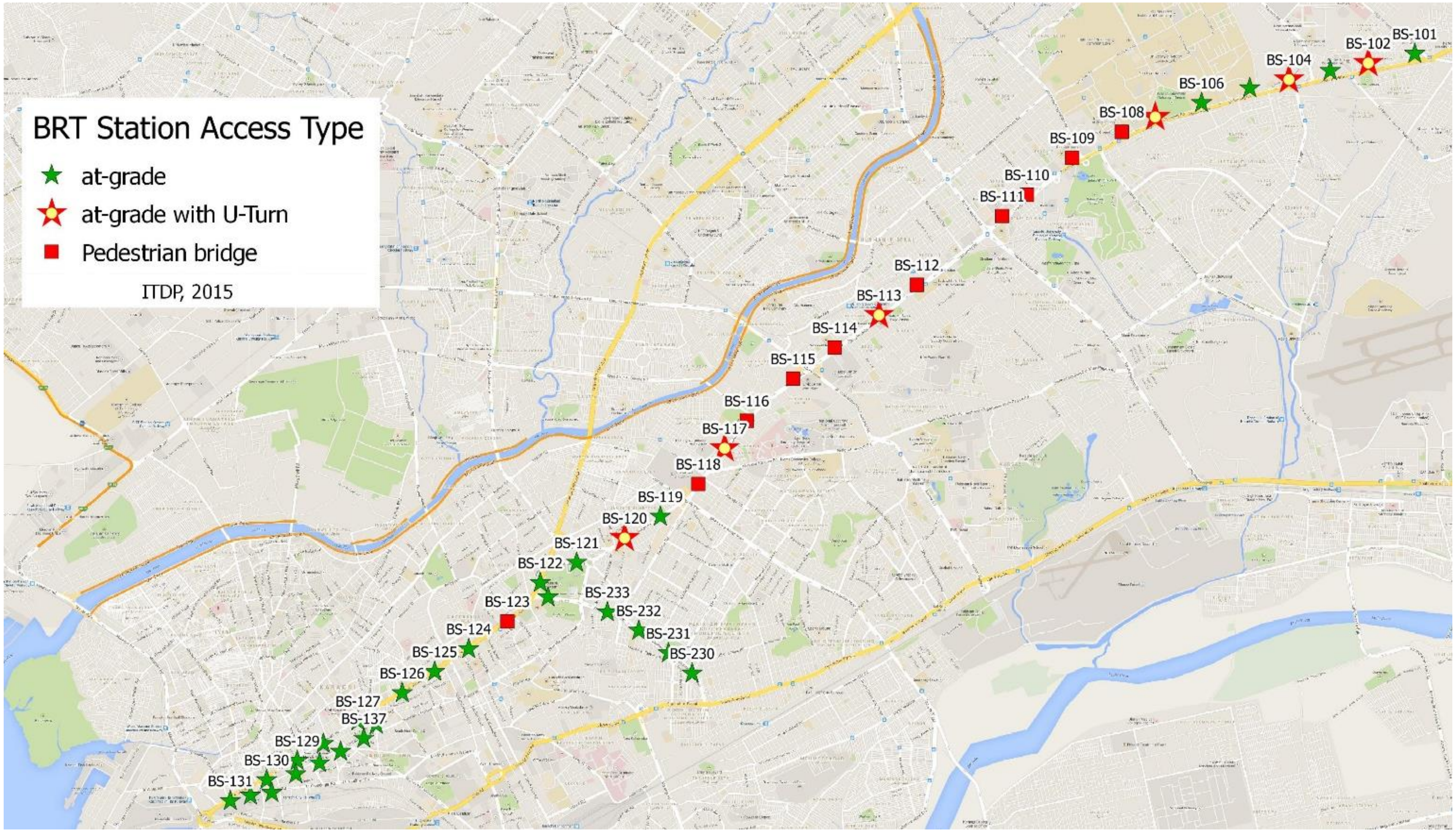



***Figure 6.49 Map of BRT Station Access Types***

# 7 Junction Analysis

## 7.1 General Principles & Junction Locations

In Karachi, many signalized junctions do not work as they are designed. Traffic police often shut down the traffic signal and control them manually, which makes it worse. In many 4-arm junctions along red line, all movements are allowed, which makes the junction operates in 4-phase, and reduce the performance.

In this preliminary analysis, most junctions are proposed with 2-phase, and only a few with 3-phase. Reduction from 4-phase to 2-phase increases junction performance, as the cycle time is reduced. Right-turn movements on 2-phase junction are normally banned and diverted as U-turn at the next junction or in the case where it is nearby to BRT station with at-grade access, the U-Turn is combined with signalized pedestrian crossing for BRT access.

Along Red Line and Shahrah e Quaideen corridor, 9 junctions and 2 roundabouts are analyzed. The analysis and propose design is aimed to improve junction performance, so that the BRT buses will not suffer from long delay at junctions. The bus priority signal will not be proposed as solution as bus frequency on BRT will be higher than100 bus/hour/direction.

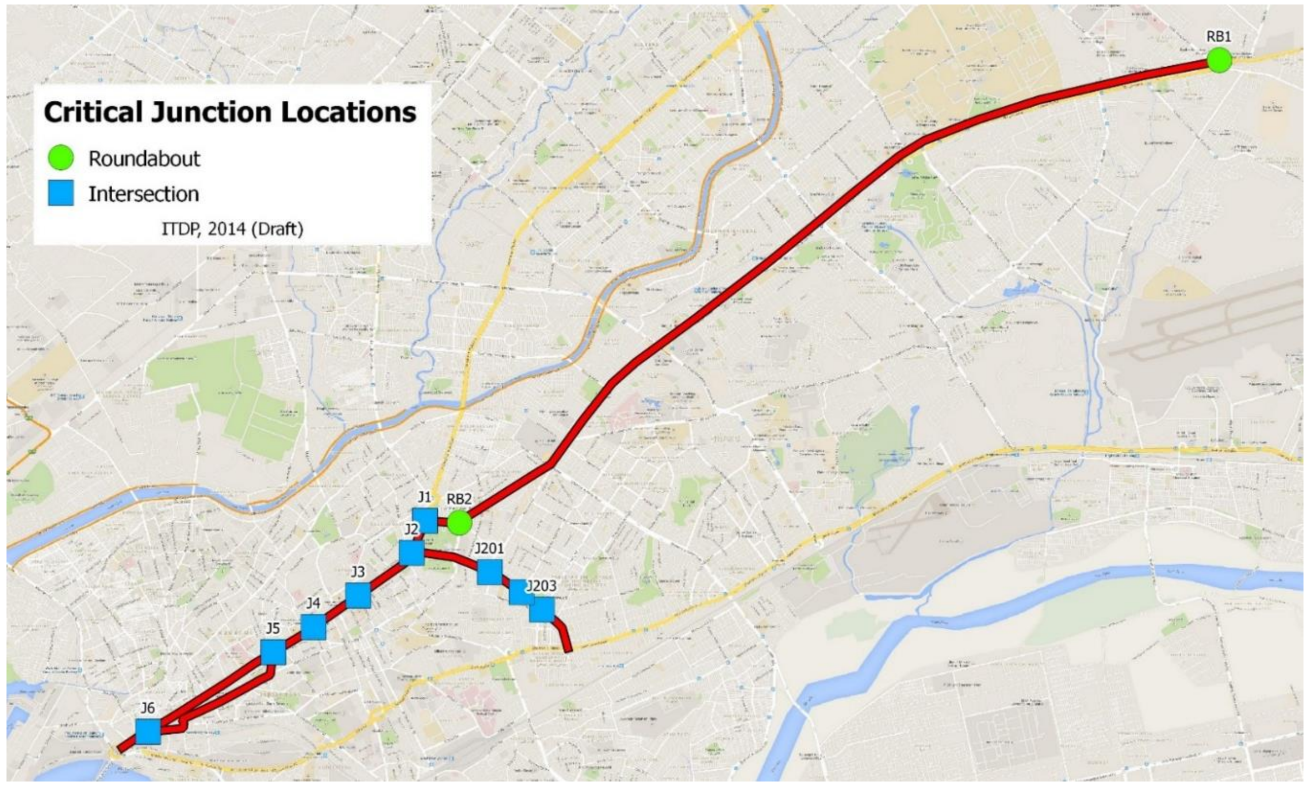



*Figure 7.1 Junction Locations alongRed Line and Shahrah  e Quaideen*

*Table 7. 1List of Junctions for analysis*

| Junction | Junction Name | Junction | Junction Name |
|---|---|---|---|
| **RB-1** | Safoora Roundabout | J6 | MA Jinnah/Bin Qassim Rd |
| **RB-2** | Secretarian Chowrangi | J7 | MA Jinnah/Tower |
| **J1** | New MA Jinnah/MA Jinnah | J201 | Shahrah e Quaideen/Khasmir Rd |
| **J2** | Numaish Chowrangi | J202 | Shahrah e Qaideen/Khalid bin Walid Rd |
| **J3** | MA Jinnah/Mansfield Rd | J203 | Shahrah e Quaideen/Tariq Rd |
| **J4** | MA Jinnah/Preedy Street | | |

## 7.2 Safoora Roundabout

Safoora roundabout at present has 2 un-signalized roundabout with 4-arm. At the moment, with 2 adjacent roundabouts, Safoora intersection has saturation of 94.06%, which is quite saturated.


*Figure 7.2 Current Intersection Layout at Safoora*

For proposed design, the 2 roundabouts are proposed to be merged as signalized intersection, as shown in the following figure. The phase is also reduced to 2 phases, and saturation is reduced to 65%, and improve the ratio by 144.46% from the existing.

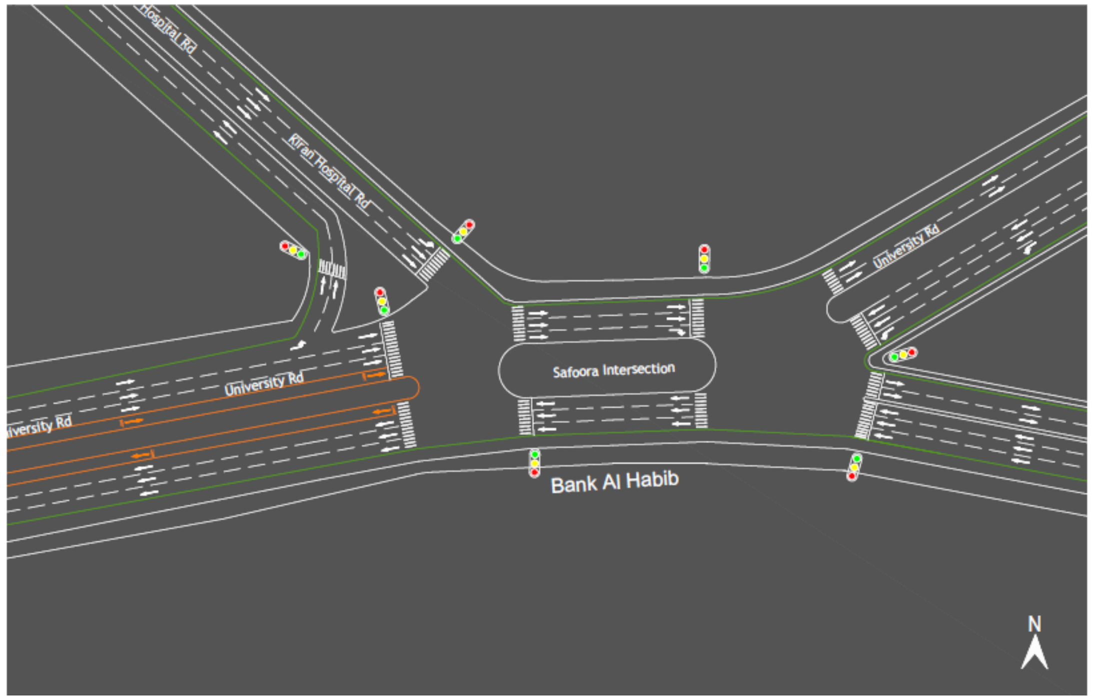



*Figure 7.3 Proposed Junction Design for Safoora*

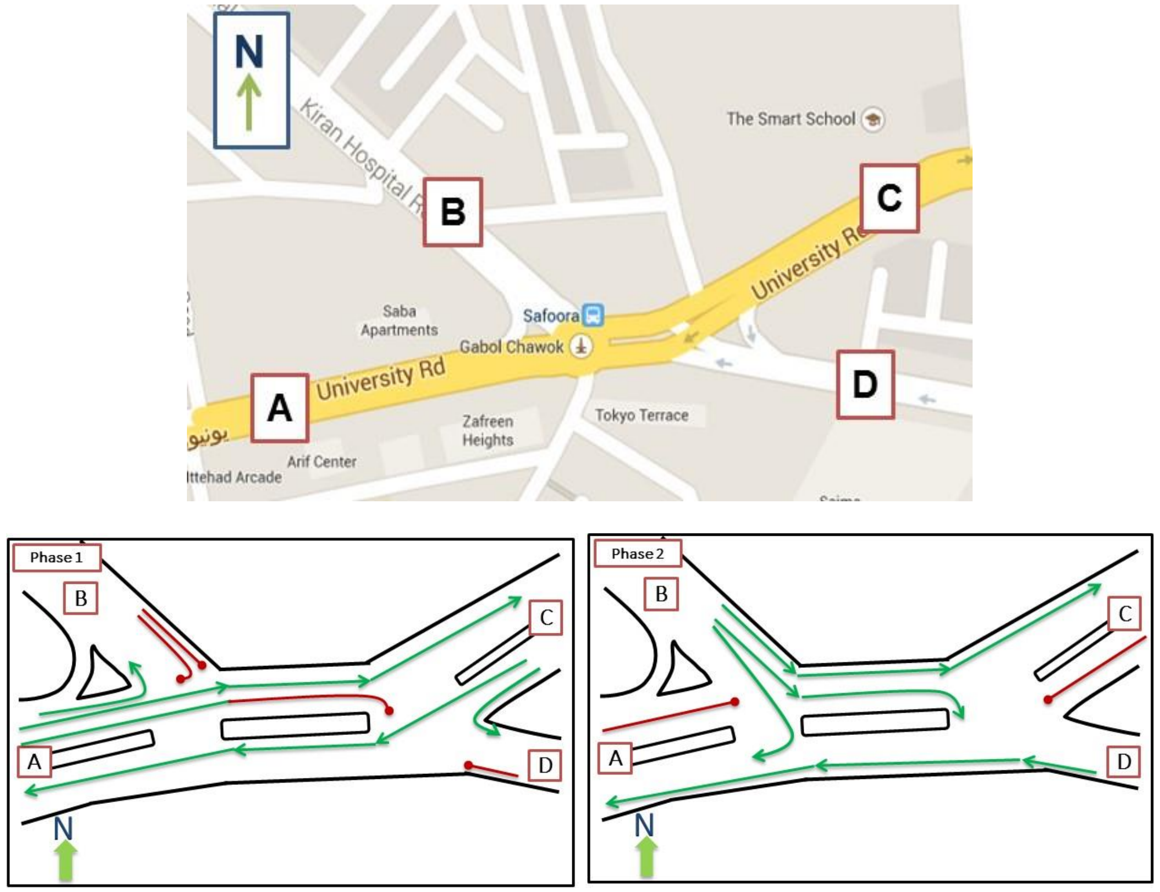



*Figure 7.4 Proposed Traffic Signal phase at Safoora*

*Table 7. 2 Safoora Junction Analysis*

| RB1 - Safoora intersection (present) | | | | | | |
|---|---|---|---|---|---|---|
| Phase | Side | To | Volume (pcu/h) | Lanes | Capacity (pcu/h) | Saturation |
| 1 | A | Left | 451 | 1 | 1800 | 25.06% |
| | | Ahead | 434 | 1 | 1800 | 24.11% |
| | | Right | 662 | 1 | 1800 | 36.78% |
| | **Maximum Saturation** | | | | | **25.06%** |
| 2 | B | Left | 245 | 1 | 1800 | 13.61% |
| | | Ahead | 175 | 1 | 1800 | 9.72% |
| | | Right | 365 | 1 | 1800 | 20.28% |
| | **Maximum Saturation** | | | | | **20.28%** |
| 3 | C | Left | 198 | 1 | 1800 | 11.00% |
| | | Ahead | 374 | 1 | 1800 | 20.78% |
| | | Right | 96 | 1 | 1800 | 5.33% |
| | **Maximum Saturation** | | | | | **20.78%** |
| 4 | D | Left | 152 | 1 | 1800 | 8.44% |
| | | Ahead | 268 | 1 | 1800 | 14.89% |
| | | Right | 503 | 1 | 1800 | 27.94% |
| | **Maximum Saturation** | | | | | **27.94%** |
| **Total** | | | | | | **94.06%** |

| RB1 - Safoora intersection (proposed) | | | | | | |
|---|---|---|---|---|---|---|
| Phase | Side | To | Volume (pcu/h) | Lanes | Capacity (pcu/h) | Saturation |
| 1 | A | Left | 425 | 1 | 1800 | 23.61% |
| | | Ahead+ Right | 1068 | 2 | 3600 | 29.67% |
| | C | Left | 90 | 1 | 1800 | 5.00% |
| | | Ahead+ right | 544 | 2 | 3600 | 15.11% |
| | **Maximum Saturation** | | | | | **29.67 %** |
| 2 | A | Right | 638 | 1 | 1800 | 35.44% |
| | B | Right | 329 | 1 | 1800 | 18.28% |
| | | Left+ Ahead | 408 | 2 | 3600 | 11.33% |
| | D | All | 875 | 3 | 5400 | 16.20% |
| | **Maximum Saturation** | | | | | **35.44%** |
| **Total** | | | | | | **65.11%** |

| Resume Intersection Improvement | |
|---|---|
| **Scheme** | **Saturation** |
| Existing | 94.06% |
| Proposed 2 phase | 65.11% |
| **Ratio** | **144.46%** |

In the proposed design, right turn from exit C and D to exit B are banned, and those movements are diverted to exit A, where they will make U-Turn at the next crossing at BRT station, and turn left from A to go to exit B.

## 7.3 Secretariat Chowrangi


*Figure 7.5 Current Junction Layout at Secretariat Chowrangi*

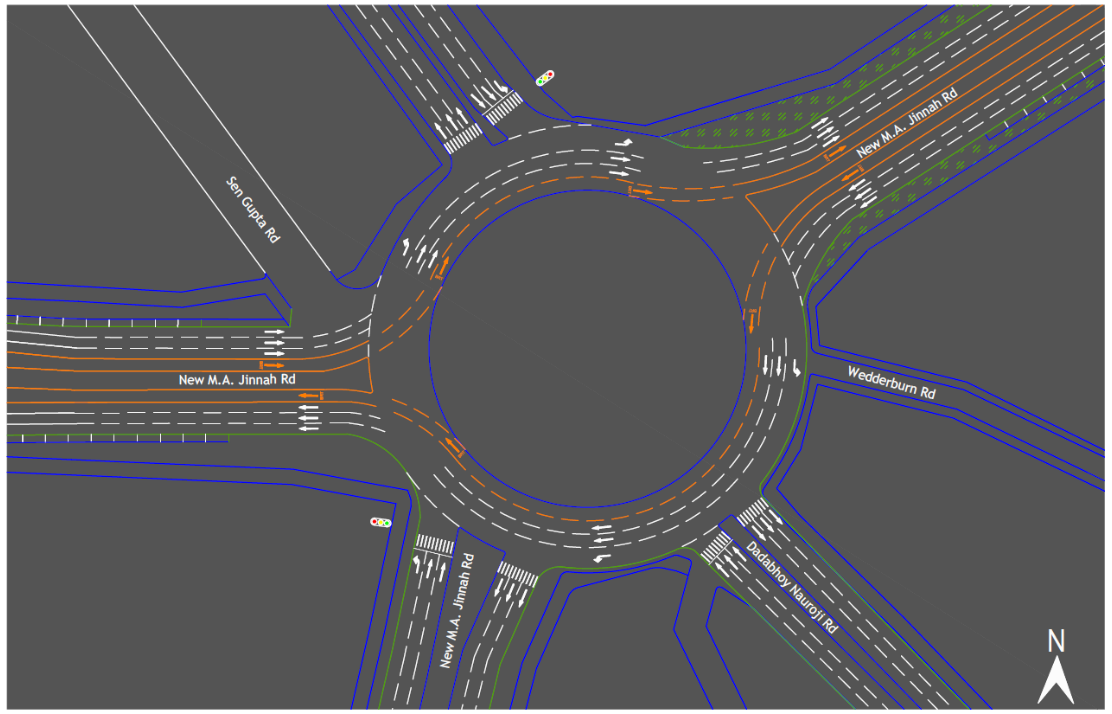



*Figure 7.6 Proposed Junction Design for Secretariat Chowrangi*

For Secretariat Chowrangi, no improvement is needed, as the roundabout still operates at 81%, or below saturated condition which starts at 85%. No major improvement is needed for this roundabout, except clear road marking to identify the BRT lane on the roundabout. However, should the regular traffic flow increase and the junction becomes saturated, special treatment can be made, such as making the BRT movement 'protected' from A to C and vice-versa, and making traffic turning right from exit E and D diverted to exit A to make a U-Turn and continue to exit B and C. This measure does not need to be applied all day and can be applied only at peak hours, when necessary.

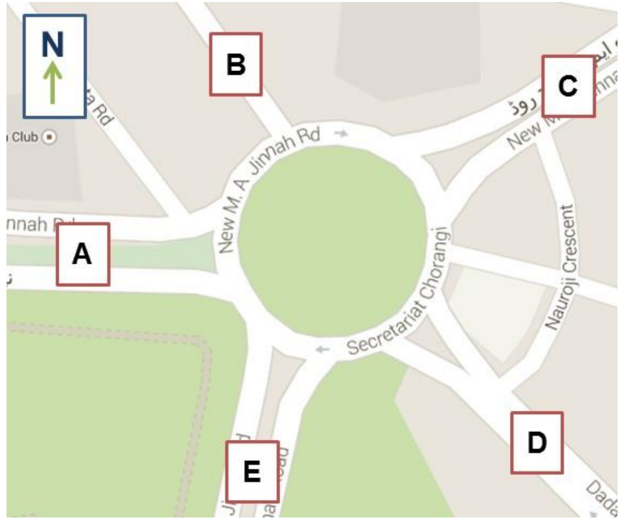



*Figure 7.7 Arm Allocation at Secretariat Chowrangi*

*Table 7. 3 Secretariat Chowrangi Analysis*

| RB2 – Secretariat Chowrangi (present) | | | | | | |
|---|---|---|---|---|---|---|
| **Phase** | **Side** | **To** | **Volume (pcu/h)** | **Lanes** | **Capacity (pcu/h)** | **Saturation** |
| | A | Left | 457 | 1 | 1800 | 25.39% |
| | | Ahead | 795 | 1 | 1800 | 44.17% |
| | B | Left | 416 | 1 | 1800 | 23.11% |
| | | Ahead | 639 | 1 | 1800 | 35.50% |
| | C | Left | 277 | 2 | 3600 | 7.69% |
| | | Ahead | 1571 | 2 | 3600 | 43.64% |
| | D | Left | 1101 | 2 | 3600 | 30.58% |
| | | Ahead | 1463 | 1 | 1800 | 81.28% |
| | E | Left | 777 | 2 | 3600 | 21.58% |
| | | Ahead | 761 | 3 | 5400 | 14.09% |
| | **Maximum Saturation** | | | | | **81.28%** |

## 7.4 MA Jinnah/Mausoleum Junction

Mausoleum intersection has un-signalized intersection with 3-arms and also has saturation of 91.86% at present.


*Figure 7.8 Current Junction Layout at MA Jinnah/Mausoleum Junction*

For proposed design, the intersection is proposed to be a signalized intersection with2 phases, which reduce the saturation to 85% and improve the ratio by 107% from the existing.

In the proposed design, right turn from MA Jinnah south is banned, except for BRT. Traffic for right turn movement are diverted do U-Turn at the next junction ahead. From New MA Jinnah, all traffic and BRT can only go left, south to MA Jinnah.

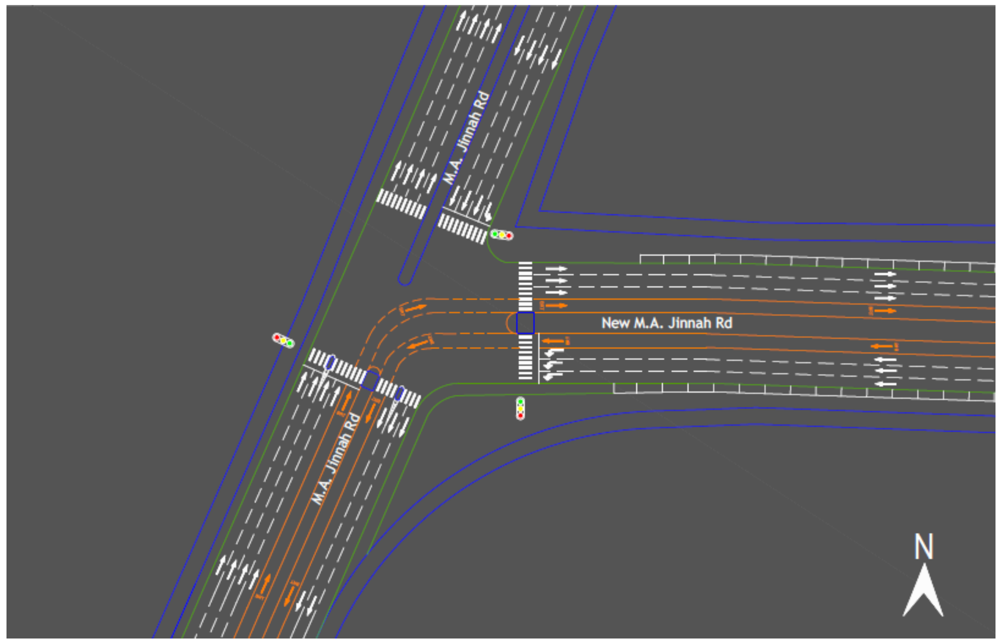



*Figure 7.9 Proposed Junction Design for MA Jinnah/Mausoleum Junction*

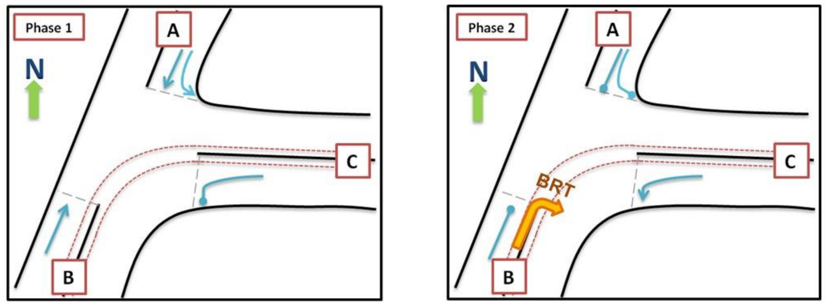




*Figure 7.10 Proposed Signal Traffic Phase*

*Table 7. 4 M.A Jinnah Rd Mausoleum Analysis*

| J1 - M.A Jinnah Rd Mausoleum (present) | | | | | | |
|---|---|---|---|---|---|---|
| **Phase** | **Side** | **To** | **Volume (pcu/h)** | **Lanes** | **Capacity (pcu/h)** | **Saturation** |
| 1 | A | Left | 91 | 1 | 1800 | 5.06% |
| | | Ahead | 2452 | 4 | 7200 | 34.06% |
| | C | Left | 689 | 2 | 3600 | 19.14% |
| | **Maximum Saturation** | | | | | **34.06%** |
| 2 | B | Ahead | 4162 | 4 | 7200 | 57.81% |
| | | Right | 912 | 1 | 1800 | 50.67% |
| | C | Right | 408 | 1 | 1800 | 22.67% |
| | **Maximum Saturation** | | | | | **57.81%** |
| **Total** | | | | | | **91.86%** |

| J1 - M.A Jinnah Rd Mausoleum (proposed) | | | | | | |
|---|---|---|---|---|---|---|
| **Phase** | **Side** | **To** | **Volume (pcu/h)** | **Lanes** | **Capacity (pcu/h)** | **Saturation** |
| 1 | A | Left | 91 | 1 | 1800 | 5.06% |
| | | Ahead | 2164 | 2 | 3600 | 60.11% |
| | B | Ahead | 4738 | 4 | 7200 | 65.81% |
| | **Maximum Saturation** | | | | | **65.81%** |
| 2 | B (BRT) | Right | 161 | 1 | 1800 | 8.94% |
| | C | Left | 1073 | 3 | 5400 | 19.87% |
| | **Maximum Saturation** | | | | | **19.87%** |
| **Total** | | | | | | **85.68%** |

| Resume Intersection Improvement | |
|---|---|
| **Scheme** | **Saturation** |
| Existing | 91.86% |
| Proposed 2 phase | 85.68% |
| **Ratio** | **107.22%** |

## 7.5 Numaish Chowrangi

Numaish Chowrangi at present has signalized intersection with 4-arms and also has saturation of 99.86% which is quite saturated. The traffic signal at this junction was shut down practically, and traffic movement was regulated by the police. In the analysis, the current phase is assumed at 2-phases, as observed on the field.


*Figure 7.11 Current Junction Layout at Numaish Chowrangi Junction*

For proposed design, the phases are reduced from 2 phases to 3 phases which make the saturation decreases to 94% and improved the ratio by 106% from the existing.

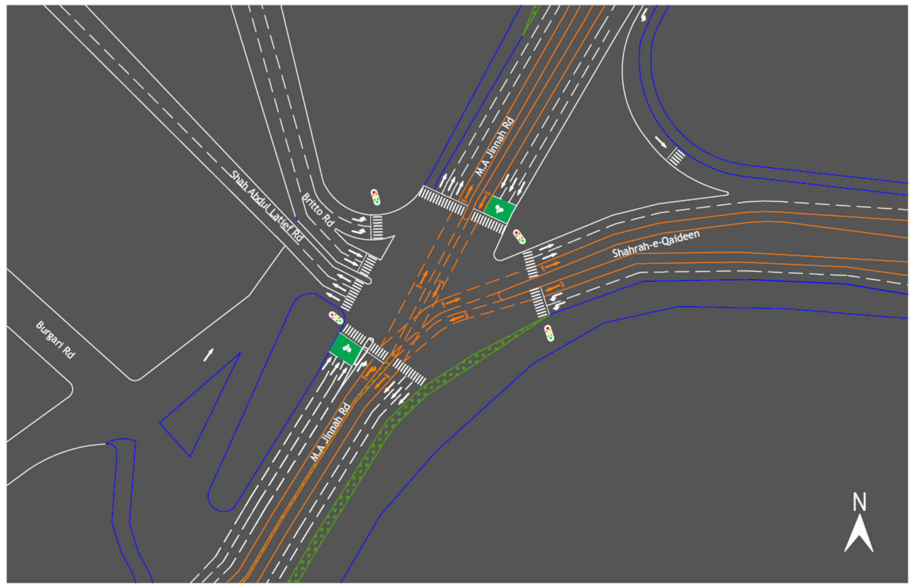



*Figure 7.12 Proposed Junction Design for Numaish Chowrangi Junction*

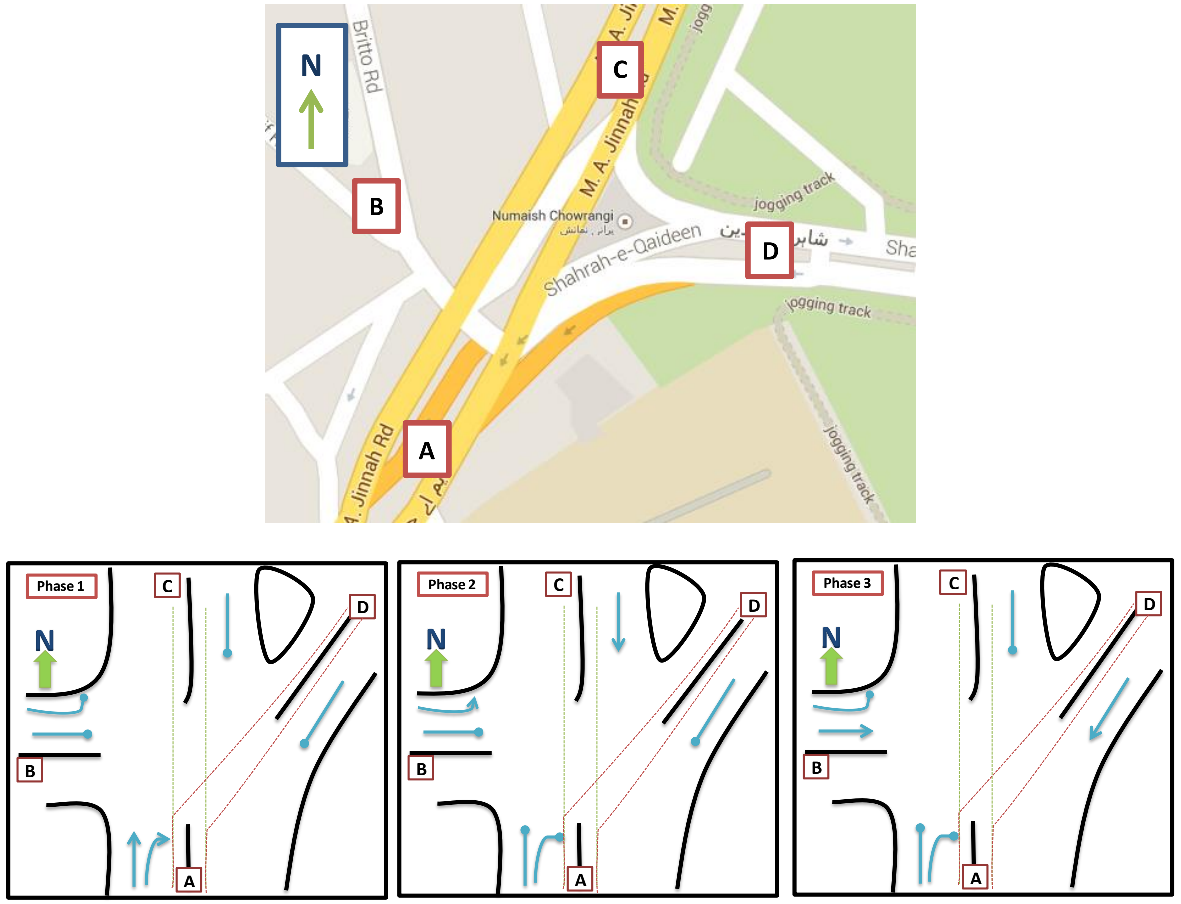



*Figure 7.13 Proposed Signal Traffic Phases*

*Table 7. 5 Numaish Chowrangi Analysis*

| J2 – Numaish Chowrangi (present) | | | | | | |
|---|---|---|---|---|---|---|
| Phase | Side | To | Volume (pcu/h) | Lanes | Capacity (pcu/h) | Saturation |
| 1 | D | Right | 279 | 1 | 1800 | 15.50% |
| | | Ahead | 928 | 1 | 1800 | 51.56% |
| | | Left | 820 | 1 | 1800 | 45.56% |
| | B | Right | 128 | 1 | 1800 | 7.11% |
| | | Ahead | 460 | 1 | 1800 | 25.56% |
| | | Left | 211 | 1 | 1800 | 11.72 |
| | Maximum Saturation | | | | | 51.56% |
| 2 | C | Right | 157 | 2 | 3600 | 4.36% |
| | | Ahead | 2340 | 4 | 7200 | 32.50% |
| | A | Right | 892 | 2 | 3600 | 24.78% |
| | | Ahead | 3478 | 4 | 7200 | 48.31% |
| | Maximum Saturation | | | | | 48.31% |
| Total | | | | | | **99.86%** |

| J2 – Numaish Chowrangi (proposed) | | | | | | |
|---|---|---|---|---|---|---|
| Phase | Side | To | Volume (pcu/h) | Lanes | Capacity (pcu/h) | Saturation |
| 1 | A | Left | 2640 | 3 | 5400 | 48.89% |
| | | Ahead | 694 | 1 | 1800 | 38.56% |
| | D | Ahead | 1957 | 2 | 3600 | 54.36% |
| | Maximum Saturation | | | | | 54.36% |
| 2 | B | Left | 339 | 2 | 3600 | 9.42% |
| | | Ahead | 436 | 2 | 3600 | 12.11% |
| | Maximum Saturation | | | | | 12.11% |
| 3 | C | Ahead | 1989 | 4 | 7200 | 27.63% |
| | Maximum Saturation | | | | | 27.63% |
| Total | | | | | | **94.10%** |

| Resume Intersection Improvement | |
|---|---|
| **Scheme** | **Saturation** |
| Existing | 99.86% |
| Proposed 2 phase | 94.10% |
| Ratio | **106.13%** |

In the proposed design, the movements from exit D to exit B and to exit C are banned and those movements are diverted to exit A, where they will make U-Turn at the next junction, then straight forward from A to go to exit C or turn left from A to go to exit B. Right turn from exit C to exit B is also banned, and diverted to exit A, where they will make U-Turn at the next crossing, and turn left from A to go to B.

## 7.6 M.A Jinnah/ Mansfield Rd Intersection


*Figure 7.14 Current Junction Layout at M.A Jinnah Rd - Mansfield Rd Junction*

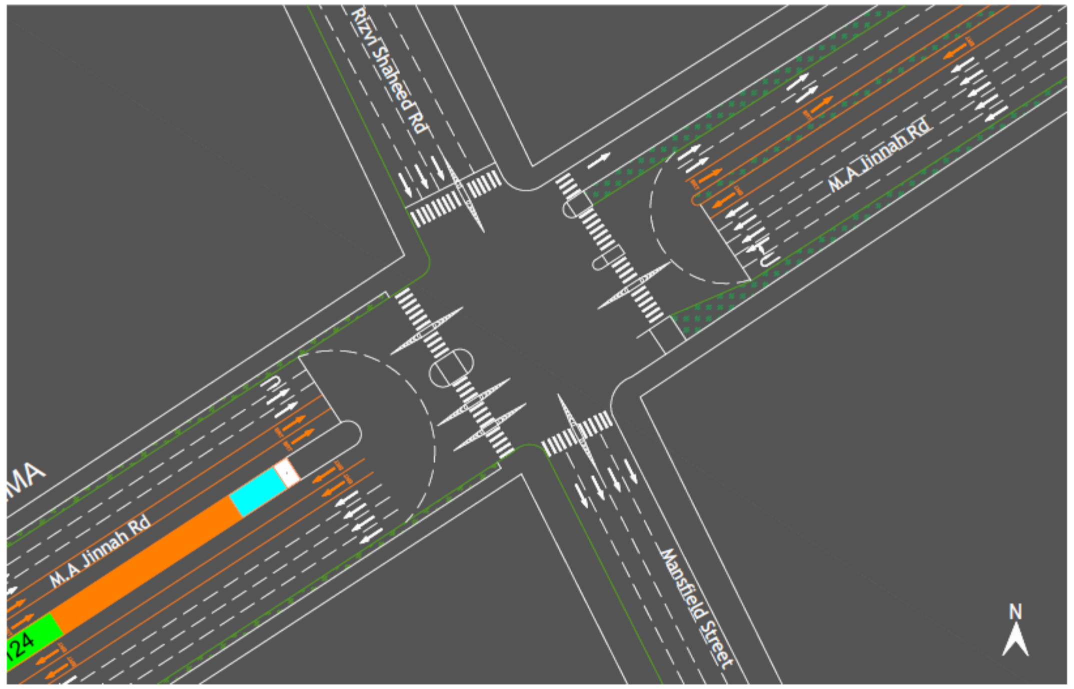



*Figure 7.15 Proposed Junction Design for M.A Jinnah Rd - Mansfield Rd Junction*

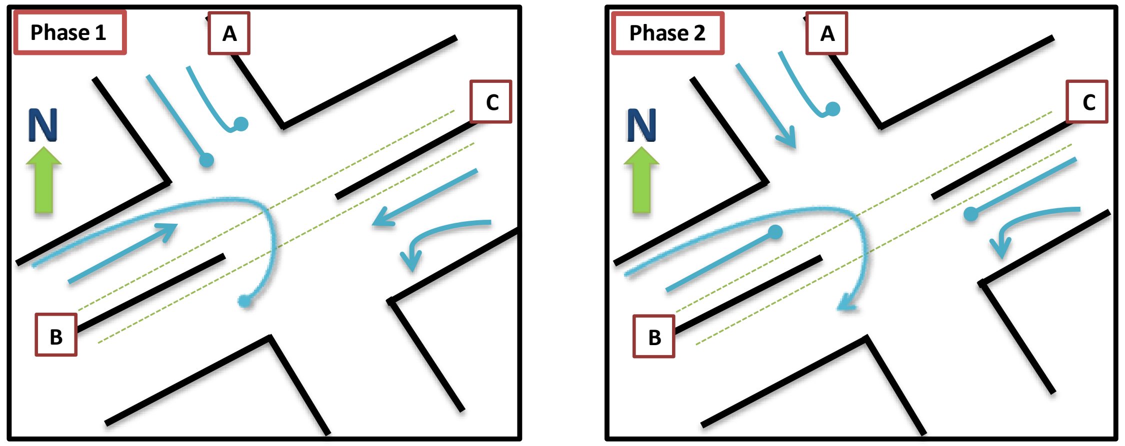




*Figure 7.16 Proposed Signal Traffic Phase*

Traffic direction from Rizvi Shaheed Rd to Mansfield Rd is one way. For intersection at M.A Jinnah and Mansfield, no major improvement is needed for this intersection except to make a U-Turn at the crossing from exit B and exit C. The intersection has signalized intersection with 4 arms and 2 phases which has saturation of 96 %.

*Table 7. 6 M.A Jinnah Rd - Mansfield Rd Analysis*

| J3 - M.A Jinnah Rd - Mansfield Rd (present) | | | | | | |
|---|---|---|---|---|---|---|
| **Phase** | **Side** | **To** | **Volume (pcu/h)** | **Lanes** | **Capacity (pcu/h)** | **Saturation** |
| 1 | A | Left | 435 | 2 | 3600 | 12.08% |
| | | Ahead | 1301 | 3 | 5400 | 24.09% |
| | **Maximum Saturation** | | | | | **24.09%** |
| 2 | B | Ahead | 1152 | 3 | 5400 | 21.33% |
| | C | Left | 1310 | 1 | 1800 | 72.78% |
| | | Ahead | 4373 | 4 | 7200 | 60.74% |
| | **Maximum Saturation** | | | | | 72.78% |
| **Total** | | | | | | 96.87% |

| J3 - M.A Jinnah Rd - Mansfield Rd (proposed) | | | | | | |
|---|---|---|---|---|---|---|
| **Phase** | **Side** | **To** | **Volume (pcu/h)** | **Lanes** | **Capacity (pcu/h)** | **Saturation** |
| 1 | B | Ahead | 892 | 2 | 3600 | 24.78% |
| | C | Left | 1240 | 1 | 1800 | 68.89% |
| | | Ahead | 4119 | 3 | 5400 | 76.28% |
| | **Maximum Saturation** | | | | | **76.28%** |
| 2 | A | Ahead | 1093 | 3 | 5400 | 20.24% |
| | | Left | 435 | 2 | 3600 | 12.08% |
| | B | U-Turn | 267 | 1 | 1500 | 17.80% |
| | C | U-Turn | 281 | 1 | 1500 | 18.73% |
| | **Maximum Saturation** | | | | | **20.24%** |
| **Total** | | | | | | **96.52%** |

| Resume Intersection Improvement | |
|---|---|
| **Scheme** | **Saturation** |
| Existing | 96.87% |
| Proposed 2 phase | 96.52% |
| **Ratio** | **100.36%** |

In the proposed design, turn right from exit A to B is banned and this movement is diverted to Cto make U-Turn at the next junction, straight forward from C to go to B. Vehicles from exit B only have one movement which is straight forward to exit C, and the movement turn right from B is diverted to exit C, where they will make U-Turn at the next crossing and turn left to Mansfield Rd.

## 7.7 M.A Jinnah/ Preedy Street Intersection


*Figure 7.17 Current Junction Layout at M.A Jinnah Rd - Preedy St Junction*

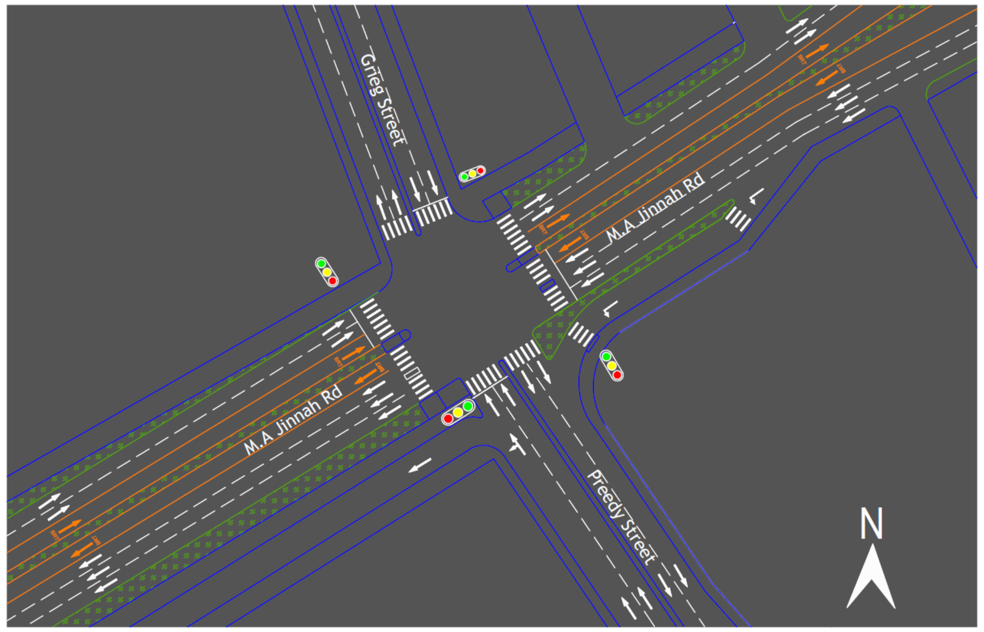



*Figure 7.18 Proposed Junction Design for M.A Jinnah Rd - Preedy St Junction*

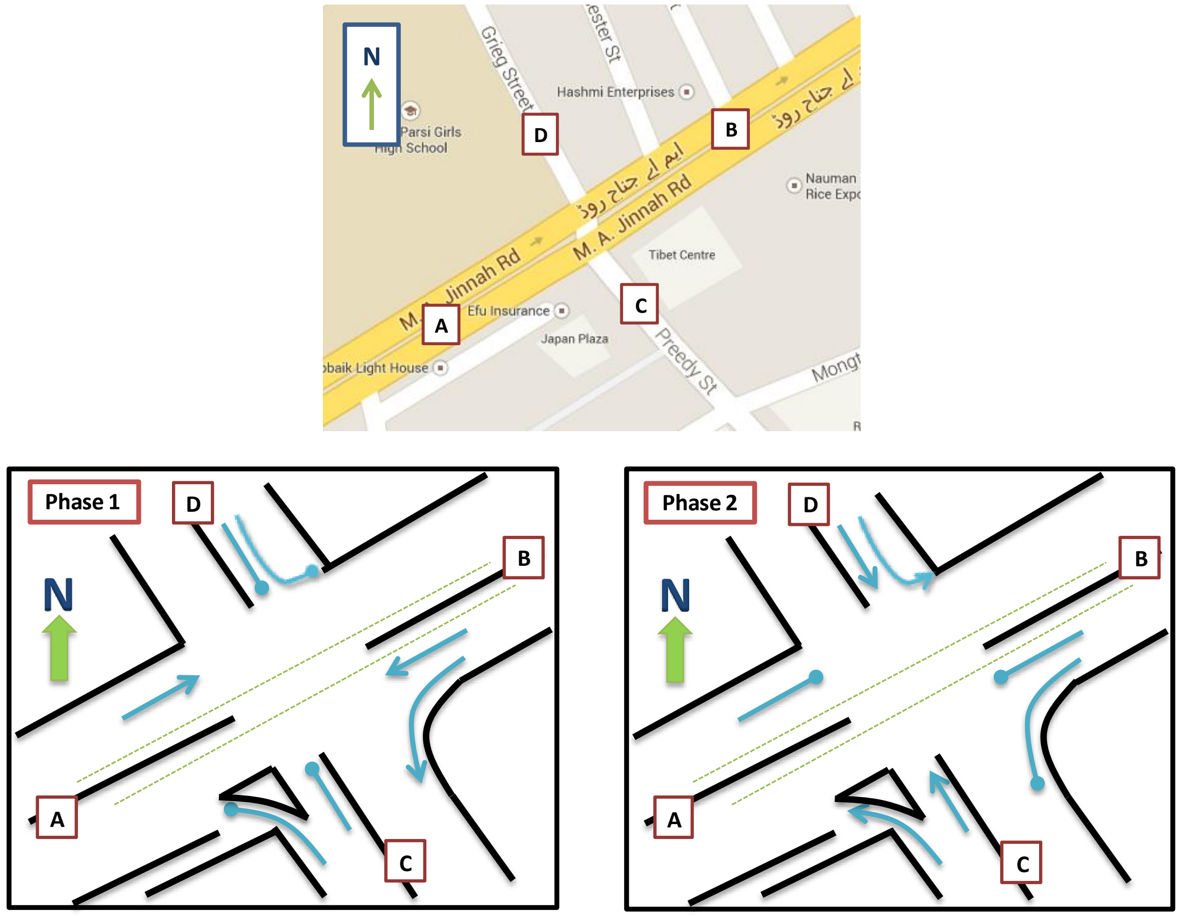



*Figure 7.19 Proposed Signal Traffic Phase*

*Table 7. 7 M.A Jinnah Rd - Preedy St Analysis*

| J4 - M.A Jinnah Rd - Preedy St (present) | | | | | | |
|---|---|---|---|---|---|---|
| **Phase** | **Side** | **To** | **Volume (pcu/h)** | **Lanes** | **Capacity (pcu/h)** | **Saturation** |
| 1 | A | Ahead | 1390 | 3 | 5400 | 25.74% |
| | | Left | 17 | 1 | 1800 | 0.94% |
| | B | Ahead | 3756 | 3 | 5400 | 69.56% |
| | | Left | 536 | 1 | 1800 | 29.78% |
| | **Maximum Saturation** | | | | | **69.56%** |
| 2 | C | Ahead | 305 | 1 | 1800 | 16.94% |
| | | Right | 358 | 1 | 1800 | 19.89% |
| | | Left | 125 | 1 | 1800 | 6.94% |
| | A | Right | 310 | 1 | 1800 | 17.22% |
| | **Maximum Saturation** | | | | | **19.89%** |
| 3 | D | Ahead | 77 | 1 | 1800 | 4.28% |
| | | Right | 46 | 1 | 1800 | 2.56% |
| | | Left | 96 | 1 | 1800 | 5.33% |
| | B | Right | 175 | 1 | 1800 | 9.72% |
| | **Maximum Saturation** | | | | | **9.72%** |
| **Total** | | | | | | **99.17%** |

| J4 - M.A Jinnah Rd - Preedy St (proposed) | | | | | | |
|---|---|---|---|---|---|---|
| **Phase** | **Side** | **To** | **Volume (pcu/h)** | **Lanes** | **Capacity (pcu/h)** | **Saturation** |
| 1 | A | Ahead | 1405 | 2 | 3600 | 39.03% |
| | B | Ahead | 3595 | 3 | 5400 | 66.57% |
| | | Left | 416 | 1 | 1800 | 23.11% |
| | **Maximum Saturation** | | | | | **66.57%** |
| 2 | C | Ahead | 663 | 2 | 3600 | 18.42% |
| | | Left | 125 | 1 | 1800 | 6.94% |
| | D | Ahead | 77 | 1 | 1800 | 4.28% |
| | | Left | 142 | 1 | 1800 | 7.89% |
| | **Maximum Saturation** | | | | | **18.42%** |
| **Total** | | | | | | **84.99%** |

| Resume Intersection Improvement | |
|---|---|
| **Scheme** | **Saturation** |
| Existing | 99.17% |
| Proposed 2 phase | 84.99% |
| **Ratio** | **116.68%** |

Intersection at M.A Jinnah and Preddy Street is a 4-arm signalized intersection. The proposed design reduces the traffic signal to 2 phases, which has reduced the saturation from 99% to 85% and improved the ratio by 116% from the existing. Special treatment can be made to protect BRT movement by banning turn right from all arms.

## 7.8 M.A. Jinnah/ Muhammad Bin Qasim Rd Intersection


*Figure 7.20 Current Junction Layout at M.A. Jinnah Rd - M. bin Qassim Rd Junction*

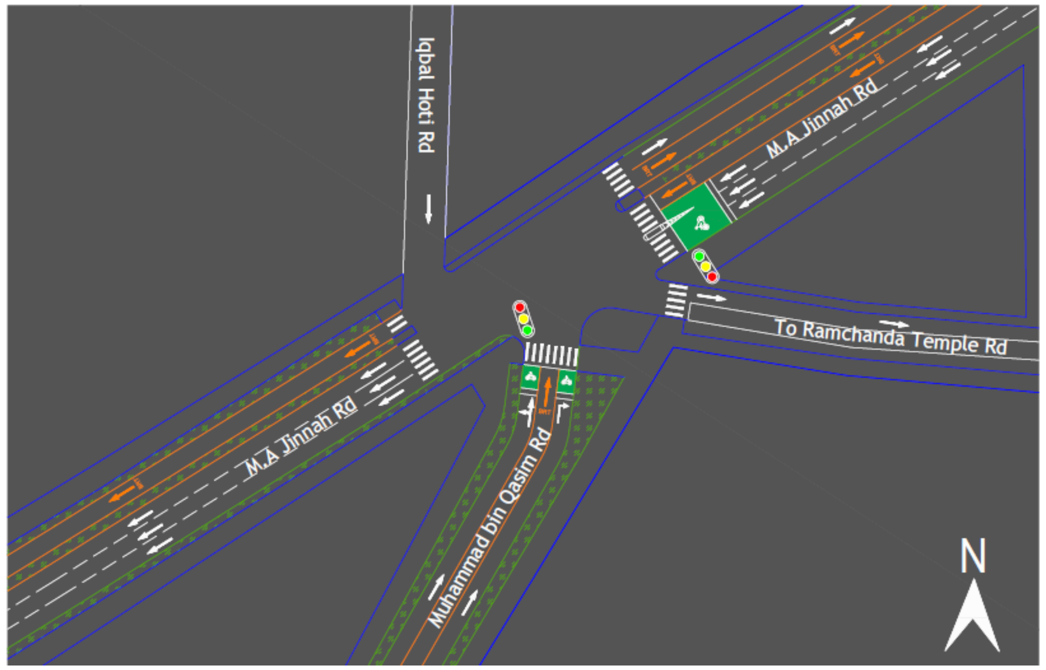



*Figure 7.21 Proposed Junction Design for M.A. Jinnah Rd - M. bin Qassim Rd Junction*

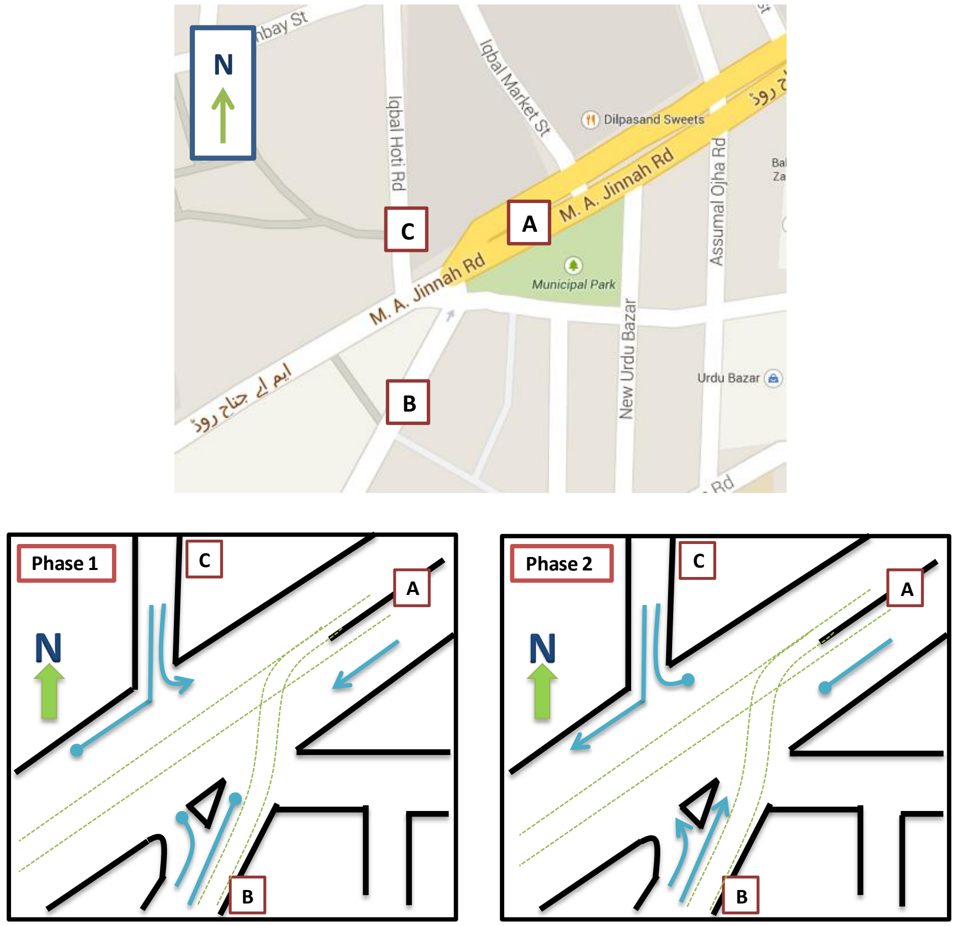



*Figure 7.22 Proposed Signal Traffic Phase*

The intersection on M.A Jinnah at Muhammad bin Qasim Rd is signalized intersection with 2-phase. The proposed design suggests banning U-Turn movement from exit A. The saturation is reduced from 96% to 94% by removing the buses from mixed traffic lane and allocate them onto BRT lane.

*Table 7. 8 M.A. Jinnah Rd - M. bin Qassim Rd Analysis*

| J5 - M.A. Jinnah Rd - M. bin Qassim Rd (present) | | | | | | |
|---|---|---|---|---|---|---|
| **Phase** | **Side** | **To** | **Volume (pcu/h)** | **Lanes** | **Capacity (pcu/h)** | **Saturation** |
| 1 | A | Ahead | 5313 | 4 | 7200 | 73.79% |
| | | U-Turn | 45 | 1 | 1800 | 3.00% |
| | B | Left | 215 | 2 | 3600 | 5.97% |
| | C | Right | 363 | 1 | 1800 | 20.17% |
| | **Maximum Saturation** | | | | | **73.79%** |
| 2 | B | Ahead | 142 | 1 | 1800 | 7.89% |
| | | Right | 816 | 2 | 3600 | 22.67% |
| | C | Left | 61 | 1 | 1800 | 3.39% |
| | **Maximum Saturation** | | | | | **22.67%** |
| **Total** | | | | | | **96.46%** |

| J5 - M.A. Jinnah Rd - M. bin Qassim Rd (proposed) | | | | | | |
|---|---|---|---|---|---|---|
| **Phase** | **Side** | **To** | **Volume (pcu/h)** | **Lanes** | **Capacity (pcu/h)** | **Saturation** |
| 1 | A | Ahead | 4149 | 3 | 5400 | 76.83% |
| | C | Left | 61 | 1 | 1800 | 3.39% |
| | B | Right | 648 | 1 | 1800 | 36.00% |
| | **Maximum Saturation** | | | | | **80.89%** |
| 2 | B | Ahead | 307 | 1 | 1800 | 17.06% |
| | C | Right | 322 | 1 | 1800 | 17.89% |
| | **Maximum Saturation** | | | | | **17.89%** |
| **Total** | | | | | | **94.72%** |

| Resume Intersection Improvement | |
|---|---|
| **Scheme** | **Saturation** |
| Existing | 96.46% |
| Proposed 2 phase | 94.72% |
| **Ratio** | **101.83%** |

## 7.9 M.A Jinnah/ Tower Intersection


*Figure 7.23 Current Junction Layout at M.A Jinnah/Tower Junction*

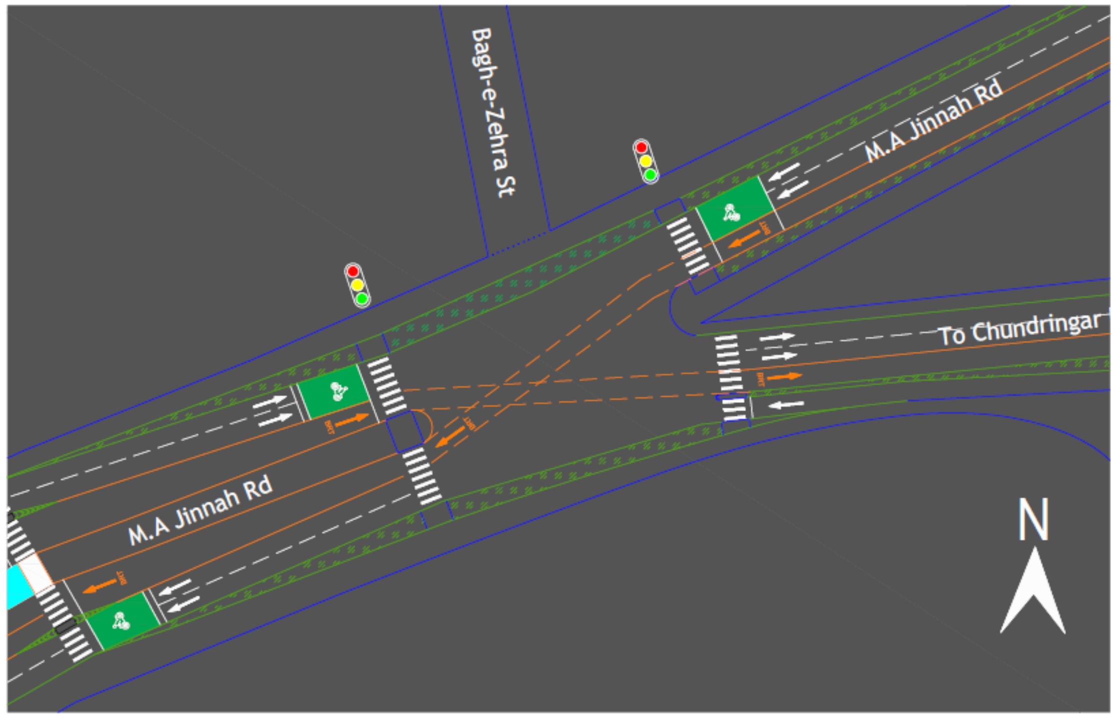



*Figure 7.24 Proposed Junction Design for M.A Jinnah/Tower Junction*

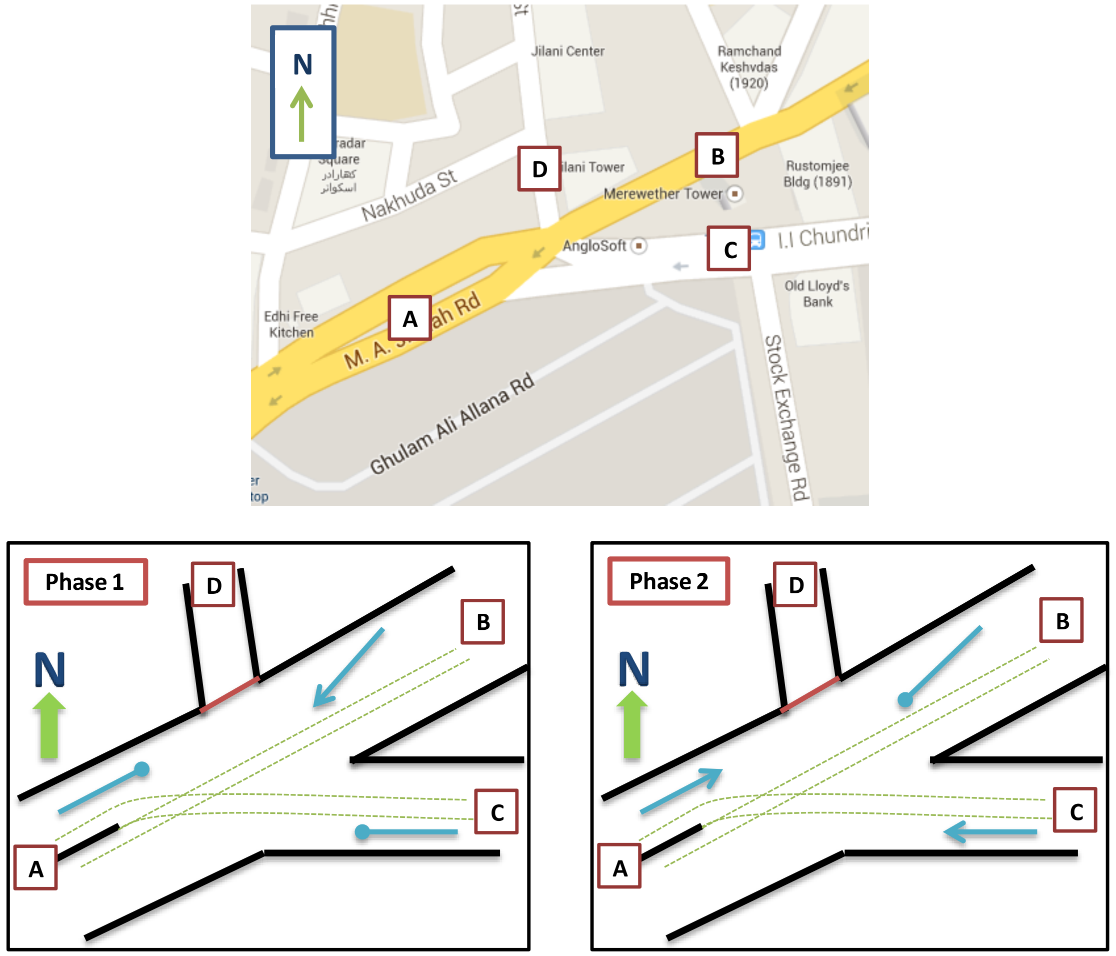



*Figure 7.25 Proposed Signal Traffic Phase*

For intersection on M.A Jinnah at Tower, the junction has 3 arms with 2 phases. Major improvement needed to close traffic from exit D, to protect BRT movement. Other special treatment is banning left turn from B and U-Turn from A. This way, junction saturation could be reduced from 95% to 94% which improves the ratio by 100.87 % from the existing.

*Table 7. 9 M.A Jinnah/Tower Intersection Analysis*

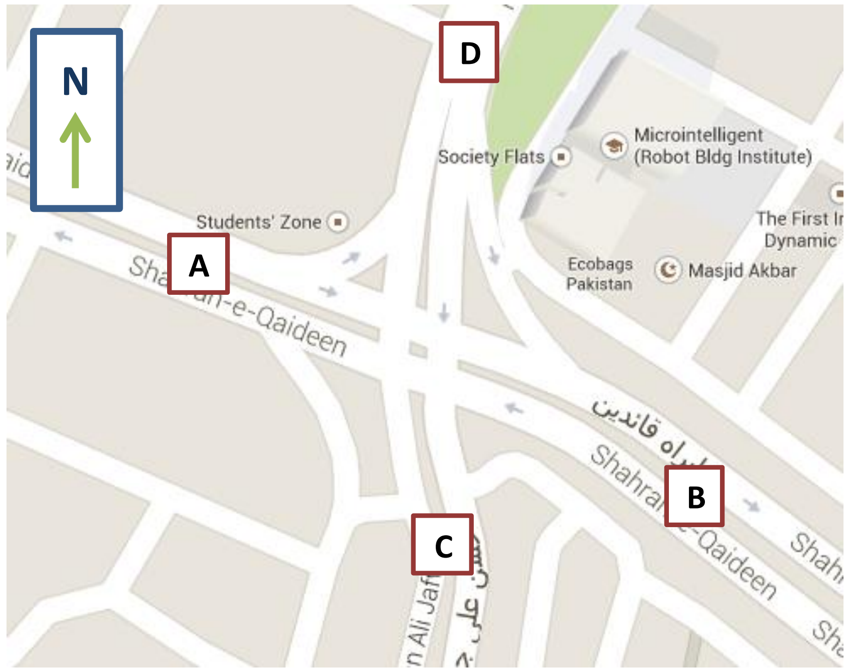
| J6–M.A Jinnah/Tower Intersection (present) | | | | | | |
|---|---|---|---|---|---|---|
| **Phase** | **Side** | **To** | **Volume (pcu/h)** | **Lanes** | **Capacity (pcu/h)** | **Saturation** |
| 1 | B | Ahead | 1510 | 2 | 3600 | 41.94% |
| | | Left | 926 | 2 | 3600 | 25.72% |
| | | Right | 29 | 1 | 1800 | 1.61% |
| | C | Ahead | 1023 | 2 | 3600 | 28.42% |
| | D | Right | 170 | 1 | 1800 | 9.44% |
| | **Maximum Saturation** | | | | | **41.94%** |
| 2 | A | U-Turn | 25 | 1 | 1500 | 1.67% |
| | | Right | 2875 | 3 | 5400 | 53.24% |
| | | Left | 55 | 1 | 1800 | 3.06% |
| | D | Left | 139 | 1 | 1800 | 7.72% |
| | **Maximum Saturation** | | | | | **53.24%** |
| **Total** | | | | | | **95.19%** |

| J6–M.A Jinnah/Tower Intersection (proposed) | | | | | | |
|---|---|---|---|---|---|---|
| **Phase** | **Side** | **To** | **Volume (pcu/h)** | **Lanes** | **Capacity (pcu/h)** | **Saturation** |
| 1 | B | Ahead | 1471 | 2 | 3600 | 40.86% |
| | **Maximum Saturation** | | | | | **40.86%** |
| 2 | C | Ahead | 963 | 1 | 1800 | 53.50% |
| | A | Right | 1863 | 2 | 3600 | 51.75% |
| | **Maximum Saturation** | | | | | **53.50%** |
| **Total** | | | | | | **94.36%** |

| Resume Intersection Improvement | |
|---|---|
| **Scheme** | **Saturation** |
| Existing | 95.19% |
| Proposed 2 phase | 94.36% |
| **Ratio** | **100.87%** |

## 7.10 Shahrah e Quaideen/ Kashmir Rd Intersection


*Figure 7.26 Current Junction Layout at Shahrah e Qaideen - Khasmir Rd junction*




The intersection at Shahrah e Quaideen which connect Hasan Ali Jafri Road to Kashmir Road is a signalized intersection with 4-arms and 3 phases signal. Current junction saturation is 94%. For proposed design, the signal phase is reduced to 2 phases. This improvement could decrease junction saturation to 90 % and improve the ratio by 103%.


*Figure 7.27 Proposed Junction Design for Shahrah e Quaideen - Khasmir Rd Junction*

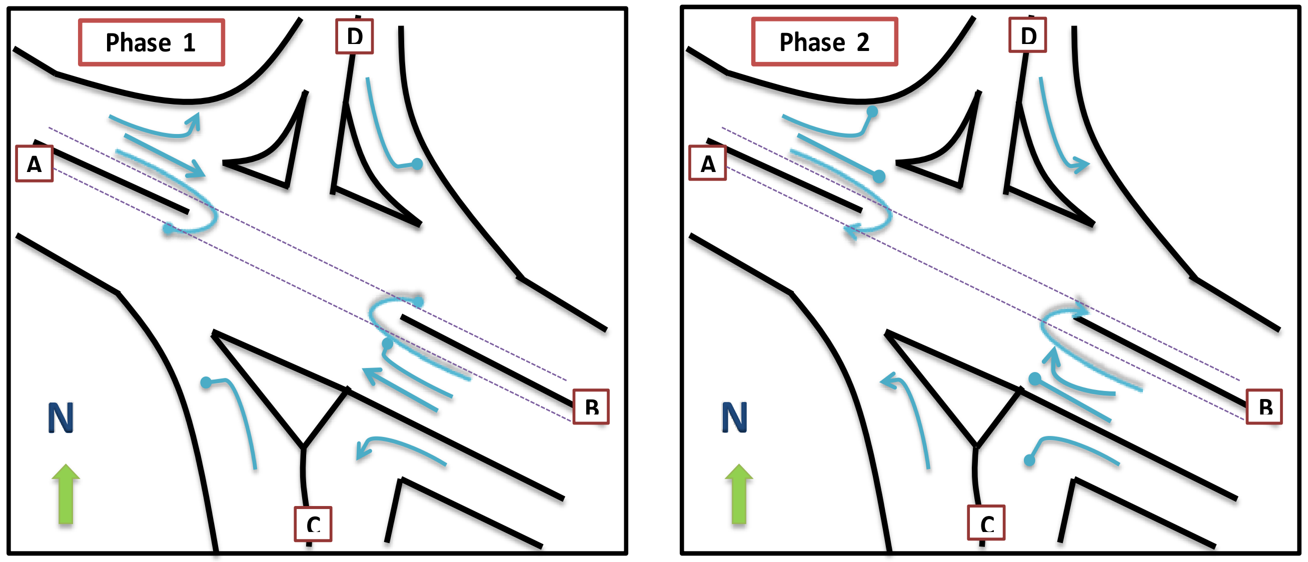



*Figure 7.28 Proposed Signal Traffic Phase*

*Table 7. 10 Shahrah e Quaideen - Khasmir Rd Analysis*

| J201 - Shahrah e Quaideen - Khasmir Rd (present) | | | | | | |
|---|---|---|---|---|---|---|
| **Phase** | **Side** | **To** | **Volume (pcu/h)** | **Lanes** | **Capacity (pcu/h)** | **Saturation** |
| 1 | B | Ahead | 1076 | 4 | 7200 | 14.82% |
| | | Left | 63 | 1 | 1800 | 3.50% |
| | A | Ahead | 1471 | 3 | 5400 | 27.24% |
| | | Left | 122 | 2 | 3600 | 3.39% |
| | | U-Turn | 60 | 1 | 1500 | 4.00% |
| | **Maximum Saturation** | | | | | **27.24%** |
| 2 | C | Ahead | 119 | 1 | 1800 | 6.61% |
| | | Right | 65 | 1 | 1800 | 3.61% |
| | | Left | 66 | 2 | 3600 | 1.83% |
| | | U-Turn | 24 | 1 | 1500 | 1.60% |
| | B | Right | 1145 | 2 | 3600 | 31.81% |
| | **Maximum Saturation** | | | | | **31.81%** |
| 3 | D | Ahead | 169 | 1 | 1800 | 9.39% |
| | | Right | 536 | 1 | 1800 | 29.78% |
| | | Left | 1249 | 2 | 3600 | 34.69% |
| | | U-Turn | 61 | 1 | 1500 | 4.07% |
| | A | Right | 85 | 1 | 1800 | 4.72% |
| | **Maximum Saturation** | | | | | **34.69%** |
| **Total** | | | | | | **93.74%** |

| J201 - Shahrah e Quaideen - Khasmir Rd (proposed) | | | | | | |
|---|---|---|---|---|---|---|
| **Phase** | **Side** | **To** | **Volume (pcu/h)** | **Lanes** | **Capacity (pcu/h)** | **Saturation** |
| 1 | A | Ahead | 1360 | 2 | 3600 | 37.78% |
| | | Left | 122 | 1 | 1800 | 6.78% |
| | B | Ahead | 923 | 2 | 3600 | 25.64% |
| | | Left | 63 | 1 | 1800 | 3.50% |
| | **Maximum Saturation** | | | | | **37.78%** |
| 2 | A | U-Turn | 55 | 1 | 1500 | 3.67% |
| | B | Right | 1103 | 2 | 3600 | 30.64% |
| | | U-Turn | 471 | 1 | 1500 | 31.40% |
| | C | Left | 247 | 1 | 1800 | 13.72% |
| | D | Left | 1895 | 2 | 3600 | 52.64% |
| | **Maximum Saturation** | | | | | **52.64%** |
| **Total** | | | | | | **90.42%** |

| Resume Intersection Improvement | |
|---|---|
| **Scheme** | **Saturation** |
| Existing | 93.74% |
| Proposed 2 phase | 90.42% |
| **Ratio** | **103.68%** |

## 7.11 Shahrah e Quaideen/ Khalid bin Walid Rd Intersection


*Figure 7.29 Current Junction Layout at Shahrah e Quaideen – Khalid bin Walid Junction*

The intersection at Shahrah e Quaideen locate at Khalid bin Walid Road has current saturation at 99% with 4 signal phases at present.

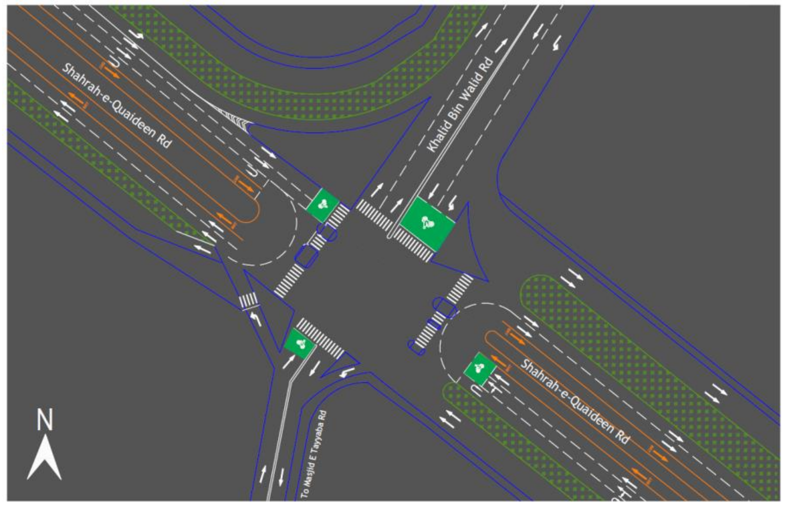
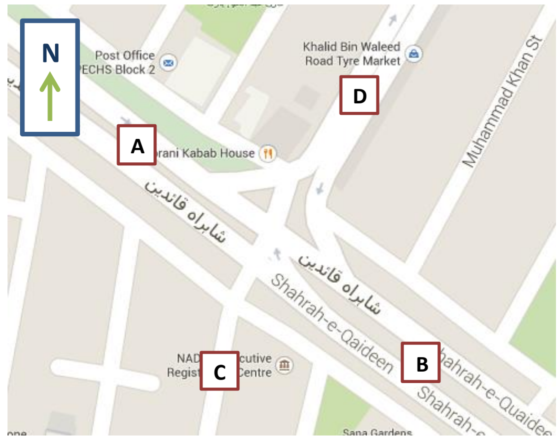



*Figure 7.30 Proposed Junction Design for Shahrah e Quaideen – Khalid bin Walid Junction*



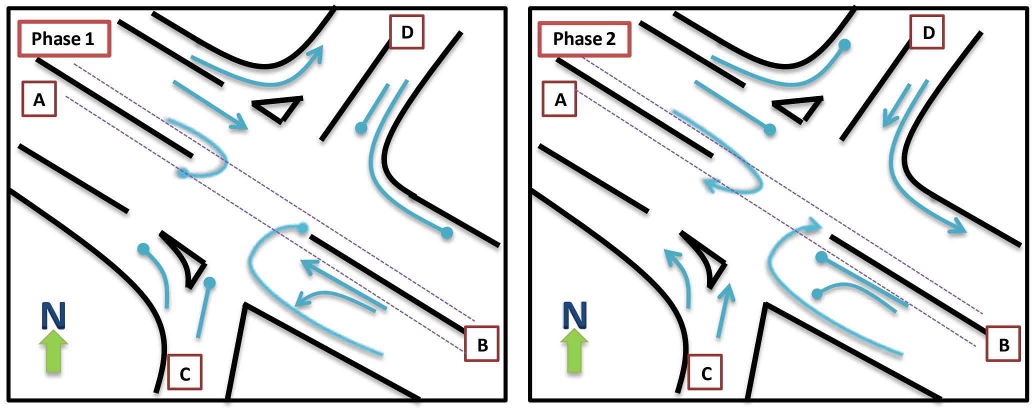




*Figure 7.31 Proposed Signal Traffic Phase*

To improve the junction performance, traffic signal phase needs to be reduced to 2-phases, which only allow straight and left movement at the junction. Right turn from each entries are banned and diverted to U-Turn at the following junction. For example, right turn from B needs to go straight to A and make a U-turn at the next junction to finally turn left to go to D, right turn movement from the minor entry D needs to turn left to B, make a U-Turn at the next junction down, and continue the movement to go to A. It will reduce junction saturation from 99% to 94%, which improves the ratio by 105% from the existing.

*Table 7. 11Shahrah e Quaideen – Khalid bin Walid Analysis*

| J202–Shahrah e Quaideen – Khalid bin Walid (present) | | | | | | |
|---|---|---|---|---|---|---|
| **Phase** | **Side** | **To** | **Volume (pcu/h)** | **Lanes** | **Capacity (pcu/h)** | **Saturation** |
| 1 | A | Ahead | 1856 | 3 | 5400 | 34.37% |
| | | Right | 190 | 1 | 1800 | 10.56% |
| | **Maximum Saturation** | | | | | 34.37% |
| 2 | B | Left | 74 | 1 | 1800 | 4.11% |
| | | Ahead | 1528 | 3 | 5400 | 28.30% |
| | | Right | 471 | 1 | 1800 | 26.17% |
| | **Maximum Saturation** | | | | | 28.30% |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 | D | Left | 478 | 1 | 1800 | 26.56% |
| | | Ahead | 229 | 2 | 3600 | 6.36% |
| | | Right | 210 | 1 | 1800 | 11.67% |
| | **Maximum Saturation** | | | | | 26.56% |
| 4 | C | Left | 81 | 1 | 1800 | 4.50% |
| | | Ahead | 188 | 1 | 1800 | 10.44% |
| | | Right | 40 | 1 | 1800 | 2.22% |
| | **Maximum Saturation** | | | | | 10.44% |
| **Total** | | | | | | **99.67%** |

| **J202–Shahrah e Quaideen – Khalid bin Walid (proposed)** | | | | | | |
|---|---|---|---|---|---|---|
| **Phase** | **Side** | **To** | **Volume (pcu/h)** | **Lanes** | **Capacity (pcu/h)** | **Saturation** |
| 1 | A | Ahead | 1924 | 2 | 3600 | 53.44% |
| | B | Ahead | 1919 | 2 | 3600 | 53.31% |
| | | Left | 74 | 1 | 1800 | 4.11% |
| | **Maximum Saturation** | | | | | 53.44% |
| 2 | A | U-Turn | 560 | 1 | 1500 | 37.33% |
| | B | U-Turn | 620 | 1 | 1500 | 41.33% |
| | D | Ahead | 229 | 1 | 1800 | 12.72% |
| | | Left | 648 | 1 | 1800 | 36.00% |
| | C | Ahead | 188 | 1 | 1800 | 10.44% |
| | | Left | 121 | 1 | 1800 | 6.72% |
| | **Maximum Saturation** | | | | | 41.33% |
| Total | | | | | | **94.78** |

| **Resume Intersection Improvement** | |
|---|---|
| **Scheme** | **Saturation** |
| Existing | 99.67% |
| Proposed 2 phase | 94.78% |
| **Ratio** | **105.16%** |

## 7.12 Shahrah e Quaideen/Tariq Rd Intersection


***Figure 7.32 Current Junction Layout at Shahrah e Quaideen – Tariq Junction***

The intersection at Shahrah e Quaideen between Captain Fareed Bukhari Shaheed Road and Tariq Road has signalized intersection with 4-arms and 4 signal phases junction. With similar approach like previous junction, the saturation is reduced from 98% to 96%, which can increase performance by 102%.

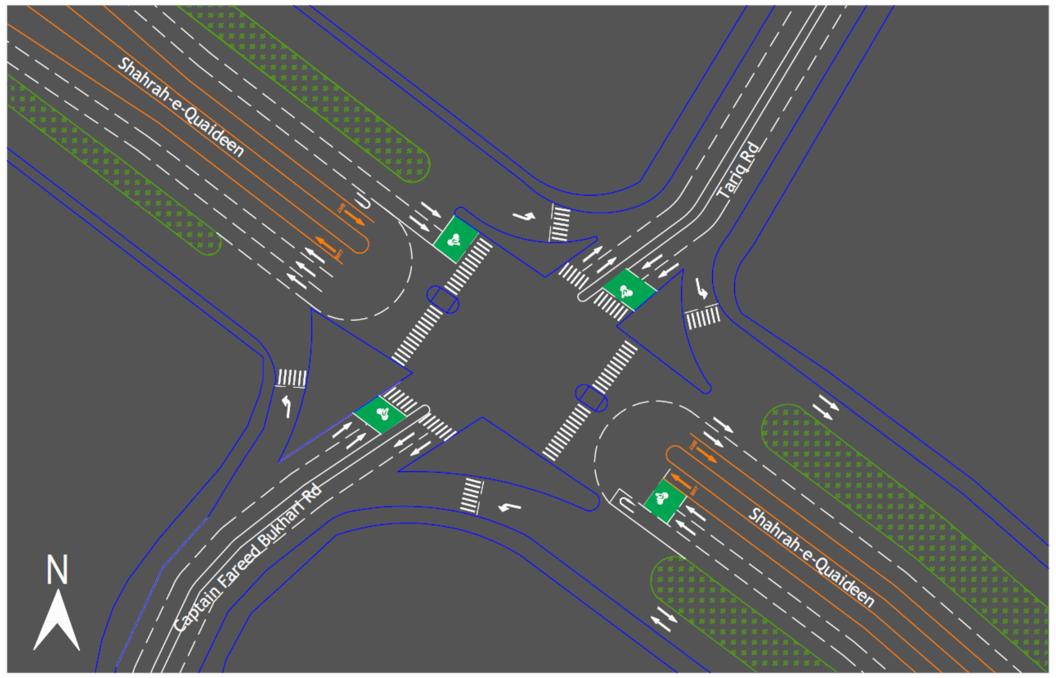
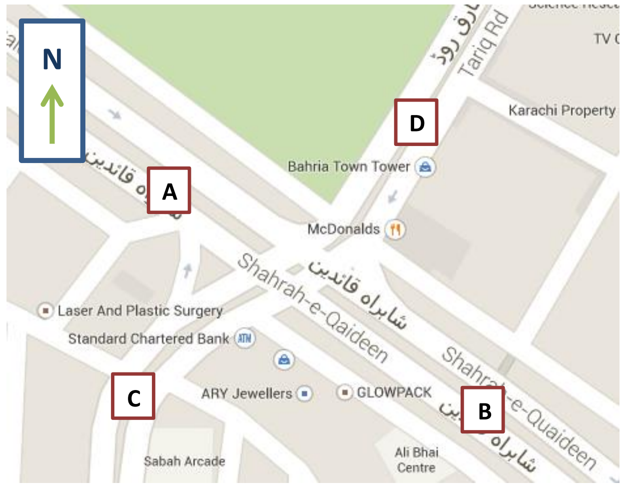



***Figure 7.33 Proposed Junction Design for Shahrah e Quaideen – Tariq Junction***



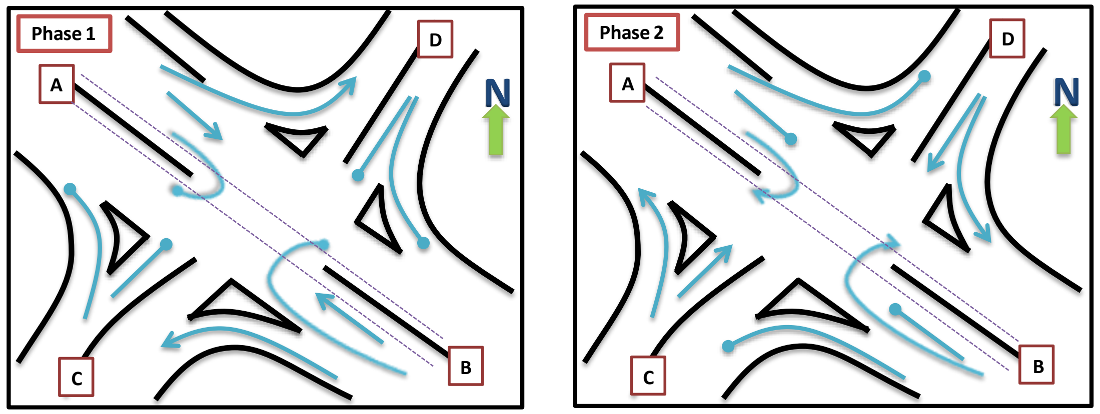




*Figure 7.34 Proposed Signal Traffic Phase*

*Table 7. 12 Shahrah e Quaideen – Tariq analysis*

| J203-Shahrah e Quaideen – Tariq (present) | | | | | | |
|---|---|---|---|---|---|---|
| **Phase** | **Side** | **To** | **Volume (pcu/h)** | **Lanes** | **Capacity (pcu/h)** | **Saturation** |
| 1 | D | Ahead | 156 | 2 | 3600 | 4.33% |
| | | Right | 358 | 2 | 3600 | 9.94% |
| | **Maximum Saturation** | | | | | 9.94% |
| 2 | A | Ahead | 2332 | 4 | 7200 | 32.39% |
| | | Right | 211 | 2 | 3600 | 5.86% |
| | **Maximum Saturation** | | | | | 32.39% |
| 3 | B | Left | 272 | 1 | 1800 | 15.11% |
| | | Ahead | 1319 | 4 | 7200 | 18.32% |
| | | Right | 379 | 1 | 1800 | 21.06% |
| | | U-Turn | 607 | 1 | 1800 | 40.47% |
| | **Maximum Saturation** | | | | | 40.47% |
| 4 | C | Ahead | 559 | 2 | 3600 | 15.53% |
| | | Right | 472 | 2 | 3600 | 13.11% |
| | **Maximum Saturation** | | | | | 15.53% |
| **Total** | | | | | | **98.33%** |

| J203-Shahrah e Quaideen – Tariq (proposed) | | | | | | |
|---|---|---|---|---|---|---|
| **Phase** | **Side** | **To** | **Volume (pcu/h)** | **Lanes** | **Capacity (pcu/h)** | **Saturation** |
| 1 | A | Ahead | 2361 | 2 | 3600 | 65.58% |
| | B | Ahead | 1528 | 2 | 3600 | 42.44% |
| | | Left | 211 | 1 | 1800 | 11.72% |
| | **Maximum Saturation** | | | | | 65.58% |
| 2 | A | U-Turn | 190 | 1 | 1800 | 12.67% |
| | B | U-Turn | 462 | 1 | 1800 | 30.80% |
| | C | Ahead | 559 | 2 | 3600 | 15.53% |
| | | Left | 472 | 1 | 1800 | 26.22% |
| | D | Ahead | 156 | 2 | 3600 | 4.33% |
| | | Left | 336 | 1 | 1800 | 18.67% |
| | **Maximum Saturation** | | | | | 30.80% |
| Total | | | | | | **96.38%** |

| Resume Intersection Improvement | |
|---|---|
| **Scheme** | **Saturation** |
| Existing | 98.33% |
| Proposed 2 phase | 96.38% |
| **Ratio** | **102.02%** |

# 8 Analysis of Current Bus Industry

This chapter discusses the current bus industry condition. Since 'Direct-Service' operational model will use the existing bus routes, the issue of accommodating the current bus operators into the BRT system becomes important. Examples from Jakarta, Mexico City and even Bogota has shown that existing bus operators who has route overlap with BRT corridor cannot be neglected, and such mistreatment to handle them would make the BRT project at trouble. Any BRT proposal which do not consider the existing bus routes and operators in their plan should be questioned, as it might not guarantee a success in the implementation.

## 8.1 Brief history of Karachi Bus Industry

The existing bus industry in Karachi are quite similar with many cities in developing world, where public transport system were developed and initiated by the operators, buses are individually owned, and role of government is very minimal in the operation, such as issuing and renewing the permit only. This has made the operators assume that they own and control the routes, not the government.

Most of the transporters started the business from 1973, mostly coming from outside Karachi, such as Khyber Pakhtunkhwa area, northern district of Pakistan. Some of them already inherited their business to their sons, and these generations of business are well educated, and have other businesses besides bus operator.

## 8.2 Stakeholders

### 8.2.1 Route Operator

Route operator and bus owner generally are called transporter. Route operator is the 'official' owner as registered in the RTA (Regional Transport Authority) database, but in reality they are not the majority bus owner in one route. They work in partnership, normally between 4-5 operators per route although only 1 name is registered in the RTA database.

For this service they receive payment from bus owner between Rs. 50-60 per bus per day for big bus, and vary for minibuses and coaches

Route operators normally own the bus, but they might not have 10 buses per route to meet the minimum requirement for a new route. Therefore route operator invited other bus owners under their supervision and with facilities to run the bus, such as depot and terminal. In some cases, route operator bears the fuel cost, driver and conductor salary to show the bus owner on the profitability of the route.

Operation-wise, the route has the responsibility to make sure each bus run on schedule. To do this, they hire time keeper, which are position at the end of each route, and sometimes at checkpoints in between. In general, 2 to 5 timekeepers are hired for every route. For example, Marwat Coach Route has 4 time keepers working on their route.

*Figure 8.1 Bus Terminal for Route 'Muslim'*

Route operators also make sure the buses running smoothly without the authority stopping them, or warn the driver to avoid certain roads due to protests or demonstrations. Any fees associated with bus operation are also the responsibility of the route operator. To run this service, they charge bus owner with some fee, varies between Rs. 200 and Rs. 700 per bus per day. This charge is used not only to cover the costs and salary, but also as 'insurance' money for bus owner should their bus is burned or severely damaged during protest and demonstration. The operator, through Bus Owner Association, would give Rs. 300,000 to Rs. 400,000 to bus owner if their bus is completely burned by riots. They also provide lawyer to assist the bus owner for any incidents.

There are bus owner association in Karachi, such as Karachi Bus Owner Association (KBOA), Karachi Muslim Minibus and Coach Association, and Karachi Muttahida Transport Owner Association. These associations are under alliance of Karachi Transport Ittehad (KTI).

*Figure 8.2 KTI Members during Discussion with Project Team*

### 8.2.2 Bus Owner

In average, there are 8-10 bus owners in one route. They join to fulfill RTA minimum fleet requirement to run one route. To run the bus, they need a route license from the RTA which costs Rs. 700/ bus, and valid for 3 years. Bus owner hire driver, conductor, to run their buses. They are also responsible to pay their salary, normally by commission basis. Vehicles maintenance is also the responsibility of bus owners, although sometimes they use joint depot facility owned by route operator.


*Figure 8.3 Bus Terminal of Route ' W-11', also Used as Depot*

### 8.2.3 Regional Transport Authorities (RTA)

Regional Transport Authority is an authorized department under the Government of Sindh, and supervised by the Commissioner. RTA issues public transport permit in city level, and every public transport such as bus, minibuses, coach, need to be registered in RTA.

Routes are selected by the transporter based on their choice and research. RTA board is headed by chairman, and RTA/commissioner Karachi approves the route.

The Procedure to apply for new route is as follow: the transporter submit application to the RTA, RTA advertise this as public announcement to look for public response/objection. If any objection were indicated, RTA will write to Traffic Police Transport & Communications Department, who will send feedback to the RTA. Highest authority for approving route classification is RTA board. There is no fee on route classification except the route operator as to pay for newspaper advertisement charges.

To get the Route Permit, transporter should pay Rs. 700 per bus which valid for 3 years. After that they need to renew the route permit and pay the same amount as before.

## 8.3 Operation

### 8.3.1 Vehicles

Although many buses in Karachi are already old, many bus owner still make the lease payment to lender, particularly for the new owner who buy second-hand buses from previous bus owner. Price of second hand bus is between Rs. 0.7 and Rs. 1.0 million for big bus, and Rs. 1.2 to Rs. 1.5 million for minibus/coach. This price also covers the license and registration, although the new owner needs to register the license transfer at the RTA.

Majority of the minibuses are Mazda brand, which were purchased in 1993. Some vehicles were used in the past, but not as tough as Mazda, which they claim have adapted into Karachi road and climate condition. Mazda stopped their bus production and recently closed the spare-part factory, so they need to find from others.

*Figure 8.4 Decorated Buses of W-11 Fleet*

The bus would be periodically maintained once per 6 months. This is fitness certificate requirement by the Govt.  Motor vehicles examiner checks the vehicle and issue fitness certificate. However, according to president KBOA, in practice the owner of bus/ mini can get their vehicle through without checking. The minibuses are decorated in a colorful pattern to attract Passengers. The decoration painting could cost around Rs. 100,000, according to one W-11 bus owner.

Recently, few Chinese buses were tested in Karachi but failed as they suffered from gearbox problem, and no technical support was provided from the manufacturers. In general, the transporters are not reluctant to other brand, as long as the technical support and spare-part are available. Some of the transporters have seen good quality Chinese buses, and are willing to test the buses if support and spare-part are available

### 8.3.2 Fare

Secretary Transport & Mass Transit of GOS is responsible for setting up fare levels of public transport in Karachi. Currently, low fare is considered a problem for the transporter with fare structure as follows:

- 1-5 km Rs. 10/-
- 5-10 km Rs. 15/-
- 10-15km Rs. 16/-
- 15+ km Rs. 16/-

Student concession are 50% i.e Rs. 5 & Rs 8)

KTI proposed the fare to be at least Rs. 20/ 5 kilometer, but the Chief Minister of Sindh did not approve. Last increase happened in 2011 and there was a correlation between fare and CNG. Thus in 2012, due to decrease in CNG price, the fare was also decreased.

## 8.4 Financing

Money lender for buses charges relatively high interest rate, at 25% per annum and 4 years tenor. This would mean for minibuses, bus owner need to pay the lease between Rs. 45,000 and Rs. 60,000 per month. Money lenders borrow from the bank at the interest rate around 12% per annum, and make profit around 50-60% in total. Money lenders arrange funds from their own sources, since banks are reluctant to give loan to transporters because of past poor lending experience during the Prime Minister Scheme.

The 'Prime Minister Scheme', launched in 1993,was aimed to help the transporter to borrow money from Bank, however due to many manipulation from the borrower (such as selling the vehicles abroad or un-experienced sector failed running the business), the scheme was stopped, and transporter having difficulties to borrow money from the Bank until today.

## 8.5 Operational Data of Selected Routes

Interviews with different bus owners, bus drivers and route operators on selected routes were conducted to understand current operational conditions, as well as financial data related to bus operations, as shown in table below. 5 major minibus routes were taken as sample. In general, they have similar model and cost structure. For example, drivers are paid on commission basis, generally around 10% from revenue. The drivers also pay the route operator at terminals, and some routes they pay at check points in between routes.

***Table 8.1 Operational Data Summary on Selected Routes***

| No | Parameter | Source | Route Name | | | | |
|---|---|---|---|---|---|---|---|
| | | | **W-11** | **Muslim** | **Marwat** | **F-11** | **D-7** |
| 1 | Salary for Driver | Bus Owner | None | None | None | None | None |
| 2 | Commission for Driver | Bus Owner | 10% Commission on Revenue | 10% on earning (Rs.600 to Rs.800 per day depending on revenue) | 10% on earning (Rs.600 to Rs.800 per day ) | 10% on earning (Rs.700 to Rs.800 per day ) | 10% on earning (Rs.800+ per day ) |
| 3 | Maintenance Cost per bus / Month | Bus Owner | Rs.15,000 per month (If the Minibus is in Good Condition) | Rs. 25,000 per month (Pair of tyres Chinese Rs. 30,000, life 6 months need to be replaced , Mobil Oil Rs.3,000 for 15 days) | Rs. 30,000 per month | Rs. 15,000 per month (This does not include the tire replacement cost which is high and need to be incurred after 6 to 7 months. | Rs.13,000 per month (Excluding Tire Cost) |
| 4 | Payment to Route Operator per bus/ Day | Bus Owner | Kemari Terminal Rs. 200 , New Karachi Terminal Rs.300 ( In between the route Rs.30+Rs.10+Rs.20=Rs.60 this amount does not go to operator but charged by the time keeper hired to maintain time schedule.) | Rs. 200+ Rs. 200 = Rs. 400 (at end points). In between the routes Rs.20+Rs.20+Rs.20+Rs.20 = Rs.80 (not going to the operator) | Rs. 200+ Rs. 200 = Rs. 400 (at end points). In between the routes Rs.100 at 3 to 4 points (not going to the operator) | Rs.100+ Rs.100 = Rs.200 (at end points). According to route operator no payment in between the route is paid. | Rs.150+ Rs.150 = Rs.300 (at end points). In between the routes Rs.50+ Rs.50 on each trip |
| 5 | Gross Revenue Per bus/ Day (From Driver) | Bus Driver | Rs.6,000 to Rs.6,500 | Rs.7,000 to Rs.8,000 | Rs. 5,500 to Rs. 6,500 (saving Rs. 2,000 after deducting expenditure) | Rs. 6,000 to Rs. 7,000 | Rs. 7,000 to Rs. 8,000 |
| 6 | CNG Consumption rate (Kg/km) | Bus Driver | 3 Km/Kg ( Pay Rs. 2,500 per day, 35 Kg CNG is consumed, Rate Rs. 70.50 per kg) | 3 to 3.5 Km/Kg (Pay Rs. 2,800 per day. About 42 Kg CNG is consumed, Rate Rs. 70.50 per kg) | 3 to 4 Km/Kg depending on traffic condition (Pay Rs. 3,000 per day. About 45 Kg CNG is consumed, Rate Rs.70.50 per kg) | 3 to 3.5 Km/Kg ( For 2 trips up and down 44 Kg CNG is consumed at cost of Rs.3,300) | Spend Rs.3,000 to Rs.4,000 per day on CNG |
| 7 | Number of Driver Shift per day | Bus Driver | 1 Driver ( 10% i.e Rs.600 to Rs.700) +1 Conductor (9 % i.e Rs.500 to Rs.600 ) | 1 Driver (10% i.e Rs.600 to Rs.700) +1 Conductor (10 % i.e Rs.600 to Rs.700) Conductor also plays an important role as he shouts and attracts passengers to the vehicle. Timing: 6 am to 11:30 pm | 1 Driver (10% i.e Rs.600 to Rs.700) +1 Conductor (10 % i.e Rs.600 to Rs.700) Conductor's role is very important as he shouts and attracts passengers to the vehicle. | 1 Driver ( 10% i.e Rs.700 to Rs.800) +1 Conductor ( Rs.400 ) | 1 Driver ( 10% i.e Rs.800) +1 Conductor ( Rs.500 ) |
| 8 | Number of Time keeper | Route Operator | 2 | 2 | 2 | 2 | 2 |
| 9 | Salary of Time Keeper | Route Operator | Rs.500 each per day | Rs.15,000 each per month | Not Sure Maybe 10% to 11% per day | Rs.500 per day (Rs.15,000 each per month) | Rs.450 per day (Rs.13,000 each per month) |
| 10 | Number of Return Trip/Bus/ Day | Route Operator | 2 (4 hours required to complete trip) | 2 to 2.5 trips (2 full 1 short depending on traffic) | 2 trips per day (5 am to 11 pm) | 2 trips per day (5:40 am to 11 pm) | 2 to 3 trips per day (6 am to 10 pm) |

## 8.6 Financial Analysis of Selected Existing Minibus Routes

Quick financial analysis of the current minibus routes are shown on the right. Most of the data were obtained through interviews and meetings with the transporters. First analysis was done to see the revenue condition of bus owner. The gross revenue between Rs. 6500 to Rs. 8000 per day, need to be deducted by the cost such as bus maintenance; payment to route operator; driver and conductor salary; and CNG, which leave the bus owner with net revenue between Rs. 1,500 and Rs. 3200 per bus per day.

The route operator's financial condition is also assessed. By getting the revenue from the bus owner between Rs.200 and Rs. 700 per bus per day, after deducted by 'other cost' and salary for timekeeper, the route operators earn between Rs. 9,000 and Rs. 21,000 per day. This net revenue still need to be split among operators with the partnership system, normally between 3 to 5 partner per route, and some of this cost might also need to be paid to the association to cover for incident, i.e. vehicle being vandalized or burned by riots.

Although this financial analysis was done rapidly with rough estimate, this may provide a basis to develop financial scheme of the BRT model, especially when illustrating the benefit of joining the BRT on monetary terms. The BRT financial scheme should generate more profit than what they are making currently.

Since there is no information obtained regarding the status of the vehicle ownership, thus it is assumed that these buses are already possessed by the bus owner and no lease payment is required. However, by assuming the lease payment at Rs. 45,000 to Rs. 60,000 per month, many routes might not make any profit, or only very small profit. This is due to high interest rate applied by the money lender.

This should be made clear that with BRT, they will need to procure the bus themselves, with possible lending scheme made special for BRT operators, with much lower interest rate, e.g. below 10%.

***Table 8.2 Summary of Cost & Revenue Analysis***

| Parameter | Route Name | | | | |
|---|---|---|---|---|---|
| | **W-11** | **Muslim** | **Marwat** | **F-11** | **D-7** |
| Number of Bus | 110 | 120 | 150 | 100 | 220 |
| Maintenance/Day (Rs) | 600 | 1000 | 1200 | 600 | 520 |
| Payment to Route Operator /Day (Rs) | 560 | 480 | 700 | 200 | 400 |
| Gross Revenue/Day (Rs) | 6500 | 8000 | 6500 | 7000 | 8000 |
| CNG Cost/Day(Rs) | 2500 | 2800 | 3000 | 3300 | 4000 |
| Salary for Driver (Rs) | 650 | 800 | 650 | 700 | 800 |
| Salary for Conductor (Rs) | 600 | 700 | 700 | 400 | 500 |
| Salary for Time Keeper (Rs) | 500 | 600 | 650 | 500 | 450 |
| Other Route Operator Cost/ Day (Rs) | 400 | 400 | 400 | 400 | 400 |
| **Bus Owner Revenue** | | | | | |
| Nett Revenue Bus Owner/Bus/Day (Rs) | 2,190 | 3,220 | 1,450 | 2,400 | 2,300 |
| **Nett Revenue Bus Owner/Bus/Month (Rs)** | **54,750** | **80,500** | **36,250** | **60,000** | **57,500** |
| **Operator Revenue** | | | | | |
| Nett Revenue Route Operator/Day (Rs) | 10,000 | 10,800 | 13,700 | 9,000 | 21,100 |
| **Nett Revenue Route Operator/Month (Rs)** | **250,000** | **270,000** | **342,500** | **225,000** | **527,500** |

# 9 Business and Partnership Model of 'Direct-Service'

## 9.1 'Direct-Service' BRT Business & Financial Model

### 9.1.1 Payment Scheme

Payment scheme of the BRT 'Direct-Service' system is proposed for two models: At the Non-BRT segment and at BRT corridor. During the non-BRT segment, BRT bus will run outside the corridor and pick up passengers from curb-side bus stops. Fare at this segment is paid on-board, either through fare box or pay to bus conductor, employed by bus operator. Fare revenues which are collected at this segment will go directly to bus operator.

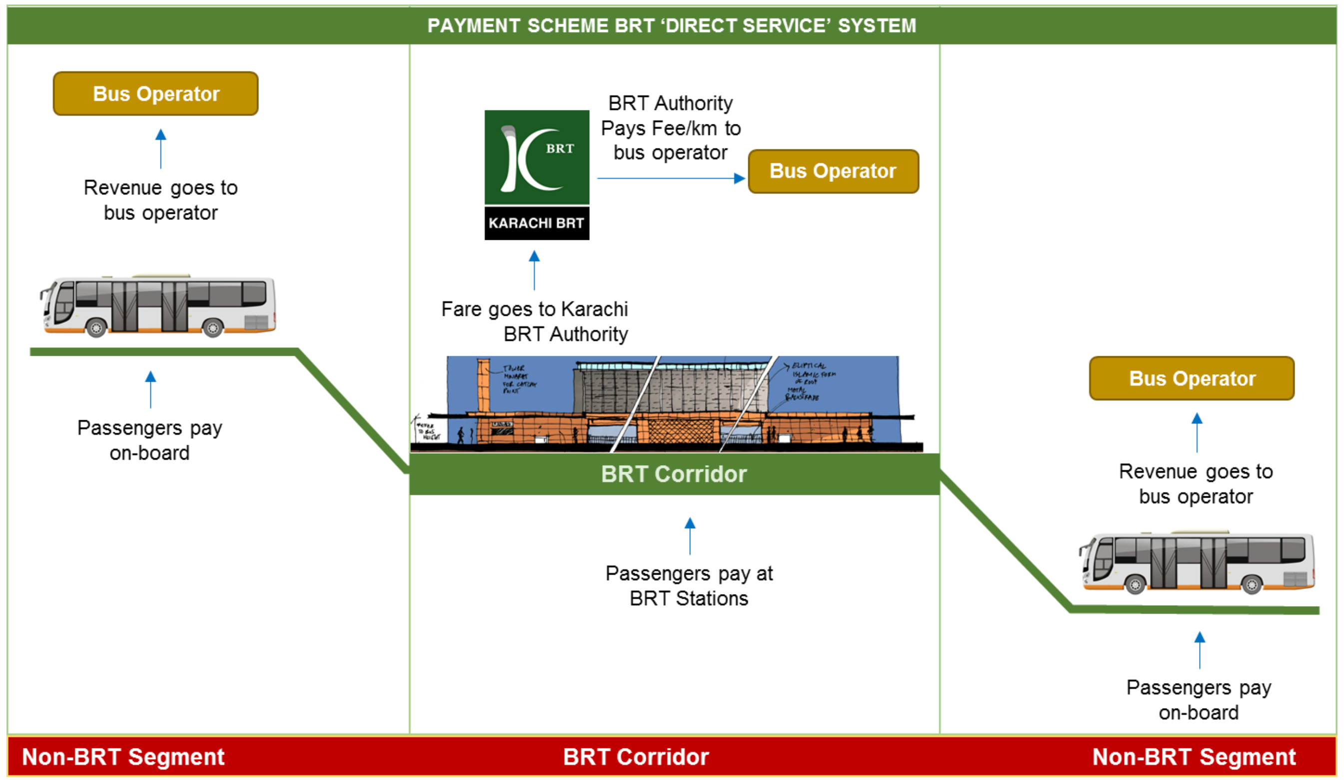



*Figure 9.1'Direct-Service' BRT Payment Scheme*

Once the bus enters the BRT corridor and stop at BRT stations, passengers can enter the bus for free, as payment is made when passengers enter the station area. During this segment, no fares can be collected by bus operator. As compensation, they receive service payment which varies according to kilometer they travel on BRT corridor. All fare revenues which are collected at BRT stations will go to the BRT authority, which will be used to pay bus operator, station & ITS maintenance and overheads. Fares at station can be managed by BRT authority, but for accountability purpose, it is recommended that fare collection operator is hired to handle revenue.

### 9.1.2 Bus Operator Contract

Contract with bus operator can be assumed with 'net cost contract' or 'semi-gross cross contract'. With net cost contract, payment to the bus operator is made through fixed fee per kilometer basis. With fixed fee per kilometer, the BRT operator will be paid according to the bus kilometer travelled on BRT corridor, regardless of number of passengers riding the system. This will give the bus operator guaranteed income every month, as long as they meet the service requirement set by the BRT authority.

Single fare system should be applied for the proposed payment scheme. Flat fare, distance-based or fare-zone system can be applied in the system, for both at non-BRT segment and on BRT corridor. It is also important for the system to consider free-transfer at station. Thus, passenger require to change bus can do so without having to pay again.

The 'semi gross-cost contract' payment will be based on proportion of the BRT kilometer travelled, combined between different BRT operators. The bus operator will be paid using the BRT fare revenue collected at the BRT stations, after deducting with overheads and fare collection fee.

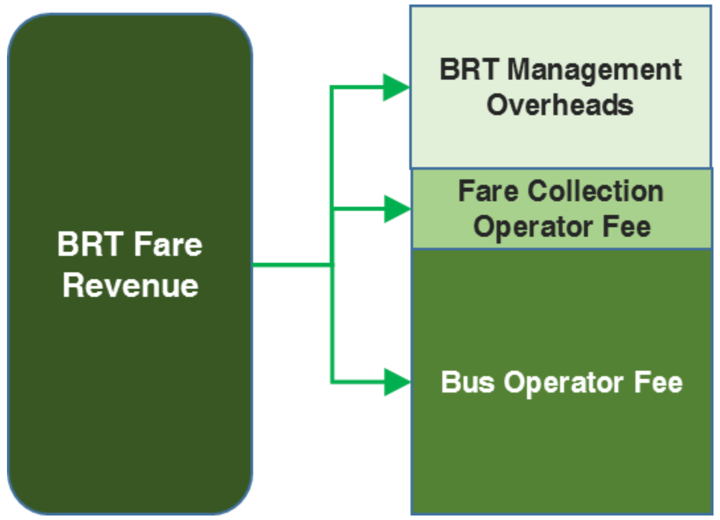



*Figure 9.2 'Semi Gross-cost' Contract Revenue Stream*

In this contract model, bus operator still bear the revenue risks from the BRT stations. However, this would also mean that the BRT bus operator can get more revenue if more passengers using the BRT system. This is important for the BRT bus operator to receive the benefit of passenger increase in the BRT, so that they are more motivated to increase the level of service and attracting more passengers.

With 'net-cost contract', any passenger increase would not make BRT bus operators getting more revenue. If any, many of them might complain since their buses getting overload, which creates quicker wear and tear, but no additional benefit will be received by them. 'Semi gross-cost' contract model will ensure the BRT bus operator receive additional benefit with additional passengers they carry from the BRT station.

To illustrate how the 'semi gross-cost' contract works in Karachi BRT, an example is shown as follow. Assuming the total BRT revenue received from station, after deducting with other payment is Rs. 2,000,000. With 5 BRT bus operators produce a total of 10,000 kilometer bus travel on BRT corridor, operator A, which produces 2,500 kilometers, will receive 25% from the total bus operator payment, or Rs. 125,000.

Total BRT Bus Km: 10,000 km | Total BRT Revenue: Rs. 2,000,000

| Operator | Km | Fee Payment |
|---|---|---|
| BRT Operator "A" | 2,500 km | Rs. 125,000 |
| BRT Operator "B" | 1,500 km | Rs. 75,000 |
| BRT Operator "C" | 1,000 km | Rs. 50,000 |
| BRT Operator "D" | 3,000 km | Rs. 150,000 |
| BRT Operator "E" | 2,000 km | Rs. 100,000 |

***Figure 9.3 Illustration of Operator's Payment***

### 9.1.3 Benefit of the New Business Model for Operator

Compare to the existing business model of Karachi Minibuses and coaches, the new business model for BRT bus operator would bring the following benefits:

- Faster travel speed on BRT corridor with dedicated lane
- Guaranteed income from the BRT corridor
- Minimize the risk of passenger revenue, especially on BRT corridor
- With demand increase in the future, expand the scale of investment for BRT fleet
- Opportunity to expand business through getting BRT contract on various BRT routes
- Opportunity to transform into more professional public transport operator

However, it should be noted that the purpose of the BRT is not to improve the business of existing bus operator, but more on wider improvement of public transport in Karachi. Therefore if there is no interest from the existing bus operator to join the BRT system, the government should leave them out of the BRT, and seek new and professional bus operator who has interest in BRT business.

### 9.1.4 Bus Operator Selection

During the initial phase, existing operator currently operating on the BRT proposed routes can be considered as BRT bus operator. This is to minimize rejection from the existing bus industry on the BRT plan. However, they cannot be automatically receives the BRT contract to run the service. Competitive tender should be held to select the bus operator for BRT. The tender should be opened to any public transport company, not only from Karachi, but also across Pakistan, so that Karachi BRT can ensure they receive the best players from the public transport industry in Pakistan. A special arrangement can also be made to invite operators from outside Pakistan, to get the international best practice in bus operation.

To accommodate the existing local bus operators in Karachi, especially whose routes will be transformed into the BRT, special privilege can be made during the tender for them. For example, in the tender scoring system, any bidder who has partnership with local bus operator on selected BRT routes will receive additional points on the tender. The other way is to make the requirement for bidder to have partnership with local bus operator on BRT routes during the bid. This way, existing local bus operator in Karachi will be accommodated in the new BRT system, with partnership with major public transport operator, who has the required financial and technical capacity to run the BRT operation.

## 9.2 Institutional Settings

### 9.2.1 Main Organizations Involved

With BRT, major changes in the regulatory settings for public transport operation and management are required. The BRT system needs to be regulated by an autonomous authority which has the responsibility to run the entire service of BRT. The responsibility of the BRT authority extends from station management, fare collection and bus operation. To run the bus operation and fare collection, the BRT authority are supported by bus operator and fare collection operator. These operators are contracted by BRT authority to make the operation more efficient.

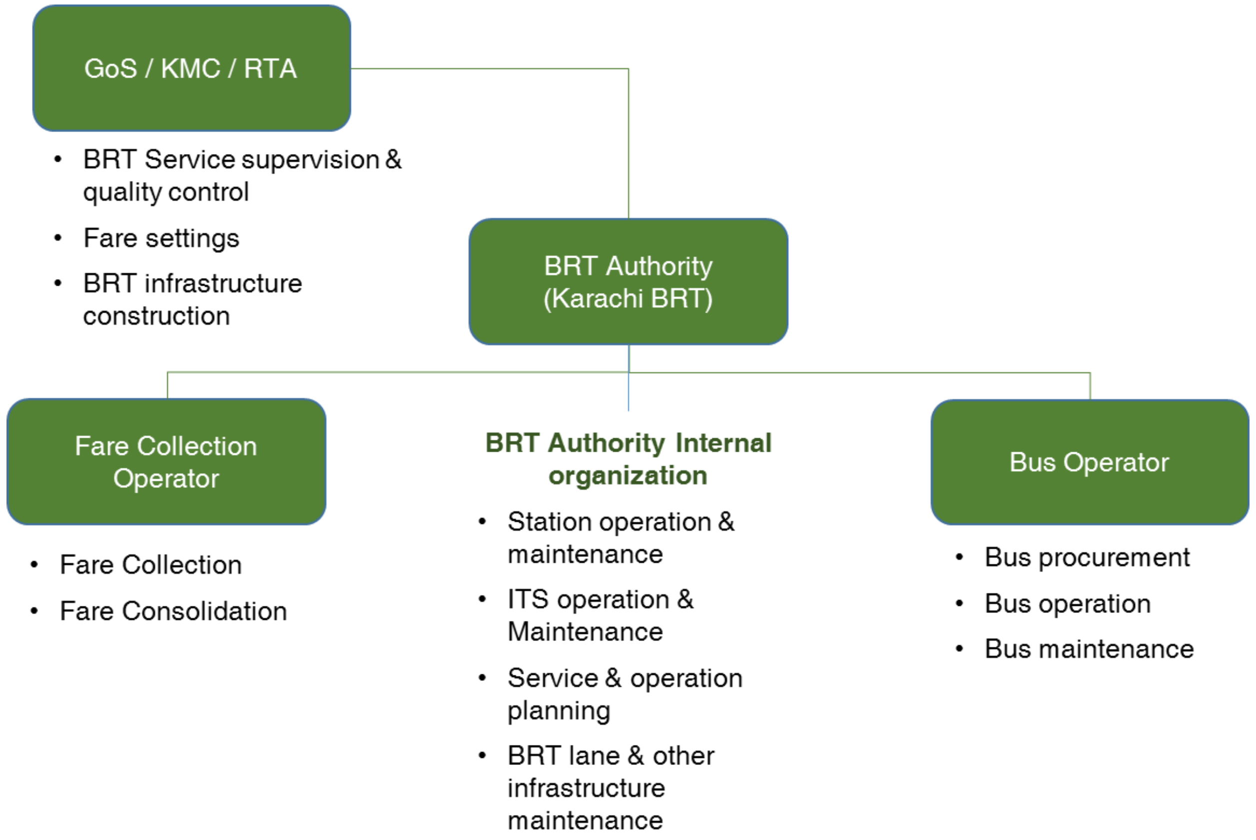



***Figure 9.4 Institutional Settings of BRT System***

In the proposed institutional settings, the role of government is specified to supervise the BRT service, as well as quality control of the BRT system, as run by the BRT authority. The government organization who will perform this role is currently being discussed by Government of Sindh. BRT standard level of service that needs to be provided by the BRT authority should be defined at the beginning and agreed by both government and the BRT authority. This is critical to ensure the BRT authority delivers the service according to the standard. Few parameters such as commercial speed, peak hour bus frequency, and security at stations and buses are examples of parameters to be set for BRT standard level of service.

Construction of BRT infrastructure is under the responsibility of the government, and BRT authority is responsible to run and maintain the infrastructure. In the proposed settings, BRT lane & other infrastructure maintenance will be handled by the BRT authority. This is to ensure that the maintenance and lane refurbishment can be managed quickly, without having to wait for different government agencies to do the maintenance. To do this, additional maintenance funding might need to be allocated by the government for the BRT authority.

In the proposed design, the commercial fare is set by the government, but the BRT authority propose the technical fare to the government, and subsidy might be required should the approved commercial fare is lower than the technical fare. However, the BRT should be aimed to be financially independent, thus the BRT authority should run the service in efficient manner.

### 9.2.2 Other Organizations for Enforcement

In addition to the main organizations listed before, the role of traffic police is also critical in the BRT operation. To ensure the BRT dedicated lanes are not violated by private vehicles and trucks, traffic enforcement cameras should be installed along the BRT lane. Putting traffic police on the road to prevent private vehicles entering have proven ineffective, as shown in Jakarta.

Transport Department who controls the traffic signal in Karachi is also critical to control the traffic movement along the BRT corridor. In the BRT control center, they should be in the same room with the BRT authority, bus operators and traffic police, to make coordination quicker. This model is proven to be effective in Bogota, where relevant parties involved in the BRT operation monitor from the same room.

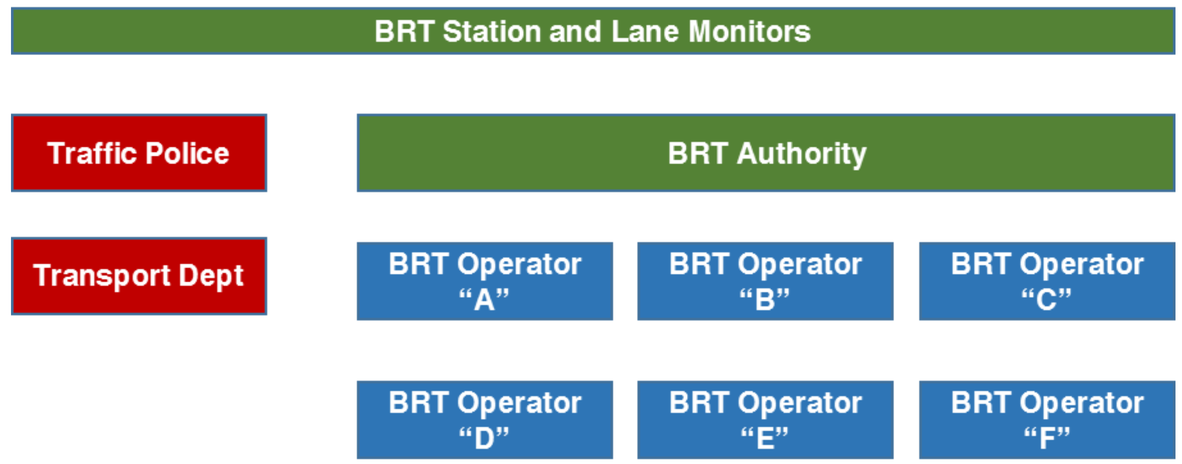



***Figure 9.5 BRT ITS Control Center Institution Arrangement***

# 10 Implementation Plan, Costing& Conclusion

## 10.1 Implementation Plan

The following phases are identified to implement the BRT in Karachi. The activities listed in each phase are not meant to be exhaustive and only covering the essentials.

a) **Preparatory work phase (6-8 month)**
   - Detailed technical design of BRT infrastructure (to be commissioned under PPTA and PDA work from ADB)
   - Environmental analysis on selected corridor
   - Land acquisition (if required)

b) **Stakeholder engagement phase (6-12 month)**
   - Bus industry transition
   - Consultation with affected business owners/residents at MA Jinnah
   - Street vendor relocation

c) **Bus operator selection Phase (10-18 month)**
   - Bus operator Tender
   - Bus operator preparation

d) **Construction Phase (12-18 month)**
   - BRT Infrastructure Construction
   - Depot Construction
   - BRT ITS control center construction

Some of the phases can be done in parallel to save time. For example, the bus operator selection can be done in parallel with BRT infrastructure construction phase. It is estimated that the whole phases can be completed between 18 and 24 months after the PPTA work begin.

## 10.2 Issues with Multiple Stakeholders on Different Lines

The BRT development in Karachi is currently done in a very unique way, where there are 5 different plans on different corridors, managed by different organizations. Typically, this is not how the BRT development is done. The more common BRT development would have single organization managing the BRT project, from planning, preparation until the construction. It is also more common to focus on opening of 1 BRT corridor, before expanding to other corridor opening.

The way the BRT project is prepared in Karachi currently poses serious risks on the sustainability of the entire BRT plan, such as:

- Different standard infrastructure and fleet design & configuration, which would make each BRT line stand on its own, with no integration between lines
- Different operational model between lines. Currently other corridors are proposed as 'Trunk-Only' corridor.
- No plan to integrate other public transport into the BRT. Which would pose a threat from existing bus industry in Karachi
- Different business model (PPP and non PPP) and fare model between lines. This is critical as passengers might need to pay twice to transfer to different corridor.
- No clear timetable and agreement on which corridor should be first.
- No single main authority to coordinate the different projects.

It is strongly recommended that single standard design should be applied across different lines, with similar business model and payment system. The Government of Sindh need to realize the main objective of BRT is to promote public transport and increase the ridership of public transport system in Karachi. Although financing is an important aspect to build the BRT, but focusing on the financing and neglecting the essential issues that matters for passengers, such as the easy access, faster travel time, single payment and minimum transfer, would not make the BRT project sustainable financially in the medium and long run.

## 10.3 KCR Issues with Phase 2 BRT

Phase 2 BRT proposed in this study, which will run alongside with the Karachi Circular Railway (KCR) is estimated as the corridor with highest demand. However, the BRT plan on Shahrah e Faisal is currently on hold and waiting to revive in the next few years. Regardless of the KCR revival, the plan to start preparation work on Phase 2 BRT should still be conducted. Even with KCR running, the BRT on Shahrah e Faisal corridor will still be providing good mass transit network in Karachi, complementing the KCR. As a start, conceptual design on Shahrah e Faisal corridor presented in Appendix C of this report should be used as basis to develop the design further.

## 10.4 Costing

Cost breakdown for Karachi BRT is shown in the Appendix. The total cost for Phase 1 BRT in Karachi is **Rs. 10,434,926,576 (Rs. 434,788,607/km)** or **$ 102,583,138 ($ 4,274,297/ km)**. Import taxes/duties for ITS/electronic components and other local taxes have not been included in the analysis. Although local cost information is already included in this estimate, but adjustment to get the actual local cost need to be made for the PPTA work. Summary of cost breakdown is shown below, and detail cost breakdown is provided in Appendix A of this report.

*Table 10.1 BRT Project Cost Summary*

| No. | COST COMPONENT | Price (Rs) | Price($) | % |
|---|---|---|---|---|
| I | Road Engineering | 4,060,791,166 | 39,921,266 | 38.92% |
| II | Bridge & Access | 1,114,728,256 | 10,958,791 | 10.68% |
| III | Greeneries | 90,676,114 | 890,029 | 0.87% |
| IV | Street Lights | 18,164,250 | 178,571 | 0.17% |
| V | Water Drainage | 34,892,333 | 342,754 | 0.33% |
| VI (A) | Traffic Engineering (road marking and traffic signal) | 77,730,819 | 764,165 | 0.74% |
| VI (B) | Traffic Signal | 77,214,881 | 759,092 | 0.74% |
| VII | BRT Station | 1,148,927,400 | 11,295,000 | 11.01% |
| VIII | BRT Station power supply and lighting | 120,172,211 | 1,181,402 | 1.15% |
| IX | BRT Station water supply, drainage and fire protection | 3,940,073 | 38,734 | 0.04% |
| X | BRT Station Ventilation and air conditioning | 4,784,374 | 47,035 | 0.05% |
| XI | On-Station BRT ITS System | 1,212,531,568 | 11,920,287 | 11.62% |
| XII | Passenger Information | 65,609,400 | 645,000 | 0.63% |
| XIII | Traffic Organization during Construction | 116,796,875 | 1,148,219 | 1.12% |
| XIV | Traffic Surveillance and Control | 406,258,784 | 3,993,893 | 3.89% |
| XV | Project Indirect Cost and Expenses | 1,881,708,071 | 18,498,900 | 18.03% |
| | **Total Project Costs** | **10,434,926,576** | **102,583,138** | |

## 10.5 Summary & Conclusion

There is a great need for BRT in Karachi, not only to give priority to bus passengers, but also to improve overall public transport condition in Karachi. Increase in motorcycle use and Chinchi needs to be tackled, and building gold standard BRT in Karachi is one effective measure to trigger shifting to public transport.

However, with multiple stakeholders working on different BRT plan in Karachi, there is a great risk that connectivity and system integration between corridors might not be achieved, and create a disastrous BRT system where passengers need to change bus and pay again every time they change corridors and buses.

ITDP BRT conceptual plan and design emphasize greatly on 'Direct-Service' BRT and integrating the BRT with current public transport routes. This integration with current public transport system is critical and any BRT plan which neglects this needs to be avoided. Such integration not only will benefit the BRT system with wide coverage and high frequency, but also ensuring passengers to have minimum or no transfer on their journey.

Additionally, with the correct measures, existing bus operators in Karachi could also get the benefit of the BRT if they are willing to work with the government to upgrade their service into a modern BRT service.